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A "Meta-Analysis" of Multibrand, Multioutlet Channel Systems

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In today's multibrand, multichannel marketplace, optimal channel design involves issues such as distribution intensity, channel exclusivity, vertical and horizontal coordination, and online–offline mixed structures. We investigate how a firm's choice in these design issues affects its profitability under varying levels of brand and outlet differentiation. Our spatial model explicitly captures heterogeneous consumer preference for brand position, store location, and outlet type, under various consumer behavior assumptions. We apply this same underlying model to 10 different channel structures, deriving associated demand functions and equilibrium solutions. We perform a meta-analysis over the entire set of results to estimate a general model that summarizes the linkages among the factors shaping optimal channel structure decisions in a multibrand, multioutlet market. This general model efficiently describes the complex interactions of channel characteristics with industry structure and consumer characteristics, providing new findings as well as greater clarity to some results in the literature. A predictive analysis applied to additional channel structures exhibits strong generalizability in qualitative findings.

Key words: channel coordination; channel structure; demand formulation; multichannel pricing; product line pricing
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1. Introduction

Major channel structure decisions, although made infrequently, represent important strategic moves. For example, Gateway, a major U.S. personal computer (PC) maker, closed all 188 of its retail stores in 2004 while keeping its Internet channel open. Subsequently, Gateway PCs were made available at third-party retail stores such as Best Buy and Costco, which also carried competing PC brands. In 2006, Apple made a major expansion of its retail efforts by selling its MacBook computers through Best Buy stores throughout the United States, going beyond its own retail and online stores. In 2009, both GM and Chrysler closed over a third of their dealerships in the United States. In doing so they greatly reduced their distribution coverage, but also reduced the inter- and intrabrand competition among the dealers. PepsiCo launched its new energy drink Fuelosophy through Whole Foods exclusively, and P&G planned to expand the number of brands sold exclusively at select retailers (Failla 2010). Both moves go against the conventional wisdom (e.g., Coughlan et al. 2001, p. 288) that convenience goods "should be distributed as intensively as possible." These illustrate the complex channel structure issues in today's multibrand, multioutlet market environment, such as distribution intensity (number of outlets), channel exclusivity (whether or not the outlets carry only one brand or multiple competing brands), vertical integration (VI), and multichannel coordination (e.g., setting different prices across different channels for joint profit maximization).

This paper investigates how these channel characteristics affect the profitability of the channel members in a market characterized by competing manufacturers and competing online and offline retail outlets. The theoretical channels literature includes mathematically tractable simpler channel structure models, composed of one manufacturer and one retailer (Jeuland and Shugan 1983), two competing manufacturers and two competing exclusive retailers (McGuire and Staelin 1983), one manufacturer and two competing retailers (Ingene and Parry 1995), two competing manufacturers and a common retailer (Choi 1991), two competing manufacturers and two common retailers (Choi 1996, Lee and Staelin 1997, Trivedi 1998), or one manufacturer using both online and offline channels (Chiang et al. 2003, Balasubramanian 1998, Cattani et al. 2006, Kumar and Ruan 2006, Liu and Zhang 2006, Yoo and Lee 2011). Consequently, they do not fully address the complex channel structure issues in our examples.

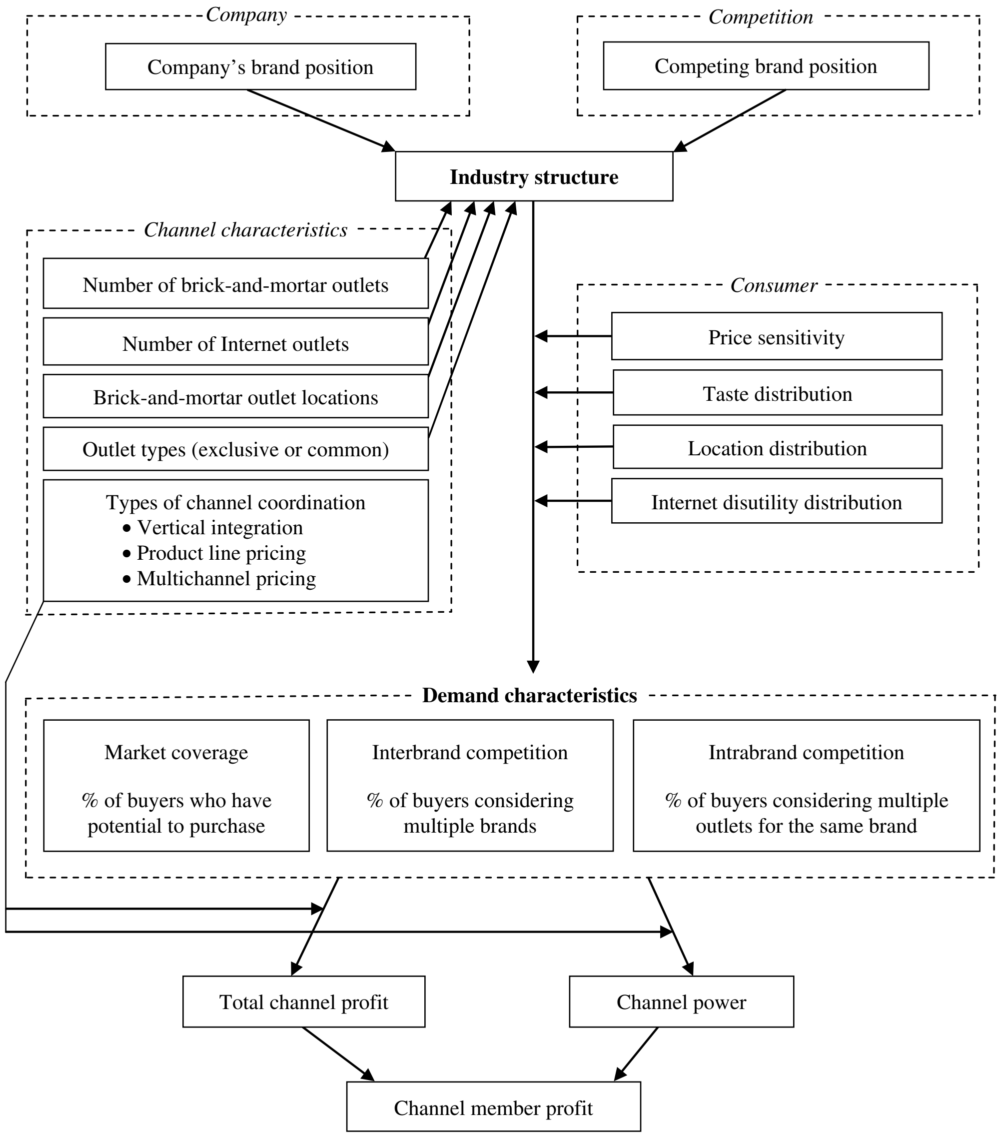
We extend the previous studies in two important ways. First, we analyze 10 channel structures, many of which are new to the literature but mirror some of the commonly found systems. For each structure we obtain equilibrium prices, quantities, and profits. Second, and perhaps more importantly, we treat these 10 channel structures as independent "thought experiments" (Moorthy 1993), within each of which we "manipulate" a number of factors to investigate the general pattern of their impact on the equilibrium results. The manipulated factors include (a) the physical locations of the retail outlets, (b) the horizontal positioning of the competing brands, (c) the distribution of consumer locations relative to the brick-and-mortar stores, (d) the distribution of consumers' ideal product positions, (e) the distribution of consumers' disutility associated with online shopping, and (f) the consumers' price sensitivity relative to travel costs and product mismatch. We use the equilibrium results from the 10 experiments as "data" for estimating a general model that links (1) the channel system characteristics, (2) competitive and company positioning, (3) channel coordination types, and (4) heterogeneity of consumer characteristics to demand characteristics and ultimately to the profits for the channel system and individual channel members. This "meta-type" analysis is intended to provide more generalizable insights into the complex linkages among the key underlying factors that affect channel member profits, and in this way takes a step toward addressing the need for an overarching theory of channel structure design (Staelin 2008).

To deliver on the two objectives mentioned above, we seek to tackle two main challenges. The first is to specify a flexible yet consistent demand model that can be applied to multiple experiments and various manipulation conditions. This issue arises because comparing different channel structures often involves comparing equilibrium results based on different sets of demand functions. For example a channel structure with two product offerings might contain one own price sensitivity parameter and one cross-price sensitivity parameter, whereas a structure with four product offerings might have one own price parameter and three cross-price parameters. For such comparisons to be meaningful, we must ensure that all the demand functions are generated from the same underlying consumer behavior structure, so that any differences in equilibrium results are attributed only to differences in the channel structure. Even within a given channel structure, we must properly model how the demand function parameters change over different manipulation settings (e.g., variations in brand positions or physical store locations), to assure the validity of comparative statics. We respond to this challenge by developing a novel three-dimensional spatial model with stochastic consumer choice.

The second major challenge is to parsimoniously summarize over 700 sets of equilibrium results across the 10 different channel structure experiments under various market conditions. To meet this challenge, we develop a general framework starting with the commonly used "three Cs" (customer, competition, and company) and add channel structure as a fourth C to characterize the market environment, as shown in Figure 1. Next, we note that the two key components of analytic channel models that drive any solution are the demand parameters and the rules of the game. Consequently, we link the factors describing the four Cs to three major demand characteristics: market coverage (i.e., size of the potential market), interbrand competition (the degree to which the brands compete for the same customers), and intrabrand competition (the degree to which the different outlets selling the same brand compete for the same customers). These three demand characteristics, along with the types of vertical and horizontal channel coordination (i.e., rules of the game) in the channel structure, affect total channel profits and the channel power (i.e., a channel member's share of total channel profits), the combination of which determines the individual channel member profits. Our conceptualization of the industry structure interacting with channel coordination types to determine profit outcomes has some similarity to the structure–conduct–performance paradigm in industrial organization economics.

