ESSAYS ON THE IMPACT OF THE INTERNET ON DISTRIBUTION CHANNEL MANAGEMENT

By

WEON-SANG YOO

B.A.(Economics), Korea University, Seoul, Korea, 1993
MBA, George Washington University, Washington D.C., USA 1996

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Abstract

Internet commerce has grown at a torrid pace over the last decade. The explosive growth in Internet usage has changed the way companies do business. The purpose of this thesis is to investigate the impact of the Internet on distribution channels.

This thesis consists of three essays. The first essay (chapter 2) examines the impact of the introduction of an Internet channel by exploring the following research questions: 1) What are the similarities and differences between adding a new physical store and adding an Internet channel to a conventional distribution channel? 2) What are the strategic underlying effects that shape the overall impact of the Internet channel introduction on the market? 3) Under what conditions is the introduction of an Internet channel beneficial or harmful to each channel member? 4) Does a manufacturer always prefer disintermediation? These questions are explored within a game theoretic model that extends the existing models in the literature by distinguishing the theoretical difference between the Internet and the physical channel, and by capturing the heterogeneity in buyer preference for the two types of channel. The closed-form equilibrium solutions of the model reveal five key underlying effects that shape the

overall impact of the introduction of an Internet channel. The results also indicate that coordinating a mixed channel is a different managerial problem from coordinating between two physical stores.

The second essay (chapter 3) extends the model used in essay 1 (chapter 2), developing a general model to examine the impact of a newly introduced Internet channel in various multi-product, multi-outlet market conditions. A set of assumptions made in the first essay is relaxed to allow the exploration of the impact of various market environments on a firm's optimal channel strategy in related to Internet channel introduction. This flexible model relaxes the assumption of the symmetric distribution of consumer heterogeneity in the first essay, by varying the distribution of consumers on one dimension while holding the other constant. The assumption of a monopoly manufacturer is also relaxed by introducing manufacturer-level competition, in which two firms produce horizontally differentiated products. In the process, this essay investigates the impact of the degree of product and store competition on various market outcomes associated with the Internet channel introduction. Numerical analyses are conducted for equilibrium solutions in order to overcome the mathematical complexity of this model. The results indicate that the strategic underlying effects identified in essay 1 (chapter 2) shape the overall impact of the introduction of an Internet outlet under various market conditions. However, the relative impact size of each underlying strategic effect varies depending on market conditions and channel structure. This essay reveals that the distribution of consumer heterogeneity, the channel structure, the locations of physical stores, and the product positioning in a market are important factors influencing the

specific impact of the introduction of an Internet channel on each individual channel member.

The third essay (chapter 4) explores the adoption and the impact of Internet channels in the trucking industry. Two of the main elements considered are electronic transportation exchanges and company Websites. Six case studies are conducted in order to identify the key factors that influence a firm's choice concerning the adoption of Internet channels. Based on these case studies, we generate a set of testable propositions that can be used as a foundation for future theoretical and empirical research. The case analyses highlight six main factors that influence the adoption and the impact of the Internet channels: size of the firm, percentage of business on the ongoing relationships, degree of fragmentation of the industry, transaction size, density of the network, and size of the network. This case study also suggests that, while it is likely that Internet channels will not entirely eliminate the roles of traditional intermediaries, the traditional intermediaries should alter the nature of their value-adding services in the long run to remain viable. Therefore, we expect to see the prevalence of a new kind of intermediary in the near future, one who combines the expertise of traditional intermediaries with the efficient tools of electronic intermediaries.

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finish this thesis. Finally, I praise God, who has provided me with an opportunity to meet all of these wonderful people in my life.

Chapter 1

Introduction

1.1. Overview

Internet commerce has grown at a rapid pace over the last decade. Between 1997 and 2003, U.S. online retail sales ballooned from $2.4 billion to over $100 billion (Forrester Research 2004). Despite the dot-com bust and an economic recession, consumers have kept shopping through the Internet for the convenience, selection, and deals available online. By 2007, another 26 million U.S. households are expected to join the 37 million households already shopping through the Internet - for a total of nearly 63 million or two-thirds of all U.S. households - and sales are expected to grow up $218 billion in 2007, representing 8% of total retail sales expected in that year (Johnson et al. 2002).

The explosive growth in Internet usage has changed the way companies do business. Armed with a mouse and a Web browser, both companies and consumers can now access almost unlimited choices of products and services, compare prices and

features on a real-time basis, and execute transactions instantaneously. In many industries, this enhanced technology has helped to squeeze out inefficiencies, to lower prices, and in effect to level the playing field for medium and small businesses and individual consumers (Cooke 2003).

Despite the exciting potential of the Internet as a marketing channel, using the Internet in this manner has proven equally challenging, as evidenced by a large number of failed or suspended attempts to launch Internet channels. Levi Straus & Co. discontinued its Internet channel at www. levis.com & www.dockers.com, and handed online sales over to a few selected e-retail partners (Collett 1999). Whirlpool Corporation, a $10.5 billion home-appliance maker, also decided not to sell refrigerators or microwave ovens directly to consumers online (Gilbert and Bacheldor 2000).

These anecdotes point to a general need for a better understanding of how the introduction of the Internet channel affects a marketing channel system, as well as each stakeholder in the channel. The purpose of this thesis is to investigate the impact of the Internet on distribution channel management. More specifically, the thesis consists of three essays that examine the impact of the Internet channel on market outcomes and channel decisions in various market environments. The remainder of the thesis is organized as follows.

In chapter 2, the first essay examines the impact of the introduction of the Internet channel on the behavior and performance of each member belonging to a channel system. This chapter develops a game theoretic model composed of a monopoly manufacturer and a physical retail store, to which an additional Internet store can be introduced by the manufacturer, the existing retailer, or a new, third party online retailer. By analyzing the

differences in equilibrium results before and after the Internet channel introduction, we explore: 1) the similarities and differences between adding a new physical store and adding an Internet channel to a conventional distribution channel; 2) the major underlying strategic effects that determine the overall impact of the Internet channel introduction on the market; 3) the conditions under which the introduction of an Internet channel is beneficial or harmful to each channel member; and 4) the conditions under which a manufacturer prefers disintermediation. The model developed in this chapter extends the existing models in the literature by distinguishing the theoretical difference between the Internet and the physical store, and by capturing the heterogeneity in buyer preference for both types of outlet.

Essay 2 in chapter 3 develops a more flexible game theoretic model to investigate the impact of the Internet channel in various market situations. This involves the relaxation of a set of assumptions made in chapter 2. The chapter examines the impact of the distribution of consumer heterogeneity on the results drawn in chapter 2, the impact of the degree of product and store competition in a market on the optimal channel strategy involving an Internet channel, and a manufacture's strategic use of an Internet channel under the multi-product, multi-channel environment. The complexity of the model is overcome by numerical analysis.

In chapter 4, essay 3 explores empirically the adoption and the impact of Internet channels, including electronic transportation exchanges and company Websites, in the trucking industry. One of the main purposes of this chapter is to develop a set of testable propositions relevant to the factors influencing a firm's choice of Internet channels. The chapter also addresses the impact of the Internet channels on traditional transportation

intermediaries. Specifically, it explores three main research questions. First, what are the major factors that influence the choice to adopt Internet channels in the trucking industry. Second, what is the impact of the Internet channels on the role of the traditional intermediary. Finally, is the traditional intermediary going to disappear in the trucking industry, and if not, how might traditional and electronic intermediaries evolve in the future. These questions are analyzed using six case studies.

Chapter 5 concludes by summarizing the main findings and implications of this research. Additionally, it also discusses the limitations of the thesis, and suggests potentially beneficial future research directions.

Chapter 2

The Impact of the Introduction of an Internet Channel on Distribution Channel Management in a Monopoly Manufacturer Market

2.1. Overview

The introduction of the Internet channel has caused profound changes in marketing channel structures and relationships in many industries. One of the most frequently discussed effects of the emergence of the Internet channel has been disintermediation (Vanderbilt 1998). Many have speculated that disintermediation would be the most notable impact on marketing channels, believing that manufacturers would bypass existing independent physical retailers, reaching the ever-expanding market directly with greater market power and low costs (Hammer 2000). Airlines, for example, are making

tremendous headway selling tickets online, causing a deep fear among travel agents of "cutting out middlemen" (Gilbert and Bacheldor 2000). In contrast, a large group of manufacturers, including Robert Bosch, Maytag, Rubbermaid, and Liz Claiborne, hesitate to extend their distribution channel to the Internet because of potential channel conflict with their traditional retailers (Batholomew 2000). Despite the general interest in the issue, disintermediation has received surprisingly little attention in analytic marketing studies. This chapter explores whether manufacturers generally prefer disintermediation, as some fear, and under what conditions it is likely to occur.

Disintermediation is just one part of a broader question: "How does Internet channel introduction affect the profitability of each channel member and consumer welfare?" Previous studies shed some light on this issue, generally agreeing that the manufacturer is always better off (Chiang et al 2003 and Liu and Zhang 2002) but the incumbent retailer's profit might increase (Kumar and Ruan 2003) or decrease (Ray et al. 2003) with the introduction of the manufacturer's Internet channel. While these studies focus on the impact of the manufacturer's introduction of a direct Internet channel, numerous retailers, such as Best Buy, Tower Records, and Toys-R-Us, have also added Internet channels to their existing offline stores. Thus, one might ask how channel members are affected when an Internet channel is introduced by an existing offline retailer. Moreover, what if a new third party online retailer enters? This chapter investigates these questions by analyzing various channel structures involving an Internet channel.

We also investigate whether the impact of the addition of an Internet channel reflects merely the impact of opening an *additional* outlet or that of opening an *Internet*

channel specifically. We compare the impact of the addition of another physical store against that of the addition of an Internet channel, and demonstrate that they have different effects. Furthermore, we perform this analysis under various market environment scenarios to reveal the conditions under which a manufacturer should add its own physical store instead of opening an Internet channel (and vice versa).

In order to explore the above research questions, we develop a game theoretic model that possesses three key characteristics. First, the main difference reflected in our model between an Internet store and a conventional brick-and-mortar store is not merely in shopping costs, convenience, operating costs, etc. (Chiang et al. 2003; Kumar & Ruan 2003; Ray et al. 2003; Pan et al. 2002; and Rhee 2001), which can all be applied to the case of two competing brick-and-mortar stores. Instead, we build on the models developed by Balasubramanian (1998) and Liu and Zhang (2002) to explicitly capture the fact that an Internet channel and a physical store exist in two different dimensions (one in physical space and the other in cyber space). This enables us to demonstrate that the effect of adding an Internet store is, indeed, different from that of adding another physical store.

Second, our model reflects the fact that consumers are heterogeneous in their preferences for using a physical store *and* for using an Internet channel. This extends the models used by Balasubramanian (1998) and Liu and Zhang (2002), which assume consumers are homogeneous in their preference for a direct/Internet channel. Furthermore, by assuming that consumer preference for an Internet channel is continuously distributed over a range, our model generalizes the assumption of two discrete consumer segments used by Kumar and Ruan (2002) and Ray et. al (2003).

Third, while retaining the above two characteristics, our model captures the vertical strategic interactions between an upstream manufacturer and a downstream retailer, making it possible to analyze the channel structure issues discussed above. Although numerous previous models capture this vertical dimension of marketing channels, none simultaneously incorporate the three characteristics reflected in our model.

These three model characteristics, combined with the analysis of various scenarios regarding who owns and operates an Internet channel, enable us to show that the impact of the introduction of an Internet channel varies considerably depending upon the channel structure and the underlying market environment. Therefore, instead of endorsing a particular result as "the" impact of the Internet channel introduction, we identify five major underlying effects caused by the introduction of an Internet channel, and demonstrate how these individual effects work together to produce the overall impact in varying situations. Some of the individual effects observed in our results are consistent with previous findings (Chiang et al. 2003; Kumar & Ruan 2003; Ray et al. 2003; Liu & Zhang 2002; and Rhee 2001), while others provide new insights. By combining these individual insights, this chapter provides a framework for understanding the nature of strategic interactions within various channel structures that include an Internet store.

The remainder of the chapter is organized as follows: Section 2.2 reviews the existing literature, and positions the current chapter. We present the model in section 2.3, and summarize the analysis results in section 2.4. Finally, we discuss the results in section 2.5, using our research questions as a framework.

2.2. Literature Review

There has been a great amount of research on the issue of coordinating multiple retailers. Ingene and Parry (1995) explore channel coordination by a manufacturer selling through directly competing retailers that are homogeneous and independent of the manufacturer. Purohit (1997) captures competition between two heterogeneous channel members using a two-period model. Both of these studies contribute to the literature through their early efforts to model strategic channel interactions among a manufacturer and *multiple* retailers within the same channel. However, these models do not capture the nature of channel competition of a mixed channel that includes both direct and indirect channels.

Lal and Sarvary (1999) examine the impact of an Internet channel on consumers' search costs and retail prices. They model two vertically integrated firms competing through online as well as offline channels. Zettlemeyer (2000) analyzes the way in which the existence and size (i.e., market coverage) of the Internet affect firms' optimal pricing and communication strategies when competing firms use multiple channels. These studies do not capture explicitly the competition between an Internet store and a conventional physical store. Instead, their models respectively focus on the role of search cost in optimal pricing within a multi-channel environment, and a firm's strategic use of information for consumer segmentation.

Despite the great potential implications for both academicians and practitioners, research on channel interactions between an Internet channel and a conventional channel is limited. Balasubramanian (1998) provides a model to analyze the multiple channel environment in the context of direct versus indirect channels. This is the first model that incorporates the theoretical difference between a conventional channel and an Internet

channel. He analyzes horizontal competition between direct and indirect channels, capturing the disutility of purchasing through the direct channel with a consumer common factor, lack of fit of the product to direct shopping. He demonstrates that demand for each type of channel is determined by the tradeoff between travel cost and the degree of fit of the product to direct shopping, moderated by prices. However, his analysis is limited because he does not consider vertical strategic interaction between a manufacturer and a retailer. Furthermore, the use of a circular model in this study limits its contribution in two ways. First, the model does not allow physical stores to compete with each other. Second, the model assumes a fixed aggregate demand, and, therefore, cannot capture the possibility that the direct (Internet) channel enhances market coverage.

Rhee (2001) explores vertical strategic interactions between channel members in a hybrid channel. Unlike Balasubramanian (1998), his model does not capture clearly the difference between a conventional channel and an Internet channel. He finds that hybrid channels enable a manufacturer to obtain greater sales and profit as compared to an Internet-only direct marketer. He finds that the added direct online marketing increases the manufacturer's sales but decreases its profit, which is different from our findings.

Liu and Zhang (2002) use the Hotelling model to investigate price competitions under multi-channel structures. They explore how a manufacturer's direct distribution channel and targeted pricing by both the manufacturer and retailers affect channel profit allocation, prices, and social welfare. Like Balasubramanian's (1998), their model captures the difference between the two types of channel and includes vertical channel interactions. An important limitation of their model is also similar to Balasubramanian's (1998). Both studies assume a constant cost (disutility) for using the Internet for all

buyers. Liu and Zhang's finding (2002) agrees with ours that channel power shifts toward a manufacturer when the manufacturer can either open a direct channel, target end-consumers, or both. Their conclusion that average price and social welfare can worsen in a market due to a manufacturer's direct channel entry differs from our results.

Pan et al. (2002) develop a game theoretic model of horizontal price competition between a pure play e-tailer and brick-and-clicks e-tailer, and derive their equilibrium prices. In their model, an Internet channel is not distinguished theoretically from a conventional channel. In addition, the model does not incorporate vertical interactions between a manufacturer and retailers. They show that the price offered by the pure play e-tailer is lower than that of the bricks-and-clicks e-tailer.

Kumar and Ruan (2003) develop a model based upon "assumed demand functions" to examine strategic underlying effects that influence a manufacturer's decision to complement its existing traditional retailer with a direct Internet channel. They model vertical strategic interactions between a manufacturer and a retailer. Like Rhee (2001) and Pan et al. (2002), their model does not capture clearly the difference between a conventional channel and an Internet channel. Furthermore, they capture consumer heterogeneity in Internet usage by dividing consumers into two groups. One group of consumers never purchases from an Internet store at any price level, and the other group has the choice of the two types of retailers in their model. The authors derive conditions where the manufacturer benefits from opening a direct channel alongside the incumbent retailer and conditions where the direct channel benefits the existing retailer.

Ray et al. (2003) also examine a monopoly manufacturer's channel coordination problem in a multi-channel environment. Their model is similar to Kumar and Ruan

(2003) in that the model does not capture theoretical differences between the two types of outlets, and that it captures consumer heterogeneity in Internet usage by dividing consumers into two groups. They find that a manufacturer uses the Internet channel in addition to the physical channel when the electronic retailer has a price premium over the physical store. It is also found that when the manufacturer sells through an independent electronic retailer, it manages price competition between the two channels, rather than trying to eliminate it, whereas when the manufacturer owns the electronic retailer, it tries to eliminate price competition between the two channels.

Chiang et al. (2003) examine the impact of consumer acceptance of a direct channel - the degree to which consumers accept a direct channel as a substitute for shopping at a conventional store - on supply chain design. They construct a price-setting game between a manufacturer and an independent physical retailer. Like many other previous models, however, theirs fail to clearly distinguish the two types of channel. In addition, they capture the disutility of using the Internet with a consumer common factor. Since they do not use a spatial model, physical locations of a store, consumers, and thus travel cost are not incorporated in the model. Their finding is consistent with Rhee's (2001) in that ignoring the disutility of using a physical store leads to the conclusion that the manufacturer's direct channel may not always be detrimental to the retailer. Our results differ on this matter. Chiang et al. (2003) find that the manufacturer's strategic use of direct marketing, involving the modification of the retailer's reaction function, helps the manufacturer improve overall profitability as well as its share of total channel profit.

This chapter differs from the existing literature in three ways. First, our model captures the theoretical difference between a conventional retailer and an Internet channel. Among the existing studies, as shown in Table 2-1, only Balasubramanian (1998) and Liu & Zhang (2002) capture this difference in their models.

(Table 2-1) Summary of Characteristics of Existing Models of Internet Channel

	Another Physical Store or an Internet?	Consumer Heterogeneity in Internet Preference	Vertical Channel Interaction
Balasubramanian 1998	√		
Rhee 2001			√
Kumar & Ruan 2002		√	√
Liu & Zhang 2002	√		√
Chiang et al. 2003			√
Ray et al. 2003		√	√
Current Research	√	√	√

Second, our model assumes that consumers are heterogeneous in relation to the disutility of using the Internet while the majority of previous studies assume a constant cost of Internet shopping for all buyers (Balasubramanian 1998; Rhee 2001; Liu & Zhang 2002; and Chiang et al. 2003). Kumar and Ruan (2003) and Ray et al. (2003) capture consumer heterogeneity in Internet use by assuming two discrete consumer segments. In contrast, we assume a continuous distribution of consumer preference for the Internet channel and for the physical store. By deriving demand functions from this underlying market model instead of assuming the popular form of demand functions (Kumar & Ruan 2003 and Ray et al. 2003), we ensure consistency in consumer behavior and market size across the various situations being compared.

Finally, we compare market outcomes across various channel structures, including new channel structures that have never been examined. One such example is

the case in which an independent physical retailer adds its own Internet channel and horizontally coordinates the two types of retailers. We also examine the channel structure formed when a manufacturer is managing its own physical store and Internet store.

2.3. Model

2.3.1. Industry & Rules of the Game

Our model consists of one manufacturer selling its product through one physical store, before an Internet store is introduced. After an Internet store is introduced to the market, the industry is comprised of one manufacturer and two types of distribution channels: a physical store and an Internet store. The physical store might be owned (and operated) by the manufacturer or an independent retailer. The new Internet store might be opened by the manufacturer, the existing independent physical retailer, or a new third party online retailer. Although this model involves only one kind of product offered by the monopoly manufacturer, consumers view each product-outlet pair as a unique offering. Thus, the introduction of the Internet store gives rise to two product offerings.

When selling through an independent retailer, the manufacturer acts as a Stackelberg leader in the model, maximizing its own profits with foresight of the retailer's optimal responses as assumed by McGuire and Staelin (1983). As the Stacklberg follower, the independent retailer maximizes its own profits, conditional on the wholesale price. When there exist two competing independent retailers, price competition between the two is assumed to be Bertrand Nash, as in the majority of other

game theoretic channel models. For simplicity of analysis, we set the marginal cost at zero, as is typical in this type of study.

2.3.2. Channel Structures & Objective Functions

The two types of retailers (physical or Internet) and the two types of ownership situations in relation to a monopoly manufacturer (owned by or independent of the manufacturer) yield various channel structures. The channel structures explored in this chapter and the objective function of each channel member are described in Figure 2-1. Before the introduction of an Internet store, products are distributed through either a vertically integrated (Figure 2-1: 111VI) or an independent physical store (112 DC). When an Internet store is introduced, it can be either independent (124 DC) or adopted by any channel member, in other words, by either the manufacturer (121 VI and 122 PI) or the independent physical retailer (123 HI). The assumptions allow the consumer to be consistently offered one product offering (from either the vertically integrated or the independent physical store) before the introduction of an Internet store, and two product offerings (from the physical retailer and from the Internet store) after the introduction of an Internet store.

In the 121 VI structure, both the physical store and the Internet store are vertically integrated to the monopoly manufacturer. 122 PI represents the channel structure in which the manufacturer distributes its products through its own Internet channel and the independent physical retailer. The independent physical retailer could open its own Internet store (123 HI) and coordinate between the two retail prices to maximize the combined profits. The monopoly manufacturer may sell its products through the

completely decentralized channel in which both the physical store and the Internet store are independent of the manufacturer (124 DC).

(Figure 2-1) Channel Structures Before and After Internet Channel Introduction

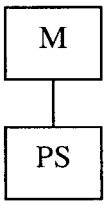
Product offering S: Manufactured by M and Sold through PS
Product offering N: Manufactured by M and Sold through N
Π : Manufacture's Profit
π_S : Physical Store's Profit
π_N : Internet Store's Profit
$p_{S(\text{or } N)}$: Price of Product offering S(or N)
$q_{S(\text{or } N)}$: Demand for Product offering S(or N)
w: Manufacturer's Wholesale Price
Manufacturer's marginal cost is assumed to be 0

_____ : vertically integrated

- - - - - - - : decentralized

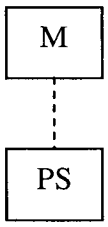
1.1. Base Cases (No Internet Channel)

111. Vertically Integrated Channel (VI)



- Objective Function for Manufacturer: $\Pi = p_S q_S$

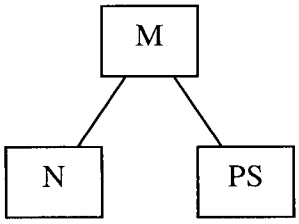
112. Decentralized Channel (DC)



- Objective Function for Manufacturer: $\Pi = wq_S$
- Objective Function for Independent Physical Store: $\pi_S = (p_S - w)q_S$

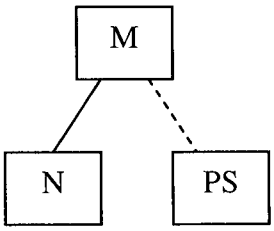
1.2. When an Internet Store is Introduced to the Market

121. Vertically Integrated Channel (VI)



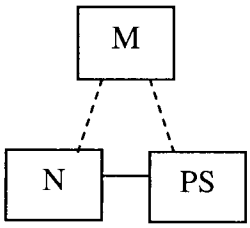
- Objective Function for Manufacturer: $\Pi = p_N q_N + p_S q_S$

122. Partially Integrated Channel (PI)



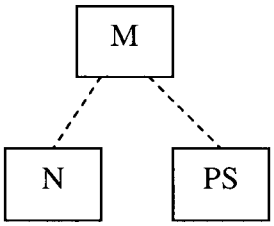
- Objective Function for Manufacturer: $\Pi = p_N q_N + wq_S$
- Objective Function for Independent Physical Store: $\pi_S = (p_S - w)q_S$

123. Horizontally Integrated Channel (HI)



- Objective Function for Manufacturer: $\Pi = w(q_N + q_S)$
- Objective Function for Retailers: $\pi = (p_N - w)q_N + (p_S - w)q_S$

124. Completely Decentralized Channel (DC)



- Objective Functions for Manufacturer: $\Pi = w(q_N + q_S)$
- Objective Functions for Retailers: $\pi_S = q_S(p_S - w)$
  $\pi_N = q_N(p_N - w)$

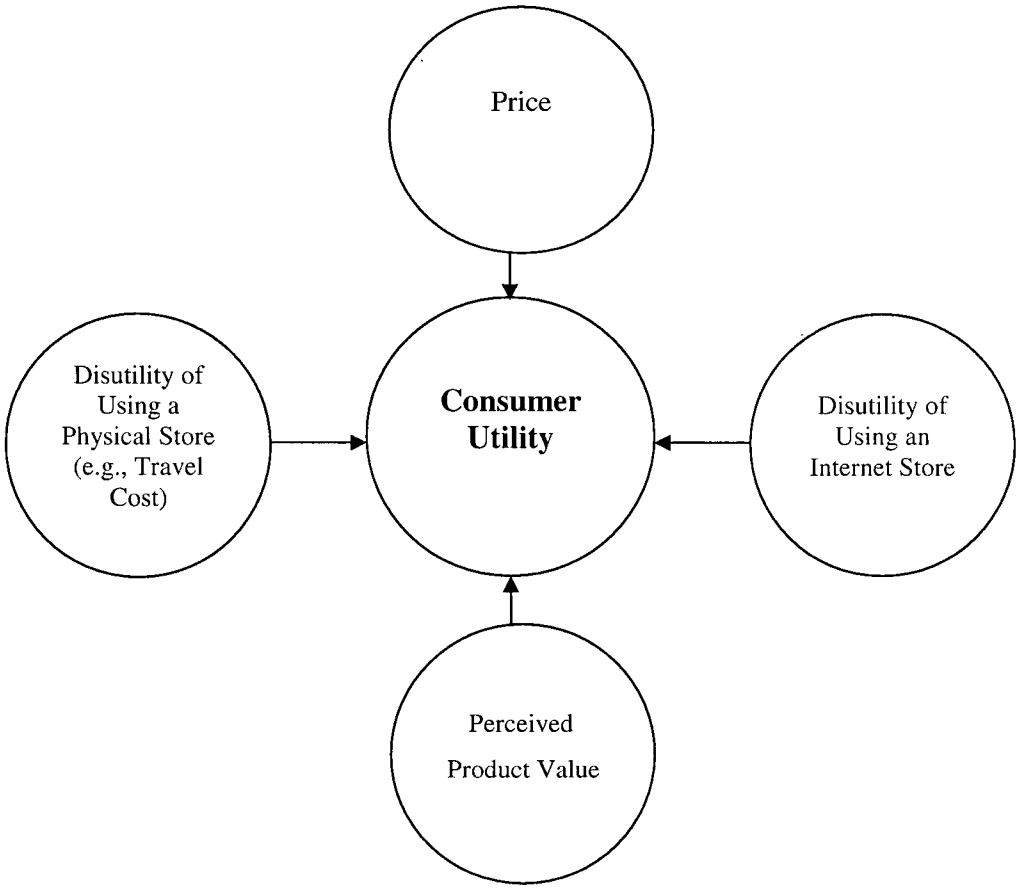
2.3.3. Demand

We now develop a spatial model that describes consumer heterogeneity and utility. Using this model, we derive the demand function for each product offering.

2.3.3.1. Consumer Utility

We assume that a consumer maximizes utility when making a purchase decision. If none of the available product offerings provide positive utility, the consumer chooses to purchase nothing. We assume the consumer i's utility is determined by the perceived benefit of the product (V), price (P), her disutility related to using a physical store (δ_{PSi}), and her disutility associated with the use of an Internet store (δ_{Ni}), as shown in Figure 2-2. The disutility of using a physical store reflects not only travel cost but also the implicit costs of inconvenience, such as opportunity cost for time (Hotelling 1929 and Balasubramanian 1998).

(Figure 2-2) Factors Influencing Consumer Utility



Note that we model the disutility of using the Internet as consumer specific (with the *i* subscript). Empirical studies have shown that levels of access to the Internet vary substantially across individuals depending upon race, gender, education, and age (Hoffman and Novak 1998; 2000). Li et al. (1999) also find that individual factors such as education, convenience orientation, experience orientation, channel knowledge, perceived distribution utility, and perceived accessibility are robust predictors of the extent to which an Internet user is a frequent online buyer. Becker-Olsen (2000) reports a survey which suggests that the most important factors determining whether consumers

buy online are their life style, propensity to adopt new innovations, and perception of the ease and convenience of using the Internet.

Nevertheless, previous studies (Balasubramanian 1998; Liu & Zhang 2002) capture the disutility of using the Internet with only common factors to all consumers, such as inconvenience of return and waiting for delivery, or the lack of fit of the product to an Internet transaction, and thereby failing to reflect varying degrees of preference for using the Internet among the consumers. In this chapter, we capture not only the common factors considered in the literature, but also the consumer-specific factors, by assuming consumer heterogeneity in terms of the disutility of using the Internet to purchase a product. The disutility of Internet use can be conceptualized as in Figure 2-3.

(Figure 2-3) Disutility of Using the Internet

- Disutility of Using Internet
  - Common Factors to All
    - Inconvenience of waiting and return
    - Lack of fit of the product to the Internet
  - **Consumer-Specific Factors**
    - Limited access to the Internet device
    - Lack of skills for using the Internet
    - Propensity to adopt & to trust Internet

We incorporate the four factors in Figure 2-2 into a simple consumer utility function:

Consumer i's utility of purchasing from the Internet: $U_{iN} = V - P_N - \delta_{Ni}$ (2-1)

Consumer i's utility of purchasing from a physical store: $U_{iS} = V - P_S - \delta_{PSi}$ (2-2)

where δ_{Ni} and δ_{PSi} represent consumer i's disutility of using an Internet store and a physical store, respectively.

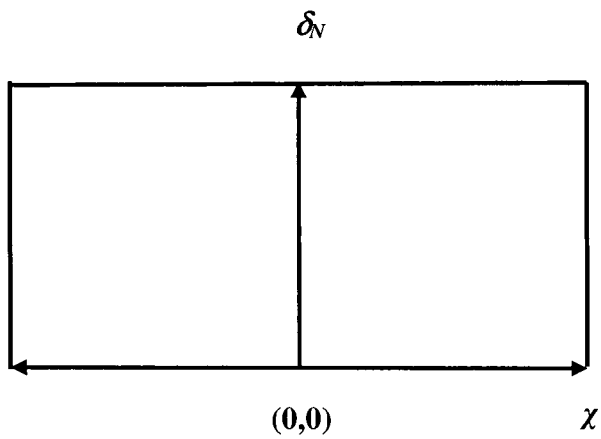
Individual consumer choice is determined by applying these utility functions to the assumption that consumers purchase one or zero units of the product to maximize utility. In the next section, we combine individual utilities with the distribution of δ_{PSi} and δ_{Ni} to derive the demand for each product offering.

2.3.3.2. Consumer Heterogeneity and Demand Derivation

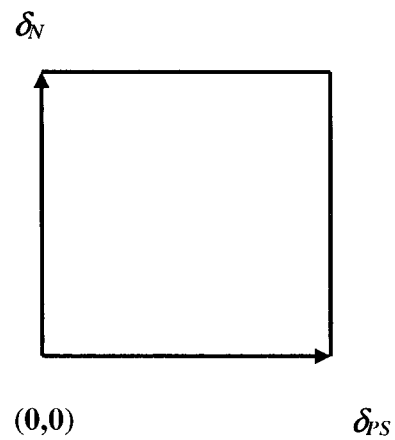
Figure 2-4 (a) illustrates our assumption concerning consumer heterogeneity. In the physical space, consumers are heterogeneous in their location, χ. As in typical linear city models, we assume χ is uniformly distributed over the horizontal line. Then, consumer i's disutility of using a physical store located at χ_{PS} is defined as $\delta_{PSi} = |\chi_i - \chi_{PS}|$. We also assume that consumers with the same physical location, χ (thus, the same level of disutility of using a particular physical store), are still heterogeneous in their disutility of using the Internet (δ_N), which is, once again, assumed to be uniformly distributed. This is consistent with Degeratu et al. (2000), who argue that the disutility of using a physical store is different from that of using an Internet channel. This two-dimensional consumer heterogeneity leads to a uniform distribution of consumers over a rectangular range as depicted in Figure 2-4 (a).

(Figure 2-4) Basic Setting

(a) Original Setting



(b) Simplified Setting

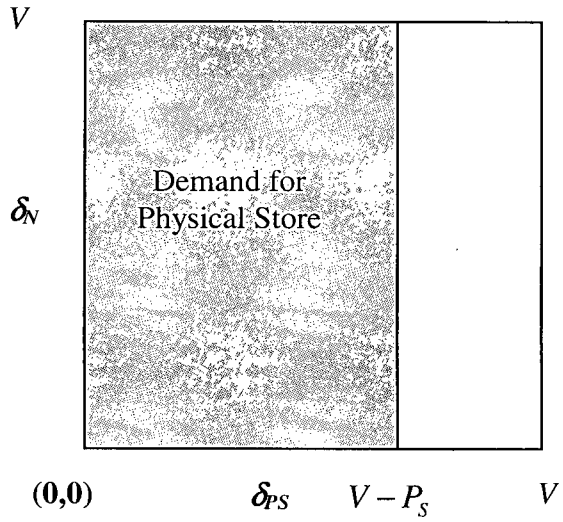


When there exists only one physical store in the market, it is easy to show that the best store location is the midpoint (i.e., χ_{PS}=0 in Figure 2-4 (a)). In this case, the symmetry of the original model in Figure 2-4 (a) allows us to express the same market with a simplified version as in Figure 2-4 (b) with a proper adjustment of the density. For the rest of the discussion, we use this simplified model for the case with one physical store.

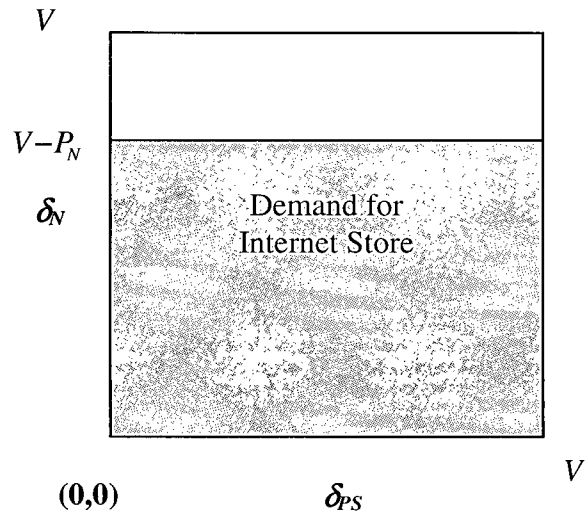
Deriving demand using the spatial model in Figure 2-4 (b) is straightforward. Figure 2-5 illustrates the demands of retailers when there exists one retail outlet in the market under the assumption that δ_{PSi} and δ_{Ni} are uniformly distributed between 0 and V. Since the marginal consumer who is indifferent between using the physical (Internet) store is defined by $V - P_S > \delta_{PS}$ ($V - P_N > \delta_N$), the demands for a single physical store and a single Internet store in the market are described, respectively, as $q_S = V(V - P_S)$ and $q_N = V(V - P_N)$. (2-3)

(Figure 2-5) Demand of a Single Retailer

(a) Demand for Physical Store



(b) Demand for Internet Store



In the case of a mixed channel, which consists of a physical store and an Internet store, the marginal consumers who are indifferent between the two stores are represented by a line, $\delta_N = \delta_{PS} + (P_S - P_N)$. This indifference line shifts up or down with changes in $(P_S - P_N)$. Since these shifts alter the demand functions for each retailer, we should consider two cases and find equilibrium for each case: $P_S \geq P_N$ and $P_S < P_N$. The area A and B in Figure 2-6 represent the demand for a physical store, while C and D represent the demand for an Internet store. Consumers in area E and F purchase from neither retailer. When $P_S \geq P_N$, each demand is described as follows:

$$q_S = \frac{1}{2}(V - P_S)^2 + P_N(V - P_S) \tag{2-4}$$

$$q_N = \frac{1}{2}(V - P_S)(P_S - 2P_N + V) + P_S(V - P_N) \tag{2-5}$$

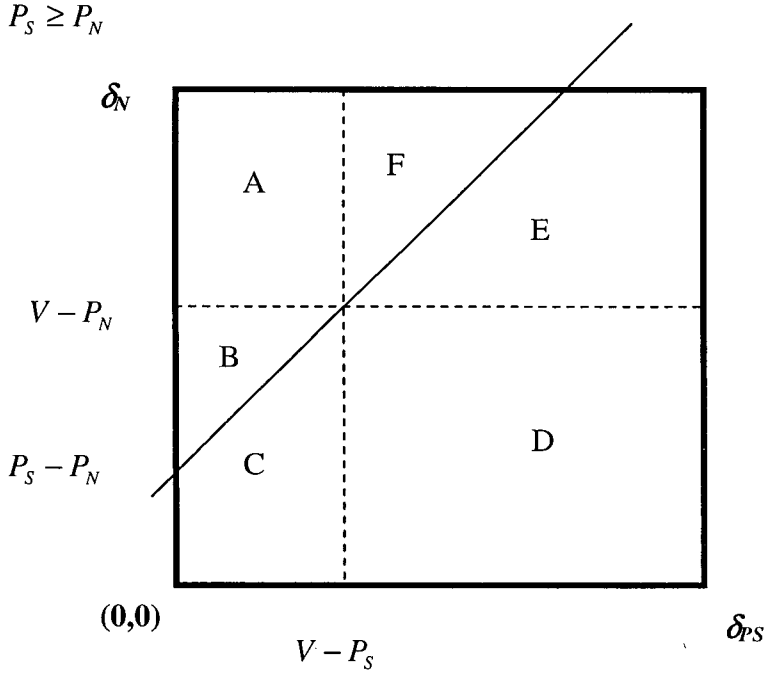
When $P_S < P_N$, on the other hand, the demand functions are expressed as:

$$q_S = \frac{1}{2}(V - P_n)(P_N - 2P_S + V) + (V - P_S)P_N \tag{2-6}$$

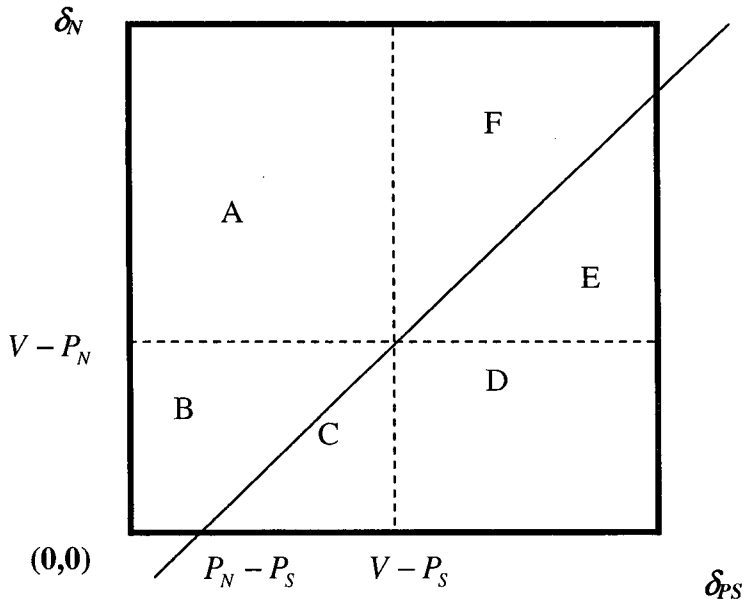
$$q_N = \frac{1}{2}(V - P_N)^2 + (V - P_N)P_S \tag{2-7}$$

(Figure 2-6) Demand for Mixed Channel

(a) $P_S \geq P_N$



(b) $P_S < P_N$



2.4. Results

The model described in the previous section is analyzed as a sequential game, in which the manufacturer is the Stackelberg leader over an independent retailer. We obtained the equilibrium solutions using the standard approach of first identifying the retailer's best response to a given wholesale price, and then solving backward the manufacturer's optimal wholesale price with the foresight. This approach assures a sub-game perfect equilibrium. Table 2-2 summarizes closed-form solutions for various channel structures. Please refer to Appendix A1 for the detailed proof.