The conceptual framework in Figure 1 provides a basis for regression models that summarize the general relationships in our results. The estimated model exhibits a remarkable ability to explain most of the variations in profits across the large number of different channel structures and market environments using just six explanatory variables: three capturing demand characteristics and three reflecting channel coordination types. In particular, our model reveals new insights into the interactions between the channel coordination mechanisms and the intensity of inter- and intrabrand competition, which lead to various optimal channel structures across different competitive environments, producing some interesting new results. For example, we find that the entry of a new nonphysical outlet (e.g., Internet, catalog, telephone

Figure 1 **General Framework**



call centers, etc.) can reduce the intensity of interbrand competition, and that, for a fixed level of market coverage, it is never optimal for manufacturers to include retailer product line pricing (PLP) in the channel structure despite its positive effect on total channel profits at high levels of interbrand competition.[1]

2. Demand Model

To analyze the complex linkages in Figure 1, we first specify the demand model. Most studies in the channel structure literature model the demand environment either by assuming sets of (typically linear) demand functions or by deriving the demand functions from one- or two-dimensional spatial models.[2] The former approach has an obvious advantage of ensuring mathematical tractability, but lacks the ability to ensure that the underlying demand-generating process remains fixed. Consequently it is impossible to verify the validity of comparative statics or comparisons of channel structures associated with different demand structures. (See Staelin 2008 for more details.)

Deriving the demand functions from an explicit spatial model eliminates such problems. Spatial models often represent the market as a unit line (Hotelling 1929), where distances represent physical distances or

[1] From now on, for expositional convenience, we will use the term "Internet outlet" to represent any nonphysical outlet.

[2] We note that a variant of this approach is to use a "representative consumer" model (e.g., Choi and Coughlan 2006, Ingene and Parry 2007) to derive demand functions.

taste differences. Demand functions (typically linear) are then derived by partitioning the unit line according to the location of the buyers who are indifferent between two offerings (i.e., equal utilities). This approach was used by Lal and Rao (1997), Lal et al. (1996), and Purohit (1997), among others. Others have extended this linear city model to allow for a circular space (e.g., Salop 1979), two unit lines representing two different consumer segments (e.g., Desai 2001, Du et al. 2005), and a rectangular space (Vandenbosch and Weinberg 1995, Yoo and Lee 2011).

All of the above derived demand models capture buyer heterogeneity and product or store differentiation (but not both) quite nicely. Moreover, they lead to linear and continuous demand functions for most simple selling environments. However, for more complex selling situations, the resulting demand function is usually kinked between multiple linear demand regions, each with its own demand parameters. For example, Du et al. (2005) analyzed a situation with three brands being sold in one retail outlet serving a market represented by two unit line segments. Even in this stylized setting, they found 49 potential linear demand regions that need to be analyzed. Consequently, although such an approach provides a clear linkage between the market environment parameters and the demand equation parameters, it is severely limited in its ability to produce demand equations that can be applied to equilibrium analysis in complex multiproduct, multioutlet settings.

This leads us to develop a new approach that allows us to capture complex channel structures and also maintains sufficient tractability. We do this by assuming consumers are heterogeneous across three aspects that are relevant to this paper. The first is the consumer's physical location, χ_i^*, which is used to determine her costs of visiting any brick-and-mortar outlets. The second is the person's ideal product position, θ_i^*. Finally each person has a disutility associated with using the Internet that captures such factors as the inability to inspect the product, the delay and cost associated with shipping the product, etc. We denote this cost as δ_{Ni}. This three-dimensional consumer heterogeneity represents an extension of the two-dimensional heterogeneity assumed by Yoo and Lee (2011).

We next assume that consumer i achieves the maximum possible expected utility, V, by purchasing product offering jk (i.e., brand j sold at physical store k) if this product offering is (a) positioned at her ideal specification ($\theta_j = \theta_i^*$, where θ_j is the position of brand j), (b) available at a physical store at her ideal location ($\chi_k = \chi_i^*$, where χ_k is the location of outlet k), and (c) sold at zero price ($p_{jk} = 0$). Any deviations from these conditions, denoted by $\delta_{\theta ij} = |\theta_j - \theta_i^*|$, $\delta_{\chi ik} = |\chi_k - \chi_i^*|$, and $p_{jk} > 0$, diminish consumer utility. If the product offering is available at an Internet outlet, consumers will not incur travel cost $\delta_{\chi ik}$, but experience disutility of δ_{Ni}. Finally we include an error term, ε_{ijk}, to reflect any other factors that also affect consumer utility. We assume ε_{ijk} is independently and identically distributed according to the double exponential distribution (McFadden 1973) and additively separable from the deterministic component of consumer utility.

The following utility function captures the above assumptions:

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

where α is an indicator of whether the offering is sold at a physical store ($\alpha = 1$) or via the Internet ($\alpha = 0$), and β converts the perceived or real distances into dollar values.[3] The term $D_{ijk\alpha}$ is the deterministic component of consumer utility, whereas λ is a nonnegative scalar indicating the impact of the stochastic component, ε_{ijk}, relative to $D_{ijk\alpha}$. We make the standard assumption that consumer i will purchase one unit of a product offering that maximizes her utility as long as the utility exceeds the utility of no purchase (assumed to be zero). This leads to the following choice model:

$$\text{Prob}_i\,(\textit{purchase offering } jk\alpha) = \frac{e^{D_{ijk\alpha}/\lambda}}{1 + \sum_{jk=1}^{JK} e^{D_{ijk\alpha}/\lambda}}, \quad (2)$$

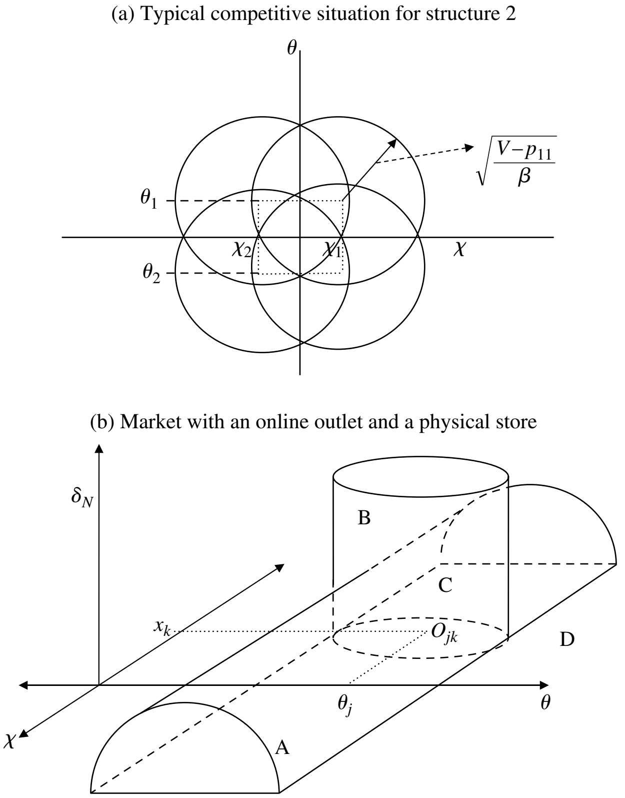
where 1 in the denominator represents the no-purchase option (i.e., $e^0 = 1$). We obtain the demand for product offering $jk\alpha$ by aggregating across all consumers in the three-dimensional market and taking the expected value, i.e.,

$$q_{jk\alpha} = \int_{\delta_{N\,\mathrm{Min}}}^{\delta_{N\,\mathrm{Max}}} \int_{\theta^*_{\mathrm{Min}}}^{\theta^*_{\mathrm{Max}}} \int_{\chi^*_{\mathrm{Min}}}^{\chi^*_{\mathrm{Max}}} \frac{e^{D_{ijk\alpha}/\lambda}}{1 + \sum_{jk=1}^{JK} e^{D_{ijk\alpha}/\lambda}} \cdot f(\chi_i^*, \theta_i^*, \delta_{Ni})\, d\chi_i^*\, d\theta_i^*\, d\delta_{Ni}. \quad (3)$$

The particular functional form of Equation (1) was chosen for two reasons: the intuitive spatial interpretation of the deterministic component, $D_{ijk\alpha}$, and the benefit of having the stochastic component in obtaining equilibrium solutions. To see spatial interpretation of $D_{ijk\alpha}$, consider the case of $\lambda = 0$ (i.e., no stochasticity in consumer utility) and $\alpha = 1$ (i.e., not sold via the Internet). Then, it is easy to see that a buyer will receive positive net utility as long as $V - p_{jk} > \beta\delta_{\theta ij}^2 + \alpha\beta\delta_{\chi ik}^2$. This means that the potential buyers of the

[3] One might question why Internet and travel costs have the same conversion factor. However, as will become evident later, we implicitly capture differences in the conversion factor by manipulating δ_{Ni}.

Figure 2 **Spatial Illustration of the Underlying Market (Based on the Deterministic Buyer Choice Assumption)**



product offering jk are located inside the circle with its center at (χ_k, θ_j) and a radius of $\sqrt{(V-p_{jk})/\beta}$ as shown in Figure 2(a). If we further assume the distribution of the buyers' ideal points is uniform with the density, $1/\pi$ (i.e., $f(\chi_i^*, \theta_i^*) = 1/\pi$), then the demand for the product offering jk sold in a monopoly market is the area of the circle, captured by the following simple linear demand function:

$$q_{jk} = \frac{V - p_{jk}}{\beta}. \tag{4}$$

Equation (4) is noteworthy for two reasons. First the parameter β not only impacts price sensitivity, but also the size of the market. We will use this fact later when analyzing different demand function parameters. Second, Equation (4) applies not only for a true monopoly market of one product offering, but also for a multibrand, multioutlet market where high differentiation between product offerings and/or high prices result in multiple local monopolies (Salop 1979). In other words, if the distances between θ_1 and θ_2 and between χ_1 and χ_2 are sufficiently large in Figure 2(a), the circles will not overlap. Figure 2(a) illustrates a more general situation in a multibrand, multioutlet market with two manufacturers and two common retailers. Overlapping of these circles indicates that some buyers have multiple product offerings in their consideration sets. This overlap provides a convenient graphical representation of the degree of interbrand and intrabrand competition, which can be measured by the percentage of potential consumers who derive positive utility from both product offerings.

We next expand this spatial representation to include nonphysical (labeled "Internet") outlets. Figure 2(b) shows the potential market for brand j that is sold in one brick-and-mortar store and one Internet outlet. Since we now need to consider three dimensions of consumer disutility ($\delta_{\theta ij}$, $\delta_{\chi ik}$, and δ_{Ni}), the potential market for a brick-and-mortar store is no longer a circle, but a cylinder, and the potential market for the Internet outlet is represented by a half-cylinder, with the width of the base equal to the diameter of the cylinder, length equal to the entire range of χ, and height equal to $\sqrt{(V-p_{jk})/\beta}$. As is shown in this figure, the consumers can be partitioned into four unique regions. The consumers in region A only consider the Internet since the travel costs to the physical store exceed the benefits. Those in region B only consider the physical store since the Internet costs exceed the benefits. Those in region C are willing to consider buying from both channels, whereas those in region D will not consider the product because it is too far from their ideal points.

Despite the nice spatial interpretation of the deterministic component of consumer utility ($D_{ijk\alpha}$ in Equation (1)), it alone yields a demand structure that is not continuously differentiable with respect to prices due to multiple kinks, making equilibrium analyses very difficult. However, as discussed by de Palma et al. (1985), the inclusion of the stochastic term in Equation (1) coupled with an appropriate choice model such as Equation (2) makes the aggregate demand in Equation (3) continuously differentiable with respect to prices, while preserving the nice properties of the deterministic component as long as λ is sufficiently small. More importantly, Caplin and Nalebuff (1991) showed that a pure strategy equilibrium solution exists using such an approach when (a) the factors representing the product offering (θ_j and χ_k in our case) and the factors representing the individuals (χ_i^*, θ_i^*, and δ_{Ni} in our case) enter into the utility function as linear interactions and (b) the distributions of individual factors (including the stochastic term) are log-concave.

These conditions are satisfied in the demand Equation (3) if (but *not* only if) we specify $D_{ijk\alpha}$ as in Equation (1) and assume one of many acceptable distributions to capture buyer heterogeneity and the stochastic term.[4] In short, the inclusion of the stochastic term, $\varepsilon_{ijk\alpha}$, allows us to obtain equilibrium solutions without having to worry about local optima

[4] Common log-concave distributions include the uniform, normal, beta, log normal, gamma, Weibull, and exponential.

or having to search over multiple demand regions. At the same time, as long as λ is kept sufficiently small, individual consumer's choice will be largely dictated by the impact of the individual $D_{ijk\alpha}$, and therefore, the graphic interpretations of the market in Figures 2(a) and 2(b) are still applicable with the proviso that the boundaries separating consumer choice are somewhat "fuzzy" due to the presence of the stochastic term.

Even with these desirable properties, the complexity of Equation (3) makes it impossible to derive closed-form equilibrium solutions mathematically. Thus, we use a numerical approach to equilibrium identification by applying the Newton–Raphson search algorithm (Press et al. 1992) to both the retailer- and manufacturer-level pricing games for different channel structures and different market conditions. Our numerical approach solves the retailers' pricing game conditional on each pair of wholesale prices set by the manufacturers in their optimization process, while each manufacturer optimizes its wholesale price conditional on the other manufacturer's wholesale price. In this way, we assume a manufacturer Stackelberg game (Choi 1991) in vertical relationship and a Bertrand–Nash game in horizontal price competition. Note that these numerically obtained equilibrium results are identical (up to round-off error) to the closed-form solution (assuming this solution was obtainable) evaluated for any particular set of parameter values.[5] Details of this iterative method are described in the electronic appendix (available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2228950).

3. Experimental Design

Using the demand-generating system described above as the "lab," we run a series of experiments where each experiment represents a particular channel structure, within which we manipulate competitive environment and consumer behavior characteristics to examine their effects on the resulting equilibrium profits. Our general conjecture is that it will be possible to identify a set of findings that hold regardless of the particular structure, competitive settings, and consumer distributions assumed. Below, we discuss the channel structures to be analyzed and then our choices for the different competitive environments and consumer distributions.

3.1. Channel Systems

We selected 10 different channel systems that represent a wide range of current marketing practices as shown in Figure 3. We start with four previously analyzed structures as the core to build on to create new channel structures. Structure 1 represents Choi's (1991) setup where a downstream monopoly common retailer carries multiple brands. Structure 2 represents a system with competing common retailers (Choi 1996, Lee and Staelin 1997). Structures 3 and 4 are McGuire and Staelin's (1983) exclusive distribution systems. The former is vertically integrated and the latter is decentralized. Note the dotted lines indicate independent downstream retailers, whereas solid lines denote vertical integration.

We build upon these four base structures by adding new channel structure elements one at a time. Thus, in structures 5–7, we add Internet outlets to a common retailer system (structure 1). In structures 5 and 6, the manufacturer coordinates its wholesale price and Internet price, whereas in structure 7, the retailer is able to coordinate its online and offline retail prices. Similarly, structures 8 and 9 are created by adding Internet outlets to the decentralized exclusive channel system (structure 4). Structure 10 is also an extension of structure 4, with two additional exclusive retail outlets. The variety of structures in our study design allows us to assess the effects of various channel structure changes such as opening additional outlets (e.g., by contrasting structures 1, 5, and 6 or structures 4, 8, and 9), moving from a common retailer system to an exclusive retailer structure (e.g., Structure 2 versus structure 4), VI versus decentralization (e.g., structure 3 versus structure 4), the presence and absence of PLP (e.g., structure 2 versus structure 10), or manufacturer multiple channel pricing (MCP) (e.g., structure 5 versus structure 7). Finally, these selected structures are a reasonable representation of real-world structures. For example, structure 5 or structure 6 mimics Gateway's current multichannel distribution system, whereas structures 4 and 10 can represent GM's and Chrysler's distribution systems before and after they reduced the number of dealers.

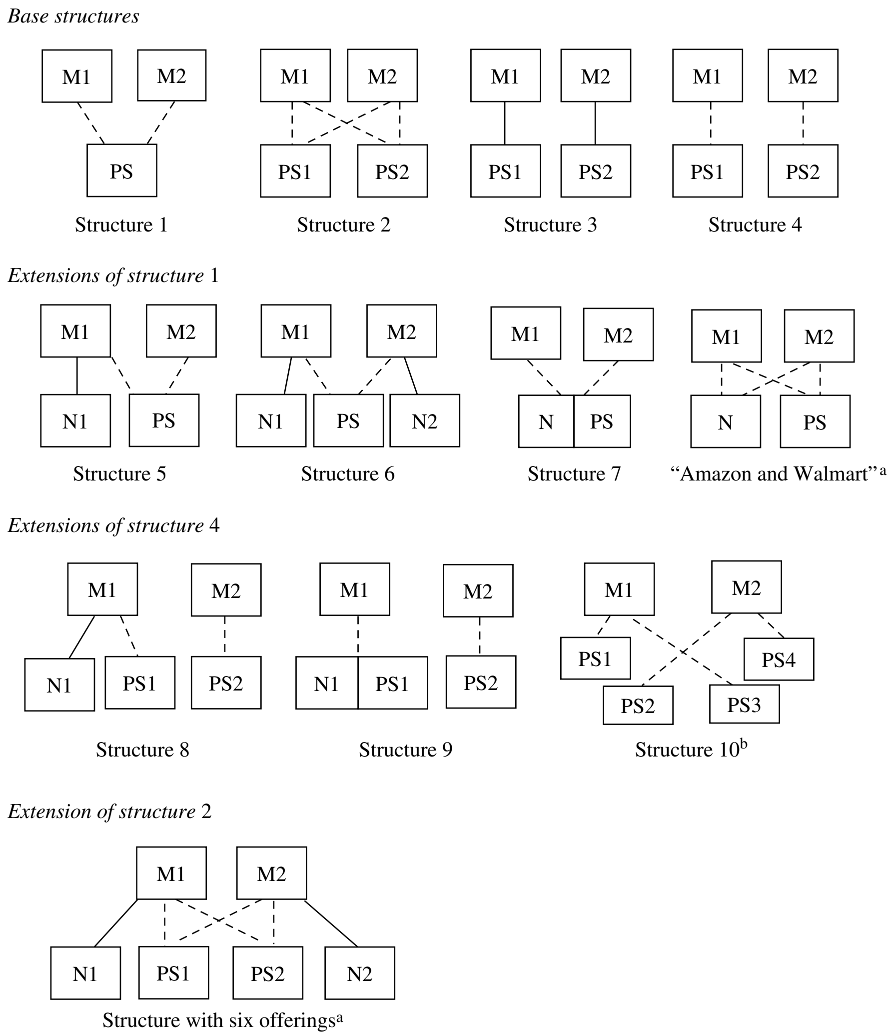
As typically done in previous studies, we assume no positive production or selling costs to focus on the interaction of the demand-side environment and channel structures. Also consistent with the majority of previous studies, we assume that manufacturers are Stackelberg leaders over retailers, that the game between competing manufacturers or between competing retailers is Bertrand–Nash, and that channel members are fully informed of all demand parameters and prices.