(Table 2-2) Market Outcomes in a Mixed Channel[1]

	111. VI	112. DC	121. VI	122. PI	123. HI	124. DC
W*	0	0.50000 V	0	0.53834 V	0.55025 V	0.52191 V
P_N*	0	0	0.57735 V	0.54759 V	0.78922 V	0.74465 V
P_S*	0.50000 V	0.75000 V	0.57735 V	0.74952 V	0.78922 V	0.74465 V
Ave. Retail Price[2]	0.50000 V	0.75000 V	0.57735 V	0.60532 V	0.78922 V	0.74465 V
Q_N	0	0	$0.33333V^2$	$0.42103V^2$	$0.18858V^2$	$0.22275V^2$
Q_S	$0.50000V^2$	$0.25000V^2$	$0.33333V^2$	$0.16855V^2$	$0.18858V^2$	$0.22275V^2$
Tot. Q	$0.50000V^2$	$0.25000V^2$	$0.66666V^2$	$0.58958V^2$	$0.37716V^2$	$0.44550V^2$
N Profit	0	0	0	0	$0.04506V^3$	$0.04962V^3$
S Profit	0	$0.06250V^3$	0	$0.03559V^3$	$0.04506V^3$	$0.04962V^3$
Tot. Retail Profit	0	$0.06250V^3$	0	$0.03559V^3$	$0.09012V^3$	$0.09923V^3$
M Profit w/ N	0	0	$0.19245V^3$	$0.23055V^3$	$0.10377V^3$	$0.11626V^3$
M Profit w/ S	$0.25000V^3$	$0.12500V^3$	$0.19245V^3$	$0.09074V^3$	$0.10377V^3$	$0.11626V^3$
Tot. M Profit	$0.25000V^3$	$0.12500V^3$	$0.38490V^3$	$0.32129V^3$	$0.20754V^3$	$0.23251V^3$
Channel Profit	$0.25000V^3$	$0.18750V^3$	$0.38490V^3$	$0.35688V^3$	$0.29766V^3$	$0.33174V^3$
Consumer Surplus	$0.12500V^3$	$0.03125V^3$	$0.14088V^3$	$0.10843V^3$	$0.03975V^3$	$0.05688V^3$

[1] The closed-form solutions are converted from fractions to decimals for easy comparison.
[2] Weighted by demands

2.4.1. Comparing across Ownership Structures

We first compare outcomes between the two channel structures before the Internet store introduction (111 VI and 112 DC). This comparison replicates a classic example of a double marginalization problem observed in previous studies (Jeuland and Shugan 1983; Rhee 2001; Liu and Zhang 2002; and Chiang et al. 2003), showing the following expected results:

a) The wholesale price in 112 DC is the same as the retail price in 111 VI.

b) The retail price in 112 DC is 50% higher than that in 111 VI.

c) The demand for 112 DC is half of that for 111 VI.

d) Consumer surplus in 111 VI is much higher than that in 112 DC.

Our results indicate that the *double marginalization effect* also exists in the channel structures with two retail outlets (122 PI, 123 HI, and 124 DC). Specifically, we find that the vertically integrated channel (121 VI) is, by far, the best structure not only for the manufacturer but also for consumers. Similarly, partial integration (122 PI) is preferred to complete vertical decentralization (124 DC and 123 HI), since double marginalization affects only one of the two outlets.

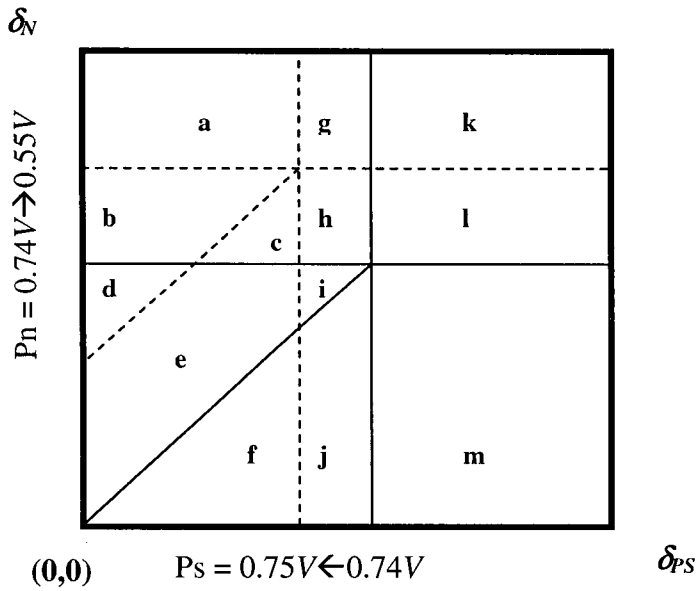
Further comparison across the channel structures with two retail outlets reveals two interesting results. First, we find that joint retail profits are greater for 124 DC than for 123 HI. In other words, the two retail outlets are *worse off* if they switch from competitive pricing (i.e., Bertrand Nash game) to price coordination (i.e., joint profit maximization). This seemingly counter-intuitive result stems from the fact that the retailers lack the foresight of the manufacturer's pricing behavior when implementing price coordination. Specifically, *for a fixed wholesale price*, the retailers are always

better off when they coordinate retail prices. However, when the retailers switch from competitive pricing to coordinated pricing, the manufacturer, with its knowledge of the changed reaction functions of the retailers, adjusts its wholesale price. With this change in wholesale price, there is no guarantee that the retailers benefit from switching to coordinated pricing. In fact, our results show that the coordinated pricing between the physical store and the Internet store operated by the same retailer (123 HI) leads not only to higher retail prices but also a higher wholesale price, aggravating the overpricing problem already caused by double marginalization. Consequently, it reduces total channel profits and individual channel member profits. We call this effect the *myopic inter-channel price coordination* in later discussions. This is consistent with Lee and Staelin's (1997) finding that a retailer could become worse off by implementing product line pricing without the foresight of the manufacturer's pricing behavior. No previous study on mixed channels has revealed the myopic inter-channel price coordination effect.

Second, note that the price in the physical store is higher for 122 PI than for 124 DC. This is counter-intuitive, considering the fact that the physical store in the partially integrated channel (122 PI) faces more intense price competition from the manufacturer's direct Internet store than that faced by the independent physical store competing with the independent Internet store (*Pn* is lower for 122 PI than for 124 DC). This result shows the manufacturer's price discrimination strategy using its own Internet store and the independent physical store. In this model, the manufacturer has an opportunity to practice price discrimination, because it faces heterogeneous consumers and can distinguish the particular type of a given consumer. Figure 2-7 illustrates how the manufacturer discriminates consumers in this model.

Suppose the market has an original retail price set (Pn=0.74V, Ps=0.74V) as in the completely decentralized channel (124 DC). The demands are described by the solid lines with the demand for the physical store (a+b+c+d+e+g+h+i) and the demand for the Internet store (f+j+m). Now, the manufacturer forces the physical store price to increase (Ps=0.75V) by imposing a high wholesale price, and decreases its own Internet store price (Pn=0.55V). The manufacture then has a large group of switching consumers from the physical store to the Internet store (c+e+h+i). As shown in the figure, switching consumers are located along the diagonal of the square market, implying that those with small difference in level of disutility between use of the Internet and the physical store switch to the other type of outlet for a lower price. In addition, the manufacturer's Internet store now attracts new customers who previously purchased from neither store (l). Now, the manufacturer's Internet store becomes a mass-retailer, serving a major part of the market. On the other hand, the independent physical store sells to those whose disutility of using a physical store is extremely low and those whose disutility of using the Internet is extremely high (a+b+d). Since this extreme category of consumers is not sensitive to the price, the manufacturer has a strong incentive to induce a high retail price (by maintaining a high wholesale price) for the niche market, while it attracts a major group of consumers to its own Internet store by lowering the price offered by the Internet store.

(Figure 2-7) Manufacturer's Price Discrimination



In other words, the manufacturer makes the retail and wholesale pricing decisions, such that the more profitable Internet channel attracts not only the consumers who prefer using an Internet channel, but also those who are relatively indifferent concerning the preference between the Internet store and the physical store. Consequently, the manufacture leaves only those with a strong preference for the physical store to be served by the independent physical store. This effect is characterized as the *price discrimination effect* in later discussions. It has a positive impact on consumer welfare, since the two types of outlet serve heterogeneous consumer groups with a low average price level. Ray et al. (2003) describe a similar effect in a fully coordinated channel setting. Interestingly, Kumar and Ruan (2003) show a reversed pattern of price discrimination, in which the price of a direct channel is higher than that of an independent physical retailer.

2.4.2. Comparing between Before and After the Internet Store Entry

Now, we compare market outcomes before and after the introduction of an Internet store. When we consider the vertically integrated channel (111 VI) to be "Before" condition, the manufacturer can open its own Internet store (121 VI) or add an independent Internet retailer (122 PI). When the channel structure is decentralized before Internet store introduction (112 DC), an Internet store can be introduced by the manufacturer (122 PI), the independent retailer (123 HI), or by a new third-party retailer (124 DC).

Making these comparisons using the solutions in Table 2-2, we find first that adding a new Internet store always leads to a higher demand. This result stems mainly from the *market coverage effect*, since the two different types of stores jointly cover a wider range of heterogeneous consumers than a single store. The improved market coverage generally improves consumer surplus as well. The only exception occurs when the vertically integrated channel (111 VI) is augmented by an independent Internet store, resulting in a partially integrated mixed channel (122 PI). In this case, the double marginalization effect associated with the decentralized part of the channel system results in decreased consumer surplus.

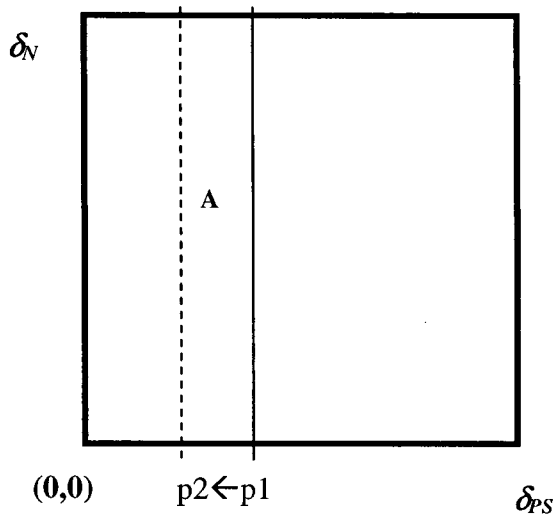
We also find that wholesale prices are higher in channel structures with two outlets than in a channel with a single store (112 DC vs. 122 PI, 123 HI, and 124 DC). Similarly, retail prices are higher with two vertically integrated stores (121 VI) than with one (111 VI). This result also stems from the market coverage effect (illustrated in Figure 2-8). The manufacturer with two stores has a stronger incentive to maintain high prices, because it does not lose as many consumers by increasing retail prices as would a

manufacturer in a channel with a single store. With increases in both demand and price, the manufacturer's profit increases after the Internet store introduction.

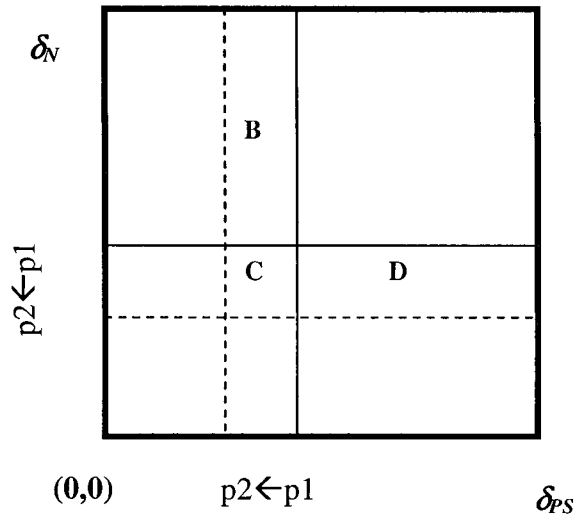
Figure 2-8 graphically illustrates the market coverage effect. In the case of a market covered by a single store, area A represents the demand loss due to the price increase from p1 to p2 (Figure 2-8 (a)). Suppose the price increases by 20%. The price increase induces a demand decrease of the same proportion, indicating that the price elasticity of demand is 1. When the market is covered by the two types of stores, on the other hand, area (B+C+D) represents the demand loss from the manufacturer's point of view (Figure 2-8 (b)). In this case, the 20% price increase induces a demand decrease of less than 20%. In other words, the price elasticity of the aggregate demand in this channel structure is less than 1, implying that the proportion of marginal consumers is decreasing with increased market coverage. The proportion of demand loss is relatively smaller than the marginal profit gain from the price increase, and thus, the manufacturer has an incentive to maintain a high wholesale price, resulting in high retail prices. This is a newly discovered effect that has never been identified in previous studies on mixed channels.

(Figure 2-8) Illustration of Market Coverage Effect

(a) Market Covered by a Single Store



(b) Market Covered by a Mixed Channel



When a new Internet channel enters as a competitor to the existing independent physical store (112 DC), retail competition occurs between the retail stores. The retail-level competition reduces retail prices, resulting in an increased quantity of sales, and thus increasing consumer surplus. Moreover, the introduction of retail-level competition provides the manufacturer with more channel power. We measure each channel member's channel power with the division of a fixed channel profit pie between the manufacturer and the independent retailer. Table 2-3 shows the measure of channel power for each channel structure. In the partially integrated channel (122 PI), we sum the physical store's profit and the manufacturer's profit only in relation to the physical store, instead of including the total profits from both stores. Therefore, the manufacturer's profit share can be represented as $0.09074\ V^3/(0.09074+0.03559)V^3$.

(Table 2-3) Channel Profit Sharing in a Mixed Channel

	Manufacturer	Independent Physical Store
111. Vertically Integrated	100.0%	N/A
112. Decentralized	66.7%	33.3%
121. Vertically Integrated	100.0%	N/A
122. Partially Integrated	71.8%	28.2%
123. Horizontally Integrated	70.0%	30.0%
124. Decentralized	70.0%	30.0%

As shown in the table above, the manufacturer selling its products through the independent retailer (112 DC) enhances its channel power when a new Internet store enters as a competitor to the existing physical store (122 PI and 124 DC). This result indicates that the manufacturer with competing retail stores can extract profitability from the channel by raising the wholesale price, because retail stores in intense competition have limited freedom to raise their retail prices accordingly, i.e., as much as in the 112 DC channel structure. In other words, the manufacturer uses the retailers to alleviate the negative impact of wholesale price increases. This is consistent with Porter (1979), who argues that powerful suppliers, who exert bargaining power on participants in an industry by raising prices, can squeeze profitability out of an industry unable to recover cost increases in its own prices due to intense competition. This effect is called the *retail competition effect* in later discussions. The effect is explored well in the literature on mixed channels (Liu &Zhang 2002; Chiang et al. 2003; and Ray et al. 2003).

The myopic inter-channel price coordination effect also has a negative impact on the channel power of coordinated retailers. As illustrated in Table 2-3, it is surprising that the independent retailer's (112 DC) channel power decreases, even after it opens its own Internet store and coordinates profits from the two stores (123 HI). With little

foresight of the manufacturer's pricing strategy, the two retailers may lose channel power by coordinating retail prices to maximize joint profits. In terms of channel power only, the manufacturer is better off with two coordinated retailers than with an independent retailer.

When the manufacturer with the independent physical store (112 DC) opens its own Internet store (122 PI), it causes decreases in retail prices and demand, and thus, in profits for the independent physical store. The wholesale price in the partially integrated channel increases slightly. The price offered by the Internet store is low, but still higher than the price for 111 VI. The total quantity and the manufacturer's profit increase by more than 100% with the new Internet store. The manufacturer's profit from the Internet store is about three times that from the physical store.

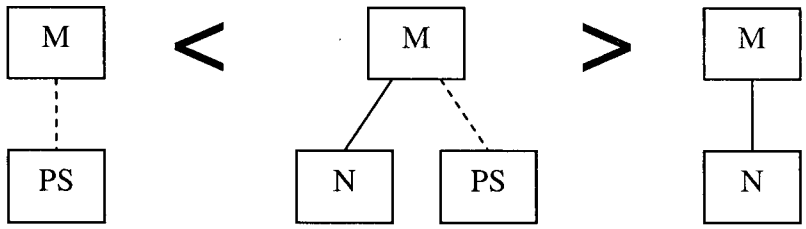
Both the manufacturer and the physical retailer are always better off when they open their own Internet channel. From the independent retailer's point of view, the Internet store introduced by a manufacturer is a more serious threat than an independent Internet store, because the manufacturer's direct channel has a cost advantage over the independent physical store. Moreover, the manufacturer could strategically use the direct Internet channel for price discrimination. Any introduction of an Internet store improves consumer surplus. An Internet store introduced by the manufacturer brings higher consumer surplus improvement, followed by an independent Internet store and one by the physical retailer.

It is obvious that the introduction of an Internet store by the manufacturer is a serious threat to the independent physical retailer. However, we find that the manufacturer prefers to keep the physical store, rather than eliminating it by charging

very high wholesale prices. This is an interesting result, because it illustrates an example of a negative incentive of disintermediation.

(Figure 2-9) Disintermediation Process and Manufacturer Profit

Decentralized w/ Physical → Partially Integrated → Vertically Integrated w/ Internet



As illustrated in Figure 2-9, a manufacturer intending disintermediation first introduces its own Internet store, and then eliminates the independent physical retailer. The results show that, when the manufacturer does not face any manufacturer-level competition, it makes a higher profit in the partially integrated channel than in the vertically integrated channel (Please refer to Table 2-2). This finding is different from Chiang et al.'s (2003), which suggests that the manufacturer who sells its products through a conventional retailer has no incentive to sell the products online.

It is not surprising that our model suggests little incentive for a manufacturer to completely disintermediate independent physical stores. This is because consumers are sufficiently heterogeneous in our model, making it always beneficial to have both types of channels for superior market coverage. This is one of the values of modeling an Internet store as a different type of store, because this model more accurately reflects the

real world, where disintermediation is taking place to a much smaller extent than many people have anticipated.

2.4.3. Comparing against Coordinating Two Physical Stores

At the beginning of this chapter, we posed the question of whether the Internet can be viewed simply as an additional channel like another physical store, or whether it acts like a different kind of channel that has different impacts on channel performance and different channel management implications. Several economic models analyzing Internet channels fail to distinguish between the two cases (Chiang et al. 2003; Kumar et al. 2002; Pan et el. 2002; and Rhee 2001). This section discusses the similarities and differences between coordinating an incumbent physical store with another physical store and coordinating a physical store with an Internet store.

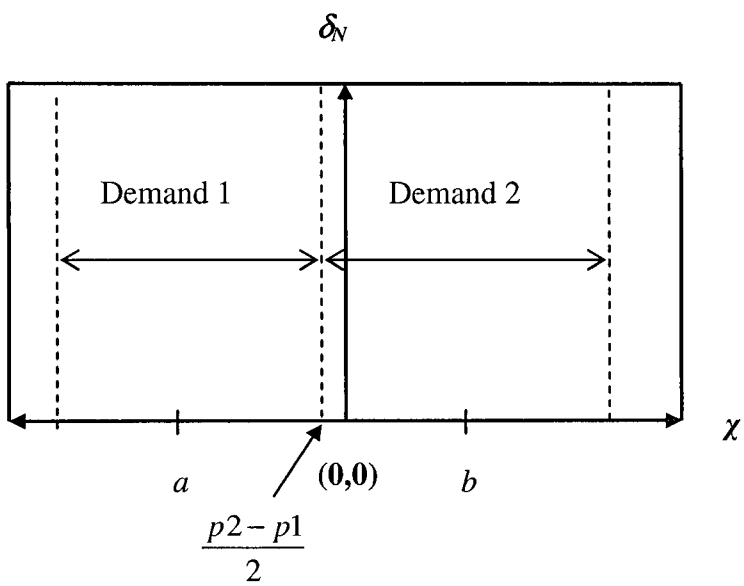
2.4.3.1. Model

We analyze a spatial model for two physical stores. Without an Internet store, our model is equivalent to Hotelling's linear city model. Since there exist two physical stores in the current analysis, we use the original setting described in Figure 2-4 (a) instead of the simplified model (Figure 2-4 (b)). As in previous sections, χ_i is assumed to be uniformly distributed along the line. The range of χ_i is set to be $-V \leq \chi_i \leq V$ and the density of the linear city to be $\frac{V}{2}$, leading to total demand V^2. Consumers are uniformly distributed over the rectangular market. This setting ensures consistency in comparing various

channel structures in the mixed channel model and those in the current model with two physical stores.

Physical store 1 and 2 are located at position a and b, respectively (Figure 2-10). Each consumer who has perfect information on prices and the product in the market purchases a single unit of the standardized product in each period. Consumers incur disutility of using physical stores at a linear rate per unit distance. This cost can be interpreted as real cost of travel, opportunity cost of shopping time, and other costs of inconvenience. Without loss of generality, we assume the rate per unit distance of disutility is 1. A consumer's disutility when using a physical store is then captured by the distance between the consumer and the physical store.

(Figure 2-10) Spatial Market for Two Physical Stores



Let's denote the price for store 1 as p1 and that for store 2 as p2. We let q1 and q2 represent the respective quantities sold. Consumer i's disutilities when using physical

store 1 (δ_{PS1i}) and 2 (δ_{PS2i}) are described as $|\chi_i - a|$ and $|\chi_i - b|$, respectively. A valuation equation of consumer i at location χ_i can be described by the following utility functions:

Consumer i's utility of purchasing from store 1: $U_{i1} = V - p1 - |\chi_i - a|$ (2-8)

Consumer i's utility of purchasing from store 2: $U_{i2} = V - p2 - |\chi_i - b|$ (2-9)

Consumers will choose the product from the store that maximizes their utility. The following constraints of non-negative utility arise from the utility functions above:

$$a - (V - p1) \le \chi_i \le a + (V - p1) \tag{2-10}$$

$$b - (V - p2) \le \chi_i \le b + (V - p2) \tag{2-11}$$

Consumers between *a-(V-p1)* and *a+(V-p1)* consider shopping at store 1, and those between *b-(V-p2)* and *b+(V-p2)* consider buying from store 2. By equating (2-8) and (2-9), we determine the location of a marginal consumer who is indifferent between the two stores, $\frac{p2 - p1}{2}$. Therefore, the demands for store 1 and 2 are written as:

$$q1 = \left(\frac{p2}{2} - \frac{3p1}{2} - a + V\right)\frac{V}{2} \quad \text{and} \quad q2 = \left(\frac{p1}{2} - \frac{3p2}{2} + b + V\right)\frac{V}{2}. \tag{2-12}$$

The channel structures, the rules of the game, and the objective functions of each player explored in this section are the same as those in the previous sections, with the

exception of the property of store location. The store location is not fixed at χ=0 in the current model. We first analyze equilibrium prices taking exogenously determined store positions that are common for all the channel structures, and then we explore the optimal positions for both stores and optimal pricing strategies for all channel members.

With store location as an additional decision variable, the game is now conceptualized in three stages, with the store locations determined in the first stage. Based on the given store locations, the manufacturer sets its wholesale price in the second stage, and then retailers optimize retail prices in the third stage. The price equilibrium is first characterized for given store locations. Solving backward, store locations are then optimized. It is reasonable to assume that the locations are determined in the first stage, because positioning of a store is a long-term decision. This sequence has been a standard way of constructing a game since Hotelling (1929). The manufacturer is assumed to have a constant marginal cost. Without loss of generality, it is assumed to be zero in this thesis.

2.4.3.2. Results

We begin the analysis by fixing the locations of two physical stores at $-a$ and a, in order to compare different channel structures with common store locations across all the channel structures.[3] Next, we relax the condition of fixed locations, allowing stores to optimize their locations.

[3] We first solved the problems with a general form of store locations, i.e., a and b. Then, we found that the location decisions of two stores are always symmetric across all the channel structures, due to the symmetry between two physical stores. Therefore, we consider symmetric cases only.

When the Locations of Physical Stores are Fixed at $-a$ and a[4]

When the locations of physical stores are fixed and the same across all the channel structures (Table 2-4), the results show little evidence that coordinating two physical retailers is the same problem as coordinating a mixed channel. We find that the two cases are consistent only in terms of the results on disintermediation. In both cases, we cannot find any incentive for disintermediation; the monopoly manufacturer is always better off with two stores than with one. As shown in Table 2-4, the manufacturer's profit in the partially integrated channel (122 PI) is always greater than that in the disintermediated channel (111 VI).

[4] The range of a is limited to $0<a<0.1429V$ for the current discussion, because two physical stores reach local monopolies for a large value of a. Any further distance between two physical stores may result in two local monopolies at a given set of optimal prices, which is not the interest of this chapter. As will be shown later, for example, two horizontally coordinated physical stores located at any distance further than $-0.1429V$ and $0.1429V$, respectively, form two local monopolies at a given set of optimal prices.

(Table 2-4) Market Outcomes when the Store Locations are Fixed at $-a$ and a[5]

	111. VI	112. DC	121. VI	122. PI	123. HI	124. DC
W*	0	$\frac{1}{2}V$	0	$\frac{1}{2}(a+V)$	$\frac{1}{2}(a+V)$	$\frac{1}{2}(a+V)$
P1*	0	0	$\frac{1}{2}(a+V)$	$\frac{1}{2}(a+V)$	$\frac{3}{4}(a+V)$	$\frac{7}{10}(a+V)$
P2*	$\frac{1}{2}V$	$\frac{3}{4}V$	$\frac{1}{2}(a+V)$	$\frac{2}{3}(a+V)$	$\frac{3}{4}(a+V)$	$\frac{7}{10}(a+V)$
Ave. Retail Price	$\frac{1}{2}V$	$\frac{3}{4}V$	$\frac{1}{2}(a+V)$	$\frac{11}{20}(a+V)$	$\frac{3}{4}(a+V)$	$\frac{7}{10}(a+V)$
Q1	0	0	$\frac{1}{4}V(a+V)$	$\frac{7}{24}V(a+V)$	$\frac{1}{8}V(a+V)$	$\frac{3}{20}V(a+V)$
Q2	$\frac{1}{2}V^2$	$\frac{1}{4}V^2$	$\frac{1}{4}V(a+V)$	$\frac{1}{8}V(a+V)$	$\frac{1}{8}V(a+V)$	$\frac{3}{20}V(a+V)$
Tot. Q	$\frac{1}{2}V^2$	$\frac{1}{4}V^2$	$\frac{1}{2}V(a+V)$	$\frac{5}{12}V(a+V)$	$\frac{1}{4}V(a+V)$	$\frac{3}{10}V(a+V)$
S1 Profit	0	0	0	0	$\frac{1}{32}V(a+V)^2$	$\frac{3}{100}V(a+V)^2$
S2 Profit	0	$\frac{1}{16}V^3$	0	$\frac{1}{48}V(a+V)^2$	$\frac{1}{32}V(a+V)^2$	$\frac{3}{100}V(a+V)^2$
Tot. S Profit	0	$\frac{1}{16}V^3$	0	$\frac{1}{48}V(a+V)^2$	$\frac{1}{16}V(a+V)^2$	$\frac{3}{50}V(a+V)^2$
M Profit w/ S1	0	0	$\frac{1}{8}V(a+V)^2$	$\frac{7}{48}V(a+V)^2$	$\frac{1}{16}V(a+V)^2$	$\frac{3}{40}V(a+V)^2$
M Profit w/ S2	$\frac{1}{4}V^3$	$\frac{1}{8}V^3$	$\frac{1}{8}V(a+V)^2$	$\frac{1}{16}V(a+V)^2$	$\frac{1}{16}V(a+V)^2$	$\frac{3}{40}V(a+V)^2$
Tot. M Profit	$\frac{1}{4}V^3$	$\frac{1}{8}V^3$	$\frac{1}{4}V(a+V)^2$	$\frac{5}{24}V(a+V)^2$	$\frac{1}{8}V(a+V)^2$	$\frac{3}{20}V(a+V)^2$
Channel Profit	$\frac{1}{4}V^3$	$\frac{3}{16}V^3$	$\frac{1}{4}V(a+V)^2$	$\frac{11}{48}V(a+V)^2$	$\frac{3}{16}V(a+V)^2$	$\frac{21}{100}V(a+V)^2$
Consumer Surplus	$\frac{1}{8}V^3$	$\frac{1}{32}V^3$	$\frac{1}{12}V(a+V)^2$	$\frac{29}{432}V(a+V)^2$	$\frac{1}{48}V(a+V)^2$	$\frac{3}{100}V(a+V)^2$

[5] Please refer to Appendix A2 for the detailed proof.

A comparison of the results in Table 2-2 and Table 2-4 shows that introducing an Internet channel leads to clearly different results compared to the introduction of another physical store. We find eight main differences in this comparison. The first major difference is observed in the wholesale price. When the channel includes two physical stores, the locations of the stores determine the wholesale price (i.e., $w = \frac{(a+V)}{2}$), the retail prices, and the quantities.

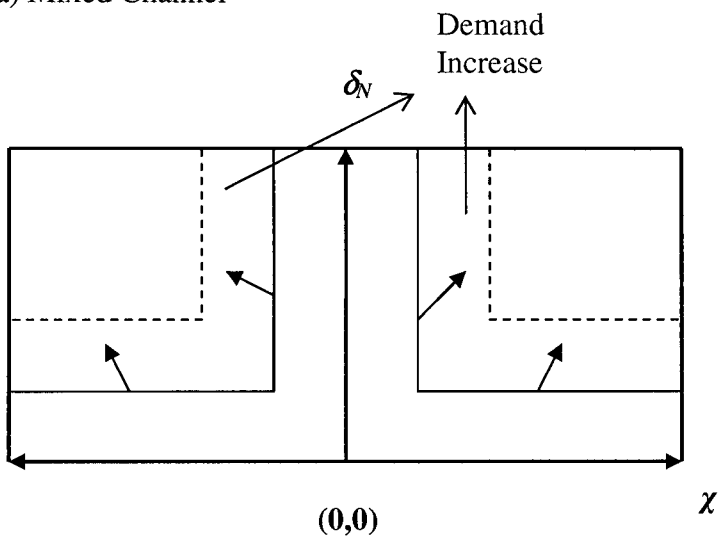
Second, the results in Table 2-4 show that the profits of the horizontally coordinated retailers (123 HI) are higher than the combined profits of the two competing retailers in the completely decentralized channel (124 DC). This contrasts with the results from mixed channels, where the combined profits of the two competing retailers are higher than the profits of the horizontally coordinated retailers. Note that wholesale prices, in the first row of Table 2-4, are the same between the two channel structures (123 HI and 124 DC), because the locations of the physical stores are the same (-*a* and *a*) across all channel structures in the current analysis. With the same (fixed) wholesale price, therefore, the horizontally coordinated retailers can maximize joint profits without facing any foresight problem related to the manufacturer. In this case, coordination does not hurt the retailers.

Third, we find that when the manufacturer sells its products through the independent physical store (112 DC), adding another independent physical store increases the retail prices (124 DC), while adding an independent Internet store decreases them. In the case of two physical stores, it is interesting to observe that retail prices increase when the retail market becomes competitive. This seemingly counter-intuitive result stems from the manufacturer's incentive to maintain a high wholesale price with

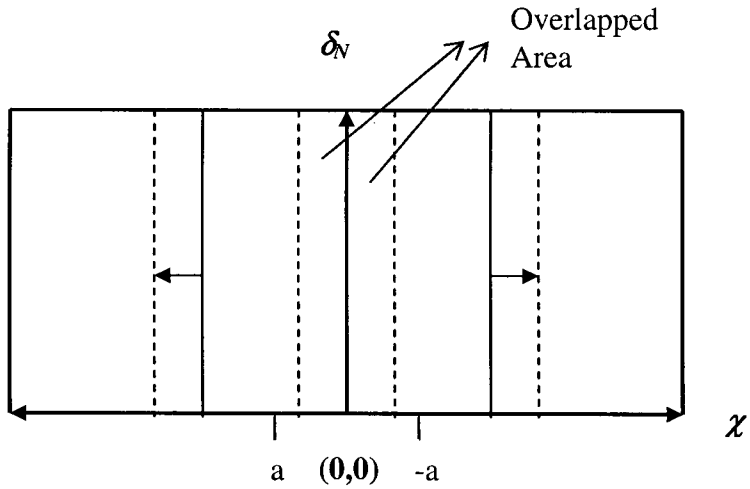
increased market coverage. Figure 2-11 illustrates the impact of price reductions in the two different cases. The areas surrounded by solid lines represent the original demands and those depicted by dotted lines indicate the increased demands. Note that the absolute demand increases in the mixed channel (Graph (a)) are greater than those in the channel with two physical stores (Graph (b)). Moreover, demand increases toward the center of the market in the channel with two physical stores are overlapped, and thus meaningless to the manufacturer. Hence, the market demand in the case of two physical stores is less price-sensitive than that of the mixed channel. In this case, the manufacturer's marginal gain from reduced prices might be negative. Therefore, the manufacturer has an incentive to force retail prices to increase by imposing a high wholesale price. The retailer margins in both cases decrease after the introduction of the competitor, implying that retailers in both cases do not want to compete.

(Figure 2-11) Demand Sensitivity with respect to Price Decrease

(a) Mixed Channel



(b) Channel with Two Physical Stores



Fourth, due to the different nature of demand shown in Figure 2-11, the two models lead to different results related to consumer welfare. When the independent physical store (112 DC) opens another physical store and coordinates the two stores (123 HI), consumer surplus decreases despite increased market coverage. However, the coordination of a mixed channel improves consumer surplus. This is because adding the same type of store does not increase actual market coverage as much as adding a different type of store, due to the overlap as shown above. In general, for this reason, adding a different type of store generates higher consumer surplus than adding the same type of store.

Fifth, the two cases also lead to different degrees of price discrimination, although the price discrimination effect appears in both cases. When the manufacturer adds the vertically integrated physical store (122 PI) to the incumbent independent physical store (112DC), the retail price of the independent physical store decreases. At the same time, the price of the independent physical store in the partially integrated channel (122 PI) is

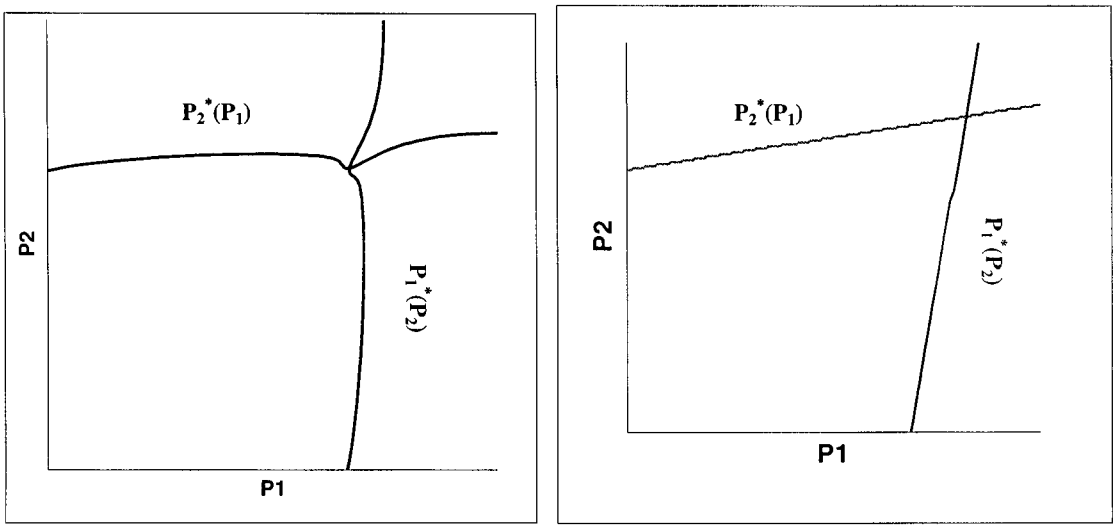
lower than that in the completely decentralized channel (124 DC). In a mixed channel case, on the other hand, the retail price of the independent retailer in the partially integrated channel (122 PI) is higher than that in the channel with two independent retailers (124 DC). This implies that the degree of price discrimination is stronger in a mixed channel than in a channel with two physical stores.

Sixth, the results indicate that multiple physical stores do not always generate higher total channel profits than a single physical store. For instance, the total channel profit of the vertically integrated channel with a single physical store (111 VI) is greater than that of the channel with the horizontally coordinated physical retailers (123 HI). On the other hand, total channel profits with two stores are always higher in the mixed channel case.

Seventh, we observe that the retailers' reaction functions for the two cases have different shapes. In the case of competition between two physical stores, we observe reaction functions with the shape of two crossing straight lines (Figure 2-12 (b)), while "wing shape" reaction functions are observed in the mixed channel case (Figure 2-12 (a)). The difference results from the complicated demand model, accommodating consumer heterogeneity in preferences for using the two different types of outlet. Therefore, a model generating straight line reaction functions may not be able to capture the core characteristics of strategic channel interactions in a mixed channel.

(Figure 2-12) Reaction Functions

(a) Internet Store vs. Physical Store **(b) Physical Store vs. Physical Store**



Finally, we find differences in the channel profit sharing pattern (Table 2-5). In mixed channels, the manufacturer gains more channel power after the independent physical store opens its own Internet store (123 HI in Table 2-3). In the market with two physical stores, on the other hand, the manufacturer's channel power remains the same when the independent physical store opens another physical store (123 HI Table 2-5). Comparing partially integrated channels (122 PI), however, the manufacturer with two physical stores gains more channel power than the manufacturer in a mixed channel.