3.2. Manipulation of Parameter Values

Within each of the 10 experiments, we vary the characteristics of the market environment as captured by the "three Cs." We do this by setting specific values for the parameters of Equations (1) and (3), which

[5] One way of testing this is to use the simple linear demand function in Equation (4) to derive the equilibrium solutions mathematically for localized monopoly cases and compare them against numerically obtained equilibrium results. We performed this analysis and confirmed the consistency between the two methods.

Figure 3 **Channel Structures**



Notes. M, manufacturer; PS, physical store; N, Internet outlet. Solid line, vertically integrated; dotted line, decentralized; connected boxes, horizontally integrated (i.e., two outlets under joint ownership).

[a]Additional structures for predictive analyses are discussed in §5.

[b]In structure 10, PS1 and PS2 are at the same location, and PS3 and PS4 are at the same location.

capture the characteristics of the consumer (V, β, λ, θ_i^*, χ_i^*, and δ_{Ni}) and the company and the competition at the brand (θ_j) and outlet (χ_k) levels.

First, without loss of generality, we assume $V = 100$, and $\lambda = 1$ for Equation (1). Given the relatively small value of λ, this makes consumer utility determined largely by its deterministic component, $D_{ijk\alpha}$.[6] We also assume $\beta = 0.01$ for our base case. Thus, few consumers in this base case are expected to consider purchasing a product offering if the retail price (p) or any of the associated disutilities ($\delta_{\theta ij}$, $\delta_{\chi ik}$, or δ_{Ni}) exceeds 100. Graphically, this translates to a radius of $10\sqrt{100 - p_{jk}}$ for the circles or cylinders in Figure 2, with the minimum value of 0 when $p_{jk} = 100$ and the maximum of 100 at zero price. We later change the β value to 0.005 and 0.02 to reflect varying degrees of price sensitivity in our experiments. Our base case also assumes consumer values of θ_i^*, χ_i^*, and δ_{Ni} to be distributed uniform over the range of $[-100, 100]$ and $[-100, 100]$ for θ_i^* and χ_i^*, respectively, and $[0, 100]$ for δ_{Ni}. Within this consumer market, we place the competitive offerings by specifying the product positions and the outlet locations. After some preliminary analysis, we find that if two competing offerings are positioned at $\theta = -25$ and $\chi = -25$ and at $\theta = 25$ and $\chi = 25$, the equilibrium results are almost the same as the monopoly outcomes. Consequently, we select (-2.5 and 2.5), (-10 and 10), (-17 and 17),

[6] We used other values of λ and found the results did not differ substantially as long as λ was small relative to the value of V. Consequently, because this parameter is associated with the stochastic term and does not seem to affect the results, we do not discuss it again.

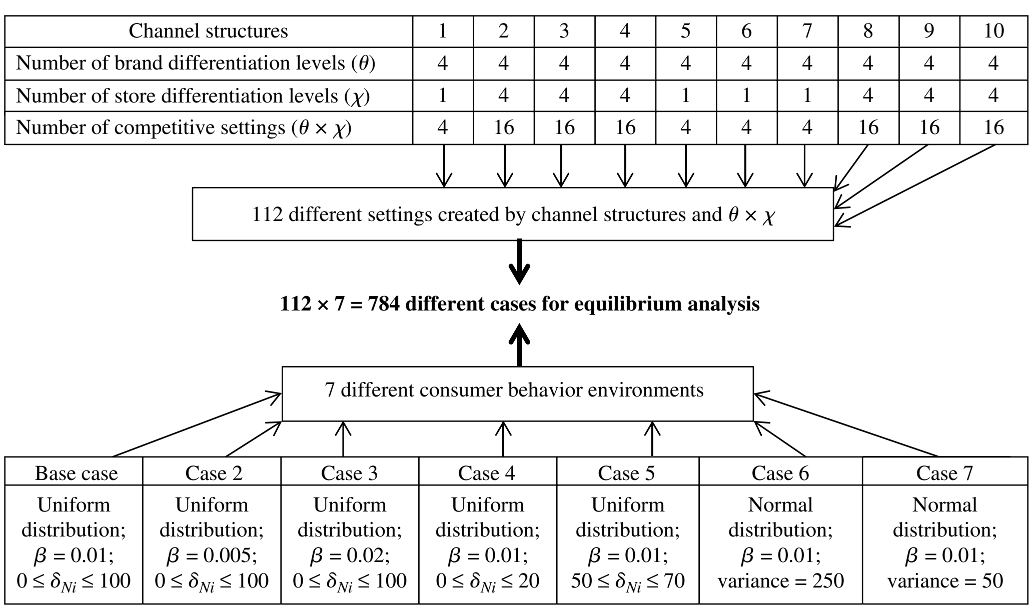
and (−25 and 25) to represent "minimal," "moderate," "fair," and "high" levels of differentiation on each of these two dimensions, respectively. We cross these four levels in χ and θ yielding 16 different market environments when there are two physical outlets, and four environments when there is only one physical outlet (located at $\chi = 0$). This led to 112 different parameter settings over the 10 different channel systems for the base case (see Figure 4).

Note that in each of these settings it is highly likely that not every consumer will buy a product. For example, a consumer with an Internet cost of $\delta_{Ni} = 100$ will only purchase the product from an Internet channel if the product characteristics match the consumer's ideal point and the price is zero. Likewise some consumers located near the boundaries of the range of $\chi(\theta)$ may be too far away from any store (brand) when the stores (brands) are located near the center of the space (i.e., $-2.5, 2.5$) to justify the travel (taste) cost, especially at higher equilibrium prices. Consequently we do not expect full market coverage at equilibrium at most χ and θ parameter settings. Finally, we note that the combination of Internet costs, store locations, and consumer locations implies that some consumers prefer to shop online, whereas others prefer to shop at a brick-and-mortar store. In our base case, between 31% and 50% of the consumers have lower Internet shopping costs depending on the location of the stores.

We augment this base case by assuming four other distributions to represent various situations regarding consumer heterogeneity and two assumptions on price sensitivity. Specifically, we assume δ_{Ni} ranges from $[0, 20]$ or $[50, 70]$. (We refer to these two conditions as having low and high percentages of consumers with high Internet shopping costs, respectively, with the base case being moderate.) We also assume two conditions where $\theta_i^* \chi_i^*$ and δ_{Ni} are distributed with a truncated trivariate normal with means of 0, 0, and 50, respectively, and variances of either 250 or 50. (We refer to these two conditions as normally distributed with large and small variance.) Note that by varying the range of δ_{Ni} we are effectively giving different weights to the spatial disutility costs relative to the Internet costs. Also note that the normal distributions imply that more consumers are located in the center of the three-dimensional space, in contrast to the uniform distribution where the customers are evenly distributed. It also implies that the large variance condition has a larger percentage of consumers with low Internet shopping costs. We also varied consumer characteristics by altering β, the importance of price relative to the disutility of the different nonprice attributes. Specifically, we changed β from the base case to 0.02 (low price sensitivity) and 0.005 (high sensitivity). These six additional consumer characteristic settings provided considerable variation in market conditions. For example, across all these conditions, we found that between 15% and 90% of all consumers have lower Internet shopping costs than the costs of shopping at their closest brick-and-mortar store. Likewise, consumers can be very price sensitive or quite price insensitive and/or located mostly in the middle or dispersed over the total region.

The above describes both how we altered the positions of the products and outlets within a specific market environment, and how we varied the market

Figure 4 **Experimental Design**



environment by altering consumer characteristics in terms of (a) the distribution of customer locations in θ and χ, (b) the distribution of customers disutility of shopping on the Internet, δ_{Ni}, and (c) the importance of price relative to the disutility of the different non-price attributes, β. Using our base case as the anchor, we varied these six additional consumer characteristic assumptions one at a time, yielding in total seven different overarching experimental settings. In effect we have a *consumer behavior* × *structure* × *competitive environment* design, where the number of analyzed environments depends on the number of outlets in a given structure. The 112 settings from the latter two factors are crossed with the seven consumer behavior settings specified in Figure 4, resulting in 784 possible analyses.

These 784 different situations span a large number of diverse possible selling environments. The question then becomes, which channel structures and the associated channel coordination mechanisms will yield higher (lower) manufacturer or retailer profits under these different consumer behavior conditions? We explore this question next.

4. Results

One of our major challenges was to efficiently summarize the plethora of equilibrium results in a manner that allows us to gain interesting insights. Conceptually, there are at least two ways to do this. The first follows the approach outlined by Moorthy (1993) and contrasts the findings across the different structures for different three C conditions. A second, and perhaps more parsimonious, approach has us develop a framework where we combine all the different equilibria into one database and then conduct a "meta-analysis" across all the different structures and three C conditions to derive a set of key insights. In this paper, we take the latter approach.

We do this by using the conceptual framework in Figure 1 and estimating this general model in two stages. First, we focus on the impact of the "four Cs" on demand characteristics, as shown in the top half of Figure 1. The figure indicates that consumer characteristics will moderate the industry structure effects and thus the coefficients of our first stage equations. For example, Equation (4) indicates that smaller values of β imply consumers place more weight on price, resulting in larger circles in our spatial representation. Consequently, we would expect inter- and intrabrand competition to be higher holding fixed the brand and outlet positions. This led us to estimate the impact of the industry structure on our three demand characteristic parameters for each of the seven consumer environments independently, resulting in 21 separate ordinary least squares (OLS) regression analyses. We expect the results of these regressions to be directionally the same, but the individual coefficients will vary predictably as a function of the underlying consumer characteristics.

In the second stage we estimate the impact of the three demand characteristics and the three channel coordination mechanisms on total profits, manufacturer power, and manufacturer profits, as shown in the bottom half of Figure 1. Here, we pool the data for all of the 784 possible cases, expecting that the demand characteristics and the rules of the game will almost completely mediate the effects of industry structure and consumer characteristics. We then use the coefficients of the three regressions to explore the impact of the different channel coordination mechanisms on total channel profit and manufacturer profit.

To run these analyses, we need to operationalize our measures of the four Cs, the resulting demand characteristics, and the channel coordination mechanisms. We discuss these measures as we present our results below, but also provide their detailed descriptions in Table 1.

4.1. Relationships Between the Industry Structure and the Demand Characteristics

Table 2 displays the three OLS regression results estimating the effect of various industry structure factors on the three demand characteristics—*market coverage*, *interbrand competition*, and *intrabrand competition*—for the seven different consumer characteristic environments.[7] We note four important points from this table. First, a small number of independent variables for each of the three dependent variable models explain most of the variance, as indicated by the high average R^2 values in the table. For both inter- and intrabrand competition, the R^2 value is over 0.96 for all seven customer market assumptions. The fit for market coverage is weaker, but still averages about 88%. In the one outlier case (environment 2 where the $\beta = 0.005$ indicates high price sensitivity), the circles indicating potential customers as shown in Figure 2 exceeded our defined ranges of θ and χ. As a result, our model overpredicted our measure of market coverage, and thus we obtain the lower goodness of fit.

Second, for all three dependent variables, the estimation results show remarkable consistency in sign and significance across the seven consumer market environments. (This is indicated by the numbers in parentheses in Table 2 showing perfect consistency

[7] One might argue that some of the independent variables are endogenous. However, note that all our independent measures were manipulated via our experimental design, and thus were set prior to "collecting" the data. Thus, none of the measures are functions of the obtained equilibrium solutions, nor are they correlated with some unobserved third factor that is also related to the dependent measure.

Table 1 Definition of Variables

(a) Channel characteristics

Variable	Definition	Coding
%VI	Proportion of product offerings sold through vertically integrated outlets	0 for structures 1, 2, 4, 7, 9, and 10; 1 for structure 3; 0.33 for structures 5 and 8; 0.5 for structure 6
%PLP	Proportion of all possible interbrand relationships that are characterized by product line pricing at the retail level	0 for structures 3, 4, 8, and 10; 1 for structures 1 and 7; 0.25 for structure 6; 0.33 for structures 5 and 9; 0.5 for structure 2
%MCP	Proportion of manufacturers who coordinate different prices across multiple channels	1 for structure 6; 0.5 for structures 5 and 8; 0 for all other structures
IntOff	Number of product offerings available on the Internet	0 for structures 1, 2, 3, 4, and 10; 1 for structures 5, 8, and 9; 2 for structures 6 and 7
StrOff	Number of product offerings available in physical stores	4 for structures 2 and 10; 2 for all other structures
Brnd@2Strs	Equal to 1 if two physical stores carry same brands; 0 otherwise	1 for structures 2 and 10; 0 for all other structures
Brnd@2Outlets	Equal to 1 if a brand is sold by multiple outlets; 0 otherwise	1 for structures 2, 5, 6, 7, 8, 9, and 10; 0 for all other structures
1Brnd@Location	Equal to 1 if only one brand is sold at a given store location; 0 otherwise	1 for structures 3, 4, 8, and 9; 0 for all other structures
2Brnd@Location	Equal to 1 if two brands are sold at the same store location; 0 otherwise	0 for structures 3, 4, 8, and 9; 1 for all other structures
1Brnd@Int	Equal to 1 if only one brand is sold on the Internet; 0 otherwise	1 for structures 5, 8, and 9; 0 for all other structures
2Brnds@Int	Equal to 1 if two brands are sold on the Internet; 0 otherwise	1 for structures 6 and 7; 0 for all other structures

(b) Competitive environment

Variable	Definition	Operationalization
StrDiff	Degree of physical store differentiation	Distance between the two store locations in χ; takes values of 5, 20, 34, or 50
BrndDiff	Degree of brand differentiation	Distance between the two brand positions in θ; takes values of 5, 20, 34, or 50
StrSub	Degree of physical store substitutability	75—*StrDiff*
BrndSub	Degree of brand substitutability	75—*BrndDiff*

(c) Demand characteristics and outcome measures

Variable	Definition	Operationalization
MktCov	Market coverage	% of consumers who receive positive net utility from at least one offering at the retail price of 43.75;[a] this number was then raised to the power of three and divided by 10,000 (for better model fit and easier reading of the estimates)
IntraB Comp	Intrabrand competition	% of consumers who have multiple outlets in their consideration sets (i.e., positive utility for multiple outlets) to purchase the same brand, out of all consumers who receive positive utility from at least one offering, measured at the retail price of 43.75, raised to the power of three and divided by 10,000
InterB Comp	Interbrand competition	% of consumers who have multiple brands in their consideration sets (i.e., positive utility from multiple brands), out of all consumers who receive positive utility from at least one offering, measured at the retail price of 43.75, raised to the power of three and divided by 10,000
Mftr Power	Manufacturer power	Proportion of manufacturers' profits out of total channel profits; between 0 and 1
Total Profit	Total channel profits	Sum of equilibrium profits of all channel members; this number was then divided by 10^6 for easier reading of the estimates
Mftr Profit	Manufacturer profit	Sum of equilibrium profits for the two manufacturers; this number was then divided by 10^6 for easier reading of the estimates

[a]The price of 43.75 is arbitrarily chosen to make the radius of the circles in Figure 2(a) equal to 75. This radius allows the circles to just fit inside the boundaries of the consumer distribution in θ and χ at the high brand/store differentiation condition of $(-25, 25)$ in our base case. We also performed the analyses with the market coverage measured at zero prices and obtained qualitatively same results.

(7/7) for most coefficients.) As expected, however, the size of the coefficients for any particular independent variable varies across the seven consumer market environments. We later investigate if there is any systematic variation across these different environments. Third, also as expected, our three channel coordination variables (%*MCP*, %*PLP*, and %*VI*) were insignificant in all 21 estimation equations. This indicates that the demand parameters are influenced by the industry structure, but not by the channel members' price coordination behavior.

Fourth, although we find most of the results in Table 2 intuitively appealing, some of the results are either different from previous study's findings or new to the literature. The results on market coverage are expected based on our graphic interpretation of our demand model, i.e., coverage increases with more store and product differentiation and as the number available outlets increases, and are consistent with existing demand models derived from other common spatial models (e.g., the Hotelling model) that do not assume full market coverage. However, they

Table 2 **Effects of Industry Structure on Market Coverage and Intrabrand and Interbrand Competition**

	Dependent variable		
Independent variables	*MktCov*	*IntraB Comp*	*InterB Comp*
Intercept	+ (6/7)	NS (7/7)	+ (6/7) − (1/7)
BrndDiff	+ (7/7)		
IntOff	+ (7/7)		
StrDiff	+ (7/7)		
StrOff	+ (7/7)		
Brnd@2Strs ∗ *StrSub*		− (7/7)	
Brnd@2Strs ∗ *StrSub*^{2}		+ (7/7)	
Brnd@2Outlets		+ (7/7)	
1Brnd@Location ∗ *StrSub* ∗ *BrndSub*			+ (7/7)
1Brnd@Location ∗ *1Brnd@Int*			− (6/7)
1Brnd@Location ∗ *1Brnd@Int* ∗ *StrDif* ∗ *BrndSub*			+ (7/7)
2Brnd@Location ∗ *BrndSub*			+ (7/7)
2Brnd@Location ∗ *1Brnd@Int* ∗ *BrndSub*			− (7/7)
2Brnd@Int ∗ *BrndSub*			NS (7/7)
%MCP	NS (7/7)	NS (7/7)	NS (7/7)
%PLP	NS (7/7)	NS (7/7)	NS (7/7)
%VI	NS (7/7)	NS (7/7)	NS (7/7)
Average R^2	0.876	0.992	0.976

Notes. Numbers in parentheses indicate number of cases out of seven different consumer behavior environments. NS, not significant at $p = 0.05$ level; +, positive and significant at $p = 0.05$ level; −, negative and significant at $p = 0.05$ level.

are inconsistent with almost all assumed linear models used in the channel literature (e.g., McGuire and Staelin 1983, Raju et al. 1995, Shugan and Jeuland 1988, Ingene and Parry 1995, Trivedi 1998, Sayman et al. 2002) and any demand model derived from a fully covered market, because all these latter demand models do not allow for the intercept to increase with greater differentiation. This difference in market expansion can result in very different conclusions, and thus highlights the critical impact of the underlying differences in demand formulations.