(Table 2-5) Channel Profit Sharing When the Locations of Physical Stores are Fixed

	Manufacturer	Independent Physical Store
111. Vertically Integrated	100.0%	N/A
112. Decentralized	66.7%	33.3%
121. Vertically Integrated	100%	N/A
122. Partially Integrated	75.0%	25.0%
123. Horizontally Integrated	66.7%	33.3%
124. Decentralized	71.4%	28.6%

When the Physical Stores Optimize their Locations

In this section, two physical stores are allowed to reposition their locations, meaning that each could move to the optimal location. The main difference between the previous section and the current section is, as shown in the first row of Table 2-6, that the optimal store locations vary across the channel structures in this section. A comparison of the closed-form solutions in Table 2-2 and Table 2-6 shows that the two cases share one more underlying market effect, in addition to the similarities discussed earlier. The results indicate that the retail-level profit of the horizontally coordinated retailers (123 HI) is lower than the combined profits of two competing retailers (124 DC). This counter-intuitive result, found earlier for the horizontally coordinated mixed channel, also holds in the case of coordination between two physical retailers.

(Table 2-6) Market Outcomes when Stores Optimize Locations[6]

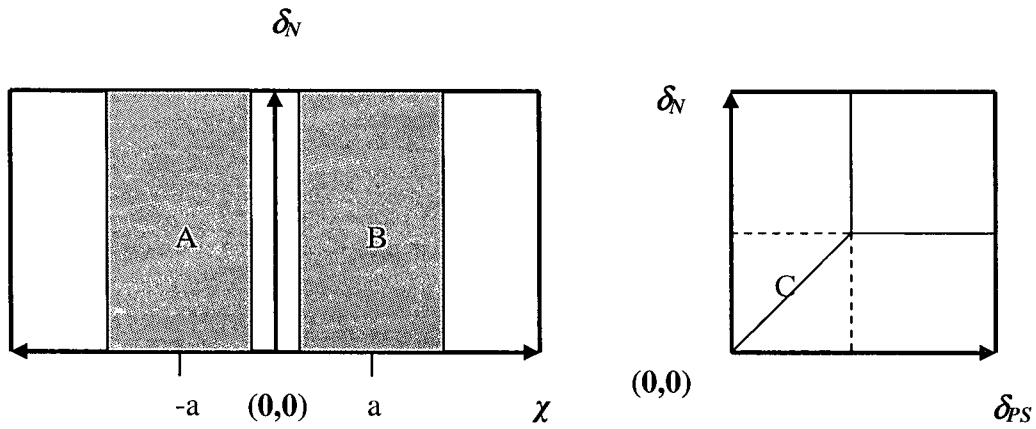
	111. VI	112. DC	121. VI	122. PI	123. HI	124. DC
a*(=-b*)	*N/A*	*N/A*	*-0.33333 V*	*-0.26316 V*	*-0.14286 V*	*-0.17647 V*
W*	*0*	*0.50000 V*	*0*	*0.63158 V*	*0.57143 V*	*0.58824 V*
P1*	*0*	*0*	*0.66667 V*	*0.63158 V*	*0.85714 V*	*0.82353 V*
P2*	*0.50000 V*	*0.75000 V*	*0.66667 V*	*0.84211 V*	*0.85714 V*	*0.82353 V*
Q1	*0*	*0*	$0.33333V^2$	$0.36842V^2$	$0.14286V^2$	$0.17647V^2$
Q2	$0.50000V^2$	$0.25000V^2$	$0.33333V^2$	$0.15790V^2$	$0.14286V^2$	$0.17647V^2$
Tot. Q	$0.50000V^2$	$0.25000V^2$	$0.66666V^2$	$0.52632V^2$	$0.28572V^2$	$0.35294V^2$
S1 Profit	*0*	*0*	*0*	*0*	$0.04082V^3$	$0.04152V^3$
S2 Profit	*0*	$0.06250V^3$	*0*	$0.03324V^3$	$0.04082V^3$	$0.04152V^3$
Tot. S Profit	*0*	$0.06250V^3$	*0*	$0.03324V^3$	$0.08164V^3$	$0.08304V^3$
M Profit w/ S1	*0*	*0*	$0.22222V^3$	$0.23269V^3$	$0.08164V^3$	$0.10381V^3$
M Profit w/ S2	$0.25000V^3$	$0.12500V^3$	$0.22222V^3$	$0.09972V^3$	$0.08164V^3$	$0.10381V^3$
Tot. M Profit	$0.25000V^3$	$0.12500V^3$	$0.44444V^3$	$0.33241V^3$	$0.16328V^3$	$0.20762V^3$
Channel Profit	$0.25000V^3$	$0.18750V^3$	$0.44444V^3$	$0.36565V^3$	$0.24492V^3$	$0.29066V^3$
Consumer Surplus	$0.12500V^3$	$0.03125V^3$	$0.14815V^3$	$0.10711V^3$	$0.02721V^3$	$0.04152V^3$

[6] Please refer to Appendix A3 for the detailed proof.

We find additional differences between the coordination of two physical retailers and the coordination of a mixed channel as well. First, the results show that when the degree of differentiation is high, two physical stores reach local monopolies. For example, the locations of physical retailers in the horizontally coordinated channel are -0.1429V and 0.1429V, respectively (123 HI in Table 2-6). The two stores are located close to each other, and any further distance results in two local monopolies at the optimal prices (Figure 2-13 (a)). Consumers under this market condition are not switching one physical store to the other. Therefore, a market with two physical stores at optimal locations tends to maintain higher retail prices than two heterogeneous retailers in the matching channel structure. In mixed channels, on the other hand, two outlets never reach local monopoly status, despite the maximum differentiation. The mixed channel model provides a consumer with two outlets that are differentiated at the maximum level in the two-dimensional space. In this setting, there consumers always exist along the indifference line (region C in Figure 2-13 (b)), who are willing to switch between the two types of outlet for a lower price.

(Figure 2-13) Local Monopolies

(a) Two Physical Stores **(b) Mixed Channel**



Second, when the manufacturer adds a vertically integrated physical store (122 PI) to the incumbent independent physical store (112 DC), the retail price of the independent physical store increases despite the direct competition introduced by the manufacturer. In a mixed channel, however, the retail price of the independent physical store decreases after the manufacturer opens its own Internet store. The results show that the manufacturer has a stronger incentive for price discrimination when it opens its own physical store in addition to the incumbent physical store and it is able to relocate the store positions including that of the existing physical store to optimize them. This is because two physical stores easily reach local monopolies when the locations are allowed to be optimized.

2.5. Discussion

2.5.1. Impact of Internet Channel Introduction

One of the main purposes of this chapter is to provide a framework to better understand the impact of introducing an Internet channel on channel competitions and strategic channel interactions. In previous sections, we have identified five key underlying effects shaping overall impacts on various market outcomes. Table 2-7 summarizes details of the main effects identified in this chapter.

Table 2-8 classifies positive and negative effects specific to each channel member. It demonstrates that the double marginalization effect and the myopic inter-channel price coordination effect have negative impacts not only on all channel members, but also on consumers under the monopoly manufacturer condition. We find that the manufacturer's interests are consistent with those of consumers, and that the interests of the manufacturer and consumers are always contrary to the independent retailer's interests in this setting.

(Table 2-7) Underlying Effects of Distribution Channel Management

Underlying Effect	Description	Impact
Double Marginalization Effect	Each independent player in a channel maximizes its own profit rather than the total channel profit.	• Raises retail price • Reduces quantity sold • Reduces profits of other channel members • Reduces total channel profit • Reduces consumer welfare
Market Coverage Effect	More stores serve a wider variety of consumers with higher prices.	• Raises retail prices • Raises quantity sold • Raises manufacturer's profit • Raises total channel profit • Raises consumer welfare
Retail Competition Effect	Adding another retailer to the incumbent channel structure introduces competition b/w retailers, resulting in lower retail profits and allowing the manufacturer to squeeze profitability from the channel.	• Raises wholesale price • Reduces retail price • Raises quantity sold • Raises manufacturer's profit and channel power • Reduces decentralized channel member's profit and channel power • Raises consumer welfare
Myopic Inter-Channel Price Coordination Effect	Retail price coordination between two retailers with little foresight of the manufacturer's pricing behavior can lead to lower profits and channel power in comparison with an uncoordinated situation.	• Raises wholesale price • Raises retail prices • Reduces quantity sold • Reduces manufacturer's profit • Raises channel power of a manufacturer • Reduces combined retail profits • Reduces channel power of retailers • Reduces consumer welfare
Price Discrimination Effect	A seller charges different prices to different consumer groups to maximize its profit, when it faces heterogeneous consumers and can distinguish the particular type of a given consumer.	• Raises wholesale price • Raises price of a decentralized retailer • Reduces price of an integrated retailer • Raises manufacturer's profit and channel power • Reduces a decentralized channel member's profit and channel power • Raises consumer welfare

(Table 2-8) Impact of Internet Channel on Each Channel Member

	Positive Effect	Negative Effect
Manufacturer	• **Market Coverage Effect**[7] • Retail Competition Effect • Price Discrimination Effect	• **Double Marginalization Effect** • **Myopic Inter-Channel Price Coordination Effect**
Independent Retailer	• **Market Coverage Effect** • Retail Coordination Effect (Avoids Retail Competition Effects)	• **Double Marginalization Effect** • Market Coverage Effect • Retail Competition Effect • Price Discrimination Effect • **Myopic Inter-Channel Price Coordination Effect**
Consumer	• **Market Coverage Effect** • Retail Competition Effect • Price Discrimination Effect	• **Double Marginalization Effect** • **Myopic Inter-Channel Price Coordination Effect**

Table 2-9 illustrates the impact of the introduction of an Internet channel on market outcomes in terms of the five strategic underlying effects discussed above. Since multiple underlying effects work simultaneously, market outcomes depend on the impact size of each effect.

(Table 2-9) Impact of the Introduction of the Internet Channel

	Internet Channel by Manufacturer	Internet Channel by Physical Store	Internet Channel by Itself
Base Case: 111. VI	• Market Coverage Effect	N/A	• Double Marginalization Effect • Market Coverage Effect • Retail Competition Effect • Price Discrimination Effect
Base Case: 112. DC	• Mitigates Double Marginalization Effect • Market Coverage Effect • Retail Competition Effect • Price Discrimination Effect	• Market Coverage Effect • Avoids Retail Competition Effects • Myopic Inter-Channel Price Coordination Effect	• Market Coverage Effect • Retail Competition Effect

[7] Common effects are written in bold.

Our results indicate that a manufacturer is always better off with any introduction of an Internet store, due to the market coverage effect. We also find that this benefit is maximized when a monopoly manufacturer integrates the Internet channel, because the manufacturer always tries to avoid the double marginalization effect that mitigates positive outcomes on its profits resulting from the market coverage effect. Therefore, the most favorable channel structure for a monopoly manufacturer is the vertically integrated channel (121 VI). This result does not necessarily mean that manufacturers are always recommended to open their own Internet stores in the real world, because the expertise and various costs associated with opening and managing an Internet channel are not considered in our model.

We also find that the consumer should not always expect the introduction of an Internet channel to lead to lower prices. When a channel is integrated, a monopoly manufacturer's introduction of an Internet channel increases market coverage, resulting in service to a wider variety of consumers. Due to the market coverage effect, the manufacturer increases its price level by a small amount. In this case, the negative impact of increased prices on consumer welfare is competing with the positive impact of wider market coverage. The results show that the negative impact turns out to be smaller than the positive impact of the market coverage, and thus net consumer welfare improves.

Our results also indicate that the introduction of an Internet channel provides the manufacturer with a tool for price discrimination. Consider the case in which a monopoly manufacturer adds its own Internet store to the existing channel with an independent physical store (122 PI). The retail price for the independent physical store is significantly higher than that for the Internet channel, due to the price discrimination

effect. The high retail price for the physical retailer relative to that for the Internet channel forces this physical retailer to serve a niche market for a small group of consumers loyal to the physical store. The manufacturer now enjoys not only the increased profit resulting from the combination of the market coverage and price discrimination effects, but also enhanced channel power allowing it to squeeze profitability from the total channel profit, due to the retail competition effect. We observe a dramatic increase in the manufacturer's profit, and this result demonstrates that the manufacturer has a strong incentive to launch a direct channel. With this channel structure, consumers face decreased retail prices and wider market coverage, resulting in higher consumer welfare.

At this stage, a logical question is whether the manufacturer wants to eliminate the middleman. Compared with the manufacturer's profit with only the vertically integrated Internet channel, that in the partially integrated channel is still much higher. This implies that the monopoly manufacturer in the current setting wants to coordinate both channels strategically, rather than eliminating the independent retailer in order to achieve disintermediation.

When the new Internet channel is introduced by the existing physical retailer, the myopic inter-channel price coordination effect occurs. Retail prices increase due to a combination of the coordination of the retail prices and the market coverage effect. The quantity sold does not significantly increase despite the market coverage effect, because the excessively high retail prices alleviate the market coverage effect to a degree. Although the retailer achieves higher profits by opening an Internet channel, total retail profits here are lower than the combined retail profits of two competing independent

retailers, due to the myopic inter-channel price coordination effect. This implies that when a physical retailer opens an Internet channel, the retailers could be better off managing the two channels separately rather than coordinating them, unless they have the foresight of the manufacturer's pricing behavior. The manufacturer uses its channel power to increase its wholesale price to extract more profits from the total channel profit. However, no other channel structures with two stores yield a lower total channel profit than this structure, and the manufacturer profit in this case is even lower than that in the vertically integrated channel with a single store (111 VI). It is not surprising that consumers also suffer low consumer welfare.

We also find that the introduction of an Internet channel affects the power balance of the channel. An independent physical retailer's channel power always diminishes after the Internet channel's introduction. Especially, an Internet channel introduced by the manufacturer reduces the channel power and the quantity of the physical retailer by the largest amount. This implies that, from the retailer's point of view, an Internet channel introduced by the manufacturer is the most serious threat, even though it is not likely to lead to complete disintermediation. The retail competition effect is strong when an independent Internet store joins a channel with an independent physical retailer (124 DC). This implies that each retailer in this structure has weak channel power. When the retail competition effect and the market coverage effect are combined, the manufacturer ends up raising the wholesale price. However, the retailers cannot increase retail prices accordingly because of the intense competition, leading to lower channel power. In this case, consumer welfare increases due to the market coverage and retail competition effects.

2.5.2. Comparing against Coordinating Two Physical Stores

The results discussed above suggest important messages for marketing researchers, practitioners, and policy makers. First, the results show that the model for a mixed channel is theoretically different from the model for two physical stores, implying that researchers should take a different approach when modeling mixed channel problems.

Second, practitioners should notice that the coordination of two physical stores and the coordination of a mixed channel are two different managerial problems with different implications, and thus an individualized approach to each case should be taken. More specifically, when a manufacturer wants to add another physical store, it should verify whether the stores including the existing one could be easily relocated. If store locations could be optimized, adding another physical store might be better (from 111 VI to 112 PI) than adding an Internet channel. If not, the manufacturer always benefits more from by adding an Internet channel. In a partially integrated channel with two physical stores, the manufacturer could discriminate retail prices more intensely than in a partially integrated channel with the two types of stores, but only if the locations of the two physical stores could be optimized. From the perspective of a physical retailer, it is always better to have an Internet store as a competitor than another physical store, since consumers are heterogeneous and each type of retail store has its own loyal consumer group.

Finally, we find that the addition of an Internet store competing against an incumbent physical store induces higher demand and lower prices, generating a higher level of consumer welfare than that produced by adding another physical store. When an

independent physical store coordinates with another physical store, consumer welfare sinks lower than the level previous to the coordination. However, coordination between the two different types of retail stores improves consumer welfare. Therefore, policy makers should consider these aspects when designing policies and regulations for channel competition.

Chapter 3

The Impact of the Market Environment on Optimal Channel Strategy Involving an Internet Channel

3.1. Overview

In chapter 2, we developed a game theoretic model to investigate the impact of the Internet channel on channel performance and optimal channel structure. The parsimonious model preserves the transparency of mathematical tractability, while it allows us to illustrate the nature of the impact of Internet channel introduction. However, in order to capture more complex market conditions, we need a more flexible model beyond the assumptions made in chapter 2. The main purpose of this chapter is to develop, by extending the basic model in chapter 2, a general model to investigate the impact of the Internet channel in a wide variety of multi-product, multi-outlet market situations. This model is then used to investigate the impact of various market

environments on a firm's optimal channel strategy in association with the introduction of an Internet channel.

The model in this chapter differs from that in chapter 2, because it accommodates multiple competing manufacturers, producing horizontally differentiated products, as well as multiple physical stores. In addition, the model provides the flexibility to examine the impact of the Internet channel in a market where the degrees of consumer heterogeneities are asymmetric between the two dimensions of the spatial model shown in Figure 2-4. The demand model is based on a logit choice model to capture consumer choice behavior among various product-outlet pairs. A consumer choice in this model is determined not only by deterministic factors, but also by random factors. The complexity of the model is overcome by numerically analyzing equilibrium solutions.

Using this flexible model, we sequentially generalize the model developed in chapter 2 and explore the following issues. First, this chapter replicates the analysis conducted in chapter 2 using a new model and methodology developed in this chapter. Through this analysis, we demonstrate that the results obtained in chapter 2 are robust, and that the insights gained in chapter 2 can therefore be applied to more complex market conditions.

Second, this chapter examines how consumer distribution in the market affects the results of the previous chapter. In the chapter 2 model, we assumed symmetry in the distributions of consumer heterogeneities related to the use of the physical store and the Internet store. However, the relative distribution of consumer heterogeneity of purchasing from the two types of outlets in the real world varies substantially depending on various market conditions, such as the E-Commerce readiness of a market, the degree

of geographic dispersion of consumers, and the product category. Therefore, the assumption of symmetric distributions of consumer heterogeneities might not adequately capture various market environments in the real world.

Chabrow (2004) reports that Denmark, UK, Sweden, and Norway exhibit high levels of E-Commerce readiness, driven by widespread Internet penetration, high broad band adoption, and strong E-Commerce and advertising trends. On the other hand, countries like Ukraine and Bulgaria have low readiness levels. The average level of consumer disutility when purchasing a product through the Internet in the former countries is significantly lower than in the latter countries. In addition, the disutility of using the Internet also depends to a large extent on the characteristics of the product (Peterson et al. 1997). For example, the average consumer disutility when purchasing a product like a music CD through the Internet is considerably lower than that of a perfume purchase. To capture the various distributions of consumer heterogeneities, we relax the assumption of symmetric distributions for the two kinds of consumer disutility by varying the distribution of one disutility while holding the other constant.

Finally, firms in a variety of *competitive* industries have established avenues for selling directly through the Internet (e.g., Nike, Estee Lauder, Eastman Kodak, Compaq, and 3Com). However, there has been little research on the strategic role of Internet store introduction in the competitive strategy of manufacturers. The last part of this chapter investigates the impact of competition on the market outcomes explored in chapter 2, by introducing manufacturer-level competition in which two competing manufacturers produce horizontally differentiated products. Table 3-1 summarizes the analyses conducted in this chapter.

(Table 3-1) Comparison between Chapter 2 and Chapter 3

Chapter	Chapter 2	Chapter 3		
		Analysis 1	Analysis 2	Analysis 3
# of Manufacturer(s)	1	1	1	2
# of Physical Store(s)	1	1	1	1 or 2
Consumer Choice	Deterministic	Stochastic	Stochastic	Stochastic
Consumer Heterogeneity	Symmetric	Symmetric	Asymmetric	Symmetric

In the process, this chapter addresses the following managerial issues: 1) As the Internet adoption rate increases, how will optimal channel strategy change? 2) Is the Internet channel as important in a market like New York City, where the geographical concentration of consumers is high, as in a market like Montana? 3) How does the impact of the Internet channel change when the products in a market become more substitutable? and 4) How does the impact of the Internet channel vary as competing physical stores become located closer to or farther apart from each other?

The remainder of the chapter is organized as follows. Section 3.2 positions the chapter by briefly reviewing the relevant literature. Section 3.3 highlights the extended demand model by describing an approach for demand derivation. Section 3.4 presents the methodology using a numerical search algorithm for equilibrium identification. Section 3.5 summarizes and discusses the results of the analysis of the cases of asymmetric consumer heterogeneities. Finally, section 3.6 presents and discusses the main findings from the multi-product, multi-channel environments.

3.2. Literature Review

One of the applications of the flexible model developed in this chapter is to examine the impact of asymmetric consumer distributions in a market. In order to explore this issue, we relax the assumption of symmetric distributions for the two kinds of consumer disutility made in the previous chapter. Many previous models assume asymmetric consumer disutility (Balasubramanian 1998; Rhee 2001; Liu & Zhang 2002; and Chiang et al. 2003). However, these models are limited in that they assume a constant cost of shopping through the Internet for all buyers, implying that consumers prefer a physical store to an Internet store at the same price. In contrast, our model assumes a continuous distribution of consumer preference for the Internet channel and for the physical store. Our flexible model allows us to investigate cases in which the average disutility of using a physical store is greater than that for the use of an Internet store, as well as the other case.

A considerable amount of research explores the issue of channel structure selection and profitability of distribution channels with multiple competing manufacturers and one or more intermediaries. McGuire and Staelin (1983) made an early effort to investigate the effect of product substitutability on Nash equilibrium distribution structures in a duopoly where each manufacturer distributes its goods through a single exclusive retailer. Choi (1991) considers a structure whereby an intermediary carries products from two manufacturers. In his model, however, retail-level competition is eliminated by focusing on a two-manufacturer-single-retailer game. Trivedi (1998) extends the literature by analyzing channel competition at both manufacturer and retailer levels. In addition to the existing channel structures examined in the literature, she

examines the channel structure in which two retailers compete with each other to sell multiple brands at the same location. Lee and Staelin (1997) examine two strategic pricing decisions within channels: using foresight and considering category implications. Using a game theoretic approach, they demonstrate that the type of vertical strategic interaction represents a key driving force for optimal decisions on channel price leadership and product line pricing. Their investigation involves a channel structure composed of two manufacturers selling competing products, both carried by two competing retailers. Like the studies mentioned above, the current chapter explores various channel structures that include two competing manufacturers, yet with an additional Internet channel in the channel system.

Recently, the literature examines the impact of the Internet channel on a channel system in which multiple manufacturers compete. Lal and Sarvary (1999) examine the impact of the Internet channel on consumers' search costs and retail prices. They model two vertically integrated firms competing through online and offline channels. Zettlemeyer (2000) analyzes the way in which the existence and the size of the Internet affect firms' optimal pricing and communication strategies when firms compete on multiple channels. As discussed in chapter 2, however, these studies do not explicitly capture the competition between an Internet store and a conventional physical store. Instead, the models above focus on the role of search cost in pricing in a multi-channel, and a firm's strategic use of information for consumer segmentation, respectively. Rhee (2001) examines a hybrid channel system in competition with an Internet-only direct channel. His work is the first that investigates the impact of the Internet channel on strategic channel interactions in a market characterized by duopoly manufacturer

competition. As pointed out in chapter 2, however, his model does not capture clearly the difference between a conventional channel and an Internet channel. His model is also not flexible enough to accommodate more than one physical store.

Several authors have applied stochastic choice models for the differentiation of product offerings to analyze strategic marketing issues. Besanko et al. (1990) examine monopolistic competition using a logit model to capture brand differentiation. The consumption value of each brand is drawn from the extreme value distribution, and the consumer then purchases the brand with the highest value. Du et al. (2001) develop methodology for deriving demand functions for multi-product, multi-outlet markets using a stochastic choice model. One important aspect of their methodology is that it derives demand functions from explicit models of buyer behavior and market conditions instead of employing the popular approach of assuming demand functions as the starting point of model development. By deriving demand functions from the underlying market model, their model ensures consistency in consumer behavior and market size across various situations.

Another advantage of employing a stochastic choice model is computational convenience. The demand function using a deterministic utility function is kinked in a multi-product, multi-channel environment. Hence, we should divide the range of parameters into several regions and examine each region to obtain the equilibrium. On the other hand, a stochastic choice model facilitates the demand function that is differentiable over all ranges of the parameters. Du et al. (2001) apply this methodology to reanalyze three channel strategy problems investigated in past studies that used assumed demand functions. The current chapter employs their methodology to

investigate the impact of the Internet channel under a multi-product, multi-outlet market environment.

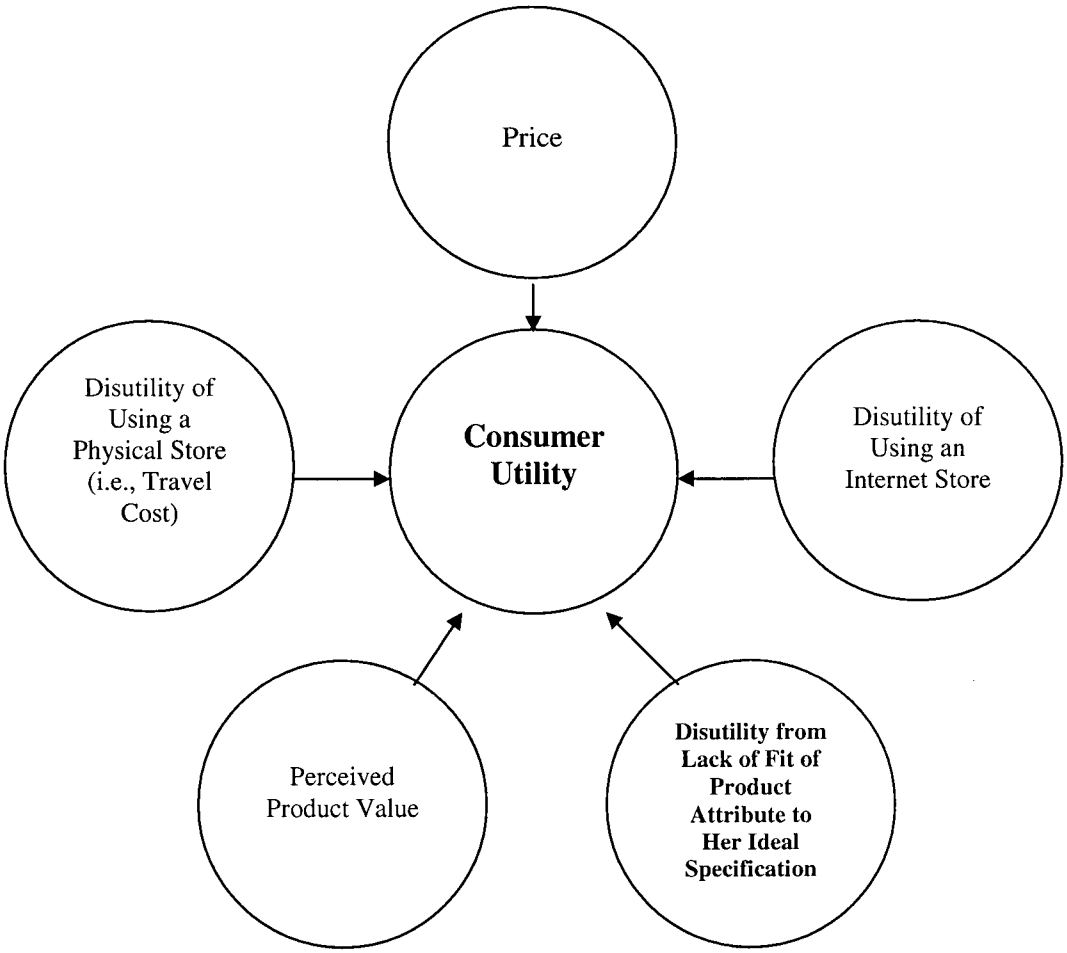
In addition to the contributions discussed in chapter 2, the current chapter makes further contributions to the existing literature in the following ways. First, we develop a general model that captures complex channel structures, including competing manufacturers, physical stores, and an Internet channel. Second, the flexibility of the model allows us to capture various market conditions, such as varying degrees of asymmetry of consumer heterogeneities. Third, we provide a simple methodology for identifying equilibrium based on a stochastic choice model. Using the advantages of this methodology, the chapter makes the first attempt to examine the impact of the Internet channel under various multi-product, multi-outlet market conditions. During the process, our model ensures consistency in consumer behavior and market size across various situations being compared.

3.3. Demand Model

This chapter extends the foundation built in chapter 2 by accommodating manufacturer-level competition where multiple manufacturers produce horizontally differentiated products. The demand function for each product offering is derived from an extended spatial demand model that reflects consumer heterogeneity in taste for a product attribute, as well as the disutility of using both types of outlets.

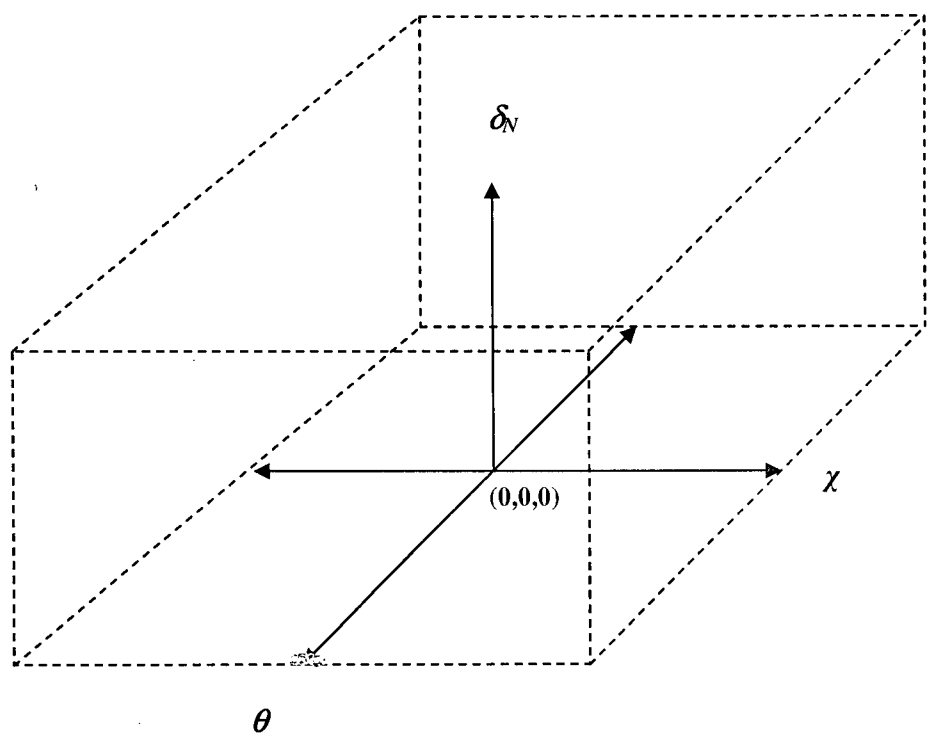
In chapter 2, consumer *i*'s utility is determined by the perceived benefit of the product (*V*), the price of the product offering, the disutility of using a physical store, and the disutility of using an Internet store, as shown in Figure 2-2. As we introduce manufacturer level competition, we add to the four factors already described in chapter 2 another factor influencing consumer *i*'s utility: consumer *i*'s disutility resulting from the discrepancy between the product and her ideal product specification. There is no unanimously agreed preference level for a horizontally differentiated product attribute, such as color or product design. The degree of congruity between a product attribute and a consumer's ideal product specification depends on the positioning of the product. As depicted in Figure 3-1, consumer *i*'s utility is influenced by five factors in this chapter.

(Figure 3-1) Five Factors Influencing Consumer Utility



In our model for the multi-product, multi-channel environment, a product offering is differentiated by a product attribute and by the type of store selling the product when the price is equal to the others. In the case of a product offering at a physical store, it is also differentiated by the store's location, since this model accommodates multiple competing physical stores. Consumers are heterogeneous in their preferences for each of the three characteristics of a product offering. Figure 3-2 illustrates the distribution of consumer heterogeneity. The dimension for consumer heterogeneity in taste for a product attribute is added to the two dimensions for the monopoly manufacturer case described in chapter 2. We assume that consumers are uniformly distributed over the three-dimensional consumer space.

(Figure 3-2) Consumer Heterogeneity



A consumer makes a purchase decision among available product offerings. Let consumer i's location be χ_i and her ideal specification for a product attribute be θ_i on each dimension. Consumer i's location in the three-dimensional space is determined by customer i's physical location, her ideal specification for the product attribute, and her disutility of using the Internet on each dimension. We assume that consumer i achieves maximum utility with product offering jk (i.e., brand j sold at physical store k), if the product offering a) has zero price (i.e., $P_{jk} = 0$); b) has consumer i's ideal specification (i.e., $\theta_j = \theta_i$); and c) is available at a physical store that incurs zero travel cost (i.e., $\chi_k = \chi_i$). Any deviation from these characteristics results in positive disutility for the consumer.

Based on the assumptions above, we can describe consumer i's deterministic utility associated with the purchase of product offering jk as $D_{ijk}(\alpha, V, \theta_j, \theta_i, \chi_k, \chi_i, \delta_{Ni}, p_{jk})$, where D_{ijk} is an increasing function in V and a decreasing function in $|\chi_k - \chi_i|$, $|\theta_j - \theta_i|$, δ_{Ni}, and P_{jk}. We define $\delta_{\theta ij} = |\theta_j - \theta_i|$ as the distance between consumer i's ideal specification and brand j's perceived position in the product attribute dimension, and $\delta_{\chi ik} = |\chi_k - \chi_i|$ as the physical distance between consumer i and physical store k in the location dimension. Since consumer i should make a choice between the two different types of stores when purchasing a product, a dummy variable (α) is employed. $\alpha = 0$, when consumer i purchases at an Internet store. $\alpha = 1$, when she chooses a physical store. We now assume consumer i will purchase one unit of a product offering that maximizes her utility, as far as the utility exceeds that of not purchasing from the product category (i.e., spending money on other goods), which is defined as 0 without loss of generality.

The general model constructed above will be used to determine aggregate demand for product offering *jk* for a given set of prices and underlying market and consumer behavior conditions. We capture the disutility associated with lack of congruity using a Euclidean distance. By adopting a quadratic functional form for the disutility of using the Internet and the physical store, the assumption of the linear functional form for disutility used in chapter 2 (2-1 and 2-2) is relaxed in this chapter. So, the utility function can be defined as:

$$U_{ijk} = D_{ijk} + \lambda\varepsilon_{ijk} = V - p_{jk} - \beta\delta_{\theta ij}{}^{2} - \alpha\beta\delta_{\chi ik}{}^{2} - (1-\alpha)\beta\delta_{Ni}{}^{2} + \lambda\varepsilon_{ijk} \qquad (3\text{-}1)$$

where β converts the distances into dollar values.

Utility function 3-1 assumes that a consumer choice is influenced not only by the deterministic factors discussed above, but also by stochastic factors independent of deterministic factors, because a consumer choice in the real world cannot be fully explained by the deterministic model. A stochastic factor is denoted by ε_{ijk} in our model, and it reflects any unobserved variables in the utility function, or truly random situational factors. We assume that the error terms representing stochastic factors are independently and identically distributed and that the distribution of error terms is double exponential (Domencich and McFadden 1975). We also assume that this random component is additively separable from the deterministic component of consumer utility (D_{ijk}), i.e., $U_{ijk} = D_{ijk} + \lambda\varepsilon_{ijk}$ where λ is a non-negative scalar indicating the impact of the stochastic component on utility relative to that of the deterministic component (Du et al. 2001). When λ is close to 0, a consumer's choice can be predicted almost with certainty by the deterministic factors (D_{ijk}). As λ approaches ∞, the choice becomes more and more

dependent on the random component ε_{ijk}. Assuming each consumer maximizes her utility, consumer i's probability of purchasing product offering jk can be described as:

$$Prob_i\ (purchase\ offering\ jk) = \frac{e^{D_{ijk}/\lambda}}{1+\sum_{jk=1}^{JK} e^{D_{ijk}/\lambda}} \tag{3-2}$$

where 1 in the denominator represents the no-purchase option (i.e., $e^0 = 1$)

Aggregating across all consumers in the three-dimensional market and taking the expected value, we arrive at the following expression for the demand for product offering jk:

$$q_{jk} = \int_{\delta_{N\,Min}}^{\delta_{N\,Max}} \int_{\theta_{Min}}^{\theta_{Max}} \int_{\chi_{Min}}^{\chi_{Max}} \frac{e^{D_{ijk}/\lambda}}{1+\sum_{jk=1}^{JK} e^{D_{ijk}/\lambda}} f(\chi_i, \theta_i, \delta_{N\,i}) \tag{3-3}$$

3.4. Methodology for Identifying Equilibrium

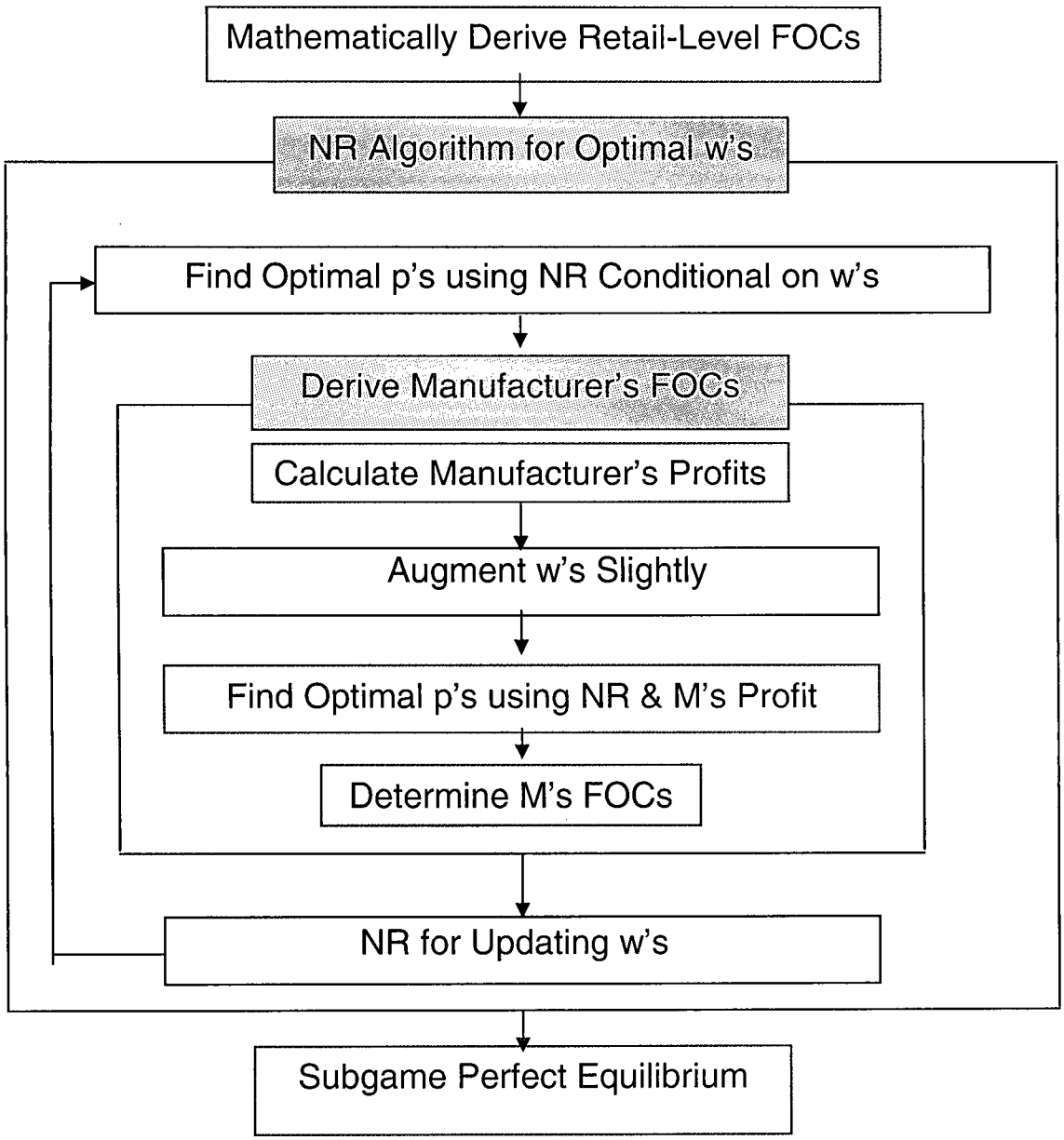
One of the motivations of this chapter is to develop a more general and flexible model to accommodate various market conditions. Due to the complex form of the demand function, however, it is infeasible to mathematically derive closed-form solutions. To overcome this mathematical complexity, we employ a numerical approach for equilibrium identification.