The results on intrabrand competition are straightforward, too. Similar to Yoo and Lee (2011), we find intrabrand competition occurs when a given brand is sold by competing outlets (*Brnd@2Outlets* = 1). Also as expected, when both of the competing outlets are physical stores (*Brnd@2Strs* = 1), we find the degree of intrabrand competition increases with the proximity between the two stores as captured by the positive interaction of *Brnd@2Strs* and store substitution (*StrSub*) in Table 2.[8] The inclusion of all the interactions terms listed in Table 2 follows this type of theoretical reasoning (rather than a random attempt to improve the goodness of fit).

[8] Although the linear term is negative in Table 2, within the range of our data, intrabrand competition is always increasing (at an increasing rate).

Analogous to the impact of store substitutability on intrabrand competition, Table 2 identifies brand substitutability (*BrndSub*) as the main determinant of interbrand competition. If the two competing brands are available at different store locations (*1Brnd@Location* = 1), a high degree of interbrand competition requires high brand substitutability *and* high store substitutability. If either variable is zero, interbrand competition is zero, as one can easily envision in a graph similar to Figure 2(a). A less obvious (and new to the literature) influence on interbrand competition is detected when one of the manufacturers in the above situation (*1Brnd@Location* = 1) adds an Internet outlet to its distribution channel (e.g., moves from structure 4 to structure 8 or 9). Although one might think the increased number of outlets would always increase interbrand competition, we find that such a channel expansion *may reduce* interbrand competition, as indicated by the negative coefficient on the interaction of *1Brnd@Location* and *1Brnd@Int*. This is because a manufacturer in an average situation in our data set further differentiates its target market from its competitor's target market by adding the new Internet channel. Said differently, many of the new customers acquired through the Internet will only consider the one brand sold via the Internet, resulting in a decreased percentage of the potential customers considering both brands. Thus, adding an Internet outlet increases interbrand competition only if the brands are highly substitutable, and the stores are located far apart, as indicated by the positive coefficient for the four-way interaction among *1Brnd@Location*, *1Brnd@Int*, *StrDif*, and *BrndSub* in Table 2. In this situation, prior to the addition of an Internet outlet, the spatial differentiation between the stores keeps the brands from competing with each other despite their high similarity. After the Internet outlet entry, however, some of the newly acquired Internet outlet customers will also consider the competing brand sold in the associated physical store, thereby increasing the percentage of customers who consider both brands.

If competing brands are sold in the same store (*2Brnd@Location* = 1), interbrand competition always increases with the degree of product substitutability. As with the case of exclusive outlets, we find the addition of one Internet outlet to the common retailer environment reduces the intensity of interbrand competition (as indicated by the negative coefficient for the three-way interaction among *2Brnd@Location*, *1Brnd@Int* and *BrndSub* in Table 2). If both brands are also sold online, one might expect the same effect of brand substitutability as seen for the case of both brands sold in the same store. However, in our data set, such a case is found only in structures 6 and 7, where the interbrand competition within the same outlet is already captured by the positive interaction between *2Brnd@Location* and *BrndSub*. Therefore, the interaction between *2Brnd@Int* and *BrndSub* does not add to the competitive intensity beyond the case of just the common retail outlet, as shown in Table 2. These findings on the impact of adding Internet outlets to existing brick-and-mortar channel systems are new to the literature.

In addition to the 21 separate regression runs reported in Table 2, we also analyzed the effects of the seven different assumptions of consumer characteristics on the magnitudes of our three demand parameters by pooling the data from the seven different data sets and adding six dummy variables to each of the three models specifications in Table 2. As expected the dummy variable coefficients indicate that lower values of beta (i.e., greater consumer price sensitivity) are associated with increases in market coverage and inter- and intrabrand competition. This, coupled with the prior findings that changes in brand and/or store differentiation affect all three demand characteristics, reinforces the idea that any demand model used for investigating the effects of differentiation and/or consumer price sensitivity needs to reflect these effects in all the parameters. Second, the dummy variable estimates imply that market coverage expands, and intrabrand competition intensifies, as the percentage of customers with low Internet costs increases, holding all else fixed. However, distributional changes in consumer preferences or spatial location (i.e., normal or uniform) showed little effect on inter- and intrabrand competition. All of these findings on the effects of different environments and consumer behavior assumptions are new but consistent with the intuition of our spatial model. Furthermore, *all* of the effects reported in Table 2 are replicated in this analysis, indicating that simplifying assumptions such as uniform distribution may not strongly affect the generalizability of the obtained results.

4.2. Effects of Channel Coordination and Demand Characteristics on Channel Member Profitability

We next investigate how channel coordination types interact with the three demand characteristics to shape the profitability of a particular channel structure. Following our conceptual framework in Figure 1, we ran three OLS regressions based on the entire set of data with total channel profits, manufacturer power, and manufacturer profit as the respective dependent variables. We display these results in Table 3. The high R^2 values indicate these models explain 90% or more of the variance for all three dependent variables only using six explanatory variables (our three demand characteristic parameters and the types of channel coordination). This implies that the three demand characteristic variables in Figure 1 represent parsimonious yet powerful mediators of a diverse set of industry structures and consumer characteristics and that our results hold across a broad range of market environments.

4.2.1. Total Channel Profits. As shown in Table 3, the impact of market coverage on total channel profit is straightforward. The positive main effect of *MktCov* implies an increase in total channel profits with increases in market coverage. The negative three-way interaction term (*MktCov* × *IntraB Comp* × *InterB Comp*) indicates that the negative profit impact of competition is magnified as market coverage increases. These effects of market coverage hold regardless of the type of channel coordination mechanisms. Consequently in determining which coordination mechanism yields the highest total channel profits, we do not have to be concerned with the level of market coverage, but only the levels of inter- and intrabrand competition.

The effects of inter- and intrabrand competition on total channel profit are more complex due to the interactions with channel coordination mechanisms as shown in Table 3. Combining the main effects (−0.043 for *InterB Comp* and insignificant for *IntraB Comp*) and the three-way interaction (−0.210 for *MktCov* × *IntraB Comp* × *InterB Comp*), one can see the negative profit impact of competition in the absence of any channel coordination, which corresponds to structures 4 and 10 in Figure 3. In addition, the significantly negative coefficient on the interaction between *InterB Comp* and *%VI* suggests that, with no intrabrand competition, the total negative profit effect of interbrand competition is more pronounced in the vertically integrated channel (structure 3) than in the decentralized exclusive retailer channel (structure 4), consistent with the well-known finding of McGuire and Staelin (1983).

The remaining seven channel structures in Figure 3 can be categorized into three types of channel coordination practices as shown in Table 4(b): retailer product line pricing only (PLP; structures 1, 2, 7, and 9), partial vertical integration with manufacturer multichannel pricing (DUAL; structure 8), and some combination of all three types of channel coordination mechanisms (TRIPLE; structures 5 and 6). For each category, we analyzed one representative case to show the directional effects of inter- and intrabrand competition on total channel profit, by applying $\%PLP = 1$ and $\%VI = \%MCP = 0$ for the PLP category, $\%PLP = 0$ and $\%VI = \%MCP = 0.5$ for DUAL, and $\%PLP = \%MCP = \%VI = 0.5$ for TRIPLE to the estimated model in Table 3.[9] Table 4(b) shows how the *horizontal*

[9] Our results are insensitive to this specific assumption. We varied the percentage from 30% to 70% and obtained very similar qualitative results.

Table 3 Effects of Channel Coordination and Demand Characteristics on Equilibrium Outcomes

	Dependent variable					
	Total profit		*Manufacturer power*		*Manufacturer profit*	
Independent variables	Coefficient	*p*-value	Coefficient	*p*-value	Coefficient	*p*-value
Intercept	8.913	0.000	67.328	0.000	5.421	0.000
MktCov	0.216	0.000			0.163	0.000
InterB Comp	−0.043	0.000	−0.055	0.000	−0.033	0.000
InterB Comp ∗ *%MCP*	−0.011	0.372	−0.253	0.000	−0.024	0.016
InterB Comp ∗ *%PLP*	0.066	0.000	−0.740	0.000	−0.056	0.000
InterB Comp ∗ *%VI*	−0.117	0.000	0.053	0.084	−0.112	0.000
IntraB Comp	0.004	0.393	0.222	0.000	0.043	0.000
IntraB Comp ∗ *%MCP*	−0.692	0.000	1.168	0.000	−0.360	0.000
IntraB Comp ∗ *%PLP*	0.018	0.107	0.138	0.000	0.012	0.187
IntraB Comp ∗ *%VI*	1.313	0.000	−1.902	0.000	0.792	0.000
MktCov ∗ *IntraB Comp* ∗ *InterB Comp*	−0.210	0.000			−0.207	0.000
%MCP	0.121	0.784	6.550	0.000	0.835	0.023
%PLP	−1.329	0.001	−3.697	0.002	−1.352	0.000
%VI	0.193	0.494	32.710	0.000	4.774	0.000
R^2	$R^2 = 0.900$		$R^2 = 0.922$		$R^2 = 0.906$	

channel coordination mechanisms included in these three prototypes can reverse the negative impact of inter- and intrabrand competition on total channel profit. Specifically, product line pricing allows a retailer to take advantage of the demand substitutability between two brands into collusive pricing, making the effect of *InterB Comp* positive for PLP. Similarly, the multichannel pricing implemented by the manufacturer in DUAL and TRIPLE takes advantage of the demand substitutability between outlets in a collusive way, producing the positive effect of *IntraB Comp*. These results are intuitive, but the results for DUAL and TRIPLE are new to the literature. In addition, as shown in Table 4(b), our results for the case of no channel coordination (NONE) and the case of VI are quite different from the previous findings of Choi (1991) and Trivedi (1998), highlighting the difficulty of conducting this type of comparative statics based upon assumed demand functions used in those studies.