The first step is to solve a Nash game between retailers who set retail prices conditional on wholesale prices. Next, we solve another Nash game between manufacturers in terms of wholesale prices, incorporating the solutions of the retailer-level game. Despite the complexity of the demand function, we are able to derive the retailer-level first order conditions (FOCs) in closed forms, by differentiating each of the retailers' profit functions with respect to its own retail price, conditional on the manufacturer's wholesale price. These closed form FOCs are used to numerically solve for a set of optimal retail prices conditional on a specific set of wholesale prices. To start conducting the numerical analysis, we specify initial values for the underlying parameters of the model, such as V, χ_k, θ_j, etc. Then, we use the Newton-Raphson search algorithm to identify optimal retail price levels (i.e., identify the prices that make all the FOCs equal zero), conditional on wholesale prices.

It is more complicated to solve the manufacturer-level FOCs, since they cannot be mathematically derived in closed forms. To derive each FOC numerically, we write each of the manufacturers' profit equations as a function of wholesale and retail prices. We then numerically evaluate each of the manufacturers' profits at some initial values of wholesale prices. Then, the initially assigned wholesale price is augmented by a small increment, updating the optimal retail prices associated with the augmented wholesale prices each time. Next, we determine the FOCs (i.e., the slope of the profit function) for the manufacturers by taking the first differences in the manufacturer profit between the initial wholesale prices and the augmented wholesale prices. Finally, we use these numerically derived FOCs as input into the Newton-Raphson search algorithm to find the set of wholesale prices that make all the FOCs simultaneously equal zero. These

equilibrium wholesale prices are the subgame perfect solutions (Du et al. 2001). Caplin and Nalebuff's (1991) proof indicates that our methodology identifies a unique equilibrium solution, not a local maximum. The methodology for identifying a subgame perfect equilibrium is summarized in Figure 3-3. Please refer to the Matlab program codes in Appendix B for more details.

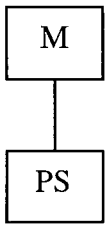
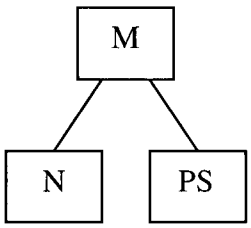
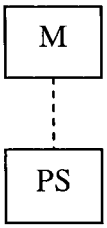
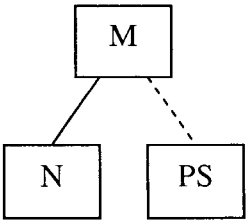
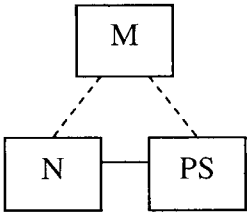
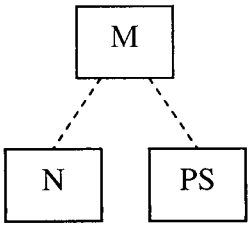
(Figure 3-3) Identification of Subgame Perfect Equilibrium



3.5. Analysis of Asymmetric Consumer Heterogeneity

This section examines the impact of the distribution of consumer heterogeneity on the results in chapter 2. To explore this issue, we relax the assumption of the symmetric distributions of the two kinds of consumer disutility, by varying the distribution of one disutility while holding the other constant. The channel structures and the rules of the game are the same as in chapter 2. Figure 3-4 summarizes the channel structures examined in this section.

(Figure 3-4) Summary of Channel Structures with Monopoly Manufacturer

Before the Internet	After the Internet	
Base Case	**Internet By Manufacturer**	**By Physical Store**
111. Vertically Integrated Channel  	**121. Vertically Integrated**  	Same as 121. VI
Base Case	**Internet By Manufacturer**	**By Physical Store**
112. Decentralized Channel  	**122. Partially Integrated**  	**123. Horizontally Integrated** 
	Internet By Independent Third Party	
	124. Decentralized Channel  	

3.5.1. Case of Symmetric Consumer Heterogeneity

Before we relax the assumption of symmetric consumer distributions, the validity of the numerical analysis approach used for identifying equilibrium is tested in this section. To test the validity, we analyze numerically the same channel structures as examined in chapter 2 under symmetric consumer distributions.

We have arbitrarily set V=100 and λ=1 for the analysis. The value of V does not affect the results, because it is a scaling factor. However, the ratio of λ/V has a significant impact on the results. A large ratio of λ/V implies that a consumer choice is largely dependent on the random factors, while a small ratio indicates a consumer choice can be predicted well by the deterministic factors. Since the purpose of this chapter is to examine the impact of strategic marketing decisions under various market environments as captured by the deterministic component of consumer disutility, we have intentionally chosen a small value of λ. In addition, we set β at 0.01 for computational convenience.

The ranges of both dimensions for consumer i's physical location (χ_i) and her ideal specification for the product attribute (θ_i) are from -100 to 100 in this chapter, because the range in chapter 2 is from $-V$ to V and the V value is set at 100 in this chapter. In the same way, we set the range of disutility of using the Internet channel (δ_{Ni}) from 0 to 100 (we used $0< \delta_{Ni} <V$ in chapter 2). We assume that the product attribute and the physical store are positioned at 0 on each dimension (i.e., θ_j=0 and χ_k=0), since there is only one brand from the monopoly manufacturer and one physical store in the market, as in chapter 2. The results of the numerical analyses are summarized in Table 3-2.

(Table 3-2) Market Outcomes with Symmetric Consumer Heterogeneity

	W	P_N	P_S	Q_N	Q_S	Total Q	Retail Profit for N	Retail Profit for PS	Total Retail Profit	M Profit Thru N	M Profit Thru PS	Total M Profit	Total Channel Profit
111. VI	0.0	N/A	50.0	0	200306	200306	0	0	0	0	10013309	10013309	10013309
112. DC	49.8	N/A	74.9	0	100454	100454	0	2519397	2519397	0	5006648	5006648	7526045
121 .VI	0.0	55.6	55.5	129580	127638	257219	0	0	0	7204656	7083953	14288610	14288610
122. PI	50.5	54.4	70.6	168582	61372	229955	0	1234195	1234195	9167537	3096841	12264379	13498574
123. HI	54.4	78.8	78.7	69964	68452	138416	1707120	1664764	3371884	3803940	3721760	7525701	10897586
124. DC	50.5	67.8	67.6	99587	99401	198988	1717876	1699762	3417638	5032132	5022748	10054880	13472519

The model analyzed in this section differs in two ways from that in chapter 2. The solutions above are obtained from the numerical analysis using the quadratic form of disutility functions, while the mathematical solutions in chapter 2 are obtained using linear disutility functions (Table 2-2). Also, the model in this section includes the stochastic factor in the utility function in addition to the deterministic factor. Despite the differences, we find that the results from both analyses are generally consistent.

The closed-form solutions in chapter 2 reveal five strategic underlying effects that shape the overall impact of Internet channel introduction. The results indicate that the monopoly manufacturer that has its own Internet channel prefers to keep an independent physical retailer rather than to eliminate it. Chapter 2 also explores ways in which the introduction of an Internet store affects the behavior and performance of each channel member. A different set of underlying effects is involved depending on the ownership of an Internet store and channel structures, leading to different market outcomes. In addition, chapter 2 finds that the monopoly manufacturer is better off with any type of Internet store introduction, while an independent physical retailer is worse off with the manufacturer's Internet store introduction.

When we substitute $V's$ of the closed-form solutions in chapter 2 with 100, the equilibrium wholesale and retail prices for 111 VI, 112 DC, and 123 HI from both chapters are almost the same, with less than 1% difference. We also find some minor differences. The wholesale and retail prices for 121 VI and 122 PI determined by the numerical analysis with the quadratic disutility functions in this chapter are about 5% lower than the mathematical solutions in chapter 2. The difference is the largest in the 124 DC channel structure. The equilibrium retail prices resulting from the numerical analysis are about 10% lower than those from the closed-form solutions. In general, however, the results from numerical analyses reveal qualitative results consistent with those in chapter 2. Therefore, the new results confirm robustness of the results in chapter 2. This implies that we can use the insights from chapter 2 in the discussion of channel strategy issues in more complex market conditions, as analyzed in the following sections.

3.5.2. Asymmetric Consumer Distribution

The results in chapter 2 are drawn from the model setting in which the distributions of disutility in using the physical store and the Internet are symmetric. However, the distribution of each consumer disutility varies depending on market conditions and product characteristics, and thus a market with asymmetric distributions of consumer heterogeneities is frequently observed in the real world. This section explores the generalizability of the findings of chapter 2 beyond the symmetric distributions of consumer heterogeneities. We extend chapter 2 by varying the range of the geographical distribution of consumers in a city (χ_i), while fixing the δ_{Ni} range constant. Since chapter

2 examines a market in which the monopoly manufacturer produces one kind of product, the distribution of consumer taste (θ_i) is not considered in this part of the extension.

The range of χ_i in our model implies the average travel cost of consumers in a city. Therefore, the wider the χ_i range of a city, the higher the average travel cost of consumers in the city (Figure 3-5 (c)), and the narrower the χ_i range, the lower the average travel cost in the city (Figure 3-5 (b)).

The relative distribution of consumer disutility when using the two types of outlets undoubtedly varies across product categories, degrees of geographic dispersion of consumers, and other market situations. For example, the relative distribution in a market for "search goods" such as airline tickets and that in a market for "experience goods" such as clothing clearly differ in this regard. The E-Commerce readiness of a market is another important factor, determining the relative distribution of consumer disutility. E-Commerce readiness, as measured by Internet penetration, high board band adoption, and E-Commerce and advertising trends, differs across countries. Scandinavian countries have led the way in the adoption of and use of the Internet, while Ukraine and Bulgaria lag significantly behind (Chabrow 2004). Levels of Internet adoption vary across regions within the same country. According to Walsh (2003), a higher percentage of people in the Rocky Mountain area – Colorado, Nevada, Wyoming, and Montana – have home-based Internet connections, compared to other regions in the U.S.

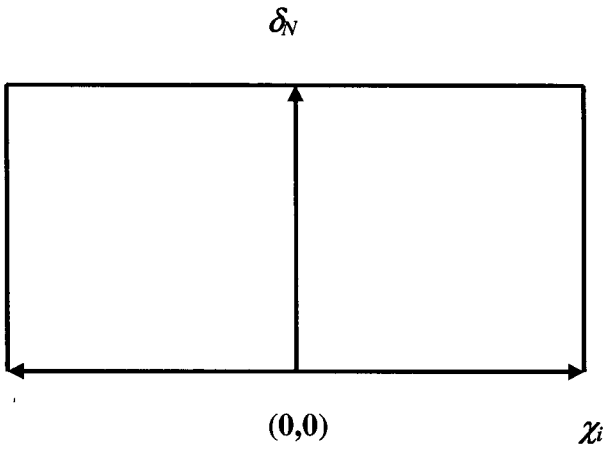
Our model captures explicitly the asymmetric distributions of consumer disutility in a market. In a market like that represented in Figure 3-5 (c), the average consumer disutility of using an Internet store is relatively smaller than that of using a physical store. For example, this case represents the market in which 1) the product is suitable for

Internet transactions (e.g., books) or 2) the level of E-Commerce readiness is high such as in Denmark or Finland. On the other hand, the average consumer disutility when using an Internet store is relatively greater than that of using a physical store in a market like that of Figure 3-5 (b). Countries like Ukraine and Bulgaria, or the market for "experience goods" such as shoes, could be examples of this market condition.

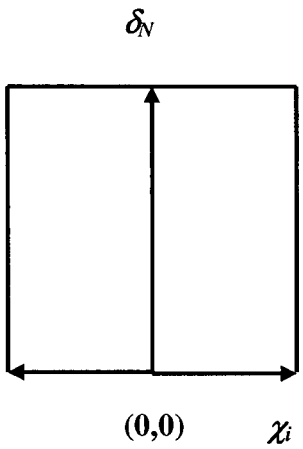
In this chapter, we compare the cases with $-50<\chi_i<50$ and $-200<\chi_i<200$ against the market with symmetric distributions ($-100<\chi_i<100$ and $0< \delta_{Ni}<100$). The average travel cost is the lowest in the market with $-50<\chi_i<50$ and the highest in the market with $-200<\chi_i<200$. The results are summarized in Table 3-3 on page 84.

(Figure 3-5) Various Ranges of χ_i

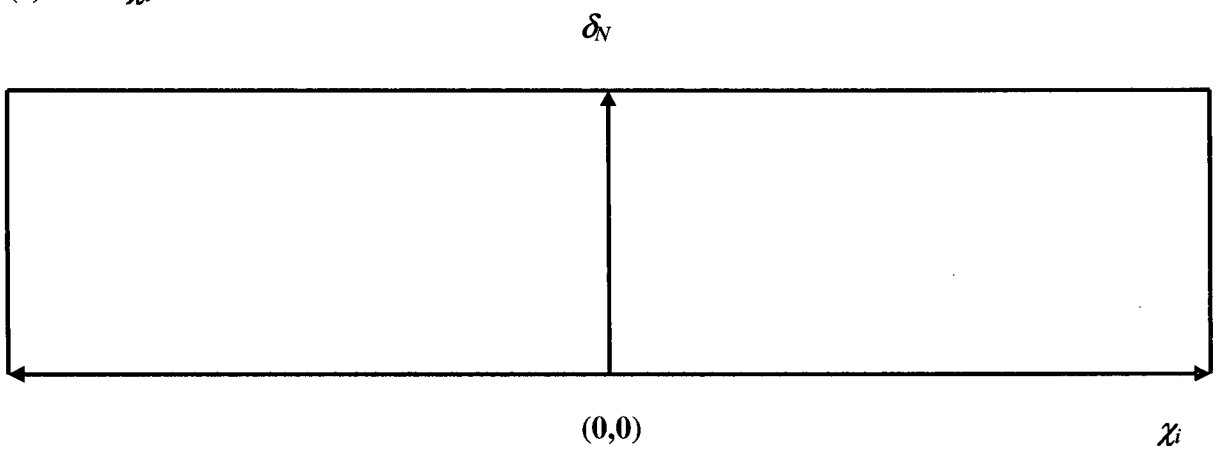
(a) Original Setting ($-100<\chi_i<100$)



(b) $-50<\chi_i<50$



(c) $-200<\chi_i<200$



3.5.2.1. Impact of Ownership Structures

As the χ_i range decreases, in general, we find that average retail price, total quantity sold, profit of both the physical store and the manufacturer, and thus total channel profit increase. On the other hand, the quantity sold through the Internet and the profit of the Internet store decrease with the decreasing χ_i range. We also find that the channel with an advantage over the other kind of channel becomes a mass-retailer by serving a larger

portion of the market. In a wider range of χ_i, where the Internet store has an advantage over the physical store, for example, the Internet store serves a larger portion of the market than the physical store in all channel structures.

We compare outcomes from the channel structures before the Internet store introduction (111VI and 112 DC). In both the $-50<\chi_i<50$ and $-200<\chi_i<200$ cases, the comparisons reveal a double marginalization problem, which is also observed in chapter 2 (the market with symmetric distributions). Our results imply that the double marginalization effect also exists in the channel structures with the two types of retail outlets (122 PI, 123 HI, and 124 DC).

We find that the myopic inter-channel price coordination effect still exists over all ranges of χ_i. The results show that price coordination between the physical store and the Internet store operated by the same retailer (123 HI) leads to a higher wholesale price as well as higher retail prices, worsening the already high retail prices caused by the double marginalization problem. Unlike the market with $-100<\chi_i<100$, however, the combined retail profits are no longer greater for 124 DC than for 123 HI in both the $-50< \chi_i <50$ and $-200<\chi_i<200$ cases. This is because the negative impact of the myopic inter-channel price coordination effect on the joint profit is compensated by the other market effects discussed below.

In chapter 2, we discussed the manufacturer's price discrimination effect. We observe that the price in the physical store is still higher for 122 PI than for 124 DC in the $-50<\chi_i<50$ and $-200<\chi_i<200$ cases. The results imply that the monopoly manufacturer has an opportunity for price discrimination, as long as it faces heterogeneous consumers and can distinguish the particular type of a given consumer. We find that the degree of

price discrimination by the manufacturer increases with the range of χ_i. This finding has intuitive appeal. As shown in Figure 3-5, the proportion of consumers who extremely prefer the Internet store to the physical store is increasing with average travel cost in the city (the range of χ_i). Therefore, a manufacture in a city where the average travel cost is high has a stronger incentive for price discrimination than one in a city where the average travel cost is low.

(Table 3-3) Market Outcomes with Asymmetric Consumer Heterogeneity

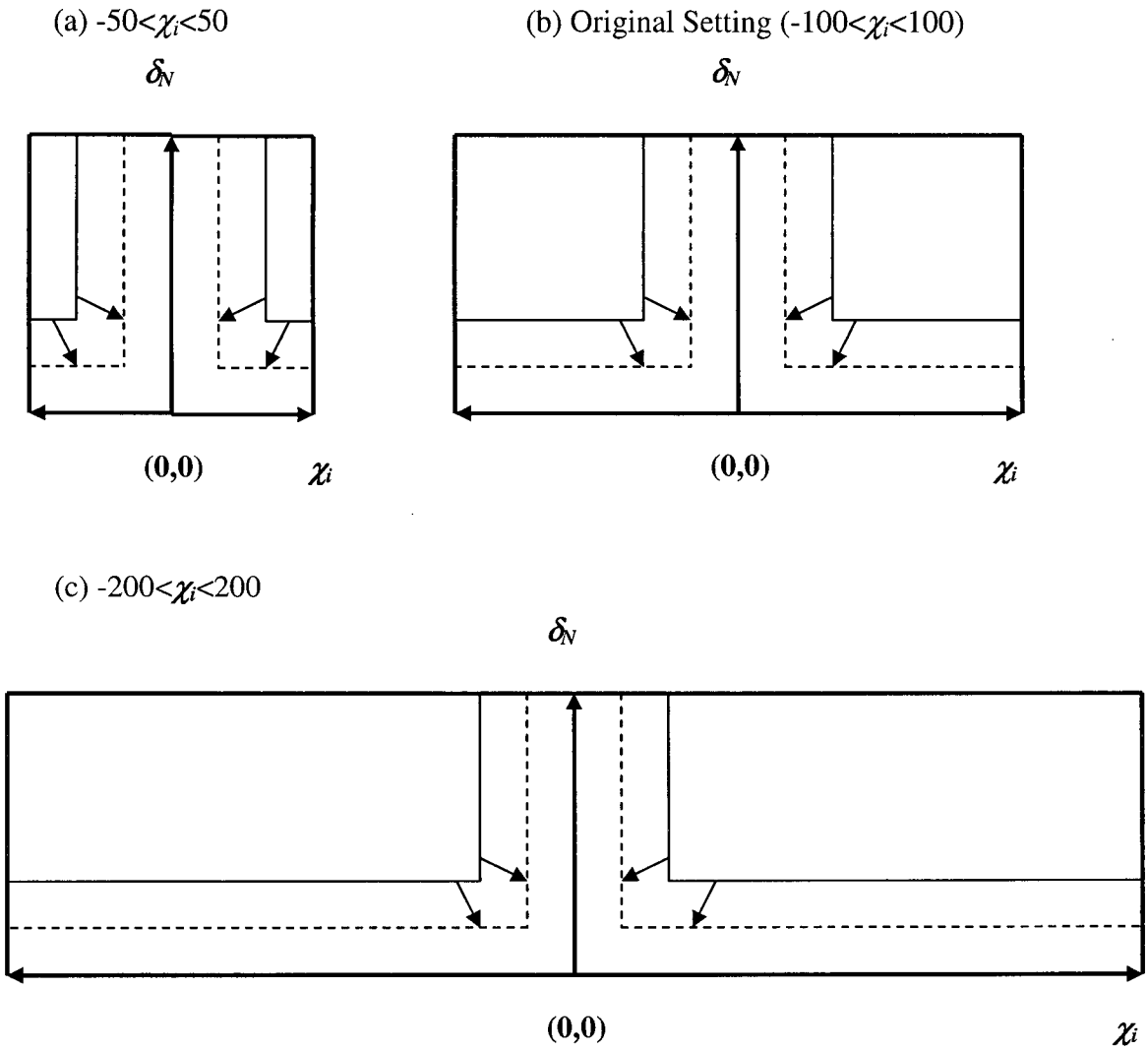
	W	P_N	P_S	Q_N	Q_S	Total Q	Retail Profit for N	Retail Profit for PS	Total Retail Profit	M Profit Thru N	M Profit Thru PS	Total M Profit	Total Channel Profit
111.VI:50	0.0	N/A	60.2	0	285478	285478	0	0	0	0	17194355	17194355	17194355
111.VI:100	0.0	N/A	50.0	0	200306	200306	0	0	0	0	10013309	10013309	10013309
111.VI:200	0.0	N/A	50.7	0	98823	98823	0	0	0	0	5007386	5007386	5007386
112.DC:50	53.0	N/A	76.6	0	187164	187164	0	4422687	4422687	0	9917824	9917824	14340511
112.DC:100	49.8	N/A	74.9	0	100454	100454	0	2519397	2519397	0	5006648	5006648	7526045
112.DC:200	49.9	N/A	75.1	0	49956	49956	0	1256412	1256412	0	2493342	2493342	3749755
121.VI:50	0.0	62.3	61.7	71800	217111	288911	0	0	0	4474600	13387081	17861681	17861681
121.VI:100	0.0	55.6	55.5	129580	127638	257219	0	0	0	7204656	7083953	14288610	14288610
121.VI:200	0.0	52.9	54.3	166060	62211	228271	0	0	0	8784573	3377463	12162036	12162036
122.PI:50	56.1	59.6	74.7	138689	109869	248559	0	2042482	2042482	8270054	6160407	14430461	16472943
122.PI:100	50.5	54.4	70.6	168412	61328	229740	0	1232080	1232080	9166676	3097679	12264356	13496436
122.PI:200	49.5	52.3	70.0	184874	30184	215059	0	619998	619998	9663390	1494153	11157543	11777541
123.HI:50	56.4	81.0	80.0	45284	134029	179312	1114438	3159062	4273500	2553109	7556552	10109661	14383162
123.HI:100	54.4	78.8	78.7	69906	68395	138301	1704315	1662012	3366328	3803601	3721404	7525005	10891334
123.HI:200	51.7	76.8	77.2	85692	35659	121351	2152601	911089	3063690	4426887	1842147	6269034	9332725
124.DC:50	58.0	71.5	74.4	79587	145876	225464	1072836	2388002	3460838	4616059	8460852	13076912	16537751
124.DC:100	50.6	67.8	67.7	99506	98268	197775	1714491	1678432	3392923	5033022	4970440	10003462	13396385
124.DC:200	50.9	72.5	70.0	96463	49216	145679	2080911	941897	3022808	4909994	2505098	7415092	10437901

3.5.2.2. Impact of the Introduction of the Internet

Now we compare market outcomes before and after the introduction of an Internet store. When we consider the vertically integrated channel (111 VI) as "before," the manufacturer can open its own Internet store (121 VI). When the channel structure is decentralized before the Internet store introduction (112 DC), an Internet store can be introduced by the manufacturer (122 PI), the independent physical retailer (123 HI), or by a new third-party retailer (124 DC).

We observe that retail prices are higher with two vertically integrated stores (121 VI) than with one (111 VI), over all ranges of χ_i examined. This result shows the market coverage effect associated with Internet store introduction, as identified in chapter 2. We find that the proportion of marginal consumers decreases with increasing market coverage. As illustrated in Figure 3-6, for example, the retail price increase by 50% from a set of original prices leads to demand decreases of 43%, 45%, and 47%, respectively, in the market with $-50<\chi_i<50$, $-100<\chi_i<100$, and $-200<\chi_i<200$. These results imply that that the narrower the χ_i range of a market, the stronger the market coverage effect.

(Figure 3-6) Market Coverage Effect with Various χ_i Ranges



As in chapter 2, competing retail stores reduce retail prices and provide the manufacturer with more channel power across all ranges of χ_i examined in this chapter. However, we discover that the retail competition effect works differently depending on the χ_i range of a market. The narrower the χ_i range of a market, the higher the channel power of the manufacturer relative to the independent physical retailer.

(Figure 3-7) Retail Competition Effect with Various χ_i Ranges

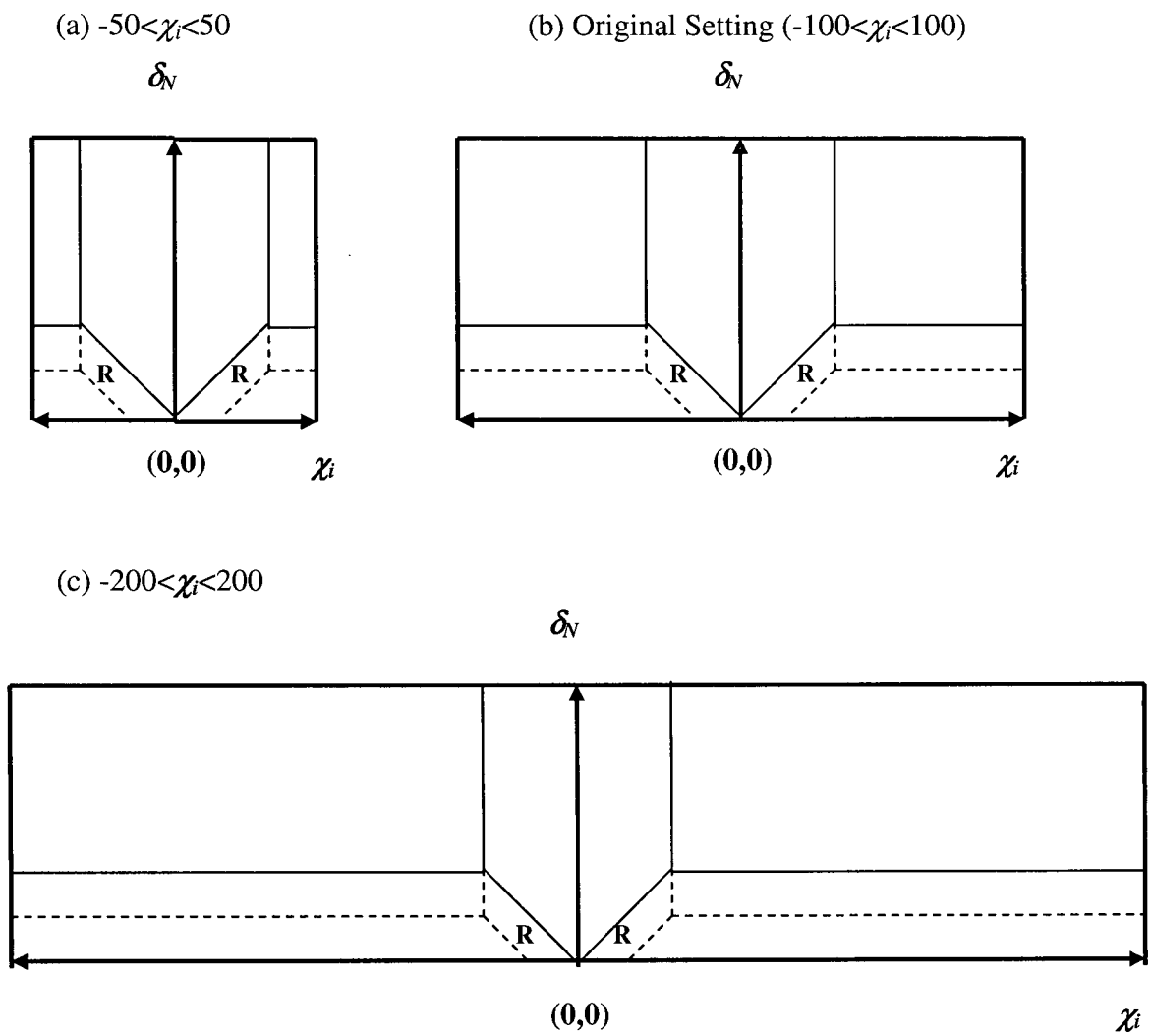


Figure 3-7 explains why the retail competition effect intensifies as the range of χ_i decreases. Suppose that a market has the same set of original retail prices for both types of stores. When the price for the Internet store increases, the *proportion* of the consumers who switch from the Internet store to the physical store is the highest in -50<χ_i<50 (area R in (a)) and the lowest in -200<χ_i<200 (area R in (c)). This implies that the cross-price effect intensifies as the range of χ_i decreases. In other words, the cross-

price elasticity becomes greater as the range of χ_i decreases, because the *proportion* of consumers who have strong preference for the Internet store in a market decreases with the decreasing range of χ_i. As a consequence, the monopoly manufacturer's channel power improves in all channel structures as the range of χ_i decreases. Table 3-4 shows how the manufacturer's channel power changes with the χ_i range.

(Table 3-4) Manufacturer's Channel Profit Sharing & the Ranges of χ_i

	$-50<\chi_i<50$	$-100<\chi_i<100$	$-200<\chi_i<200$
111. Vertically Integrated	100%	100%	100%
112. Decentralized	69.2%	66.5%	66.5%
121. Vertically Integrated	100%	100%	100%
122. Partially Integrated	75.1%	71.5%	70.7%
123. Horizontally Integrated	70.3%	69.1%	67.2%
124. Decentralized	79.1%	74.7%	71.0%

As in chapter 2, we find that the manufacturer is always better off with any type of Internet channel introduction and the best structure for the manufacturer is the vertically integrated channel (121 VI) across all the χ_i ranges examined. (Please refer to Table 3-3.) We also find that the independent physical store prefers to open its own Internet store in the market with $-200<\chi_i<200$, which is consistent with the result in chapter 2. In the market with $-50<\chi_i<50$, however, the independent physical retailer (112 DC) is worse off when it opens its own Internet outlet and coordinates both outlets (123 HI). Surprisingly, 112 DC is the most profitable channel structure for the independent physical retailer when $-50<\chi_i<50$. This is because the narrow range of χ_i aggravates the already weak channel power of the independent physical retailer caused by the myopic inter-channel price coordination (123 HI).

3.5.3. Discussion

This section examines the impact of the distribution of consumer disutility in a market on the optimal channel strategy of each channel member. As the average travel cost in a market decreases while the average disutility of Internet use remains the same, average retail price, total quantity sold, physical store profit, monopoly manufacturer profit, and thus, total channel profit increase. On the other hand, the quantity sold through the Internet and the profit of the Internet store decrease with a decreasing average travel cost relative to the average disutility of Internet use.

A channel that has an advantage over the other kind of channel serves a larger portion of the market. In a market with a high average travel cost, in which the Internet store has a relative advantage over the physical store, for example, the Internet store becomes a mass-retailer serving a larger portion of the market. This result implies that the Internet becomes a more significant distribution channel in those markets characterized by greater geographical dispersion of buyers, and/or as consumers become more proficient in Internet usage.

We find that the multiple underlying effects identified in chapter 2 either work together toward the same outcome or compete against one another, determining the overall impact of Internet store introduction. As the average travel cost relative to the average disutility of Internet use varies in a market, however, the relative impact size of each effect turns out to be different from that in chapter 2, leading to different specific results.

The results indicate that when the distributions of consumer disutility are asymmetric, the combined retail profits of the two independent retailers (124 DC) are no

longer greater than those of the coordinated retailers (123 HI). This is because the over pricing problem of the myopic inter-channel price coordination effect on joint profits is compensated by other market effects.

The degree of price discrimination also varies depending on the distribution of consumer disutility in a market. The manufacturer in a market in which the average travel cost is higher than the average disutility of using the Internet has a stronger incentive for price discrimination than the manufacturer in a market where the average travel cost is relatively lower. We also find that the manufacturer has a stronger incentive to maintain a high price level when the average travel cost in a market is relatively low. This is because the market coverage effect strengthens in a market as the average travel cost in the market decreases.

Additionally, the retail competition effect due to Internet channel introduction strengthens as average travel cost in a market decreases. This result indicates that a manufacturer's channel power relative to that of the independent physical retailer becomes stronger with a decreasing average travel cost. This implication is counter-intuitive, because it is widely believed that the negative impact of Internet channel introduction on a competing physical retailer is more significant in a market like Montana, where consumers are more geographically dispersed, than in a market like New York City, that has a condensed geographic distribution of consumers. When mangers consider the overall impact of the Internet channel, however, they should consider not only channel power, but also sales volume. When both are considered, the introduction of the Internet channel is revealed as more harmful to a physical retailer in Montana than

one in New York City, because the sales volume decrease for a physical store due to Internet channel competition is much greater in Montana than in New York City.

As discussed in chapter 2, the manufacturer is always better off with any type of Internet store introduction, and the best structure for the manufacturer across all ranges of average travel cost examined is the vertically integrated channel (121 VI). The independent physical store benefits from opening its own Internet store when the average travel cost is higher relative to the disutility of using the Internet. This is consistent with the results in chapter 2. When the average travel cost is relatively low, however, the independent physical retailer (112 DC) is worse off when it opens its own Internet outlet and coordinates both outlets (123 HI). This is because the low average travel cost significantly reduces the channel power of the independent physical retailer, further aggravating the already weak channel power caused by myopic inter-channel price coordination. Therefore, channel members and policy makers should explicitly consider the factors determining the relative distributions of both kinds of consumer disutility, when they make a channel decision involving an Internet channel. These factors include the suitability of a product for Internet shopping, the level of E-Commerce readiness of a market, and the degree of geographic dispersion of consumers in a market.

3.6. Multi-Product, Multi-Channel Environment

3.6.1. Industry Structure

This section is the last of three steps in the sequential extension of chapter 2. We now introduce manufacturer-level competition, and thus the model accommodates two competing manufacturers (manufacturer 1 and manufacturer 2) producing horizontally differentiated products. By introducing another manufacturer and another physical store selling the additional manufacturer's product, we examine a wider variety of channel structures in this section than in the previous analyses. As in chapter 2, this section compares various market outcomes before and after Internet channel introduction. We use the same numerical analysis methodology described in Figure 3-3. Detailed results are attached in Appendix C.

After an Internet store is introduced to the market, the industry is comprised of two competing manufacturers and two types of retail outlets: physical store(s) and an Internet store. For the sake of simplicity of the model, we assume that only manufacturer 1's product is sold through an Internet store, when an Internet store is available. In other words, an Internet store can be owned (and operated) either by manufacturer 1 or by an independent physical store (physical store 1) that sells manufacturer 1's product. These assumptions allow the consumers to be consistently offered two product offerings (manufacturer 1's product from a physical store and manufacturer 2's product from a physical store) before the introduction of an Internet store, and three product offerings (manufacturer 1's product from a physical store, manufacturer 2's product from a physical store, and manufacturer 1's product from an Internet store) after the introduction

of an Internet store. Figure 3-8 describes the channel structures explored in this section and the objective function of each channel member.

(Figure 3-8) Channel Structures Before and After Internet Channel Introduction

Product offering *jk*: Manufactured by M*j* and Sold through PS *k*
Product offering *jn*: Manufactured by M*j* and Sold through N

Π_j : Manufacture *j*'s Profit

π_k : Physical Store *k*'s Profit

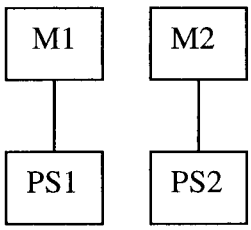
$p_{jk(\text{or } jn)}$: Price of Product Offering *jk* (or *jn*)
$q_{jk(\text{or } jn)}$: Demand for Product Offering *jk* (or *jn*)
w_j: Wholesale Price of Manufacturer *j*
Manufacturer's marginal costs is assumed to be 0

——— : vertically integrated

------- : decentralized

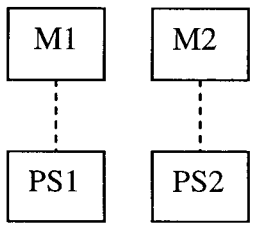
2.1. Base Case (No Internet Channel)

Vertically Integrated Physical Store (VIPS)



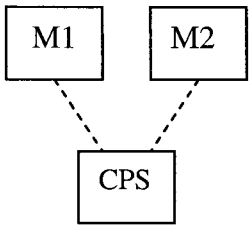
- Objective Function for M*j*: $\Pi_j = p_{jk} q_{jk}$

Decentralized Physical Store (DCPS)



- Objective Function for Mj: $\Pi_j = w_j q_{jk}$
- Objective Function for PSk: $\pi_k = (p_{jk} - w_j) q_{jk}$

Common Physical Store (CPS)

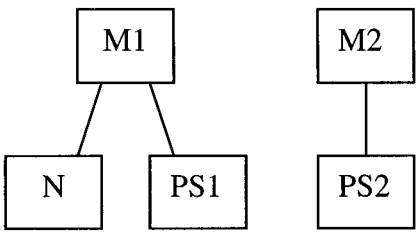


- Objective Function for Mj: $\Pi_j = w_j q_{jCPS}$
- Objective Function for CPS:
  $\pi_{CPS} = \sum_{j=1}^{2} (p_{jCPS} - w_j) q_{jCPS}$

2.2. After an Internet Store is Introduced to the Market

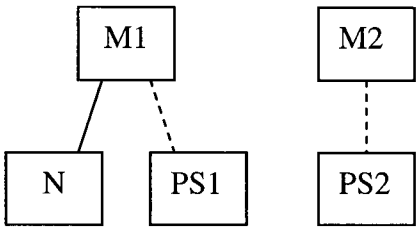
2.2.1. Internet Store is owned by Manufacturer 1

Vertically Integrated Physical Store (VIPS)



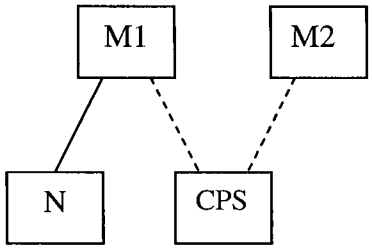
- Objective Function for M1:
  $\Pi_1 = p_{1n} q_{1n} + p_{11} q_{11}$
- Objective Function for M2: $\Pi_2 = p_{22} q_{22}$

Decentralized Physical Store (DCPS)



- Objective Function for M1: $\Pi_1 = p_{1n}q_{1n} + w_1 q_{11}$
- Objective Function for M2: $\Pi_2 = w_2 q_{22}$
- Objective Function for PSk: $\pi_k = (p_{jk} - w_j)q_{jk}$

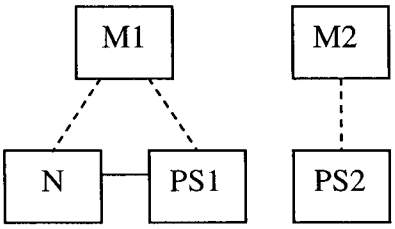
Common Physical Store (CPS)



- Objective Function for M1: $\Pi_1 = p_{1n}q_{1n} + w_1 q_{1CPS}$
- Objective Function for M2: $\Pi_2 = w_2 q_{2CPS}$
- Objective Function for CPS: $\pi_{CPS} = \sum_{j=1}^{2} (p_{jCPS} - w_j)q_{jCPS}$

2.2.2. Internet Store is Owned by PS1

Decentralized Physical Store (DCPS)



- Objective Function for M1: $\Pi_1 = w_1 q_{1n} + w_1 q_{11}$
- Objective Function for M2: $\Pi_2 = w_2 q_{22}$
- Objective Function for PS1: $\pi_1 = (p_{1n} - w_1)q_{1n} + (p_{11} - w_1)q_{11}$
- Objective Function for PS2: $\pi_2 = (p_{22} - w_2)q_{22}$

Before the introduction of an Internet store, each manufacturer's product is sold through the manufacturer's own exclusive physical store (21 VIPS), an exclusive

physical store that is independent of any manufacturer (21 DCPS), or an independent physical store that sells the products of both manufacturers (21 CPS).

An Internet store can be introduced by manufacturer 1. If the base case is 21 VIPS, the new channel structure with an additional Internet store is 221 VIPS. In this channel structure, manufacturer 1 coordinates the vertically integrated physical and Internet stores, and maximizes joint profits. On the other hand, manufacturer 2 still sells its product through the vertically integrated physical store. Under this channel structure, Manufacturer 1, selling through both types of outlet, competes with manufacturer 2, selling through only the physical store.

If manufacturer 1 adds its own Internet store to the base case 21 DCPS, the channel structure changes to 221 DCPS. In this structure, manufacturer 1 sells its products through its own Internet store as well as the independent physical store (physical store 1). This implies that physical store 1 competes not only with manufacturer 1's direct Internet store but also with physical store 2, which is an incumbent independent retailer selling manufacturer 2's product. When an Internet store is introduced by manufacturer 1 to the 21 CPS base case, 221 CPS is the new channel structure. The common physical retailer faces competition with manufacturer 1's direct Internet store in this case.

An independent physical store can open its own Internet store as well. When an independent physical store opens and operates its own Internet store in addition to a 21 DCPS channel structure, the new channel structure is 222 DCPS. Physical store 1 maximizes the joint profits between the physical store and the Internet store by coordinating both types of outlets.

We set the range of each dimension of the spatial demand model at $-100<\chi_i<100$, $-100<\theta_i<100$, and $0<\delta_{Ni}<100$ for consistency with chapter 2, where we set the ranges at $-V<\chi_i<V$ and $0<\delta_{Ni}<V$. In this model, the degree of competition between product offerings depends on the product positioning (θ_1 and θ_2) of the two competing manufacturers and the locations of the two physical stores (χ_1 and χ_2).

Figure 3-9 is the two-dimensional illustration of competition between two product offerings (e.g., A and B) from two vertically integrated channels (21 VIPS) before Internet introduction. Each dotted circle represents consumers willing to buy each product offering at the equilibrium prices. Figure 3-9 is drawn from the deterministic component of consumer utility (D_{ijk}). Since the Internet channel is not available in this market structure, D_{ijk} is described as follows:

$$D_{ijk} = V - p_{jk} - 0.01 * \delta_{\theta ij}^{\ 2} - 0.01 * \delta_{\chi ik}^{\ 2} \tag{3-4}$$

Therefore, the radius of the circle is $\sqrt{100(V - p_{jk}^{*})}$. The equilibrium price under this specific case is 45.5, and we set V=100, as in the previous analyses. Thus, the radius of each circle is about 74 in this case. The overlapping area of the two circles represents switching consumers between product offering A and B.

(Figure 3-9) Competition when θ_1=-25, θ_2=25, χ_1=-25, and χ_2=25

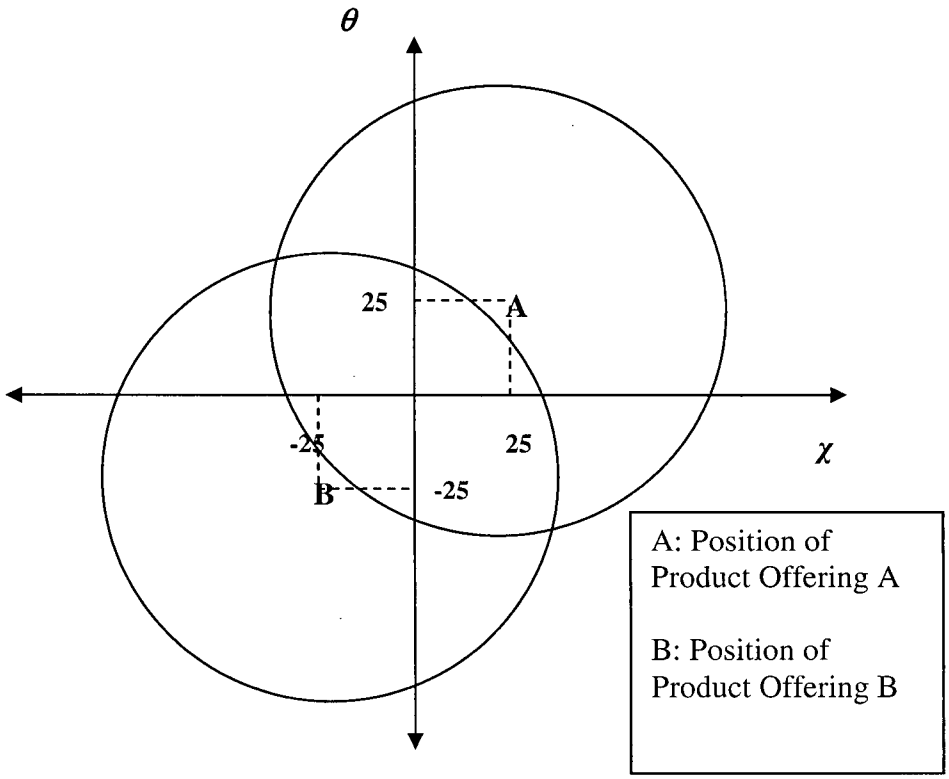


Table 3-5 shows how the proportion of switching consumers under the 21 VIPS channel structure changes with product substitutability and store proximity before Internet channel introduction. The proportion of switching consumers increases as product substitutability and the proximity of the two physical stores increase, and the proportion of switching consumers indicates the level of competition between the product offerings. It should be noted that the proportions are calculated based solely on the deterministic part of the utility function for demonstration purposes. Hence, switching consumers still exist even when the two circles are detached (e.g., 0% switching

consumers at the equilibrium prices under the 21 VIPS channel structure), because our demand model includes the random factor as well as the deterministic factor.

(Table 3-5) Proportion of Switching Consumers

	When P=0	**At Equilibrium Prices under 21. VIPS Channel Structure**
θ_1=-10, θ_2=10, χ_1=-10, χ_2=10	70%	65%
θ_1=-25, θ_2=25, χ_1=-25, χ_2=25	39%	26%
θ_1=-50, θ_2=50, χ_1=-50, χ_2=50	10%	0%

As shown in Table 3-5, the proportion of switching consumers is low when θ_1=-50, θ_2=50, χ_1=-50, and χ_2=50. On the other hand, the proportion is much higher (70% when p=0) when θ_1=-10, θ_2=10, χ_1=-10, and χ_2=10. This indicates that the competition intensity is much higher when θ_1=-10, θ_2=10, χ_1=-10, and χ_2=10 than when θ_1=-50, θ_2=50, χ_1=-50, and χ_2=50. When θ_1=-25, θ_2=25, χ_1=-25, and χ_2=25, the competition level is "moderate." In the following analysis, we investigate three levels of competition: "low" (θ_1=-50, θ_2=50, χ_1= -50, and χ_2=50), "moderate" (θ_1=-25, θ_2=25, χ_1=-25, and χ_2=25), and "high" (θ_1=-10, θ_2=10, χ_1= -10, and χ_2=10).

Among various possible combinations of θ's and χ's, the less extreme case θ_1= -25, θ_2=25, χ_1=-25, and χ_2=25 is chosen for initial analysis, implying that both product substitutability and physical store proximity are moderate. After the analysis for the initial case, we expand this result to the more extreme values of θ's and χ's shown in Table 3-5.

3.6.2. Base Case (θ_1=-25, θ_2=25, χ_1=-25, and χ_2=25)

Under the current level of "moderate" market competition, our results indicate that manufacturer 1 is always better off with any type of Internet store introduction because of the market coverage effect, while manufacturer 2 is always worse off with the Internet store selling manufacturer 1's product. We also find that manufacturers always prefer to integrate the channel to avoid any negative profit effect from double marginalization. Please refer to Appendix C for the detailed analysis results.

(Table 3-6) Impact of the Introduction of the Internet Channel

	Internet Channel by Manufacturer 1	**Internet Channel by Physical Store 1**
Base Case: 21. VIPS	**221. VIPS** • Market Coverage Effect	N/A
Base Case: 21. DCPS	**221. DCPS** • Mitigates Double Marginalization Effect • Market Coverage Effect • Retail Competition Effect • Price Discrimination Effect	**222. DCPS** • Market Coverage Effect
Base Case: 21. CPS	**221. CPS** • Mitigates Double Marginalization Effect • Market Coverage Effect • Retail Competition Effect • Price Discrimination Effect	N/A

Table 3-6 summarizes the impact of the introduction of an Internet store on market outcomes in terms of the major strategic effects identified in chapter 2. Since these multiple effects work simultaneously, a market outcome depends on the relative impact size of each effect, determined by the specific market environment and the channel structure.

The first row of Table 3-6 indicates that when the channels are integrated (21 VIPS), manufacturer 1's introduction of the direct Internet outlet (221 VIPS) increases market coverage, enabling it to serve a wider variety of consumers. Due to the market coverage effect on manufacturer 1, it charges a retail price level higher than that of manufacture 2. The price for the Internet store is the highest, since it does not have the same type of competing outlet in the market. This fully integrated channel (221 VIPS) is the channel structure most preferred by manufacturer 1, since only positive effects on the manufacturer occur when the Internet outlet is added. With the competitor's direct Internet channel in place, the retail price and profit of manufacturer 2 decrease. This is due to the increased competition caused by the presence of the competitor's Internet channel, even though it is the "indirect" competition between the moderately differentiated products across the different types of outlets.

Next, we consider the case in which manufacturer 1 adds its own Internet store (221 DCPS) to the incumbent independent physical retailer (21 DCPS). As shown in Table 3-6, four strategic effects stem from the introduction of the Internet store to this channel structure. The wholesale price for manufacturer 1 increases due to the retail competition and price discrimination effects combined, while that for manufacturer 2 decreases due to the increased retail-level competition from the competitor's new Internet store. The retail price for independent physical store 1 decreases because of the retail competition effect, but is higher than that for manufacturer 1's direct Internet outlet, due to the price discrimination effect. The retail price is lower at physical store 1 than at physical store 2, because physical store 1 faces competition not only from physical store 2 but also from manufacturer 1's Internet outlet within the channel, which could be more

direct competition than that from physical store 2. In addition to the market coverage and price discrimination effects, manufacturer 1 also gains enhanced channel power by squeezing a greater share out of the total channel profit due to the retail competition effect. As a consequence, we observe a dramatic increase in manufacturer 1's profit, and a significant decrease in the profits of manufacturer 2 and the two independent physical retailers, particularly physical store 1.

Interestingly, our results indicate that the channel power of physical store 2 increases with manufacturer 1's direct Internet store introduction. This result is due to the asymmetric foresight between a manufacture and a retailer, as captured by a Stackelberg game. Note that each manufacturer acts as a Stackelberg leader over its retailer in this game. This implies that manufacturer 2 has a better understanding of the competition from manufacturer 1's new Internet store than physical store 2 does. Since manufacturer 2 has the foresight, its wholesale pricing decision reflects a higher sensitivity to the competition from the Internet store. On the other hand, physical store 2 cannot "see" the competition directly and simply takes the wholesale price from manufacturer 2, a price which reflects the competition from the Internet store. Therefore, manufacturer 2 makes a more conservative pricing decision than physical store 2, to protect its market share. As a result, manufacturer 2's channel power decreases while that of physical store 2 increases. In this sense, "Ignorance is bliss." Although McGuire and Staelin (1983) do not discuss this issue in their paper, we find a consistent result in their model. We analyze their model and find that a manufacturer's share of total channel profit decreases as product substitutability between two manufacturers, who have the foresight, increases.

It is possible that an independent physical store could open its own Internet store to maximize joint profit by coordinating the two retail prices (222 DCPS). The coordinated retailers (physical store 1 and the newly added Internet store) achieve higher profits than any non-coordinated retailer across the various channel structures, because the market coverage effect is involved in the introduction of the Internet channel, as indicated in the second row of Table 3-6. The market coverage effect leads to an increase in manufacturer 1's profit. However, the profits of channel members in the competing channel (physical store 2 and manufacturer 2) decrease under the current parameter setting, because the competing retailer's newly added Internet channel takes away a share of their customers.

An Internet store could be opened by manufacturer 1 selling the product through the common retailer (221 CPS). As indicated in the last row of Table 3-6, four strategic effects are involved in the Internet store introduction in this case. Due to the contribution of the market coverage and retail competition effects, the wholesale price, the channel power, and the profit of manufacturer 1 improve dramatically. On the other hand, the profit and channel power of the common physical retailer decrease significantly. It is interesting that manufacturer 2's channel power increases while its profit decreases. This result has intuitive appeal. The business of the common physical store becomes more dependent on manufacturer 2, when the common retailer faces competition from manufacturer 1's direct Internet store, which is selling the same product. The retail competition effect reduces the prices for the common physical store, leading the price for manufacturer 2's product to become the highest in the market. This is because the

product sold through manufacturer 1's Internet outlet competes with products sold through the common physical store, particularly with the product of manufacturer 1.

In summary, we find that the results from the competing manufacturer market under the current setting are generally consistent with the results from the monopoly manufacturer model in chapter 2. However, there exist some qualitatively different results in prices and channel power, which stem from the newly introduced manufacturer level competition and the expanded retail level competition. These competitive forces work together with the multiple underlying effects of the Internet introduction identified in chapter 2, and these effects simultaneously determine the overall impact of Internet store introduction on various market outcomes under the multi-product, multi-outlet environment.

These results are based on the case of θ_1=-25, θ_2=25, χ_1=-25, and χ_2=25. However, the results change as the degree of product or store competition varies. In the next section, we investigate the impact of the two competition factors on the market outcomes discussed above.

3.6.3. Impact of the Degree of Product and Store Differentiation

As shown in Table 3-7, we analyze the seven sets of parameters to examine the impact of the degree of product and store differentiation on the results drawn in the previous section. Note that case 4 is the base case discussed in the previous subsection. First, we analyze cases 2, 4, and 6 to investigate the impact of the degree of product differentiation. After that, we investigate cases 3, 4, and 5 to examine the impact of physical store

differentiation. Finally, we analyze cases 1 and 7 to ensure that we do not overlook any significant insights from other conditions.

(Table 3-7) Degrees of Product and Store Differentiation

	(χ_1=-10, χ_2=10)	**(χ_1=-25, χ_2=25)**	**(χ_1=-50, χ_2=50)**
(θ_1=-10, θ_2=10)	Case 1	Case 2	
(θ_1=-25, θ_2=25)	Case 3	Case 4	Case 5
(θ_1=-50, θ_2=50)		Case 6	Case 7

3.6.3.1. Impact of Product Differentiation

To examine the impact of product differentiation on market outcomes, we vary the degree of product substitutability between two products from "low" (θ_1=-50 and θ_2=50) to "moderate" (θ_1=-25 and θ_2=25) and to "high" (θ_1=-10 and θ_2=10) while holding the proximity between two physical stores at "moderate" (χ_1=-25 and χ_2=25). Detailed results are shown in Appendix C.

When substitutability between the two products is significantly low (i.e., θ_1= -50 and θ_2=50), the results indicate that the impact of the introduction of an Internet store selling manufacturer 1's product has little impact on the profits of manufacturer 2 and physical store 2. This is not surprising.

However, when the products are highly substitutable (θ_1=-10 and θ_2=10), we find the following three interesting results. First, we find that manufacturer 1's preference between a decentralized and a vertically integrated channel depends on product substitutability. The results reveal that manufacture 1's profit is higher under 221 DCPS than under 221 VIPS. This is different from our results in chapter 2, where we find the monopoly manufacturer is always better off with a vertically integrated channel. It

demonstrated that the introduction of the competition force in this chapter leads to different results. When facing competition, the manufacturer prefers the partially integrated channel over the vertically integrated channel, when the products are sufficiently substitutable. When the substitutability is low (i.e., θ_1=-50 and θ_2=50), on the other hand, the manufacturer prefers the vertically integrated channel over the partially integrated one. This is consistent with McGuire and Staelin's (1983) finding that manufacturers in a highly competitive retail market are better off if they can shield themselves from the environment by inserting privately owned profit maximizers between themselves and the ultimate retail market.

Second, we find that manufacturer 1's introduction of an Internet channel can be beneficial to its competitor, manufacturer 2, when the products are highly substitutable (θ_1=-10 and θ_2=10). It is surprising to observe that manufacturer 2, selling its products through the common physical retailer (21 CPS), benefits from manufacturer 1's introduction of an Internet channel (221 CPS). Manufacturer 1's addition of the Internet store to the incumbent common physical retailer improves manufacturer 2's profit as well as its own profit. This interesting result has intuitive appeal. Before the Internet store introduction, the competition level between the manufacturers is high, due to the high product substitutability. Moreover, the manufacturers sell the highly substitutable products through the same physical retailer, resulting in extremely high manufacturer-level competition and thus extremely strong channel power for the common physical retailer. However, the introduction of the Internet store by manufacturer 1 dramatically weakens the channel power of the common physical retailer. In this case, the positive effect of increased channel power on manufacturer 2's profit is greater than the negative

effect of additional competition from manufacturer 1's Internet outlet, because the market was already highly competitive even before the introduction of the Internet store.

The third interesting finding is that the impact of the introduction of an Internet channel by a competing physical store also depends on product substitutability. When the products are highly substitutable (θ_1=-10 and θ_2=10), the retail price for physical store 2 across all channel structures decreases with any type of introduction of an Internet store. However, when the products are significantly differentiated from each other (i.e., θ_1=-50 and θ_2=50), the retail price for physical store 2 increases with the introduction of an Internet store selling manufacturer 1's product, no matter who owns the Internet store. This result is seemingly counter-intuitive, in that the price for manufacturer 2's product increases, even when competition becomes more intense with an additional Internet store selling the competitor's product. The intuition behind this is that low product substitutability and low Internet price of manufacturer 1's product encourage the channel members in the competing channel to narrow its target market. Despite low product substitutability, some consumers still switch product sources for a lower price. While leaving these less loyal switching customers for the competitor's Internet channel, manufacturer 2 (or physical store 2) has an incentive to focus on a smaller group of loyal customers with a higher retail price. This result implies that the introduction of an Internet channel to a market is not necessarily good news for consumers.

3.6.3.2. Impact of Store Differentiation

We now examine the impact of store positioning on market outcomes, by varying the proximity between two physical stores from "low" (χ_1=-50 and χ_2=50) to "moderate"

(χ_1= -25 and χ_2=25) and to "high" (χ_1=-10 and χ_2=10), while holding product substitutability at "moderate" (θ_1=-25 and θ_2=25). We do not observe any significant qualitative changes when the proximity of the physical stores is low (χ_1=-50 and χ_2=50).

When the proximity of the two physical stores is high (χ_1=-10 and χ_2=10), once again we find that manufacture 1's profit is higher under 221 DCPS than under 221 VIPS, consistent with our previous analysis. There are two other interesting results. We find that the introduction of an Internet channel can alleviate competition intensity between two competing physical stores located close to each other. When the proximity between two physical stores is high (χ_1=-10 and χ_2=10), the retail price for manufacturer 2 increases in the fully integrated channel (221 VIPS) when manufacturer 1 introduces an Internet store. This is counter-intuitive considering that the retail price increases even with the entry of an additional competing channel. Before the Internet channel introduction, the target markets of the two manufacturers overlap greatly in this case. After manufacturer 1's introduction of the Internet channel, the market covered by manufacturer 1 increases substantially, making the proportion of the overlap out of the total market served by both channels much smaller. This implies that the proportion of switching customers, represented by the overlapping portion out of manufacturer 1's total customers, decreases significantly. This gives manufacturer 1 a strong incentive to maintain high retail prices. Given the significant increase in the competitor's prices, manufacturer 2's marginal profit gain from increasing its price is greater than the marginal profit loss from the demand decrease due to the price increase. Consequently, manufacturer 2 raises its retail price, following manufacturer 1. Note that we observe this result only in the vertically integrated channel (221 VIPS), where price competition is

more intense than in other channel structures. This is because high store proximity alone does not provide a sufficiently competitive environment, which is a necessary condition of this finding. This result implies that the introduction of an Internet channel can be used strategically to alleviate competition intensity in a market. The result also implies that Internet channel introduction is not always beneficial to consumers.

The second interesting result is that manufacture 2's profit improves when physical store 1 opens its own Internet store and coordinates both outlets (222 DCPS). Note that this happens only when the proximity of the two physical stores is high (χ_1=-10 and χ_2=10). This is a surprising result considering that the coordinated retailer sells the competing product. Before the Internet store is introduced, the under-pricing problem due to intense competition caused by the high proximity of the two physical stores was detrimental to total channel profit and the profit of each channel member. When physical store 1 opens its own Internet store and coordinates between the Internet and physical outlets, its coordinated pricing significantly increases its retail prices. In addition, the presence of a strong market coverage effect associated with Internet store introduction contributes to higher retail prices, particularly when the distance between the physical stores is very small. This increase in retail prices mitigates the negative effect of intense price competition on total channel profit. Consequently, the profits of the channel members, including manufacturer 1, physical store 1, and even manufacturer 2, improve accordingly.

3.6.3.3. The Impact of Simultaneous Changes in Product & Store Differentiation

After we examine the impact of each competition factor, we analyze cases 1 and 7 to guard against missing any significant insights from other cases. In this section, we find generally consistent but slightly more extreme results than those discussed in the previous sections.

First, we examine market outcomes under intense competition, where both product substitutability and proximity between the physical stores are high (θ_1=-10, θ_2=10, χ_1=-10, and χ_2=10). We find results consistent with findings in the market using θ_1=-10, θ_2=10, χ_1=-25, and χ_2=25. Under intense competition, the common physical retailer has extremely strong channel power before the Internet store introduction. Manufacturer 1's direct Internet store changes the situation dramatically. After the introduction, the common physical retailer's profit decreases significantly, while manufacture 1's profit rises by 400%, and even manufacturer 2's profit improves slightly. The results also indicate that under intense competition, manufacture 1's profit is higher in the partially integrated channel (221 DCPS) than in the fully integrated channel (221 VIPS).

We also find a result consistent with the finding related to the market with θ_1=-25, θ_2=25, χ_1=-10, and χ_2=10. The results show that manufacturer 2's profit increases, when physical store 1 opens its own Internet store and coordinates both outlets (222 DCPS) under intense competition.

Next, we investigate a market characterized by minor competition, in which both product substitutability and the proximity between the two physical stores are low (θ_1=-50, θ_2=50, χ_1=-50, and χ_2=50). This market condition is similar to that of two local

monopolies, where a channel member's action has little impact on the competitor in the other channel. In general, the price increase of manufacturer 1's product, caused by the introduction of an Internet outlet, leads manufacturer 2's retail price to increase slightly. This is because the marginal profit gain from the price increase is greater than the marginal profit loss from the demand decrease due to the price increase, when cross-price elasticity is significantly low.

Although overall inter-channel competition is considerably low in this case, this does not completely rule out the retail-level competition between the Internet store and physical store 1, because both outlets sell exactly the same product. When manufacturer 1 introduces its own Internet outlet in addition to the independent physical retailer (221 DCPS), for example, physical store 1 faces competition with the manufacturer's direct Internet outlet, while the impact on physical store 2 is trivial. This case is similar to the market condition in chapter 2, with one manufacturer and one physical store in the market.

3.6.4. Discussion

This section investigates the impact of competition on the various market outcomes by introducing manufacturer-level competition where two competing manufacturers produce horizontally differentiated products. With multiple products and multiple physical stores, the competition level between product offerings depends on product substitutability and the proximity between the two physical stores.

Our results indicate that a manufacturer always benefits from the introduction of any type of Internet store selling its product, because the new Internet store leads to a

channel power increase as well as wider market coverage for the manufacturer. However, the optimal channel structure for the manufacturer depends on product or store substitutability. When product or store substitutability is high, for example, the manufacturer with both kinds of outlets prefers a partially integrated channel over a fully integrated channel. This is because the manufacturer with both kinds of outlets wants to protect itself from the highly competitive environment by inserting an independent physical store between the two competing manufacturers.

The results reveal that the impact of Internet store introduction in a channel on the competing manufacturer varies with product and store substitutability. In general, a manufacturer's profit decreases with the entry of its competitor's Internet channel. However, when two competing manufacturers sell highly substitutable products through the common physical retailer, a manufacturer's introduction of an Internet store significantly improves its own profit, and slightly increases the profit of the competing manufacturer as well. Additionally, when the distance between two physical stores is very small, a manufacturer may be better off after Internet store introduction by a physical store selling the competing manufacturer's product. These results imply that the introduction of an Internet store in a channel is not always detrimental to a manufacturer in a competing channel.

We find that a physical store is worse off with the intensification of competition caused by a manufacturer's new Internet store, unless a physical store opens its own Internet store. Particularly when two competing manufacturers sell their products through a common retailer, the introduction of an Internet store by a manufacturer significantly undermines the common retailer's profit and improves the channel power of

both manufacturers. Interestingly, a physical store's profit decreases less when the manufacturer producing the competing product opens an Internet store than when the competing physical store does. Likewise, a manufacturer prefers the Internet store introduced by the physical store selling the competing product over the competing manufacture's Internet store.

Our results show the introduction of an Internet channel to a market is not always good news for consumers. In general, a newly added Internet channel decreases retail prices, because the competition becomes more intense with the additional Internet channel. However, retail prices increase with an additional Internet channel under specific conditions. For example, when products in a market are sufficiently differentiated, the introduction of an additional Internet store increases not only the retail price for the physical store in the same channel, but also that in the competing channel. The retail prices in the fully integrated channels also increase with the introduction of an Internet store to a channel, when the two physical stores are closely located to each other.

The results also indicate that the Internet channel could be an effective strategic tool for a manufacturer. In general, the benefit of the Internet channel is more significant under intense competition. When manufacturers under intense competition sell their products through a common physical retailer, for example, a manufacturer's introduction of an Internet store dramatically improves its own profit while significantly undermining the profit and channel power of the common physical retailer. In this case, the new Internet store improves the competing manufacturer's profit as well, by weakening the channel power of the common physical retailer. When the competition between two physical stores is intense, as discussed earlier, a manufacturer in a fully integrated

channel can introduce an Internet channel to alleviate competition intensity, resulting in increased retail prices.

In summary, the strategic effects identified in chapter 2 shape the overall impact of the introduction of an Internet outlet in the multi-product and multi-channel environment. However, the underlying market effects affect market outcomes differently depending on the degree of competition and the channel structure in the market. Therefore, policy makers and channel members should observe such market conditions carefully when making a channel decision involving the Internet.

Chapter 4

The Adoption and Impact of Internet Channels: A Case Study of the Trucking Industry

4.1. Overview

In addition to industries selling tangible products, the Internet is also changing the competitive framework of service industries, such as the trucking industry, both directly and indirectly. Direct influences include changes in the marketing channels of the industry. Indirect influences include the demand for quicker delivery, greater service quality, and critical service innovation by shippers and consignees (Nagarajan et al. 2001).

Despite the explosive growth, a great deal of uncertainty still exists about the specific impact of the Internet channel in the trucking industry, because the Internet channel is still at an immature and unstable stage in this industry. Many have viewed the

potential for success of new Internet channels, including electronic transportation exchanges and company Websites, as a credible threat to the viability of traditional middlemen in transportation marketing channels. These include transportation brokers, freight forwarders, and third-party logistics companies (Cooke 2003). On the other hand, some point out that many electronic transportation exchange models fail, because they do not meet shippers' needs. In addition, the fact that they focus on price makes them unpopular with carriers. In fact, a number of electronic exchanges in the transport industry have recently merged, folded or left the business (Coppersmith 2002).

This raises a number of interesting research questions. What are the major factors that influence the choice to adopt Internet channels in the trucking industry? In other words, what kind of Internet channel does a trucking firm adopt under various conditions? What is the impact of Internet channels on the role of the traditional intermediary? And finally, is the traditional intermediary going to disappear in the trucking industry? If not, how might traditional and electronic intermediaries evolve in the future?

The main purpose of this exploratory chapter is to develop a set of empirically derived propositions and observations on the research questions above. The testable propositions generated from our case study could be used to build a foundation to guide future theoretical and empirical research, not only for the transportation and other service industries, but also for other product industries. To examine these issues, we have extensively reviewed past conceptual and empirical research on the adoption of the Internet channels as well as surveys on the impact of the Internet on the transportation industry. We have also carefully analyzed six case studies.

This chapter is in line with the preceding chapters in that this chapter also examines the impact of the Internet on distribution channel management in a broad sense. However, this chapter explores a new topic empirically: What are the major factors influencing a firm's choice to adopt a specific type of Internet channel? Furthermore, this chapter has a different context from the two chapters discussed earlier. The first and most important difference is the commodity transacted in the market. In the earlier chapters, manufacturers sell tangible and standardized products that are horizontally differentiated from the buyer's perspective, while this chapter deals with an intangible transportation service. Detailed characteristics of the transportation service are discussed in the next section. The second important difference is that the physical distance between a customer and a service provider becomes much less significant in this chapter. Since the transportation service is "delivered" to where a buyer needs the service, the concept of transportation costs in the earlier chapters is not an important factor in determining a transportation service provider. Finally, the transportation intermediary in this chapter has control over market information and its own service level, while retailers in the earlier chapters make pricing decisions only. Shippers would benefit from perfect information about carriers and their services, but this is an unrealistic assumption in the transportation industry. As we explore the research questions discussed above, we take into account the unique context of the transportation industry.

This chapter proceeds as follows. Section 4.2 gives relevant background to the trucking industry. A literature review is presented in section 4.3. Section 4.4 outlines the research methodology. Finally, section 4.5 highlights observations from the case study and generates a set of testable propositions.

4.2. Trucking Industry Background

4.2.1. Characteristics of Transportation Service

Trucking firms provide transportation services to their customers. The transportation service has a number of characteristics that contrast with those of tangible products. This section discusses the distinctive characteristics of the transportation service.

First, it is difficult for consumers to measure the quality of the transportation service, because transportation services are intangible commodities. The transportation industry can provide service across many dimensions, and the service can vary across a wide range for each dimension. A carrier typically provides services tailored to the needs of the individual shipper, because the shipper's needs vary. These characteristics often lead consumers to rely on the reputation of the service firm when selecting a service (Zeithaml 1996).

Second, like other services, the transportation service is a perishable commodity. Because it cannot be stored, it is lost forever when not used. In addition, demands for a transportation service exhibit cyclic behavior with considerable variation between peaks and valleys. Therefore, capacity is an important issue in the transportation industry (Slack 1998).

Finally, unlike manufacturing firms, which require distribution channels for physically moving goods from factories to customers, transportation service providers combine the factory and point of consumption into one. An intermediary in this case is a channel for information rather than for products (Slack 1998).

4.2.2. Trucking Industry Background

The trucking industry is the primary mode of freight movement in the U.S. and Canada, and plays a significant role in the economy. Over 80% of America's freight measured by revenue is shipped by truck. At $500 billion, truck transportation is the largest single component of overall logistics cost in the U.S. (Wilson and Delaney 2003).

4.2.2.1. Supply Market

The supply market is extremely fragmented, with nearly 200,000 separate trucking companies in the U.S. 95% of which have fewer than 25 trucks in their fleet, and service limited areas of the country or specialized market segments. The industry appears to be dichotomous with a small number of large carriers at one end and a large number of small carriers at the other end.

It is also highly variable in terms of the markets served, with many carriers moving general freight but others focusing on special commodities. A general freight carrier moves general products typically packaged in boxes or palletized. A special commodity carrier utilizes its processes and equipment to efficiently transport specific commodities. For example, these carriers specialize in the movement of household goods, motor vehicles, bulk liquid, and products requiring temperature control. In the 1980s and 1990s, deregulation in the U.S. led to fierce competition, resulting in the industry operating on very small margins, particularly in the general freight category (Nagarajan et al. 1999).

Within the trucking industry, freight movement is distributed among truckload (TL), less than truck load (LTL), and private fleet segments. TL carriers specialize in

large shipments. TL firms pick the load up from the shipper and move it directly to the consignee, without transferring the freight from one trailer to another. Thus, TL carriers do not require a network of facilities, such as consolidation centers and satellite terminals. The TL segment of the industry is highly fragmented and competitive, because there are very low barriers to entry (CITT 2002).

LTL carriers move shipments that usually weigh between 150 and 10,000 pounds. The average weight is slightly over 1000 pounds. The key economies of scale and density for an LTL carrier come from consolidating many shipments going to the same area. Such consolidation requires a terminal network. Thus, LTL shipments will typically be picked up at the shipper's dock by a pickup and delivery truck and moved to the trucking firm's local terminal, where they will be unloaded and consolidated with other shipments going to similar destinations. Key goals in managing LTL firms are increasing density and line haul network optimization. Since the LTL business requires a high network density and substantial investment in satellite facilities, there has been considerable consolidation and concentration in this sector (CITT 2002). As a consequence, the LTL sector has fewer trucking firms than the TL sector. In the private fleet segment, firms transport their own products. Since this chapter focuses on distribution channel systems, the private fleet segment falls outside the scope of this chapter.

4.2.2.2. Pricing

Pricing for the transportation industry, with its long history of regulation, still tends to be very complicated, with a variety of tariffs and discounts that vary by distance, weight,

product type, priority level, need for specialty services such as unpacking or set up at the destination, and many other related factors. Small companies shipping products in LTL amounts are often quoted prices by carriers using the National Motor Freight Classification system that includes over 10,000 different product codes and classifications (Nagarajan et al. 1999). With deregulation, each individual trucking company can quote rates (prices) in a variety of formats, allowing for customized pricing for larger customers.

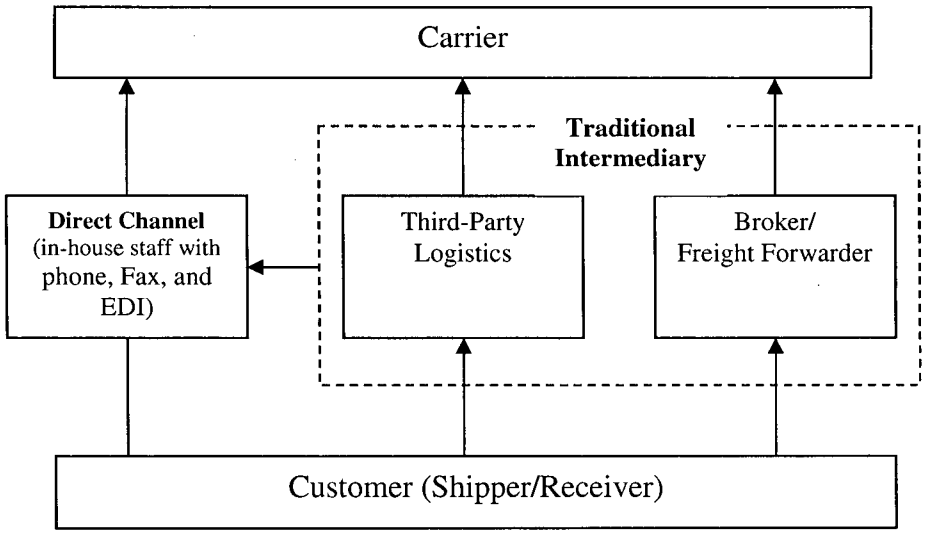
4.2.2.3. Consumer Group

The consumer group is large and diverse, with over two million businesses that ship products. While Fortune 500 companies are the biggest shippers, small and medium-sized companies that typically spend $1-$10 million annually on transportation comprise a substantial share of the overall market (Nagarajan et al. 2001).

4.2.2.4. Traditional Marketing Channels in the Trucking Industry

This section outlines traditional marketing channels in the trucking industry. Before the introduction of the Internet, as presented in Figure 4-1, consumers search and determine a trucking firm through the direct sales departments of a trucking firm, third-party logistics providers, brokers, or freight forwarders (CITT 2002).

(Figure 4-1) Traditional Marketing Channels[8]



In a traditional direct channel, trucking firms have a direct sales department to sell their services to customers. These in-house sales staffs communicate with the customers mainly through telephone, fax, and Electronic Data Interchange (EDI) (IBI Group 2001). The customers of this channel include not only transportation, logistics or purchasing departments of businesses and individual shippers, but also traditional intermediaries as depicted in Figure 4-1.