4.2.2. Manufacturer Power. The effects of our three demand characteristic measures on manufacturer power are straightforward as summarized in Table 4(b). First, market coverage affects the size of the "pie" to be shared by the manufacturers and the retailers in the channel, but does not determine the size of each channel member's slice. Thus, it has no effect on manufacturer power, regardless of channel coordination practice type. Second, the effect of interbrand competition on manufacturer power is negative with the exception of the VI case, in which the manufacturers' share of the total channel profit is 100% by definition, regardless of the degree of interbrand competition. The estimates in Table 3 indicate that this negative effect of interbrand competition on manufacturer power is particularly pronounced for PLP. Third, intrabrand competition has a positive effect on manufacturer power, except for VI (representing structure 3, which has no intrabrand competition). Table 3 indicates that this positive effect of intrabrand competition on manufacturer power is particularly pronounced when *%MCP* is high.

4.2.3. Manufacturer Profit. The aggregate profit for the manufacturers in our model is simply a product of the total channel profit and manufacturer power. Therefore, unless the effects of a demand characteristic variable on total channel profit and manufacturer power are in opposite directions, its impact on manufacturer profit is easy to predict. For instance, holding fixed competitive intensity, an increase in market coverage always leads to an increase in total channel profit without affecting manufacturer power, as discussed above. Therefore, it should always lead to an increase in manufacturer profit. Our analysis of the estimates of the manufacturer profit model in Table 3 confirms this prediction, as shown in Table 4(b).

Using the same logic, one can also predict the negative effect of interbrand competition on manufacturer profit in most cases shown in Table 4(b). The only exception is the case of PLP, in which an increase in interbrand competition decreases total channel profit but increases manufacturer power. Our analysis reveals that the combined effect on manufacturer is negative, indicating that the positive effect on total channel profit is not sufficient to compensate for the negative effect on manufacturer power. In a parallel way, we find that the effect of intrabrand

Table 4 Summary of Key Results

(a) From Table 2

Market coverage increases		
As products become more differentiated	Expected	Generally consistent with existing spatial models
As stores become more differentiated	Expected	
As more offerings become available offline	Expected	Not reflected in assumed demand functions
As more offerings become available online	Expected	
The degree of intrabrand competition increases		
As the two stores selling the same brand become more substitutable	Expected	Consistent with existing spatial models
When two different outlets sell the same brand	Expected	Consistent with Yoo and Lee (2011)
When only one brand is sold at a physical location, the degree of interbrand competition		
Increases as the stores *and* brands become more substitutable	Expected	Consistent with Trivedi (1998)
Increases with the entry of the Internet channel only if the stores are sufficiently differentiated and the brands are sufficiently substitutable; otherwise, it might decrease with the introduction of the Internet outlet	Not expected	New
When competing brands are sold at the same physical location, the degree of interbrand competition		
Increases as the brands become more substitutable	Expected	Consistent with Choi (1991)
Decreases when an Internet outlet is introduced under high brand substitutability	Not expected	New

(b) From Table 3

Channel coordination practice		*MktCov*	*InterB Comp*	*IntraB Comp*
NONE: No channel coordination (structures 4 and 10)	Total channel profit	Positive	Negative[a, b]	Negative[b]
	Manufacturer power	No effect	Negative	Positive
	Manufacturer profit	Positive	Negative[a, b]	Positive[d]
VI: Vertical integration only (structure 3)	Total channel profit	Positive	Negative[a, b]	n/a
	Manufacturer power	No effect	No effect	n/a
	Manufacturer profit	Positive	Negative[a, b]	n/a
PLP: Product line pricing only (structures 1, 2, 7, and 9)	Total channel profit	Positive	Positive[d]	Negative
	Manufacturer power	No effect	Negative	Positive
	Manufacturer profit	Positive	Negative[a, b, e]	Positive[d, e]
DUAL[c]: Vertical integration and multichannel pricing (structure 8)	Total channel profit	Positive	Negative	Positive
	Manufacturer power	No effect	Negative	Positive
	Manufacturer profit	Positive	Negative	Positive
TRIPLE[c]: Vertical integration, product line pricing, and multichannel pricing (structures 5 and 6)	Total channel profit	Positive	Negative	Positive
	Manufacturer power	No effect	Negative	Positive
	Manufacturer profit	Positive	Negative	Positive

[a]Our result is contrary to Choi's (1991) Proposition 2.
[b]Our result is contrary to Trivedi's (1998) findings in her Figure 2.
[c]The results for these channel structures are new to the literature.
[d]Consistent with Trivedi's (1998) finding.
[e]Consistent with Choi's (1996) Proposition 5.

competition on manufacturer profit is always positive, directionally consistent with its impact on manufacturer power. This was the case even when an increase in intrabrand competition decreases total channel profit, as seen in NONE and PLP in the table.

Once again, our results are intuitively appealing, but many of them are new to the literature. No previous studies analyzed the DUAL and TRIPLE cases. Furthermore, our finding of the negative effect of interbrand competition on manufacturer profit goes counter to the previous results of Choi (1991) and Trivedi (1998), which indicate that manufacturers are often worse off as the competing brands become more differentiated. The rescaled demand function used by McGuire and Staelin (1983) is also incapable of reflecting the negative profit impact of interbrand competition, as shown in their Figure 2. In contrast, our finding of the positive effect of intrabrand competition on manufacturer profit for NONE, VI, and PLP is consistent with those of Choi (1996) and Trivedi (1998).

4.3. Optimal Channel Structure Type

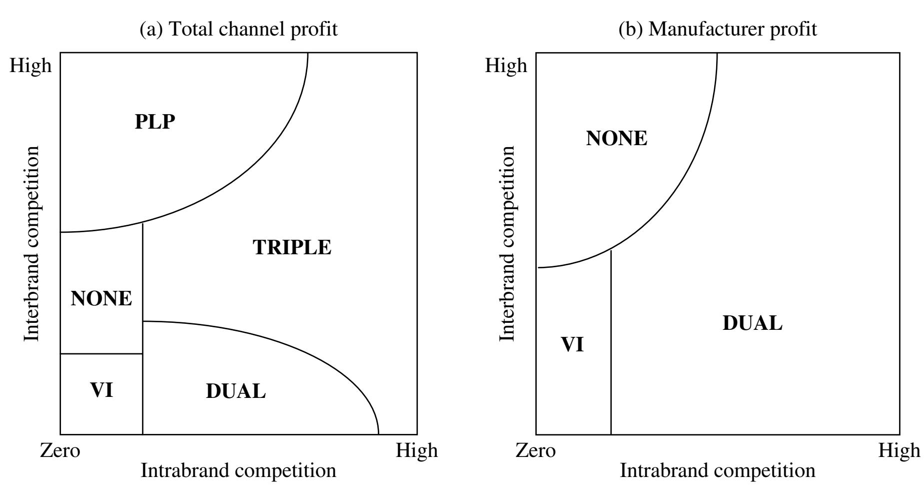
Having documented in Table 4(b) the impact of the demand characteristics on total channel profit and manufacturer profit *within* each of the five channel structure types that are defined in terms of the different coordination mechanisms, we now turn our attention to how these demand characteristics affect the relative profitability *across* the five channel structure types. This is easily done by applying varying values of *MktCov*, *InterB Comp*, and *IntraB Comp*, as well as the definitions of the five channel structure types in terms of *%VI*, *%MCP*, and *%PLP*, to the estimated total channel profit and manufacturer profit equations presented in Table 3. As mentioned before, *MktCov* does not interact with the three channel coordination mechanisms, and thus has no effect on which channel structure type is the most profitable. Therefore, our analysis focuses on the relative profitability of NONE, VI, PLP, DUAL, and TRIPLE at various levels of *InterB Comp* and *IntraB Comp*, holding fixed the same level of*MktCov*.

We display the results for total channel profit and manufacturer profit in Figures 5(a) and 5(b), respectively. Figure 5(a) indicates that VI is the best structure for total channel profit maximization with no intra- and interbrand competition. This is because vertical integration eliminates the pricing inefficiency associated with double marginalization, as shown by Jeuland and Shugan (1983). However, as interbrand competition increases, we find NONE dominates VI. This is because without double marginalization, competition would drive the price down too low. This moderating effect of higher levels of competition is consistent with McGuire and Staelin's (1983) finding. At still higher levels of interbrand competition with no intrabrand competition, we find PLP is the preferred coordination mechanism. The logic here is similar to that above. Now both double marginalization and the retailer's product line pricing behavior moderate the effects of severe price competition caused by the lack of differentiation.