A transportation broker is a company that provides a mechanism for matching carrier capacity with shipper needs for their mutual benefit (Walle et al. 1988). The most important contribution of this transport intermediary is to increase the efficiency of the marketplace, by serving as the collector and disseminator of information and by

[8] The direction of an arrow in the diagram indicates the direction of customers' search for a service provider.

providing opportunities to shippers and carriers alike. The role of a freight forwarder is similar to that of a broker. In addition to functions performed by a broker, a freight forwarder consolidates freight to take advantage of lower rates for large shipments or to utilize transport capacity purchased in advance (Murphy and Daley 2000).

The typical margin charged by traditional brokers and freight forwarders is about 10% of the price shippers pay (CITT 2002). With the complex nature of price-service options available today, however, the transport intermediary is able to arrange a more optimal package for both carriers and shippers (CITT 2002).

In addition to the matching service, brokers provide a number of other services with attractive prices, such as helping trucking firms overcome shortages of equipment. Brokers also help determine the reliability of unknown carriers' service. Having many contacts, brokers are able to help shippers find transportation in emergency situations. Many brokers also provide bookkeeping and analytic services; they often function as an outsource traffic department that streamlines the operations of their clients. As more companies cut back on their in-house traffic staff, they are looking to outside sources for help. In the case of some large shippers, brokers have actually placed full-time "traffic coordinators" in the shipper's office (Walle et al. 1988), and many brokers providing this type of service have evolved into Third-Party Logistics providers (TPL).

Third-Party Logistics providers (TPL) originated after the deregulation of the transportation industry in the U.S. in the 1980s. They provide shippers with the convenience of "one-stop shopping" by offering them a broad array of order fulfillment activities, ranging from storage to order picking to transportation (Song and Regan 2001).

In other words, TPLs add value by providing transportation services in which the TPL identifies, selects, negotiates with, and controls specific carriers to meet the needs of a shipper. TPL services inherently involve long-term, interdependent relationships, oriented towards solving problems for customers, sharing risks and benefits, and recognizing mutual interdependency. The TPL sector is currently a rapidly growing area (IBI Group 2001).

In summary, the traditional marketing channel of the industry includes a traditional direct channel and indirect channels governed by traditional intermediaries such as Third-Party Logistics companies, freight forwarders, and brokers.

4.2.2.5. Transport Marketing Channels with the Internet

The Internet enables carriers to sell their services to shippers through online marketing channels like company Websites and electronic transportation exchanges. These Websites and exchanges combined will be called "Internet channels" for the remainder of this discussion.

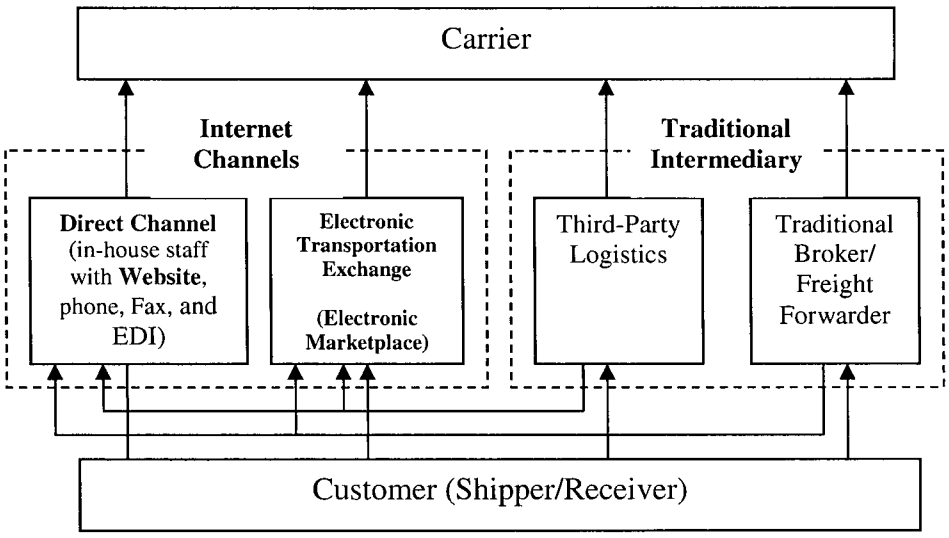
As shown in Figure 4-2, the traditional direct channel is strengthened with the Internet. Through the Internet, trucking firms are able to reach a wider range of customers and to improve their business processes and efficiencies. Using Internet technologies, firms provide improved customer services such as online invoicing, price inquiry, shipment tracking, and account managements. (IBI Group 2001).

In addition to connecting carriers with customers directly, the Internet has led to the emergence of electronic transportation exchanges. An exchange or virtual

marketplace is the online forum in which buyers and sellers can meet, exchange information, and perform transactions (Bakos 1997). An electronic exchange brings previously fragmented buyers and sellers together into one community, through a many-to-many electronic platform (Choudhury et al. 1998). Through the Internet, both sellers and buyers have access to more buyers and sellers without using traditional intermediaries.

Transportation exchanges provide online transportation procurement services and other Web-hosted transportation services. Exchanges provide spot market and auction capabilities (Song and Regan 2001). A spot market allows shippers and carriers to post available loads or capacity on the Web and to select the best carriers or loads from an online list. An auction model enables the online purchase and sale of freight transportation capacity based primarily on price. For example, shippers post loads and define some selection criteria on the Web, and carriers make online bids on these loads. In addition to this reverse-auction model, a small number of forward-auction sites are available. Auctions are used to buy and sell not only individual movements, but contracts as well.

(Figure 4-2) Marketing Channels After the Internet



Unlike traditional intermediaries, electronic exchanges charge either a membership fee or a service charge per transaction in the form of flat rate regardless of the transaction volume, which is typically much lower than the commission of traditional intermediaries (Song and Regan 2001). In other words, the pricing structure of the electronic marketplace is transparent from the perspective of consumers. Electronic marketplaces are similar to the direct channel in that they directly link shippers and carriers for a fixed rate without playing a pricing game. On the other hand, many traditional intermediaries, such as freight forwarders and TPLs, dictate their resale prices for shippers. Brokers tend to operate more like pure exchanges, unless they provide additional services which enable them to dictate prices by linking matching services with other value-added services.

The Internet channel can be classified into three categories based on accessibility to participation in the channel. We call this characteristic "the degree of openness" (Table 4-1). The most popular category is the public electronic transportation exchange, which is open to a large, potentially unlimited, number of customers and service providers. This "open" type of Internet channel mainly facilitates spot market exchanges. Instead of being open to any shipper and carrier, the private exchange is a platform allowing only a small group of service providers and their transportation partners to trade on the Internet. This model allows shippers to maintain long-term relationships with their transportation providers while eliminating unqualified traders, yet it still aggregates volume and automates the transportation process (Chow 2001). The nature of this kind of exchange is closer to that of a direct channel than the public electronic exchange is. The most "exclusive" type of Internet channel is the company Website, with which customers can communicate with only one service provider.

(Table 4-1) Types of Internet Channel in the Trucking Industry

Degrees of Openness	Public	Small Group	Exclusive
Internet Channel	Public Electronic Transport Exchanges	Private Electronic Transport Exchanges	Company Websites

As illustrated in Figure 4-2, traditional intermediaries such as TPLs are still using trucking firms' direct channels as well as electronic transportation exchanges for online load matching. In order to be successful, the electronic transportation exchange must attract a high volume of carriers and shippers, so that they provide a competitive marketplace that results in lower pricing and has broader network coverage (Cooke 2003).

The marketing channel system in the trucking industry after the introduction of Internet channels is summarized in Table 4-2. The traditional direct sales channel is enhanced greatly by company Websites providing various marketing, transaction, and customer service functions. These two channels work closely, and in many firms it becomes hard to distinguish one from the other.

(Table 4-2) Marketing Channels of the Trucking Industry After the Internet

	Intermediary	Direct
Traditional Channels	Brokers, Freight Forwarders, and Third-Party Logistics Providers	Direct Sale Department (In-House Staffs using EDI, Phone, and Fax)
Internet Channels	Electronic Transportation Exchanges (Private and Public)	Company Websites

4.3. Literature Review

Bakos (1997) made an early effort to study electronic marketplaces and their effects of lowering search costs. His theoretical investigation finds the projected impact of lower search costs results in a sharply heightened price competition. However, his study is limited to the case in which an electronic marketplace only allows participating buyers and sellers to exchange information. Actual transactions occur through the conventional retail network, after buyers and sellers have been matched in the electronic marketplace. In other words, Bakos does not consider cases in which online exchanges compete with conventional retailers.

Choudhury et al. (1998) examine the uses and consequences of electronic marketplaces in the aircraft parts industry. Their case study empirically investigates the

impact of the Inventory Locator Service (ILS) on the market price, the role of intermediaries, and inventory levels. They find little evidence supporting increased price competition, disintermediation of traditional middlemen, or changes of inventory levels. They also examine when buyers decide to use electronic marketplaces. Unlike in the current chapter, the scope of ILS in their study is limited to the identification process, and thus the generalization of their findings to systems that also support selection and execution should be made with caution. Another major difference between the two studies is the commodity sold in the market. Their study deals with aircraft parts, which are tangible and are well standardized.

Murphy and Daley (2000) explore various Internet issues relevant to international freight forwarders. They find that freight forwarders believe the Internet can offer numerous benefits, and also that the majority of forwarders currently use the Internet for their business operations. Their study reveals a negative relationship between a firm's age and perceived barriers to the adoption of Internet technologies. The focus of their study is various applications of information technology in the freight forwarding industry, while the examination at hand focuses on the impact of the Internet channel on the marketing channel of the trucking industry.

Golicic and Davis (2003) discuss an emerging intermediary, the "hypermediary." The hypermediary is a new kind of middleman operating across traditional and virtual structures to facilitate all types of flows in the supply chain, from physical to informational. Their case study examines the impact of hypermediaries on the relationship among supply chain members, information visibility, and communication. They find that the outcome of introducing a hypermediary to existing relationships is to

break old bonds and forge new ones. They also find greater visibility in supply chain activities with the hypermediary. While their study focuses on the hypermediary only, the research interests here encompass traditional intermediaries to the company Website and the electronic transportation exchange.

There have been major surveys on the impact of E-Commerce on the trucking industry (IBI Group 2001 and Nagarajan et al. 2001) and the Canadian transportation industry (Chow 2001). Although these surveys provide a solid background for this chapter, their topics are rather broad, instead of focusing on the adoption and impact of the Internet as a marketing channel. The topics of surveys include assessments of the E-Commerce environment, impacts on competitiveness of the industry, levels of implementation of various information technologies, and implications for government policy.

Song and Regan (2001) provide insights on emerging freight transportation intermediaries such as Web-based online transportation exchanges. Their conceptual paper describes the potential benefits and drawbacks of using these online service providers. The authors also address current market trends related to the emergence of electronic transportation exchanges. Table 4-3 summarizes the empirical studies reviewed for this chapter.

(Table 4-3) Summary of the Literature

	Research Focus	Research Method	Industry
Choudhury et al. 1998	Uses and consequences of electronic exchanges	Case Study	Aircraft parts
Murray and Daley 2000	IT impact on the overall industry	Case Study	Transportation
Golicic and Davis 2003	Hypermediary impact on supply chain	Case Study	Transportation
Chow 2001	IT impacts on the overall industry	Survey	Transportation
Nagarajan et al. 2001	IT impacts on the overall industry	Survey	Trucking
IBI Group 2001	IT impacts on the overall industry	Survey	Trucking
Current Study	**Impact of Internet channels (both company websites and electronic exchanges) on marketing channel**	**Case Study**	**Trucking**

When there are various Internet channels available in the market (Table 4-1), firms choose different kinds of Internet channels, since the optimal type of Internet channel for an individual firm varies depending on various factors to the specific firm. However, the literature has paid surprisingly little attention to the *diversity* of the Internet channel. To the best of our knowledge, this chapter is an early empirical effort to examine the adoption and impact of Internet channels, including not only the two kinds of electronic transportation exchanges but also company Websites, on the marketing channel of a service industry in the business-to-business context.

4.4. Research Methodology

4.4.1. Case Study

Despite the explosive growth of Internet channels, exactly what changes have been occurring is hard to describe, as the Internet channels are in a phase of rapid growth and constant change in the trucking industry. Previous studies report difficulty in quantifying the monetary changes resulting from an Internet channel introduction. For example, Golicic and Davis (2003) indicate that most interviewees relied on subjective information and gut feelings, when they estimating the dollar value of changes related to a new intermediary equipped with the Internet.

Given the preliminary state of current knowledge and evidence on the impact of the Internet in the trucking industry, we believe that conducting multiple in-depth case studies is an appropriate strategy for empirical examination. Examining only one case study limits insights to one example, and carries the risk of misinterpretation and biased observations. Multiple case studies allow for cross-case comparisons and further generalizations. According to Yin (1994), six to ten case studies should be sufficient to properly examine a set of theoretical expectations.

The appropriate logic for case studies is not statistical generalization - as in sampling, where the results are generalized to a larger population - but analytical generalization, where the researcher is trying to generalize a particular set of results to a broader theory (Yin 1994). This is consistent with the objective of this chapter: developing testable propositions based on empirical observations. Although our model must be subjected to further empirical validation, we believe that it can serve as a useful starting point and a foundation for future theoretical and empirical studies on this subject.

4.4.2. Sample

We classified the trucking companies using the three criteria discussed previously: firm size, the type of business that a firm serves, and commodity specialization. To assure the best industry representation from the case studies, we decided that each individual firm should represent a unique aspect of the industry. The two initial firms were selected based on the authors' knowledge of the industry. Seven additional firms were selected as potential candidate cases from a list obtained from the British Columbia Trucking Association, based on consultation with the association. Next, the candidates were sequentially contacted to arrange for interviews, and four interviews were scheduled from the pool of seven additional candidates.

The full spectrum of firms was not available or not relevant. For example, we do not have an LTL carrier specializing in special commodities in the sample, because special commodities are generally hauled in truckloads. We limited candidate firms to those who were available for an interview in British Columbia. Due to company unavailability and schedule constraints, no interview was secured with a medium-sized LTL firm nor a small-sized TL firm moving specialized commodities. In total, six trucking companies representing various aspects of the industry participated in the case study. The sample firms are summarized in Table 4-4[9].

Company A is a general freight carrier operating around Pacific Northwest America, mainly serving British Columbia, Alberta, Washington, and Oregon. This company owns 50 tractors and primarily deals with TL shipments. Company B is a mid-sized company operating 80 tractors. It hauls truckloads of general commodities in the

[9] Upon the request of some participants, the firms' names have been kept confidential.

west coast areas of the U.S. and Canada, including British Columbia, Alberta, Oregon, Washington, Idaho, and California. Company C specializes in truckloads of bulk liquids such as milk, wine, juice, beverage concentrates, and cooking oil. The major markets of this medium-sized TL carrier are British Columbia and Alberta, although it occasionally serves other west coast areas of the U.S. and Canada. Company D is a large-sized truckload company operating 1200 tractors. Although it started its business hauling automobiles which is a special commodity, it now hauls both general and special commodities. Its market covers most of North America and Mexico. Company E is a small-sized less-than-truck-load company carrying general commodities. It operates 35 tractors and mainly serves British Columbia. Company F is one of the largest less-than-truck-load carriers in the world, and mainly hauls general commodities. Its annual revenue is over US $3 billion. It has the largest network and market coverage, serving the U.S., Canada, and Mexico.

(Table 4-4) Sample Trucking Companies

Size / Business Type	**Small** (0-50 Power Units)	**Medium** (51-100 Power Units)	**Large** (Over 100 Power Units)
TL	**Company A** (General Commodity)	**Company B** (General Commodity) **Company C** (Special Commodity)	**Company D** (General/ Special Commodity)
LTL	**Company E** (General Commodity)	None	**Company F** (General Commodity)

4.4.3. Data Collection

The main data collection method was face-to-face, structured interviews with management personnel from the participating companies. However, when necessary, telephone interviews with other personnel in the firms were conducted to supplement the information gathered during the personal interviews. The positions of the respondents include president, vice-president operation, vice-president marketing, sales manager, and senior E-Business systems field manager. All interviews were tape recorded, except those with two companies that asked to be off the record. To enhance the validity of the answers, summaries of the major findings of each interview were verified by the respondents after each interview session.

A structured interview guide was used for all interviews to ensure consistency and reliability. The interview guide includes not only company-specific questions but also questions about the respondents' insights into overall changes and trends in the trucking industry. Several open-format questions are included to allow the respondents flexibility in their responses. Please refer to the interview guide in Appendix D for details.

4.5. Case Study Observations

The first objective of this section is, based on observation of the trucking industry, to generate testable propositions on the factors that influence a trucking firm's choice in adopting the Internet channel. The section also addresses the impact of Internet channels on trucking intermediaries.

4.5.1. Choice of the Internet Channels

Based on our case study observations, we identified six factors that influence a trucking firm's adoption behavior toward Internet channels, including company Websites and electronic transportation exchanges. Table 4-5 summarizes the observations from the case study analysis.

(Table 4-5) Summary of Case Study Observations

Company	**A** (TL/General Commodity)	**B** (TL/General Commodity)	**C** (TL/Special Commodity)	**D** (TL/General /Special)	**E** (LTL/General Commodity)	**F** (LTL/General Commodity)
Firm Size	Small	Medium	Medium	Large	Small	Large
Dependence on Ongoing Relationship	Moderate	Moderate	High	N/A	Moderate/High	N/A
Degree of Fragmentation	High	High	High	High	Low	Low
Transaction Size	Large	Large	Large	Large	Medium	Medium
Network Density	Low	Moderate	N/A	N/A	N/A	N/A
Network Size	Small	Small/Medium	Small/Medium	Large	Small	Large
Preference for More Closed Type of Internet Channel	**Low**	**Moderate**	**High**	**High**	**Moderate**	**High**

We discuss those factors in greater detail in later sections, distinguishing those that appear to be specific to the transportation industry and those generalizable to a broader context. Each factor is discussed below.

4.5.1.1. Size of Firm

Observations from the case studies indicate that there are differences in use of Internet channels between large and small carriers. We looked closely at the relationship between a firm's adoption behavior and the size of the firm. As shown in the second row of Table 4-5, it appears that larger carriers tend to choose more closed forms of Internet channel, such as company Websites or private exchanges. On the other hand, smaller carriers tend to prefer the open form of the Internet channel, public exchanges.

The respondent from a large TL company (Company D) stated, "It (using online exchanges) is simply waste of time. We don't get our business that way." According to the respondent from a large LTL carrier (Company F), the sales through its company Website have increased by 300% this year and are expected to grow by 500% in the next few years. Compared with larger carriers, small and medium carriers are expected to rely on a more open type of Internet channel, such as a public exchange, for a larger portion of their revenues.

This is not surprising, because the size of a firm indicates the resources available to the firm. The higher the level of resources, the more likely the firm will be an adopter of company Websites integrating all internal business functions. The respondent from a small TL firm (Company A) states, "If possible, everyone prefers to go directly to the

customers because we can earn a higher margin that way." Large carriers benefit most from closed networks that facilitate improved communication and allow large carriers to subcontract suboptimal loads in spot markets. According to Chow (2001), carriers who have such Websites are able to embed their people, processes, and technologies inside their customers' own processes. Such carriers have an incentive to capture market share and raise switching costs, potentially locking out carriers unable to reach this stage of direct channel. In this case, small carriers may be at an inherent disadvantage, being forced to be subcontractors, providing capacity to the intermediaries who own the relationship with the customer. They are less likely to negotiate favorable contract terms and less likely to earn the highest margins in this system.

Another reason that larger carriers prefer a more closed form of the Internet channel is reputation. Brand differences are more important online than offline, and more so in service industries than in manufacturing industries (IBI Group 2001). The shippers need perfect information about the carriers and their services in order to make the optimal choice, but this is a far too unrealistic assumption in the transportation industry. It is likely that shippers receive a different level and quality of information about carriers and their services depending on how large the carrier is. In the transportation industry, the larger the carrier, the more direct customers the carrier could have. This is consistent with the IBI Group's (2001) finding that 56 % of online insurance customers went straight to brand-name sites as compared with 32 % for aggregation sites.

Smaller trucking firms frequently lack the resources to invest in building such internally integrated Web-based systems, even considering the minimal start up and

operational costs required to operate such an exclusive form of Internet marketing channel. Consequently, small carriers are limited in the new business they can acquire on their own due to their limited market access and brand image. However, the threshold cost of entry into the more open form of network, such as public electronic exchanges, is relatively inexpensive. For small carriers, convenient access to open exchanges could make a significant difference in profitability, providing that the cost of accessing these markets is reasonable. Smaller firms are able to obtain more loads due to the freight-matching transparency of the Internet. We believe that this size factor has never been identified in previous case studies as a factor influencing a firm's adoption of a type of Internet channel (open or closed). This factor is believed to be generalizable beyond service industries to product industries.

> *Proposition 1: A larger-sized firm will prefer to use a more closed form of Internet channel, while a smaller-sized firm will prefer to use a more open form of Internet channel.*

4.5.1.2. Percentage of Business Generated by the Ongoing Relationships

We observe that a negative relationship exists between the percentage of a carrier's business under long-term contract and the firm's use of a more open type of Internet channel as a marketing channel. Our case analyses show that carriers, who rely heavily on ongoing relationships with a group of loyal customers (Company C and E in Table 4-5), tend to show a relatively lower usage level of public electronic exchanges, as

compared with companies with similar sizes, i.e., compare Company B vs. C and Company A and E in Table 4-5. Instead, they prefer to use a direct channel that allows a personal relationship, such as a company Website.

Public electronic exchanges maximize a buyer's chances of finding the best price. However, they have an opportunity cost. The buyer must forego the transaction cost efficiencies gained from the standardization and routinization of ongoing relationships (Aldrich 1979). The benefits of the dyadic transactional efficiencies of routinization and electronic integration include lower selection, negotiation, and transaction execution costs (Choudhury et al. 1998). Therefore, buyers face a tradeoff between spot exchanges via public electronic exchanges and ongoing relationships via electronic integration using the direct channel.

In general, the demand for transportation is not movement for its own sake but a derived demand. In other words, the demand for transportation is often linked to other demands to be fulfilled. This is why many transport purchases are under contract from carriers with whom the shippers have developed trusted relationships. Most shippers are not going to do business with someone with whom they are not familiar when a mission-critical function that cannot tolerate disruption is at stake (Chow 2001).

The respondent from Company C specializing in bulk liquid stated, "Food companies are very specific about who they want to work with. They audit their trucking partner every year. Suppose one million Coke cans are produced from one tank of concentrate. If contaminated, one million customers could be in danger." In fact, 100% of this firm's business comes from direct relationships with its long-term partners, and thus 0% from any type of intermediaries or a spot market. A customized contract covers

more than price; it includes service criteria as well. Indeed, reliable transportation services, rather than low price alone, ensure the success of shippers' operations (IBI Group 2001).

Loyal customers become critical in a competitive environment, where there are a large number of trucking firms from which the customer can choose. Major carriers and special carriers already enjoy the competitive advantages of long-term contracts with high-volume shippers (Song and Regan 2001). Shippers will want to maintain their existing long-term relationships with reliable carriers, which have been nurtured and developed over many years.

Therefore, we suggest that both online and offline intermediaries will find it difficult to justify their roles in situations in which shippers establish permanent, regular arrangements and relationships with specific carriers. This observation is consistent with Choudhury et al. (1998), who find the frequency of purchase to be an important influence on a firm's adoption of the Inventory Locator Service. We believe this factor could be generalized beyond service industries to product industries.

Proposition 2: A firm that relies heavily on ongoing relationships with a group of loyal customers will prefer a more closed form of Internet channel.

4.5.1.3. Degree of Fragmentation

It is observed that the TL transportation sector, being the most fragmented transport sector, with a large number of smaller firms, utilizes both traditional and electronic

intermediaries more frequently than the LTL sector. The literature confirms that the majority of both traditional brokers and electronic intermediaries specialize in TL sales and services, although LTL brokers still exist (Nagarajan et al. 2000). The respondent from a small LTL carrier (Company E) also stated that the role of the middlemen is trivial in the LTL sector and that they will disappear in the near future.

Due to the nature of LTL, the business requires high network density and huge investment on satellite terminal facilities. As a result, there has been considerable consolidation and concentration in this sector, leading to a smaller number of trucking companies (CITT 2002). Therefore, a public electronic exchange designed to facilitate an extensive market search is likely to be of limited value in this sector.

The Package Express (PE) industry, which requires the highest level of network density and the largest network, is an extreme example. The PE industry is extremely concentrated in a few giants such as FedEx and United Parcel Service of America, Inc. (UPS). They do not have to participate in electronic exchanges to obtain new business (Chow 2001). Table 4-6 classifies the trucking industry into three sectors based on the degree of fragmentation of each sector.

(Table 4-6) Degree of Fragmentation of the Trucking Industry

Degree of Fragmentation	**Extremely Low**	**Low**	**High**
Trucking Sector	Package Express (FedEx, UPS, etc.)	Less Than Truckload (LTL)	Truckload (TL)

This is also observed in highly specific service markets with very few buyers and sellers. The respondent from Company C commented, "We do not use intermediaries,

because our service is very specialized. We have only a small number of service providers and buyers in the market. We all know each other." Even though Company C is a TL carrier, its specialized business sector is much less fragmented than the TL sector for general commodities. When compared with Company B in the TL sector for general commodities (Table 4-5), Company C appears to prefer a more closed form of Internet channel than Company B which has a similar size. The specialized aspect of its business leads Company C to strongly prefer direct relationships with its customers. Therefore, it is suggested that the more fragmented an industry, the more open form of Internet channel is preferred.

This observation is consistent with Chow (2001), who finds that public electronic transportation exchanges concentrate on load matching for TL shipping capacity and small- to mid-sized shippers. This factor could well explain the adoption of the Internet channels not only in other service industries but also in many other product industries. Thus, we arrive at the third proposition.

Proposition 3: A firm in a greatly fragmented industry will prefer a more open form of Internet channel, while a firm in a concentrated industry will prefer a more closed form of Internet channel.

4.5.1.4. Transaction Size

Observations imply that the relationship between an average shipment size and a firm's preference for a certain type of Internet channel. As shown in Table 4-7, PE and LTL

shippers use the trucking service for smaller shipment sizes while TL shippers buy the service for larger shipment sizes. TL carriers specialize in moving large shipments often over 20,000 pounds for long distances. The average TL shipment weighs about 27,000 pounds. LTL carriers move shipments that usually weigh between 150 and 10,000 pounds. The average LTL shipment weighs slightly over 1,000 pounds. PE carriers usually deal with shipments that weigh less than 150 pounds (Nagarajan et al. 2000). In general, the value per transaction is highest in the TL sector and lowest in the PE sector.

(Table 4-7) Transaction Size in the Trucking Industry

Transaction Size	**Small (Less than 150 lbs.)**	**Medium (150-10,000 lbs.)**	**Large (Over 10,000 lbs.)**
Trucking Sector	Package Express (FedEx, UPS, etc.)	Less Than Truckload (LTL)	Truckload (TL)

Consequently, even a small percentage saving in the price of large shipments like those usually handled by TL firms could be significant to shippers. On the other hand, the same percentage of saving in the small shipments usually handled by PE carriers could be trivial, when compared with the search and opportunity costs for using more open forms of Internet channels such as public electronic transportation exchanges. Therefore, shippers in the TL sector have a stronger incentive to use electronic marketplaces to find the best deal than shippers in the PE and LTL sectors.

When we compare Company A in the TL sector and E in the LTL sector, Company E shows stronger preference for a more closed form of Internet channel despite the similar firm sizes (Table 4-5).

As Choudhury et al. (1998) also identify product value as an important factor influencing an airline company's adoption of the Inventory Locator Service, it can be applied to more general settings as well. In general, the greater the value per transaction, the more likely it is that even a small percentage saving in price – from comparison shopping through an electronic exchange – can offset the opportunity costs of foregoing benefits from direct transactions with the carrier.

Proposition 4: When the value per transaction is high, customers will prefer a more open form of Internet channel.

4.5.1.5. Density of Network

Our observations imply that the density of a firm's network is another factor influencing the firm's adoption behavior toward Internet channels. As shown in Table 4-5, the network sizes of Company A and B are not very different from each other, although Company B's network appears to be slightly larger than A's. Both companies mainly serve British Columbia, Alberta, Oregon, Washington, Idaho, and occasionally California. However, the annual business volume of Company B ($ 22 million), in terms of revenue, is almost three times as high as that of Company A ($ 8 million). This implies that Company B's network density is much higher than that of Company A. We note that Company A utilizes and expects to utilize the public electronic exchange more than Company B.

The observation implies that a carrier with lower network density benefits from business stability arising from access to the dense network of freight made available through public electronic transportation exchanges. For instance, a carrier with lower network density often faces an empty backhaul problem. Load matching and the utilization of excess capacity can be facilitated by public electronic exchanges. Through these exchanges, empty miles can be reduced by auctioning temporary excess capacity. Such efforts could form the foundation for a collective effort to improve the competitive edge of the industry as a whole (Chow 2001).

Therefore, we suggest that the lower the density of a firm's network, the more benefit the carrier enjoys when joining a more open form of Internet channel such as a public electronic exchange. This factor has never been identified in previous studies. Unlike the four factors discussed above, the density of a network seems to be an industry-specific factor. In other words, this factor is not applicable to other service or manufacturing industries.

Proposition 5: A firm with low network density will prefer a more open form of Internet channel to a closed form of Internet channel.

4.5.1.6. Size of Network

Table 4-5 indicates that a firm with a larger network size tends to prefer a more closed form of Internet channel. In general, public electronic exchanges can provide carriers with access to more business and higher efficiency. Electronic exchanges can increase

operational efficiency and revenues by maximizing utilization of container capacity, as well as by reaching a wider customer base (IBI Group 2001). However, the marginal benefit from participating in the electronic exchange varies depending on the size of the network that a carrier serves.

The respondents agreed that the public electronic exchange provides a carrier that has a smaller network size with access to a much wider range of customer base and leads to higher efficiency. For a carrier with a larger network, on the other hand, the marginal benefit of participating in the complementary network of the public exchange would be smaller. Rather, carriers with a larger network prefer to form private alliances. The private exchange of a few large networks overcomes many of the uncertainty problems of the public exchange related to carrier quality and capacity, while it still has enough network complementariness to maximize the utilization of the container capacity of the participants (Chow 2001).

Therefore, it could be suggested that the smaller the network of a carrier, the more benefit the carrier enjoys by joining a more open form of Internet channel, such as a public electronic exchange. On the other hand, a carrier with a larger network will prefer to use a more closed form of Internet channel, such as private electronic exchanges or company Websites. Like network density, this factor has never been identified in previous studies, and it seems also to be an industry-specific factor.

Proposition 6: A firm with a larger network will prefer a more closed form of Internet channel, while a firm with a smaller network will prefer a more open form of Internet channel.

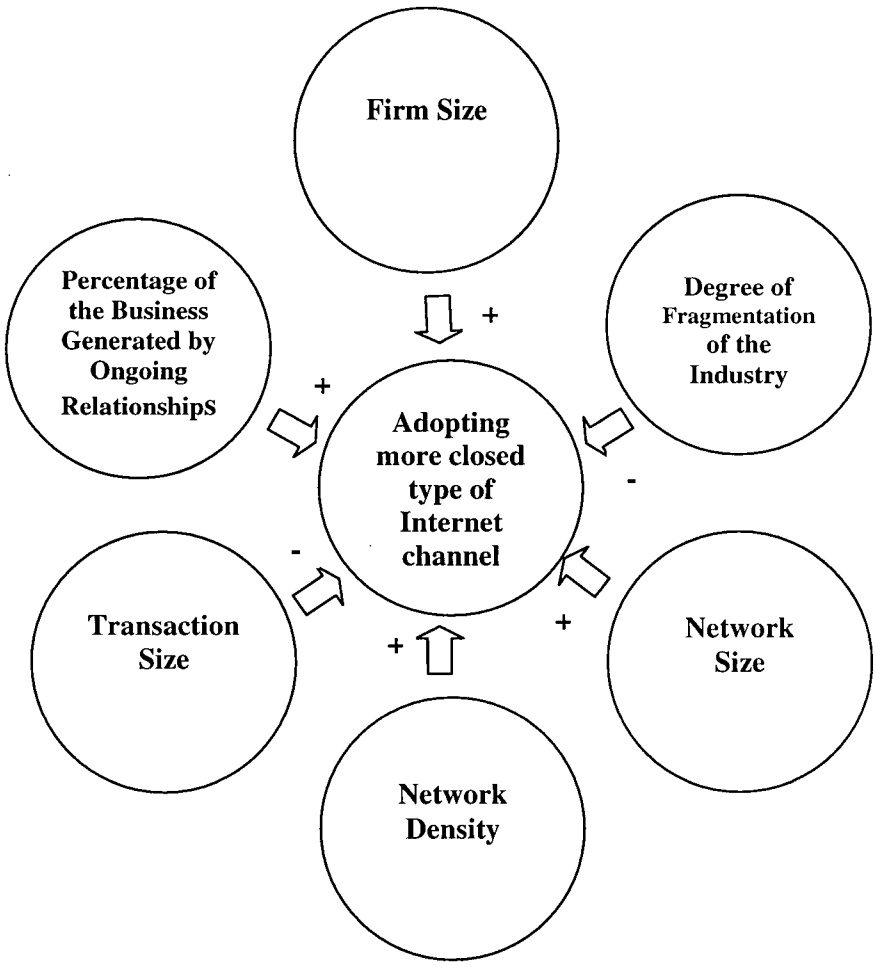
Table 4-8 summarizes the propositions developed in the above discussion.

(Table 4-8) Propositions on Choice of Internet Channels

Factors	Relationship with adopting more closed (exclusive) type of Internet channel	Generalizability
Size of Firm	Positive	Other Industries
% of Ongoing Relationship	Positive	Other Industries
Degree of Fragmentation	Negative	Other Industries
Transaction Size	Negative	Other Industries
Density of Network	Positive	Transportation Industry
Size of Network	Positive	Transportation Industry

Figure 4-3 depicts the above propositions as a simple conceptual model of the factors that influence a firm's choice in adopting an Internet channel, in terms of the type of Internet channel.

(Figure 4-3) Conceptual Model for Choice of Internet Channel



4.5.2. Role of online and traditional Intermediaries

Since the introduction of the Internet, many have viewed the potential for success of Internet channels as calling into question the role of traditional intermediaries, including transportation brokers, freight forwarders, and third-party logistics providers. On the other hand, it is observed that many online intermediaries fail because they do not meet shippers' needs due to the fact that they focus mainly on price. In fact, a number of electronic transportation exchanges in the transport industry have merged or left the

business (Coppersmith 2002). This section explores issues related to the disintermediation of traditional middlemen and the future of both traditional and online intermediaries.

4.5.2.1. Role of Traditional Intermediary

The respondents generally agreed that the overall impact of the Internet channels on traditional intermediaries is not yet clear. The role of traditional brokers in helping buyers with selection and negotiation, and the overall extent to which buyers use brokers, have not been significantly affected. The respondents predicted, however, that in the near future Internet channels, especially electronic transportation exchanges, will significantly change the framework of the traditional transport marketing channel.

It is expected that Internet channels will reduce the usage of traditional intermediaries. In other words, the size of the customer base relying on traditional intermediaries will become increasingly smaller. However, the respondents generally agreed that pure disintermediation of traditional middlemen is unlikely to occur as far as they can provide value-added services that electronic exchanges do not offer. Small shippers often lack the necessary skill and scale to manage their purchases. Unlike most electronic exchanges, traditional brokers take responsibility for the actions of the carriers they choose to handle a shipper's freight. In addition, they provide services related to following up with billing, insurance, damage, shipment status visibility, proof of delivery, etc. (Murphy and Daley 2000).

The TPL industry has historically supported a large number of small companies as well as larger industry leaders. TPLs have skills and knowledge that are difficult for small carriers to develop, and they have very secure, long-term relationships with shippers and carriers. Such TPLs will probably not be forced out by new online players anytime soon. On the other hand, traditional intermediaries who do not add much value, but simply match buyers and sellers, are expected to disappear (Song and Regan 2001).

The key insight for traditional intermediaries may be that while electronic exchanges do not necessarily eliminate their roles, they may need to shift the nature of their service, especially over the long term (Song and Regan 2001). To survive the threats from Internet channels, brokers should continue to add value to their service by assisting buyers with negotiation and performing other supporting services.

Another potential source of service value that could be added by brokers may be a function that can be termed "data validation" (Choudhury et al. 1998). Data validation is particularly beneficial to small shippers that seek reliable yet cheap service but lack the expertise needed to find it. Such shippers rely on brokers to "screen" carriers. One of the most serious problems in the transportation industry is asymmetric and insufficient information. Shippers have little indication of the reliability and qualifications of the numerous carriers (Murphy and Daley 2000). For these shippers, traditional intermediaries could help with the often difficult task of finding trucking companies that can provide both better rates and consistently high quality. In fact, with the online market exchange, the function of data validation may have increased in importance, because a buyer searching exchanges may find a longer list of suppliers, many of whom the buyer has never previously transacted with before. With a longer list, buyers may

increasingly be forced to rely on traditional intermediaries for information on the reliability of suppliers and the data they list on the system, because traditional intermediaries eliminate some of the uncertainty faced by shippers (Choudhury et al. 1998).

If an electronic exchange supports only identification and direct comparison of price and product information, and not selection, the respondents suggested that buyers may continue to use traditional intermediaries even though they subscribe to the electronic exchange. Therefore, a strategy for traditional intermediaries could be to focus on matching small- and medium-sized shippers with the equipment and capacity offered by small-l and medium-sized truckers. This is because the value added services of the traditional intermediary are particularly beneficial not only to small shippers, but also to carriers who want access to a larger market (Nagarajan et al. 2001).

Interestingly, many respondents commented that the introduction of electronic exchanges may actually enhance the role of traditional brokers and other intermediaries. They suggested that public electronic exchanges will help traditional intermediaries, particularly those with value-added services, to access load information. Ironically, even as they threaten the viability of traditional intermediaries, brokers and other intermediaries have become some of exchanges' best customers. Brokers may even be able to increase their market share if they can use the public electronic exchange to improve the service they offer (Murphy and Daley 2000). With value-added services, it is expected that the overall cost of intermediary service is unlikely to decline much or at all. Instead, consumers will benefit from better services (IBI Group 2001).

In summary, we believe that traditional intermediaries are unlikely to disappear as long as they prove their worth to shippers by providing value-added services. An increasing number of such traditional intermediaries are expected to benefit from working closely with online intermediaries. The close collaboration between two types of intermediaries is forecasted to improve customer service and sustain their profit margin.

4.5.2.2. Role of Electronic Intermediaries

Transportation expertise is becoming at least as important as new Internet technologies in ensuring the success of the electronic transportation exchange (Golicic and Davis 2003). Transportation is not a pure commodity. Rather, it is a service in which expertise and relationships are very important. How online intermediaries will stay profitable is a key issue. Subscription fees or fixed transactional fees do not appear to be a workable model. Therefore, providing value-added services, including logistics consulting and software support for fees, are likely to be the key to profitability (Song and Regan 2001).

Recent market trends also indicate that online intermediaries are attempting to offer integrated supply chain solutions and one-stop shopping (Murphy and Daley 2000). Single functions are not attractive to shippers. TPLs and carriers not only want to use electronic exchanges to trade with their partners, but also want them to provide Application Service Provider (ASP) based software to optimize routing and scheduling and to manage ordering and billing (Song and Regan 2001).

The industry has begun to realize the limitations of pure electronic public transportation exchanges. Transportation exchanges were originally targeted toward matching freight and transportation capacity with access to the general public. The main idea was that these exchanges could leverage economies of scale, reduce search costs, and "disintermediate" redundant links in the transportation marketing channel. Nonetheless, the transaction volumes on electronic transportation exchanges have been lower than expected (Anonymous 2000).

Electronic exchanges could reduce already low margins. Participating in a public exchange may also result in pricing transparency that may undermine the pricing strategy of the carrier. As a respondent indicated, for example, cheaper deals sold online may undermine contract prices. Carriers perceive electronic exchanges as another intermediary between themselves and the customer, and therefore they fear they could lose their customer relationships to online intermediaries (Golicic and Davis 2003).

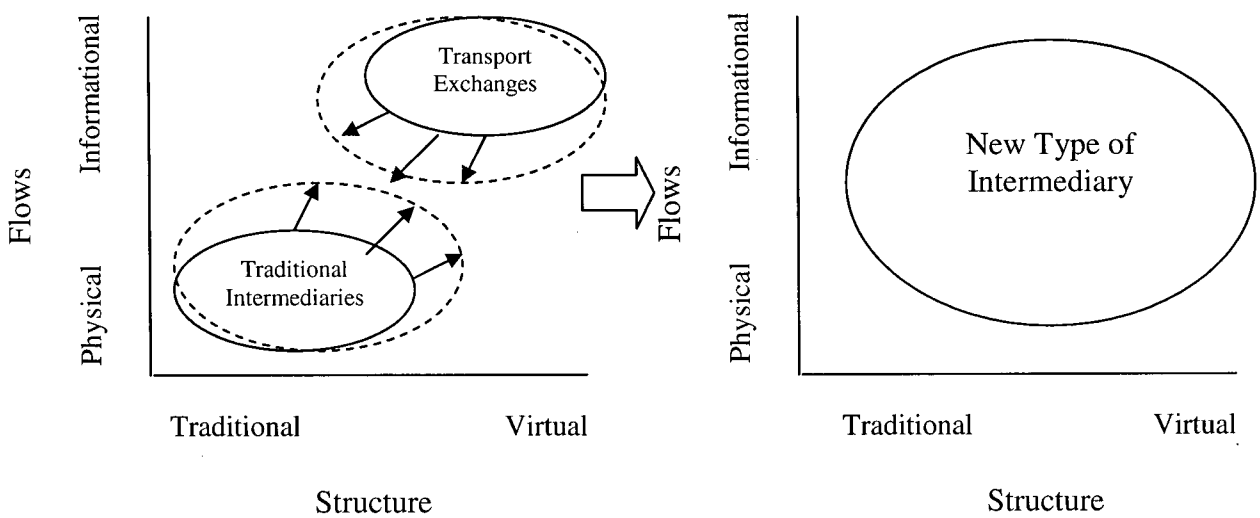
Due to the limitations of online intermediaries as discussed above, the respondents predicted the emergence of a new type of intermediary. They agreed that the focus is moving away from a spot exchange. According to them, many electronic transportation exchanges are becoming transportation management exchanges with additional services to help manage the transportation and logistics process that used to be handled by traditional intermediaries such as a TPL. On the other hand, in order to counter their weaknesses, some large traditional intermediaries such as TPLs are transforming by equipping themselves with electronic exchange functions in addition to

their own transportation expertise. This transformation process is described in Figure 4-4.

Therefore, we suggest that the boundary (or "borderline" as described by one respondent) between online and offline intermediaries will be disappearing, as they expand their business areas in each other's direction to complement their own weaknesses. Reflecting these market trends, numerous mergers, acquisitions, and exits are expected to continue.

(Figure 4-4) New Type of Intermediary

(a) Traditional/Current Intermediaries **(b) Emerging Intermediary**



(Source: Adopted from Golicic and Davis (2003))

Chapter 5

Conclusions and Future Research

5.1. Summary of Thesis

This thesis has investigated the impact of the Internet channel on distribution channel management. Chapter 2 examined the impact of the introduction of an Internet channel on a conventional distribution channel in a monopoly manufacturer market. The closed-form solutions revealed five underlying effects that work together to shape various market outcomes. The framework developed in this chapter, which consists of the five underlying strategic effects, is not limited to the understanding of channel competition involving the Internet channel, but can be generalized to any dual-channel coordination and competition.

The model in this chapter has extended existing models in the literature by distinguishing the theoretical difference between the Internet and the physical outlet, and by capturing the heterogeneity in buyer preferences for the two types of outlet. By examining this model, chapter 2 makes the following contributions. First, our model

clearly captures theoretical differences between a direct Internet channel and a conventional channel. Second, the chapter identifies five major underlying effects, and examines how those effects work together and lead to overall impacts. In addition, the chapter explores various ownership structures for an Internet store, while most of the existing studies examine the Internet channel introduced and owned by the manufacturer. The contributions described above provide a rich framework for understanding the nature of strategic interactions of channel members within a mixed channel including an Internet store.

The results clearly show that adding an Internet store to a conventional channel creates a different managerial problem from adding another physical store. We have found that a monopoly manufacturer that has its own Internet channel prefers to keep an independent physical store rather than eliminating it. We also have explored how the introduction of the Internet channel affects the behavior and performance of each channel member. Different underlying effects are involved depending on various market conditions, such as the ownership of an Internet store and channel structures, resulting in different market outcomes.

The results imply that theoretical modelers should take different approaches when modeling a mixed channel problem as opposed to analyzing a channel with two homogeneous retailers. Practitioners should carefully examine the key underlying effects before they make a decision on Internet channel management. Policy makers should watch changes in market structures closely, because even a small change may have a significant impact on consumer welfare.

Chapter 3 developed a general model to investigate the impact of the Internet channel in a wide variety of multi-product, multi-outlet market environments. Based on the flexible model, the chapter examined the impact of various market environments on distribution channel strategies involving an Internet channel.

A set of assumptions made in chapter 2 was relaxed, allowing the exploration of various market conditions. First, the linear function of the two kinds of consumer disutility was generalized to the quadratic function. Second, we relaxed the assumption of the symmetric distributions of consumer heterogeneities, by varying the distribution on one dimension while holding the other constant. Finally, manufacturer-level competition, in which competing manufacturers produce horizontally differentiated products, was introduced in order to relax the monopoly manufacturer assumption. This chapter investigated the impact of the degree of product and store competition on various market outcomes associated with Internet store introduction in multi-product, multi-outlet environments. In the process, the chapter discussed the generalizability of the results in chapter 2 beyond the monopoly model with symmetric distributions of consumer heterogeneities. The mathematical complexity of the model was overcome by conducting numerical analyses.

The results from the model employing the quadratic disutility function and the stochastic choice model are consistent with that using the linear disutility function. This implies that the results in chapter 2 are robust, and consequently, we can use the insights obtained in that chapter to analyze more complex channel problems. As in chapter 2, we found that multiple underlying effects determine the overall impact of the Introduction of an Internet outlet under various market conditions. However, the relative impact size of

each underlying strategic effect varies depending on market conditions and channel structures. The specific impact of the introduction of the Internet channel on each channel member is highly dependent on the distribution of consumer heterogeneity, the channel structure, the locations of physical stores, and the product positioning in a market. Therefore, channel members and policy makers should carefully assess such market conditions and structures when making a channel decision involving an Internet channel.

Chapter 4 explored the adoption and the impact of Internet channels, including electronic transportation exchanges and company Websites, in the trucking industry. Six case studies were investigated carefully to generate testable propositions about factors influencing a firm's choice regarding the adoption of Internet channels, and to address the impact of the Internet channel on the traditional transportation intermediary.

The literature review and case analyses suggest six major factors that influence the adoption and impact of Internet channels: size of firm, percentage of business generated by ongoing relationships, degree of fragmentation of the industry, transaction size, density of network, and size of network. We believe that the first four factors are generalizable to other product industries, and the last two factors are industry-specific.

Chapter 4 also suggests that while Internet channels do not necessarily eliminate the role of traditional intermediaries, intermediaries should adapt their value-added services to remain a viable force in future markets. Therefore, we expect to see the prevalence of a new kind of intermediary in the near future. The new type of intermediary is expected to provide the expertise of traditional intermediaries, such as managing the logistics process, and the efficient search tools of electronic intermediaries.

5.2. Limitations and Future Research

There has been a significant amount of research on Internet channels. Including this thesis, however, none has theoretically distinguished modeling the Internet channel from modeling other direct channels, such as mail order through catalogs or TV home shopping channels (Balasubramanian 1998; Liu & Zhang 2002; Pan et al. 2002; Kumar et al. 2003; Ray et al. 2003; and Chiang et al. 2003). Research capturing core characteristics of the Internet channel will make a significant contribution not only to academia but also to practitioners.

Some channel structures have not been analyzed in chapters 2 and 3. First, the current setting permits only one channel to be a strategic channel designer, who is able to introduce an Internet channel. For example, manufacturer 1 in chapter 3 is always better off with the entry of an Internet channel within the channel under the current setting. What would happen to manufacturer 1's profitability if manufacturer 2 were also able to introduce an Internet channel? Future research could provide more room for these kinds of game theoretic possibilities.

Chapter 3 has not considered the case in which an Internet store is introduced by an independent Internet retailer. Future research could examine this channel structure for a richer understanding of the emerging online intermediary. For instance, major hotel chains, including Hilton, Marriott, and Hyatt are now trying aggressively to add their own Internet channel to the existing popular travel Websites, such as Travelocity.com and Expedia.com, after they experienced a huge profit leak from these independent online travel agencies (CNN.com 2004).

In addition, we have not analyzed the channel structure in which the common physical retailer opens and operates its own Internet channel, because this structure is not justified by the assumption in chapter 3 that only manufacturer 1's products are sold through the Internet store. Under this assumption, the common physical retailer that operates its own Internet channel cannot sell manufacturer 2's product through the Internet channel. In the real world, however, the common physical retailer has freedom to sell both manufacturers' products through any of its coordinated channels. By exploring these channel structures, we could develop a more complete picture of the impact of the Internet channel across various channel structures.

Chapters 2 and 3 assume that consumers are uniformly distributed on the spatial market. Different distributions of consumers could be analyzed to test the generalizability of our results beyond the assumption of uniform distribution, and to better understand the impact of Internet channel introduction under various market conditions.

Although chapter 4 has provided preliminary discussions on the adoption and impact of Internet channels, further research is needed to complete our understanding of this subject. We believe that the propositions and forecasts suggested in chapter 4 could be used as a foundation for future theoretical and empirical research. For example, we believe that our propositions can form the basis of larger-scale studies to examine the validity and generalizability of the propositions, and to improve and refine them.

As with any other exploratory study, it is possible that additional significant factors have not been included in the current model. Researchers who believe that additional variables play a critical role in the adoption of Internet channels could use our

model in their studies to better estimate the influence of each factor. Another limitation of this case-based investigation is that it is based on a study of a single industry. Similar studies are needed in different settings, with different kinds of electronic exchanges, and in various product industries.

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Appendix A

Proof of Mathematical Solutions

This appendix provides the proofs of the mathematical solutions for the equilibrium prices shown in Chapter 2. In this appendix, we do not show how to get other results, such as channel power and consumer surplus, since they can be easily obtained from the equilibrium prices. All other details can be obtained from the author.

A1. Proof of Mathematical Solutions for the Mixed Channel

111. Vertically Integrated Channel

The demand for the physical store, which is vertically integrated to the manufacture, is described as:

$$q_S = V^2 - VP_S$$

Manufacturer maximizes its profit through the vertically integrated physical store.

$$\Pi_M = (V^2 - VP_S)P_S$$

We can obtain the FOC by taking the first derivative from the manufacturer's profit function.

$$FOC = -2VP_S + V^2$$

By solving *FOC=0,* we obtain the equilibrium price, $P_S^* = \frac{1}{2}V$. The demand at the equilibrium price is $q_S^* = \frac{1}{2}V^2$.

112. Decentralized Channel

Since we assume that the manufacturer is a Stackelberg leader, we need to solve the independent physical retailer's profit maximization problem first to obtain the sub-game perfect equilibrium.

The demand for the independent physical retailer is $q_S = V^2 - VP_S$, and it maximizes its profit conditional on the manufacture's wholesale price.

$$\pi_S = (V^2 - VP_S)(P_S - w)$$

Then we can get FOC by taking the first derivative w.r.t. the retailer's retail price. (P_S).

$$FOC_S = V^2 - VP_S - (P_S - w)V$$

By solving $FOC_S=0$, we are able to obtain the retailer's equilibrium price conditional on the manufacturer's wholesale price, $P_S^* = \frac{1}{2}V + \frac{1}{2}w$.

Solving backward, we then solve the manufacturer's profit maximization problem by incorporating the optimal retail price, $P_S^* = \frac{1}{2}V + \frac{1}{2}w$.

$$\Pi_M = w(V^2 - \frac{1}{2}V(V + w))$$

The manufacturer's FOC is

$$FOC_M = V^2 - \frac{1}{2}V(V + w) - \frac{1}{2}Vw$$

By solving $FOC_M=0$, we can obtain the manufacturer's equilibrium wholesale price.

$$w^* = \frac{1}{2}V$$

With the equilibrium wholesale price, we can obtain other solutions.

$$P_S{}^* = \frac{3}{4}V, q_S^* = \frac{1}{4}V^2$$

121. Vertically Integrated Channel

With both the Internet and the physical stores, the manufacturer maximizes the integrated channel profit. As discussed in chapter 2, we have to consider two cases: $P_S \geq P_N$ and $P_S < P_N$ to solve the problem. To save space, we only show the condition where the equilibrium exists.

When $P_S \geq P_N$, the demand for the Internet store and that for the physical store are described as the following:

$$q_N = P_S(V - P_N) + \frac{1}{2}(V - P_S)(P_S - 2P_N + V)$$

$$q_S = P_N(V - P_S) + \frac{1}{2}(V - P_S)^2$$

The manufacturer maximizes the joint profits from both outlets.

$$\Pi_M = P_N(P_S(V - P_N) + \frac{1}{2}(V - P_S)(P_S - 2P_N + V)) + P_S(P_N(V - P_S) + \frac{1}{2}(V - P_S)^2)$$

We can calculate the following FOC's for each retail price.

$$FOC_N = -VP_N + P_S(V - P_N) + \frac{1}{2}(V - P_S)(P_S - 2P_N + V)) + P_S(V - P_S)$$

$$FOC_S = 2P_N(V - P_S) + (-P_N + P_S - V)P_S + \frac{1}{2}(V - P_S)^2$$

By simultaneously equating two FOC's to 0, we can get the equilibrium prices.

$$P_S^* = P_N^* = \frac{\sqrt{3}}{3}V$$

122. Partially Integrated Channel

When $P_S \geq P_N$, the demand for the Internet store and that for the physical store are described as the following:

$$q_N = P_S(V - P_N) + \frac{1}{2}(V - P_S)(P_S - 2P_N + V)$$
$$q_S = P_N(V - P_S) + \frac{1}{2}(V - P_S)^2$$

Since the physical store is independent of the manufacturer, we need to solve the independent retailer's profit maximization problem first.

$$\pi_S = (P_S - w)(P_N(V - P_S) + \frac{1}{2}(V - P_S)^2)$$

Then the FOC of the physical retailer is

$$FOC_S = P_N(V - P_S) + (-P_N + P_S - V)(P_S - w) + \frac{1}{2}(V - P_S)^2$$

Solving *FOCs=0,* we can calculate the manufacturer's equilibrium price for the independent physical retailer.

$$P_S^* = \frac{2}{3}P_N + \frac{1}{3}w + \frac{2}{3}V - \frac{1}{3}\sqrt{4P_N^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2}$$

Solving backward, we now solve the manufacturer's profit maximization problem incorporating the retailer's optimal pricing decision.

$$\Pi_M = P_N(P_S(V - P_N) + \frac{1}{2}(V - P_S)(P_S - 2P_N + V)) + w(P_N(V - P_S) + \frac{1}{2}(V - P_S)^2$$

After substituting P_S^* into the functions for the demands and the wholesale price, we can obtain the manufacturer's profit function as follows.

$$\Pi_M = w(P_N(\frac{1}{3}V - \frac{2}{3}P_N - \frac{1}{3}w + \frac{1}{3}\sqrt{4P_N{}^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2})$$
$$+\frac{1}{2}(\frac{1}{3}V - \frac{2}{3}P_N - \frac{1}{3}w + \frac{1}{3}\sqrt{4P_N{}^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2})^2)$$
$$+P_N(\frac{2}{3}P_N + \frac{1}{3}w + \frac{2}{3}V - \frac{1}{3}\sqrt{4P_N{}^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2})(V - P_N)$$
$$+\frac{1}{2}(\frac{1}{3}V - \frac{2}{3}P_N - \frac{1}{3}w + \frac{1}{3}\sqrt{4P_N{}^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2})$$
$$(-\frac{4}{3}P_N + \frac{1}{3}w + \frac{5}{3}V - \frac{1}{3}\sqrt{4P_N{}^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2}))$$

FOC's w.r.t each of the wholesale price and the retail price for the Internet channel are the following.

$$FOC_{Pn} = \frac{1}{9}(4wV\sqrt{4Pn^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2}$$
$$-12P_N{}^2\sqrt{4Pn^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2}$$
$$-16P_N V\sqrt{4Pn^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2}$$
$$-6wP_N\sqrt{4Pn^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2}$$
$$+8V^2\sqrt{4Pn^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2} + 5wP_N V + 3w^2 + 24P_N{}^3 + 6wP_N{}^2$$
$$-6P_N w^2 + 5wV^2 - 7Vw^2 + P_N V^2 + 2P_N V^2 - V^3$$
$$-3w^2\sqrt{4Pn^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2} / \sqrt{4Pn^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2}$$

$$FOC_w = -\frac{1}{9}(4wV\sqrt{4Pn^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2}$$
$$+3P_N{}^2\sqrt{4Pn^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2}$$
$$-4P_N V\sqrt{4Pn^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2}$$
$$+6wP_N\sqrt{4Pn^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2}$$
$$-V^2\sqrt{4Pn^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2} + 14wP_N V + 3w^2 - 6P_N{}^3 + 12wP_N{}^2$$
$$-9P_N w^2 + 5wV^2 - 7Vw^2 + 5P_N V^2 - 7P_N V^2 - V^3$$
$$-3w^2\sqrt{4Pn^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2} / \sqrt{4Pn^2 - 2P_N w + 2P_N V + w^2 - 2Vw + V^2}$$

By simultaneously equating two FOC's to 0, we can solve the equilibrium price for the Internet and the wholesale price.

$$P_N^* = 0.54759V \text{ and } w^* = 0.53834V$$

123. Horizontally Integrated Channel

When $P_S \geq P_N$,

$$q_N = P_S(V - P_N) + \frac{1}{2}(V - P_S)(P_S - 2P_N + V)$$
$$q_S = P_N(V - P_S) + \frac{1}{2}(V - P_S)^2$$

Under this channel structure, the independent retailer coordinates both outlets and maximizes the joint profit conditional on the manufacturer's wholesale price.

$$\pi_S = (P_N - w)(P_S(V - P_N) + \frac{1}{2}(V - P_S)(P_S - 2P_N + V)) + (P_S - w)(P_N(V - P_S) + \frac{1}{2}(V - P_S)^2)$$

The FOC's w.r.t. the retail prices for each type of store are

$$FOC_N = P_S(V - P_N) + \frac{1}{2}(V - P_S)(P_S - 2P_N + V) - (P_N - w)V + (P_S - w)(V - P_S)$$
$$FOC_S = (P_N - w)(V - P_S) + P_N(V - P_S) + \frac{1}{2}(V - P_S)^2 + (P_S - w)(-P_N - V + P_S)$$

We then solve the two retail prices that simultaneously make all the FOC's 0.

$$P_N^* = P_S^* = \frac{1}{3}w + \frac{1}{3}\sqrt{w^2 + 3V^2}$$

Solving backward, we can solve the manufacturer's profit maximization problem incorporating the retailer's optimal pricing decision.

$$\Pi_M = w((P_S(V - P_N) + \frac{1}{2}(V - P_S)(P_S - 2P_N + V)) + (P_N(V - P_S) + \frac{1}{2}(V - P_S)^2))$$

After we substitute $P_N^* = P_S^* = \frac{1}{3}w + \frac{1}{3}\sqrt{w^2 + 3V^2}$ to the manufacturer's profit function, we get

$$\Pi_M = w(V + \frac{1}{3}w + \frac{1}{3}\sqrt{w^2 + 3V^2})(V - \frac{1}{3}w - \frac{1}{3}\sqrt{w^2 + 3V^2})$$

Then, the FOC w.r.t. w is

$$FOC_w = (V + \frac{1}{3}w + \frac{1}{3}\sqrt{w^2 + 3V^2})(V - \frac{1}{3}w - \frac{1}{3}\sqrt{w^2 + 3V^2})$$
$$+ w(\frac{1}{3} + \frac{1}{3}\frac{w}{\sqrt{w^2 + 3V^2}})(V - \frac{1}{3}w - \frac{1}{3}\sqrt{w^2 + 3V^2})$$
$$+ w(-\frac{1}{3} - \frac{1}{3}\frac{w}{\sqrt{w^2 + 3V^2}})(V + \frac{1}{3}w + \frac{1}{3}\sqrt{w^2 + 3V^2})$$

The equilibrium wholesale price that makes the FOC 0 is

$$w^* = \frac{\sqrt{2}}{2}\sqrt{-3V^2 + \sqrt{13}V^2}$$

124. Decentralized Channel

When $P_S \geq P_N$,

$$q_N = P_S(V - P_N) + \frac{1}{2}(V - P_S)(P_S - 2P_N + V)$$
$$q_S = P_N(V - P_S) + \frac{1}{2}(V - P_S)^2$$

Since there are two independent retailers in this structure, the first step is to solve a Nash game between retailers who set retail prices conditional on wholesale prices. The profit functions of each retailer are as follows.

$$\pi_N = (P_N - w)(P_S(V - P_N) + \frac{1}{2}(V - P_S)(P_S - 2P_N + V))$$
$$\pi_S = (P_S - w)(P_N(V - P_S) + \frac{1}{2}(V - P_S)^2)$$

FOCs of each retailer are the following.

$$FOC_N = -V(P_N - w) + \frac{1}{2}(V - P_S)(P_S - 2P_N + V) + (V - P_N)P_S$$

$$FOC_S = P_N(V - P_S) + (-P_N + P_S - V)(P_S - w) + \frac{1}{2}(V - P_S)^2$$

We can solve the two retail prices that simultaneously make all the FOC's 0.

$$P_N^* = P_S^* = -V + \sqrt{2V^2 + 2wV}$$

Solving backward, we then solve the manufacturer's profit maximization problem incorporating the solutions of the retailer level game.

$$\Pi_M = w((P_S(V - P_N) + \frac{1}{2}(V - P_S)(P_S - 2P_N + V)) + (P_N(V - P_S) + \frac{1}{2}(V - P_S)^2))$$

After we incorporate the retailers' pricing strategies, $P_N^* = P_S^* = -V + \sqrt{2V^2 + 2wV}$, into the manufacturer's profit function, we get

$$\Pi_M = w\sqrt{2V^2 + 2wV}(2V - \sqrt{2V^2 + 2Vw})$$

Then, the FOC w.r.t. w is

$$FOC_w = \sqrt{2V^2 + 2Vw}(2V - \sqrt{2V^2 + 2Vw}) + V\frac{w(2V - \sqrt{2V^2 + 2Vw})}{\sqrt{2V^2 + 2Vw}} - Vw$$

The equilibrium wholesale price that makes the FOC 0 is

$$w^* = 0.52191V$$

A2. Proof of Mathematical Solutions when the Stores are Fixed at –*a* and *a*

This appendix provides the equilibrium solutions when physical store 1 and physical store 2 are fixed. We first solved these problems with a general form of store locations, i.e., *a* and *b*. Then, we found that all the location decisions of the two stores are always symmetric to each other across all the channel structures, due to the symmetry between two physical stores. Therefore, we consider symmetric cases only (i.e., -*a* and *a*).

Before the introduction of another physical store, the channel structures and equilibrium solutions for 111. VI and 112. DC are the same as those for 111. VI and 112. DC in Appendix A1.

121. Vertically Integrated Channel

With both physical stores, the manufacturer maximizes the integrated channel profit. The demand for the physical store 1 and that for the physical store 2 are described as the following:

$$q_{S1} = V(\frac{P_{S2}}{2} - \frac{3P_{S1}}{2} + a + V)$$

$$q_{S2} = V(\frac{P_{S1}}{2} - \frac{3P_{S2}}{2} + a + V)$$

The manufacturer maximizes the joint profits from both outlets.

$$\Pi_M = VP_{S1}(\frac{P_{S2}}{2} - \frac{3P_{S1}}{2} + a + V) + VP_{S2}(a + V - \frac{3P_{S2}}{2} + \frac{P_{S1}}{2})$$

We can calculate the following FOC's for each retail price.

$$FOC_{S1} = -\frac{3}{2}VP_{S1} + (a + V - \frac{3P_{S1}}{2} + \frac{P_{S2}}{2})V + \frac{VP_{S2}}{2}$$

$$FOC_{S2} = -\frac{3}{2}VP_{S2} + (a + V - \frac{3P_{S2}}{2} + \frac{P_{S1}}{2})V + \frac{VP_{S1}}{2}$$

By simultaneously equating two FOC's to 0, we can obtain the equilibrium prices.

$$P_{S1}{}^{*} = P_{S2}{}^{*} = \frac{1}{2}(a+V)$$

122. Partially Integrated Channel

The demand functions for physical store 1 and 2 are the same as above. Since physical store 2 is independent of the manufacturer, we need to solve the independent retailer's profit maximization problem first.

$$\pi_{S2} = (P_{S2} - w)(a + V - \frac{3P_{S2}}{2} + \frac{P_{S1}}{2})V$$

Then the FOC of the physical retailer is

$$FOC_{S2} = -\frac{3}{2}V(P_{S2} - w) + V(a + V - \frac{3P_{S2}}{2} + \frac{P_{S1}}{2})$$

Solving *FOCs=0,* we can obtain the manufacturer's equilibrium price for the independent physical retailer.

$$P_S{}^{*} = \frac{2a + 2V + 3w + P_{S1}}{6}$$

Solving backward, we then solve the manufacturer's profit maximization problem.

$$\Pi_M = VP_{S1}(\frac{P_{S2}}{2} - \frac{3P_{S1}}{2} + a + V) + Vw(a + V - \frac{3P_{S2}}{2} + \frac{P_{S1}}{2})$$

After incorporating the retailer's optimal price, $P_S{}^{*}$ into the functions for the demands and the wholesale price, we obtain the manufacturer's profit function as follows.

$$\Pi_M = VP_{S1}(\frac{14a + 14V - 17P_{S1} + 3w}{12}) + Vw(\frac{2a + 2V + P_{S1} - 3w}{4})$$

FOC's w.r.t each of the wholesale price and the retail price for physical store1 are the following.

$$FOC_{S1} = -\frac{17}{12}VP_{S1} + (\frac{14a + 14V - 17P_{S1} + 3w}{12})V + \frac{Vw}{4}$$

$$FOC_w = \frac{1}{4}VP_{S1} - \frac{3}{4}Vw + (\frac{2a + 2V + P_{S1} - 3w}{4})V$$

By simultaneously equating two FOC's to 0, we can solve the equilibrium price for physical store 1 and the wholesale price.

$$w^* = P_{S1}{}^* = \frac{1}{2}(a + V)$$

123. Horizontally Integrated Channel

Under this channel structure, the independent retailer coordinates both outlets and maximizes the joint profit conditional on the manufacturer's wholesale price.

$$\pi_{S2} = (P_{S1} - w)(\frac{P_{S2}}{2} - \frac{3P_{S1}}{2} + a + V)V + (P_{S2} - w)(a + V - \frac{3P_{S2}}{2} + \frac{P_{S1}}{2})V$$

The FOC's w.r.t. the retail prices for each type of store are

$$FOC_{S1} = (\frac{P_{S2}}{2} - \frac{3P_{S1}}{2} + a + V)V - \frac{3}{2}(P_{S1} - w)V + \frac{(P_{S2} - w)V}{2}$$
$$FOC_{S2} = (\frac{P_{S1}}{2} - \frac{3P_{S2}}{2} + a + V)V - \frac{3}{2}(P_{S2} - w)V + \frac{(P_{S1} - w)V}{2}$$

We can solve the two retail prices that simultaneously make all the FOC's 0.

$$P_{S1}{}^* = P_{S2}{}^* = \frac{1}{2}(a + w + V)$$

Solving backward, we now solve the manufacturer's profit maximization problem incorporating the optimal pricing strategy of the retailers.

$$\Pi_M = wV((\frac{P_{S2}}{2} - \frac{3P_{S1}}{2} + a + V) + (a + V - \frac{3P_{S2}}{2} + \frac{P_{S1}}{2}))$$

After we incorporate the retailer's optimal pricing strategy, $P_{S1}{}^* = P_{S2}{}^* = \frac{1}{2}(a + w + V)$, into the manufacturer's profit function, we get

$$\Pi_M = wV(V + a - w)$$

Then, the FOC w.r.t. w is

$$FOC_w = V(V+a)$$

The equilibrium wholesale price that makes the FOC 0 is

$$w^* = \frac{(a+V)}{2}$$

124. Decentralized Channel

Since there are two independent retailers in this structure, the first step is to solve a Nash game between retailers who set retail prices conditional on wholesale prices. The Profit function of each retailer is as follows.

$$\pi_{S1} = (P_{S1} - w)(a + V - \frac{3P_{S1}}{2} + \frac{P_{S2}}{2})V$$
$$\pi_{S2} = (P_{S2} - w)(a + V - \frac{3P_{S2}}{2} + \frac{P_{S1}}{2})V$$

FOC's of each retailer are the following.

$$FOC_{S1} = -\frac{3}{2}V(P_{S1} - w) + V(a + V - \frac{3P_{S1}}{2} + \frac{P_{S2}}{2})$$
$$FOC_{S2} = -\frac{3}{2}V(P_{S2} - w) + V(a + V - \frac{3P_{S2}}{2} + \frac{P_{S1}}{2})$$

We solve the two retail prices that simultaneously make all the FOC's 0.

$$P_N^* = P_S^* = \frac{1}{5}(3w + 2a + 2V)$$

Solving backward, we now solve the manufacturer's profit maximization problem incorporating the solutions of the retailer level game.

$$\Pi_M = wV((\frac{P_{S2}}{2} - \frac{3P_{S1}}{2} + a + V) + (a + V - \frac{3P_{S2}}{2} + \frac{P_{S1}}{2}))$$

After we incorporate the retailers' pricing strategies, $P_N^* = P_S^* = \frac{1}{5}(3w + 2a + 2V)$, into the manufacturer's profit function, we get

$$\Pi_M = \frac{6}{5}Vw(a + V - w)$$

Then, the FOC w.r.t. w is

$$FOC_w = \frac{6}{5}V(a + V - w) - \frac{6}{5}Vw$$

The equilibrium wholesale price that makes the FOC 0 is

$$w^* = \frac{1}{2}(V + a)$$

A3. Proof of Mathematical Solutions when the Stores Optimize the Locations

In addition to the proofs shown in Appendix A2, this section shows how the optimal store locations are determined as the last step of the game. Before the introduction of another physical store, the channel structures and equilibrium solutions for 111. VI and 112. DC are the same as those for 111. VI and 112. DC in Appendix A1.

121. Vertically Integrated Channel

We start from the equilibrium solutions in Appendix A2. When we substitute $P_{S1}^* = P_{S2}^* = \frac{1}{2}(a + V)$ into the manufacturer's profit maximization function, we get

$$\Pi_M = 2V(\frac{a+V}{2})^2 \text{ and } FOC_a = 2V(\frac{a+V}{2})$$

By solving the FOC=0, we can calculate the optimal store locations of physical store 1 and 2 are $-V$ and V, respectively. It implies that the stores are located at each end of the market. Across all the channel structures, we found that the optimal location decisions for the stores are the maximum differentiation. However, these locations lead to two local monopolies, which is not our interest in this study. Due to the local monopoly issue, we limited the distance between the two stores, such that local monopolies do not occur. In other words, our model allows the stores to differentiate their locations only within the range where there is overlap of the market coverage between the two stores.

When the prices for the both physical stores are the same, the marginal consumer between two stores is located at $\frac{1}{2}(P_{S2} - P_{S1})$=0. Under 121 VI, we can draw the following condition for the optimal a from the demand model: $a = \frac{1}{4}(a+V)$. Therefore, the optimal store locations of physical store 1 and 2 are $-\frac{1}{3}V$ and $\frac{1}{3}V$, respectively.

122. Partially Integrated Channel

Under 122 PI, the marginal consumer between two stores is located at $\frac{1}{2}(P_{S2} - P_{S1}) = \frac{1}{6}(a+V)$, since the retail prices are different.

We can find the following condition for the optimal a from the demand model: $a = \frac{1}{8}(a+V) + \frac{1}{12}(a+V)$.

Therefore, the optimal store locations of physical store 1 and 2 are $-\frac{5}{19}V$ and $\frac{5}{19}V$, respectively.

123. Horizontally Integrated Channel

When the prices for the both physical stores are the same, the marginal consumer between two stores is located at $\frac{1}{2}(P_{S2} - P_{S1})$=0. Under 123 HI, we can draw the

following condition for the optimal a from the demand model: $a = \frac{1}{8}(a+V)$. Therefore, the optimal store locations of physical store 1 and 2 are $-\frac{1}{7}V$ and $\frac{1}{7}V$, respectively.

124. Decentralized Channel

When the prices for the both physical stores are the same, the marginal consumer between two stores is located at $\frac{1}{2}(P_{S2} - P_{S1})$=0. Under 124 DC, we can draw the following condition for the optimal a from the demand model: $a = \frac{3}{20}(a+V)$. Therefore, the optimal store locations of physical store 1 and 2 are $-\frac{3}{17}V$ and $\frac{3}{17}V$, respectively.

Appendix B

Matlab Programs for Numerical Analysis

This appendix provides the computer algorithms to illustrate basic procedures of numerical analyses conducted for identifying the sub-game perfect equilibrium. The programs are coded in Matlab. In this appendix, we show three representative Matlab codes instead of showing all of them, since many of the codes are similar to each other. All other program codes are available from the author.

Code B.1: Matlab Code Used for 122. Partially Integrated Channel in the Monopoly Market, when the distributions of consumer disutility are symmetric

Main Program

```
tic
clear
ctr=0;
global v x N y t step
v=100; t=1; step = 0.01;

wstart = .5*[v,v];
wnash = Wholesalenash_new(wstart(1),wstart(2));
```

```
pnash = Retailnash(wnash(1),wnash(2));
q1 = Demand1(wnash(1),pnash);
q2 = Demand2(wnash(1),pnash);
ctr = ctr+1;
result(ctr,:)= [t,wnash',pnash,q1,q2]
save equi_dms result
fid = fopen('equi_dms.txt','w');
fprintf(fid,'%6.2f %6.2f %6.2f %6.2f %6.2f %6.2f\n',result');
fclose(fid);

toc
```

Wholesalenash new

```
function wnash = wholesalenash_new(p1,w)
global step

diff = [step;step];

while sum(abs(diff))> step,

  foc1_p1 = (Wholesaleprofit1(p1+step,w)-Wholesaleprofit1(p1,w))/step;
  foc2_w = (Wholesaleprofit1(p1,w+step)-Wholesaleprofit1(p1,w))/step;
  foc = [foc1_p1; foc2_w]

  foc1_p1_a = (Wholesaleprofit1(p1+2*step,w)-Wholesaleprofit1(p1+step,w))/step;
  foc1_p1_b = (Wholesaleprofit1(p1+step,w+step)-Wholesaleprofit1(p1,w+step))/step;
  foc2_w_c = (Wholesaleprofit1(p1+step,w+step)-Wholesaleprofit1(p1+step,w))/step;
  foc2_w_d = (Wholesaleprofit1(p1,w+2*step)-Wholesaleprofit1(p1,w+step))/step;

  Dfoc1_p1 = (foc1_p1_a - foc1_p1)/step;
  Dfoc1_w = (foc1_p1_b - foc1_p1)/step;
  Dfoc2_p1 = (foc2_w_c - foc2_w)/step;
  Dfoc2_w = (foc2_w_d - foc2_w)/step;
  Newton = [Dfoc1_p1, Dfoc2_p1; Dfoc1_w, Dfoc2_w]

  diff=-inv(Newton)*foc;
  if abs(diff) > 20, diff = sign(diff)*20; end
  p1 = p1+diff(1)
  w = w+diff(2)

end
wnash=[p1;w];
```

Wholesaleprofit1

```
function profit = wholesaleprofit1(p1,w)
global v x y N t

p=Retailnash(p1,w);
profit=p1*Demand1(p1,p)+w*Demand2(p1,p);
```

Retail Nash

```
function pnash = Retailnash(p1,w)
global v x y N t

p=1.05*w;
diff=Foc(p1,p,w).*-inv(Newton(p1,p,w));
if abs(diff) > 20, diff = sign(diff)*20; end
pnew=p+diff;

while sum(abs(pnew-p))> .00001,
  p=pnew;
  diff=-inv(Newton(p1,p,w)).*Foc(p1,p,w);
  if abs(diff) > 20, diff = sign(diff)*20; end
  pnew=p+diff;
  pnew=min([pnew;v])';

end
pnash=pnew;
```

FOC

```
function Matrix = FOC(p1,p2,w)
global v x y N t

[x,y,N]= meshgrid(-100:2:100, -100:2:100, 0:2:100);

euN = exp(t*(v-p1-.01*(y).^2-.01*N.^2));
euS = exp(t*(v-p2-.01*(x).^2-.01*(y).^2));
euNS = (1+euN+euS);

p2w=p2-w;
sN = euN./euNS; sS = euS./euNS;
foc = sS.*(1-t*(1-sS)*p2w);
Matrix =[sum(sum(sum(foc)))];
```

Newton

```
function Matrix = Newton(p1,p2,w)
global v x y N t

[x,y,N]= meshgrid(-100:2:100, -100:2:100, 0:2:100);

euN = exp(t*(v-p1-.01*(y).^2-.01*N.^2));
euS = exp(t*(v-p2-.01*(x).^2-.01*(y).^2));
euNS = (1+euN+euS);
p1w=p1-w;
p2w=p2-w;

sN = euN./euNS; sS = euS./euNS;
```

```
DsNp1 = -t*sN.*(1-sN); DsSp1 = t*sN.*sS;
DsNp2 = t*sS.*sN; DsSp2 = -t*sS.*(1-sS);

brev1 = 1-t*(1-sN)*p1w;
brev2 = 1-t*(1-sS)*p2w;

Dfocp2 = DsSp2.*brev2+sS.*(-t*(1-sS)+t*DsSp2*p2w);
Matrix = [sum(sum(sum(Dfocp2)))];
```

Demand 1

```
function q = Demand1(pN,pS)
global v x y N t

[x,y,N]= meshgrid(-100:2:100, -100:2:100, 0:2:100);

euN = exp(t*(v-pN-.01*(y).^2-.01*N.^2));
euS = exp(t*(v-pS-.01*(x).^2-.01*(y).^2));
euNS = (1+euN+euS);
sN = euN./euNS;
q =sum(sum(sum(sN)));
```

Demand 2

```
function q = Demand2(pN,pS)
global v x y N t

[x,y,N]= meshgrid(-100:2:100, -100:2:100, 0:2:100);

euN = exp(t*(v-pN-.01*(y).^2-.01*N.^2));
euS = exp(t*(v-pS-.01*(x).^2-.01*(y).^2));
euNS = (1+euN+euS);
sS = euS./euNS;
q =sum(sum(sum(sS)));
```

Code B.2: Matlab Code Used for 122. Partially Integrated Channel in the Monopoly Market, when $0<\delta_{PSi}<50$ and $0<\delta_{Ni}<100$

[x,y,N]= meshgrid(-100:2:100, -100:2:100, 0:2:100) in Code B1 is replaced with [x,y,N]= meshgrid(-50:1:50, -100:2:100, 0:2:100). To examine a market with $0<\delta_{PSi}<50$, the range of δ_{PSi} is modified. The population density of the

market is adjusted accordingly, to maintain the same number of consumers in the market after the market size changes. Everything else is the same as Code B1.

Code B.3: Matlab Code Used for 221. Decentralized Channel in the Duopoly Market

Main Program

```
tic
clear
ctr=0;
global v1 v2 x1 x2 y1 y2 t N step r1 r2
v1=100; v2=100; t=1; step = 0.1; r1 = 50; r2 = 50;
y = -[50,25,10];
x = -[50,25,10];
wstart = .5*[v1,v1,v2];
for ctr1 = 1:3
  y1 = y(ctr1);
  y2= -y1;
for ctr2 = 1:3
  x1 = x(ctr2);
  x2 = -x1;
wnash = Wholesalenash_new(wstart(1), wstart(2), wstart(3));
pnash = Retailnash(wnash(1),wnash(2),wnash(3));
q1 = Demand1(wnash(1),pnash(1),pnash(2));
q2 = Demand2(wnash(1),pnash(1),pnash(2));
q3 = Demand3(wnash(1),pnash(1),pnash(2));
ctr = ctr+1;
result(ctr,:) = [t,x1,x2,y1,y2,wnash(1),wnash(2),wnash(3),pnash',q1,q2,q3]
save equi_dms result
fid = fopen('equi_dms.txt','w');
fprintf(fid,'%6.2f %6.2f %6.2f %6.2f %6.2f %6.2f %6.2f %6.2f %6.2f %6.2f
%6.2f %6.2f\n',result');
fclose(fid);
wstart = wnash;
if x1 == -50, wtempt = wnash; end
end
wstart = wtempt;
end

toc
```

Wholesalenash_new

```
function wnash = wholesalenash_new(p10,w10,w20)
global step
```

```
diff = [step;step;step];

while sum(abs(diff))> step,

  p10w10w20_1 = Wholesaleprofit1(p10,w10,w20);
  p10Sw10w20_1 = Wholesaleprofit1(p10+step,w10,w20);
  p10w10Sw20_1 = Wholesaleprofit1(p10,w10+step,w20);
  p10w10w20S_1 = Wholesaleprofit1(p10,w10,w20+step);
  p10Sw10Sp20_1 = Wholesaleprofit1(p10+step,w10+step,w20);
  p10w10w20S_2 = Wholesaleprofit2(p10,w10,w20+step);


  foc1_p1 = (p10Sw10w20_1-p10w10w20_1)/step;
  foc2_w1 = (p10w10Sw20_1-p10w10w20_1)/step;
  foc3_w2 = (p10w10w20S_2-Wholesaleprofit2(p10,w10,w20))/step;

  foc = [foc1_p1; foc2_w1; foc3_w2]

  foc1_p1_a = (Wholesaleprofit1(p10+2*step,w10,w20)-p10Sw10w20_1)/step;
  foc1_p1_b = (p10Sw10Sp20_1-p10w10Sw20_1)/step;
  foc1_p1_c = (Wholesaleprofit1(p10+step,w10,w20+step)-p10w10w20S_1)/step;

  foc2_w1_a = (p10Sw10Sp20_1-p10Sw10w20_1)/step;
  foc2_w1_b = (Wholesaleprofit1(p10,w10+2*step,w20)-p10w10Sw20_1)/step;
  foc2_w1_c = (Wholesaleprofit1(p10,w10+step,w20+step)-p10w10w20S_1)/step;

 foc3_w2_a = (Wholesaleprofit2(p10+step,w10,w20+step)-
Wholesaleprofit2(p10+step,w10,w20))/step;
foc3_w2_b = (Wholesaleprofit2(p10,w10+step,w20+step)-
Wholesaleprofit2(p10,w10+step,w20))/step;
  foc3_w2_c = (Wholesaleprofit2(p10,w10,w20+2*step)-p10w10w20S_2)/step;

  Dfoc1_p1 = (foc1_p1_a - foc1_p1)/step;
  Dfoc1_w1 = (foc1_p1_b - foc1_p1)/step;
  Dfoc1_w2 = (foc1_p1_c - foc1_p1)/step;
  Dfoc2_p1 = (foc2_w1_a - foc2_w1)/step;
  Dfoc2_w1 = (foc2_w1_b - foc2_w1)/step;
  Dfoc2_w2 = (foc2_w1_c - foc2_w1)/step;
  Dfoc3_p1 = (foc3_w2_a - foc3_w2)/step;
  Dfoc3_w1 = (foc3_w2_b - foc3_w2)/step;
  Dfoc3_w2 = (foc3_w2_c - foc3_w2)/step;

Newton = [Dfoc1_p1, Dfoc2_p1, Dfoc3_p1; Dfoc1_w1, Dfoc2_w1, Dfoc3_w1;
Dfoc1_w2, Dfoc2_w2, Dfoc3_w2]

  diff=-inv(Newton)*foc;
  if abs(diff) > 20, diff = sign(diff)*20; end
  p10 = p10+diff(1)
  w10 = w10+diff(2)
  w20 = w20+diff(3)

end
wnash=[p10;w10;w20];
```

Wholesaleprofit1

```
function profit = wholesaleprofit1(p1, w1, w2)
global v1 v2 x1 x2 y1 y2 N t
p=Retailnash(p1,w1,w2);
profit=p1*Demand1(p1,p(1),p(2))+w1*Demand2(p1,p(1),p(2));
```

Wholesaleprofit2

```
function profit = wholesaleprofit2(p1, w1, w2)
global v1 v2 x1 x2 y1 y2 N t
p=Retailnash(p1,w1,w2);
profit=w2*Demand3(p1,p(1),p(2));
```

Retailnash

```
function pnash = Retailnash(p1,w1,w2)
global v1 v2 x1 x2 y1 y2 t

p=1.05*[w1,w2]';
diff=-inv(Newton(p1,p(1),p(2),w1,w2))*Foc(p1,p(1),p(2),w1,w2);
if abs(diff) > 20, diff = sign(diff)*20; end
pnew=p+diff;

while sum(abs(pnew-p))> .01,
  p=pnew;
  diff=-inv(Newton(p1,p(1),p(2),w1,w2))*Foc(p1,p(1),p(2),w1,w2);
  if abs(diff) > 20, diff = sign(diff)*20; end
  pnew=p+diff;
  pnew=min([pnew';v1,v2])';
end
pnash=pnew;
```

Newton

```
function Matrix = Newton(p1,p2,p3,w1,w2)
global v1 v2 x1 x2 y1 y2 N t
[i,j,N]= meshgrid(-100:2:100, -100:2:100, 0:2:100);

euij1 = exp(t*(v1-p1-.01*(N).^2-.01*(y1-j).^2));
euij2 = exp(t*(v1-p2-.01*(x1-i).^2-.01*(y1-j).^2));
euij3 = exp(t*(v2-p3-.01*(x2-i).^2-.01*(y2-j).^2));
euij123 = (1+euij1+euij2+euij3);

p2w1=p2-w1; p3w2=p3-w2;

sij1 = euij1./euij123; sij2 = euij2./euij123; sij3 = euij3./euij123;

Dsij1p1 = -t*sij1.*(1-sij1); Dsij2p1 = t*sij1.*sij2; Dsij3p1 = t*sij1.*sij3;
Dsij1p2 = t*sij2.*sij1; Dsij2p2 = -t*sij2.*(1-sij2); Dsij3p2 = t*sij2.*sij3;
```

```
Dsij1p3 = t*sij3.*sij1; Dsij2p3 = t*sij3.*sij2; Dsij3p3 = -t*sij3.*(1-sij3);

brev2 = 1-t*(1-sij2)*p2w1;
brev3 = 1-t*(1-sij3)*p3w2;

Dfoc2p2 = Dsij2p2.*brev2+sij2.*(-t*(1-sij2)+t*Dsij2p2*p2w1);
Dfoc3p2 = Dsij3p2.*brev3+sij3.*(t*Dsij3p2*p3w2);

Dfoc2p3 = Dsij2p3.*brev2+sij2.*(t*Dsij2p3*p2w1);
Dfoc3p3 = Dsij3p3.*brev3+sij3.*(-t*(1-sij3)+t*Dsij3p3*p3w2);

Matrix = [sum(sum(sum(Dfoc2p2))), sum(sum(sum(Dfoc3p2)));
  sum(sum(sum(Dfoc2p3))), sum(sum(sum(Dfoc3p3)))];
```

Foc

```
function Matrix = FOC(p1,p2,p3,w1,w2)
global v1 v2 x1 x2 y1 y2 N t

[i,j,N]= meshgrid(-100:2:100, -100:2:100, 0:2:100);

euij1 = exp(t*(v1-p1-.01*(N).^2-.01*(y1-j).^2));
euij2 = exp(t*(v1-p2-.01*(x1-i).^2-.01*(y1-j).^2));
euij3 = exp(t*(v2-p3-.01*(x2-i).^2-.01*(y2-j).^2));
euij123 = (1+euij1+euij2+euij3);

p2w1=p2-w1; p3w2=p3-w2;

sij1 = euij1./euij123; sij2 = euij2./euij123; sij3 = euij3./euij123;

foc2 = sij2.*(1-t*(1-sij2)*p2w1);
foc3 = sij3.*(1-t*(1-sij3)*p3w2);

Matrix =[sum(sum(sum(foc2))); sum(sum(sum(foc3)))];
```

Demand1

```
function q = Demand1(p1,p2,p3)
global v1 v2 x1 x2 y1 y2 N t

[i,j,N]= meshgrid(-100:2:100, -100:2:100, 0:2:100);

euij1 = exp(t*(v1-p1-.01*(N).^2-.01*(y1-j).^2));
euij2 = exp(t*(v1-p2-.01*(x1-i).^2-.01*(y1-j).^2));
euij3 = exp(t*(v2-p3-.01*(x2-i).^2-.01*(y2-j).^2));

euij123 = (1+euij1+euij2+euij3);
sij1 = euij1./euij123;
q =sum(sum(sum(sij1)));
```

Demand2

```
function q = Demand2(p1,p2,p3)
```

```
global v1 v2 x1 x2 y1 y2 N t

[i,j,N]= meshgrid(-100:2:100, -100:2:100, 0:2:100);

euij1 = exp(t*(v1-p1-.01*(N).^2-.01*(y1-j).^2));
euij2 = exp(t*(v1-p2-.01*(x1-i).^2-.01*(y1-j).^2));
euij3 = exp(t*(v2-p3-.01*(x2-i).^2-.01*(y2-j).^2));

euij123 = (1+euij1+euij2+euij3);
sij2 = euij2./euij123;
q =sum(sum(sum(sij2)));
```

Demand3

```
function q = Demand3(p1,p2,p3)
global v1 v2 x1 x2 y1 y2 N t

[i,j,N]= meshgrid(-100:2:100, -100:2:100, 0:2:100);

euij1 = exp(t*(v1-p1-.01*(N).^2-.01*(y1-j).^2));
euij2 = exp(t*(v1-p2-.01*(x1-i).^2-.01*(y1-j).^2));
euij3 = exp(t*(v2-p3-.01*(x2-i).^2-.01*(y2-j).^2));

euij123 = (1+euij1+euij2+euij3);
sij3 = euij3./euij123;
q =sum(sum(sum(sij3)));
```

Appendix C

Numerical Search Results

This appendix provides the summary of the numerical analyses results conducted over various channel structures and degrees of competition. All other results are available from the author.

When X=-10,10 and Theta=-10,10

	w1	w2	pn	p1	p2	qn	q1	q2	Tot. q	R pr N	R pr S1	R1 Pr Tot	R pr S2	R pr Tot	M1 pr N	M1 pr S	M1 pr Tot	M2 pr S	M Tot Pr	Chn Tot Pr	S1 Power	S2 Power	M1 Power	M2 Power
21 VIPS				28.91	28.91	0.00	172659.70	172659.70	345319.40	0.00	0.00	0.00	0.00	0.00	0.00	4991591.93	4991591.93	4991591.93	9983183.85	9983183.85	0.00	0.00	100.00	100.00
221 VIPS	0.00	0.00	40.43	31.27	27.85	105834.78	121420.58	160155.04	387410.40	0.00	0.00	0.00	0.00	0.00	4278900.16	3796821.54	8075721.69	4460317.86	12536039.56	12536039.56	0.00	0.00	100.00	100.00
21 DCPS	39.21	39.21	0.00	59.62	59.62	0.00	103619.46	103619.46	207238.92	0.00	2114873.18	2114873.18	2114873.18	4229746.36	0.00	4062919.03	4062919.03	4062919.03	8125838.05	12355584.41	34.23	34.23	65.77	65.77
221 DCPS	40.91	34.34	47.06	55.77	53.84	155449.60	61589.15	91994.33	309033.08	0.00	915214.77	915214.77	1793889.44	2709104.20	7315458.18	2519612.13	9835070.30	3159085.29	12994155.59	15703259.80	26.65	36.22	73.35	63.78
222 DCPS	45.27	40.22	69.80	64.70	60.66	69746.67	69064.36	102295.23	241106.26	1710885.82	1341920.51	3052806.33	2090914.50	5143720.83	3157431.75	3126543.58	6283975.33	4114314.15	10398289.48	15542010.31	32.70	33.70	67.30	66.30
21 CPS	24.10	24.10	0.00	63.74	63.74	0.00	87949.33	87949.33	175898.66	0.00	3486311.44	3486311.44	3486311.44	6972622.88	0.00	2119578.85	2119578.85	2119578.85	4239157.71	11211780.59	62.19	62.19	37.81	37.81
221 CPS	28.49	26.52	46.20	55.80	55.01	164844.60	56772.88	83173.76	304791.24	0.00	1550467.35	1550467.35	2369620.42	3920087.78	7615820.52	1617459.35	9233279.87	2205768.12	11439047.99	15359135.76	48.94	51.79	51.06	48.21

When X=-25,25 and Theta=-25,25

	w1	w2	pn	p1	p2	qn	q1	q2	Tot. q	R pr N	R pr S1	R1 Pr Tot	R pr S2	R pr Tot	M1 pr N	M1 pr S	M1 pr Tot	M2 pr S	M Tot Pr	Chn Tot Pr	S1 Power	S2 Power	M1 Power	M2 Power
21 VIPS	0.00	0.00	0.00	45.52	45.52	0.00	173009.33	173009.33	346018.66	0.00	0.00	0.00	0.00	0.00	0.00	7875384.70	7875384.70	7875384.70	15750769.40	15750769.40	0.00	0.00	100.00	100.00
221 VIPS	0.00	0.00	50.21	49.95	44.20	111580.40	111021.90	163098.11	385700.41	0.00	0.00	0.00	0.00	0.00	5602451.88	5545543.91	11147995.79	7208936.46	18356932.25	18356932.25	0.00	0.00	100.00	100.00
21 DCPS	48.58	48.58	0.00	74.21	74.21	0.00	93384.94	93384.94	186769.88	0.00	2393456.01	2393456.01	2393456.01	4786912.02	0.00	4536640.39	4536640.39	4536640.39	9073280.77	13860192.79	34.54	34.54	65.46	65.46
221 DCPS	49.28	46.09	52.81	69.38	71.00	159704.30	56440.17	82245.63	298390.10	0.00	1134447.42	1134447.42	2048738.64	3183186.06	8433984.08	2781371.58	11215355.66	3790701.09	15006056.75	18189242.81	28.97	35.08	71.03	64.92
222 DCPS	53.07	48.35	77.79	77.99	73.87	65435.27	63503.47	91640.08	220578.82	1617559.87	1582506.47	3200066.35	2338654.84	5538721.19	3472649.78	3370129.15	6842778.93	4430797.87	11273576.80	16812297.99	31.86	34.55	68.14	65.45
21 CPS	41.16	41.16	0.00	73.30	73.30	0.00	85088.36	85088.36	170176.72	0.00	2734739.89	2734739.89	2734739.89	5469479.78	0.00	3502236.90	3502236.90	3502236.90	7004473.80	12473953.58	43.85	43.85	56.15	56.15
221 CPS	43.39	41.82	51.88	68.33	69.86	164734.92	50672.15	79607.23	295014.30	0.00	1263763.42	1263763.42	2232186.73	3495950.15	8546447.65	2198664.59	10745112.24	3329174.36	14074286.60	17570236.75	36.50	40.14	63.50	59.86

When X=-50,50 and Theta=-50,50

	w1	w2	pn	p1	p2	qn	q1	q2	Tot. q	R pr N	R pr S1	R1 Pr Tot	R pr S2	R pr Tot	M1 pr N	M1 pr S	M1 pr Tot	M2 pr S	M Tot Pr	Chn Tot Pr	S1 Power	S2 Power	M1 Power	M2 Power
21 VIPS	0.00	0.00	0.00	60.09	60.09	0.00	144037.16	144037.16	288074.32	0.00	0.00	0.00	0.00	0.00	0.00	8655192.94	8655192.94	8655192.94	17310385.89	17310385.89	0.00	0.00	100.00	100.00
221 VIPS	0.00	0.00	62.84	63.48	61.20	106505.02	99106.90	138299.53	343911.45	0.00	0.00	0.00	0.00	0.00	6692775.46	6291306.01	12984081.47	8463931.24	21448012.70	21448012.70	0.00	0.00	100.00	100.00
21 DCPS	52.48	52.48	0.00	76.34	76.34	0.00	94745.42	94745.42	189490.84	0.00	2260625.72	2260625.72	2260625.72	4521251.44	0.00	4972239.64	4972239.64	4972239.64	9944479.28	14465730.73	31.25	31.25	68.75	68.75
221 DCPS	56.17	52.66	60.56	74.66	76.70	138700.31	56006.21	92493.19	287199.71	0.00	1035554.82	1035554.82	2223536.29	3259091.11	8399690.77	3145868.82	11545559.59	4870691.39	16416250.97	19675342.09	24.77	31.34	75.23	68.66
222 DCPS	54.53	52.50	78.85	78.77	76.34	69728.31	68214.78	94721.46	232664.55	1695792.50	1653526.27	3349318.77	2258159.61	5607478.37	3802284.74	3719751.95	7522036.70	4972876.65	12494913.35	18102391.72	30.81	31.23	69.19	68.77
21 CPS	52.54	52.54	0.00	76.41	76.41	0.00	94450.15	94450.15	188900.30	0.00	2254525.08	2254525.08	2254525.08	4509050.16	0.00	4962410.88	4962410.88	4962410.88	9924821.76	14433871.92	31.24	31.24	68.76	68.76
221 CPS	56.00	52.83	60.51	74.63	76.85	138852.31	56035.05	91878.07	286765.43	0.00	1043932.98	1043932.98	2206911.24	3250844.22	8401953.28	3137962.80	11539916.08	4853918.44	16393834.52	19644678.74	24.96	31.26	75.04	68.74

When X=-10,10 and Theta=-25,25

	w1	w2	pn	p1	p2	qn	q1	q2	Tot. q	R pr N	R pr S1	R1 Pr Tot	R pr S2	R pr Tot	M1 pr N	M1 pr S	M1 pr Tot	M2 pr S	M Tot Pr	Chn Tot Pr	S1 Power	S2 Power	M1 Power	M2 Power
21 VIPS	0.00	0.00	0.00	41.65	41.65	0.00	168069.78	168069.78	336139.56	0.00	0.00	0.00	0.00	0.00	0.00	7000106.34	7000106.34	7000106.34	14000212.67	14000212.67	0.00	0.00	100.00	100.00
221 VIPS	0.00	0.00	49.63	46.74	42.25	113857.59	109221.63	161069.73	384148.95	0.00	0.00	0.00	0.00	0.00	5650752.19	5105018.99	10755771.18	6805196.09	17560967.27	17560967.27	0.00	0.00	100.00	100.00
21 DCPS	46.15	46.15	0.00	70.95	70.95	0.00	93589.78	93589.78	187179.56	0.00	2321026.54	2321026.54	2321026.54	4642053.09	0.00	4319168.35	4319168.35	4319168.35	8638336.69	13280389.78	34.95	34.95	65.05	65.05
221 DCPS	47.79	44.44	52.44	67.00	68.91	159604.38	55976.47	83364.69	298945.54	0.00	1075307.99	1075307.99	2039933.96	3115241.95	8369653.69	2675115.50	11044769.19	3704726.82	14749496.01	17864737.97	28.67	35.51	71.33	64.49
222 DCPS	51.94	46.98	76.87	76.06	71.96	68188.44	60879.21	92125.07	221192.72	1699937.81	1468406.55	3168344.35	2301284.25	5469628.60	3541707.57	3162066.17	6703773.74	4328035.79	11031809.53	16501438.13	32.09	34.71	67.91	65.29
21 CPS	41.16	41.16	0.00	73.30	73.30	0.00	85088.36	85088.36	170176.72	0.00	2734739.89	2734739.89	2734739.89	5469479.78	0.00	3502236.90	3502236.90	3502236.90	7004473.80	12473953.58	43.85	43.85	56.15	56.15
221 CPS	43.39	41.82	51.88	68.33	69.86	164734.92	50672.15	79607.23	295014.30	0.00	1263763.42	1263763.42	2232186.73	3495950.15	8546447.65	2198664.59	10745112.24	3329174.36	14074286.60	17570236.75	36.50	40.14	63.50	59.86

When X=-50,50 and Theta=-25,25

	w1	w2	pn	p1	p2	qn	q1	q2	Tot. q	R pr N	R pr S1	R1 Pr Tot	R pr S2	R pr Tot	M1 pr N	M1 pr S	M1 pr Tot	M2 pr S	M Tot Pr	Chn Tot Pr	S1 Power	S2 Power	M1 Power	M2 Power
21 VIPS	0.00	0.00	0.00	56.23	56.23	0.00	157869.69	157869.69	315739.38	0.00	0.00	0.00	0.00	0.00	0.00	8877012.67	8877012.67	8877012.67	17754025.34	17754025.34	0.00	0.00	100.00	100.00
221 VIPS	0.00	0.00	52.96	56.51	51.01	115361.90	104335.79	146260.05	365957.74	0.00	0.00	0.00	0.00	0.00	6109566.22	5896015.49	12005581.72	7460725.15	19466306.87	19466306.87	0.00	0.00	100.00	100.00
21 DCPS	51.70	51.70	0.00	75.92	75.92	0.00	96412.84	96412.84	192825.68	0.00	2335118.98	2335118.98	2335118.98	4670237.97	0.00	4984543.83	4984543.83	4984543.83	9969087.66	14639325.63	31.90	31.90	68.10	68.10
221 DCPS	53.63	50.80	53.46	73.09	74.10	162170.95	52871.76	78185.25	293227.96	0.00	1028884.45	1028884.45	1821716.33	2850600.77	8669658.99	2835512.49	11505171.48	3971810.70	15476982.18	18327582.95	26.62	31.44	73.38	68.56
222 DCPS	53.98	51.43	78.44	78.48	75.55	63077.25	68787.38	90629.53	222494.16	1542869.54	1685290.81	3228160.35	2185984.26	5414144.61	3404909.96	3713142.77	7118052.73	4661076.73	11779129.46	17193274.06	31.20	31.93	68.80	68.07
21 CPS	41.16	41.16	0.00	73.30	73.30	0.00	85088.36	85088.36	170176.72	0.00	2734739.89	2734739.89	2734739.89	5469479.78	0.00	3502236.90	3502236.90	3502236.90	7004473.80	12473953.58	43.85	43.85	56.15	56.15
221 CPS	43.39	41.82	51.88	68.33	69.86	164734.92	50672.15	79607.23	295014.30	0.00	1263763.42	1263763.42	2232186.73	3495950.15	8546447.65	2198664.59	10745112.24	3329174.36	14074286.60	17570236.75	36.50	40.14	63.50	59.86

When X=-25,25 and Theta=-10,10

	w1	w2	pn	p1	p2	qn	q1	q2	Tot. q	R pr N	R pr S1	R1 Pr Tot	R pr S2	R pr Tot	M1 pr N	M1 pr S	M1 pr Tot	M2 pr S	M Tot Pr	Chn Tot Pr	S1 Power	S2 Power	M1 Power	M2 Power
21 VIPS	0.00	0.00	0.00	41.65	41.65	0.00	168069.78	168069.78	336139.56	0.00	0.00	0.00	0.00	0.00	0.00	7000106.34	7000106.34	7000106.34	14000212.67	14000212.67	0.00	0.00	100.00	100.00
221 VIPS	0.00	0.00	40.97	41.67	35.12	112961.43	109494.45	157255.72	379711.60	0.00	0.00	0.00	0.00	0.00	4628029.79	4562633.73	9190663.52	5522820.89	14713484.41	14713484.41	0.00	0.00	100.00	100.00
21 DCPS	46.15	46.15	0.00	70.95	70.95	0.00	93589.78	93589.78	187179.56	0.00	2321026.54	2321026.54	2321026.54	4642053.09	0.00	4319168.35	4319168.35	4319168.35	8638336.69	13280389.78	34.95	34.95	65.05	65.05
221 DCPS	45.79	37.22	47.96	64.51	59.57	161465.43	54319.05	87112.37	302896.85	0.00	1016852.62	1016852.62	1946961.47	2963814.09	7743882.02	2487269.30	10231151.32	3242322.41	13473473.73	16437287.82	29.02	37.52	70.98	62.48
222 DCPS	48.85	43.84	72.32	72.99	67.41	67747.29	64555.06	96242.70	228545.05	1590028.90	1558359.15	3148388.04	2268440.44	5416828.48	3309455.12	3153514.68	6462969.80	4219279.97	10682249.77	16099078.25	32.76	34.97	67.24	65.03
21 CPS	24.10	24.10	0.00	63.74	63.74	0.00	87949.33	87949.33	175898.66	0.00	3486311.44	3486311.44	3486311.44	6972622.88	0.00	2119578.85	2119578.85	2119578.85	4239157.71	11211780.59	62.19	62.19	37.81	37.81
221 CPS	28.49	26.52	46.20	55.80	55.01	164844.60	56772.88	83173.76	304791.24	0.00	1550467.35	1550467.35	2369620.42	3920087.78	7615820.52	1617459.35	9233279.87	2205768.12	11439047.99	15359135.76	48.94	51.79	51.06	48.21

When X=-25,25 and Theta=-50,50

	w1	w2	pn	p1	p2	qn	q1	q2	Tot. q	R pr N	R pr S1	R1 Pr Tot	R pr S2	R pr Tot	M1 pr N	M1 pr S	M1 pr Tot	M2 pr S	M Tot Pr	Chn Tot Pr	S1 Power	S2 Power	M1 Power	M2 Power
21 VIPS	0.00	0.00	0.00	56.23	56.23	0.00	157869.69	157869.69	315739.38	0.00	0.00	0.00	0.00	0.00	0.00	8877012.67	8877012.67	8877012.67	17754025.34	17754025.34	0.00	0.00	100.00	100.00
221 VIPS	0.00	0.00	62.64	62.75	56.56	104148.25	101501.89	156655.19	362305.33	0.00	0.00	0.00	0.00	0.00	6523846.38	6369243.60	12893089.98	8860417.55	21753507.52	21753507.52	0.00	0.00	100.00	100.00
21 DCPS	51.70	51.70	0.00	75.92	75.92		96412.84	96412.84	192825.68	0.00	2335118.98	2335118.98	2335118.98	4670237.97	0.00	4984543.83	4984543.83	4984543.83	9969087.66	14639325.63	31.90	31.90	68.10	68.10
221 DCPS	55.46	52.10	60.59	74.15	76.41	137970.51	57648.19	93636.03	289254.73	0.00	1077444.67	1077444.67	2276291.89	3353736.56	8359633.20	3197168.62	11556801.82	4878437.16	16435238.98	19788975.54	25.21	31.82	74.79	68.18
222 DCPS	54.52	51.72	78.84	78.77	75.93	69737.26	68235.88	96372.92	234346.06	1696010.16	1654720.09	3350730.25	2333188.39	5683918.65	3802075.42	3720220.18	7522295.59	4984407.42	12506703.02	18190621.66	30.82	31.88	69.18	68.12
21 CPS	52.54	52.54	0.00	76.41	76.41	0.00	94450.15	94450.15	188900.30	0.00	2254525.08	2254525.08	2254525.08	4509050.16	0.00	4962410.88	4962410.88	4962410.88	9924821.76	14433871.92	31.24	31.24	68.76	68.76
221 CPS	56.00	52.83	60.51	74.63	76.85	138852.31	56035.05	91878.07	286765.43	0.00	1043932.98	1043932.98	2206911.24	3250844.22	8401953.28	3137962.80	11539916.08	4853918.44	16393834.52	19644678.74	24.96	31.26	75.04	68.74

Information provided in the interview will be kept strictly confidential, and will be used for the purpose of this study. Responses will only be reported in the aggregate.

Part A: Company profile

1. Name of firm

2. Website address if any

3. Interviewee's name and position in the firm

4a. Size of the firm in terms of rough # of trucks, tractors, or trailers

4b. Size of the firm in terms of rough annual revenue

5. Type of business
TL: % LTL: % Other (Specify:) %

6. Geographic market served

7. Market served

General Freight___ Special Freight___ (Specify:)

8. How much of your business is from regular transactions (i.e., long term contractors or loyal customer base)?

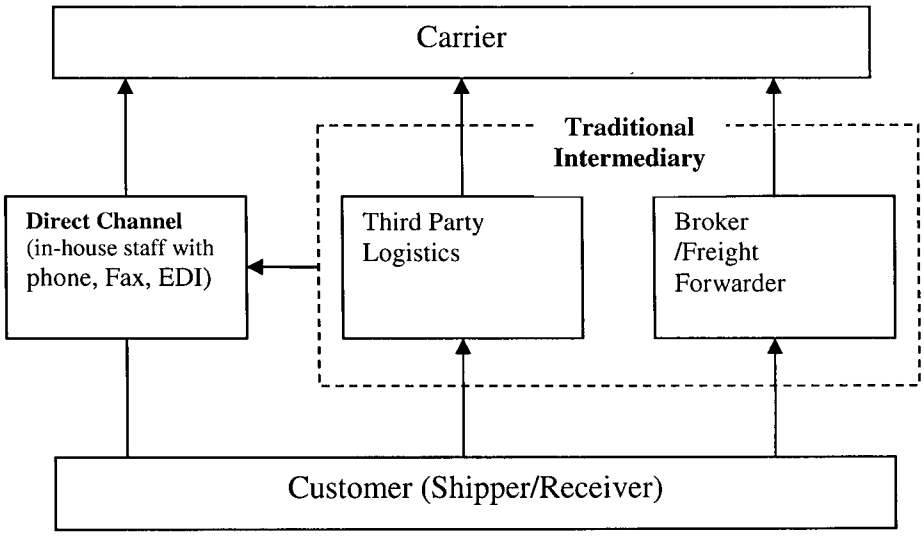
Part B: E-Commerce Experience

9. How does your firm use the Internet for business? (Please check everything that applies to your company)

Providing Contacts (Phone # or E-mail)___ Advertising (Building Awareness)___ Providing Price Information___ Order Processing (Invoicing)___ Transacting (Payment) ___ Pick-up/Dispatching____ Tracking___ Shipment Consolidation Real-time Shipment Visibility___ Integrating Internal Functions ___

10a. Figure 1 represents the marketing channel system of the trucking industry **before** the Internet channel introduction (before late 90's). Do you have something to add or delete?

Traditional Marketing Channels

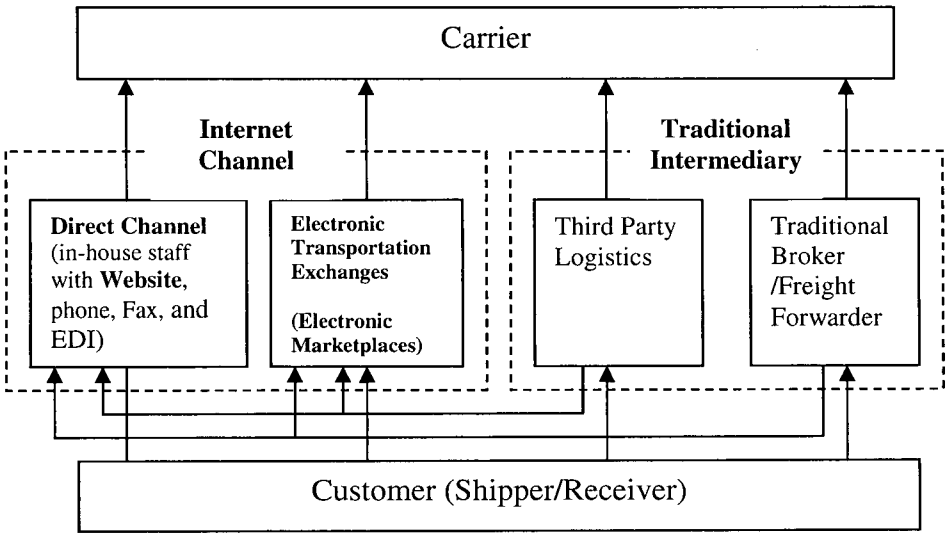


10b. How was the revenue allocation among the channels before the Internet channel introduction?

Direct Sales (1-800 number, etc.): %
Third Party Logistics Provider: %
Brokers: %
Others (Specify:): %

11a. Figure 2 represents the marketing channel system of the trucking industry **after** the Internet channel introduction (early 2000's-Current). Do you have something to add or delete?

Marketing Channels After the Internet



11b. How has been the revenue allocation among the channels since Internet channel introduction?

Direct Channel (1-800 #, or Direct Sales Force): %
Company Website: %
Third Party Logistics Provider: %
Brokers: %
Internet Exchanges: %
Others (Specify:): %

11c. How much is the margin of the traditional middlemen?

Part C: Impact of E-Commerce on Distribution Channel

12. How will be the revenue allocation among the channels in the future (5 years later)?

Direct Channel (1-800#, or Direct Sales Force): %
Company Website: %
Third Party Logistics Provider: %
Brokers: %
Internet Exchanges: %
Others (Specify:): %

13. What do you think about the change in overall **revenue** of your firm between before and after the Internet channel (both carriers' Website and Exchanges)? ( )
1. Seriously Decreased 2. Slightly Decreased 3. No Change 4. Slightly Increased 5. Seriously Increased

14. What do you think about the change in overall market **price** for shippers between before and after the Internet channel (both carriers' Websites and Exchanges)? ( )
1. Seriously Decreased 2. Slightly Decreased 3. No Change 4. Slightly Increased 5. Seriously Increased

15. What do you think about the change in overall profit **margin** for traditional middlemen between before and after the Internet channel (both carriers' Websites and Exchanges)? ( )
1. Seriously Decreased 2. Slightly Decreased 3. No Change 4. Slightly Increased 5. Seriously Increased

16. What do you think about the change in profit **margin** of the Website and direct channel (1-800 number or Internet channel) of your company between before and after the Internet **Exchanges**? ( )
1. Seriously Decreased 2. Slightly Decreased 3. No Change 4. Slightly Increased 5. Seriously Increased

17. What do you think about the change in overall **revenue** of your firm between before and after the Internet channel (both carriers' Website and Exchanges)? ( )
1. Seriously Decreased 2. Slightly Decreased 3. No Change 4. Slightly Increased 5. Seriously Increased

18. What are your intuitions behind those changes, if any?

19. Do you see Internet channels (including carriers' Websites and exchanges) as credible threats to the traditional middlemen (brokers, freight forwarders, or third party logistics provider)?

20. What do you think the future (prospect for opportunities and challenges) of the role of traditional middlemen (brokers, freight forwarders, or third party logistics provider)?

21. What are the differences in nature of services provided between by Internet channel (Internet Exchanges and Company Websites) and indirect channels (brokers, freight forwarders, or third party logistics provider)?

Part D: Discussion on overall trucking industry (Not company specific questions)

22. Between TL and LTL, which business would be more suitable for each channel below? (Please underline your choice) Why do you think so?

    Company Websites: TL or LTL
    (Direct Channel (1-800#, or Direct Sales Force): TL or LTL)
    Internet Exchanges: TL or LTL
    Traditional Middlemen: TL or LTL

23. Between a well-known carrier and a relatively unknown carrier, what kind of a carrier would be more suitable for each channel below (Please underline your choice)? Why do you think so?

    Company Websites: Known one or Unknown one
    (Direct Channel (1-800 #, or Direct Sales Force): Known one or Unknown one)
    Internet Exchanges: Known one or Unknown one
    Traditional Middlemen: Known one or Unknown one

24. Between a carrier with a large network and one with a small network, what size of a carrier would be more suitable for each channel below (Please underline your choice)? Why do you think so?

    Company Websites: Large one or Small one
    (Direct Channel (1-800 #, or Direct Sales Force): Large one or Small one)
    Internet Exchanges: Large one or Small one
    Traditional Middlemen: Large one or Small one

25. Any other comments or suggestions?

Thank you very much for your time!!