Just as the retailer's product line pricing can protect the profitability of a channel system under high levels of interbrand competition, the manufacturer's multichannel pricing behavior can also play a role under intrabrand competition. As shown in Figure 5(a), for low levels of inter- and intrabrand competition we find DUAL to be the best mechanism for total channel profit, because the presence of partial vertical integration alleviates the effect of double marginalization, and the multichannel pricing alleviates the negative effect of intrabrand competition. However at higher levels of interbrand competition (but still low to moderate intrabrand competition), it is best to use TRIPLE, because the partial addition of product line pricing helps offset the potentially negative effect of the higher levels of interbrand competition. At very high levels of interbrand competition, it is best to completely eliminate vertical integration from the channel and to maximize retail level pricing coordination using PLP. At very high levels of intrabrand competition, the channel system benefits from having all three coordination mechanisms in the system, finding TRIPLE the best in situations with very high inter- and intrabrand competition.

We find these results both reassuring and new. They are reassuring in that the pattern of results is consistent with our expectations on various types of channel coordination mechanisms necessary to protect total channel profit from the potential pricing inefficiencies caused by two well-known strategic forces, double marginalization and price competition, both between competing manufacturers and competing retailers. It also is reassuring in that our results for the case of no intrabrand competition are in line with those of both Jeuland and Shugan (1983) and McGuire and Staelin (1983), who demonstrated that superior total channel profits are achieved via vertical integration at lower levels of interbrand competition, whereas decentralization (i.e., no vertical coordination) yields the largest total channel profits at higher levels. Interestingly, we find that at even higher levels of interbrand competition (and no intrabrand competition), PLP is the best, because it combines the benefits of both double marginalization and coordinated retail pricing to offset the potentially negative effects of interbrand competition. This finding

Figure 5 **Impact of Interbrand and Intrabrand Competition on Optimal Channel Coordination Type**



concerning the optimality of the channel structures involving *horizontal* types of coordination mechanisms is new. Also new is the more nuanced understanding of the interaction between interbrand competition and intrabrand competition. Specifically, with no intrabrand competition and high interbrand competition, PLP is best. With low levels of intrabrand and interbrand competition, DUAL (which combines vertical integration and MCP) is the best, because it can soften double marginalization and price competition via its coordinated pricing across multiple channels. At even higher levels of both types of competition, TRIPLE is the best, because it adds the product line pricing element to enhance the ability to protect the total channel profit from the negative effect of aggressive price competition.

Figure 5(b) shows the partitioning of the two-dimensional competitive environment space in terms of manufacturer profit. We note that the maximizing channel structure type is consistent with, but simpler than, that for total channel profit. This is because the profits for the manufacturers (and the retailers) are a function of both total channel profit and each channel member's ability to extract its portion of these profits, as shown in Figure 1. Thus, consistent with the total channel profit result, when there is no intrabrand competition, we find VI is the best under low levels of interbrand competition, whereas NONE is more profitable for higher levels. Also consistent with the result for total channel profit, VI is never the profit maximizing channel structure, once some intrabrand competition is introduced.

However, the influence of manufacturer power on the manufacturer's profit leads to three notable differences between the two graphs in Figure 5. First, VI is the best channel structure over a wider range of interbrand competition for manufacturer profit than for total channel profit. This reflects the greater benefit of the manufacturer's ability to extract 100% of total channel profit in VI compared to the benefit of the increased total channel profit via decentralization over the moderate range of interbrand competition. However, the latter benefit becomes greater than the former when interbrand competition becomes higher, as shown by McGuire and Staelin (1983). Second, holding fixed market coverage, PLP is never the best channel structure for the manufacturers despite its superiority in terms of total channel profit under high interbrand competition and low to moderate intrabrand competition. This result is consistent with the finding of Lee and Staelin (1997) and reflects a strong shift of channel power in favor of retailers associated with product line pricing in situations with poorly differentiated products. Consequently, NONE is the optimal channel structure for the manufacturers for high interbrand competition, not only in the absence but also in the presence of moderate levels of intrabrand competition. Third, for a similar reason, holding fixed market coverage, TRIPLE, which includes an element of retailer product line pricing, is never optimal for manufacturers. Instead, DUAL, which can soften the negative impact of intrabrand competition through multichannel pricing without diminishing the manufacturers' channel power, is preferred for the most of the area with intrabrand competition.

Once again, we find the findings in Figure 5(b) intuitively appealing and supportive of prior research. However, the finding that DUAL is the manufacturers' preferred channel system over a large range of inter- and intrabrand environments is new to the literature. Our result that no channel coordination at high levels of interbrand competition is best for the manufacturers is not new, but we extend this finding to situations with intrabrand competition, again showing that coordinating the channel via vertical integration (to any degree) is not always optimal for the manufacturer. A more general insight, coming from the presence of PLP and TRIPLE in Figure 5(a) and their absence in Figure 5(b), is that the main issue for *total channel profit* maximization is *whether* proper channel coordination mechanisms are in place regardless of who implements them, whereas *who* implements channel coordination becomes a much more critical issue for *channel power* and *manufacturer profit* maximization. Finally, it should be noted that Figure 5 is created assuming a fixed level of market coverage. In contrast, channel structure decisions in the real world often involve comparing alternatives associated with different levels of market coverage. Therefore, our results do not necessarily imply that manufacturers should never use PLP or TRIPLE type channel structures. Instead, it suggests that these channel structures are to be used only when they bring a superior level of market coverage (or any other significant benefits not incorporated in our model) that is sufficient to compensate for the diminished manufacturer power in these channel types.

5. Predictive Analysis

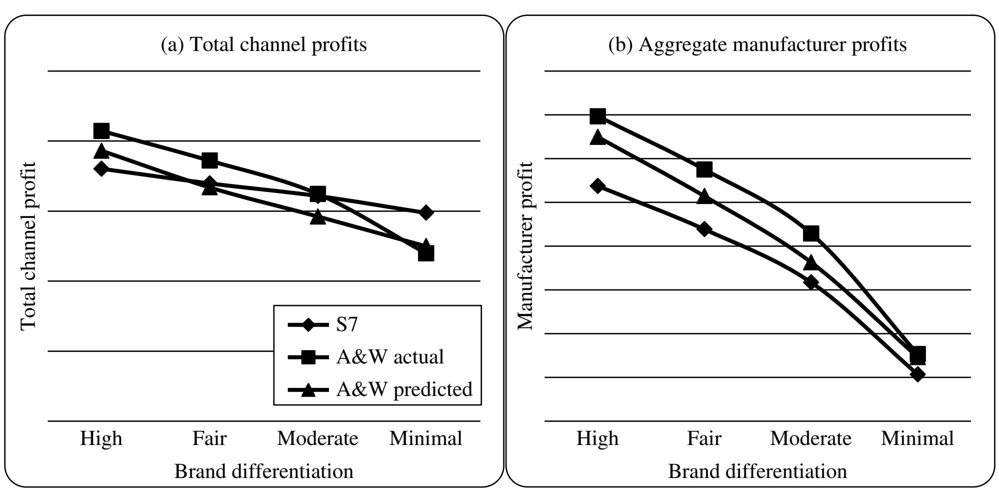
To assess the generalizability of our results presented in Tables 2 and 3, we created one other channel structure to mirror manufacturers distributing competing products through offline (e.g., Walmart) and online (e.g., Amazon) common retailers, labeled as "A&W" in Figure 3. This new structure is similar to structure 7 in that there are four product offerings, two sold via the Internet and two sold via the physical store. However, in structure 7 the one common retailer sells the two competing products both online and offline. In contrast, in "A&W" the common retailer still has a monopoly in the physical space, but now is in direct competition with the Internet common retailer. Thus, the two structures have the same demand parameters, but differ in the mechanism available for channel coordination. Specifically, there is 100% product line pricing in structure 7, but only 50% in the new structure.

We first predict market coverage and intrabrand and interbrand competition for this new structure for four different levels of brand differentiation using the Table 2 baseline consumer environment estimates. We then plug these estimated demand parameters into the Table 3 results to predict total channel profits and manufacturer profits. Figure 6 presents the comparison of the "predicted" outcomes, the "actual" outcomes of the new channel structure and the "actual" results of structure 7. This figure shows that our estimated model performed well in predicting the outcomes of the new "Amazon and Walmart" structure over a wide range of possible competitive environments. Specifically, at "high" levels of brand differentiation, the "Amazon and Walmart" channel structure leads to greater channel profits than structure 7. However, with decreases in brand differentiation, we find that total channel profits decrease slower with structure 7, so that at lower levels of differentiation, structure 7 outperforms the new structure.

We use our Table 2 and 3 results to gain insights into the forces that affect these profitability differences between the new structure and Structure 7. As mentioned above, the only difference between the new structure and structure 7 is the extent of product line pricing usage; i.e., structure 7 has 100% product line pricing coordination, whereas the new structure only has 50% coordination. From Table 3 we see that this difference will be reflected in the negative fixed effect of *%PLP* and positive interaction of this variable on the slopes of inter- and intrabrand competition. From Table 2 we note that brand differentiation only impacts interbrand competition. Consequently, the only factors impacting the difference in total channel profit between the two structures are the negative main effect of product line pricing (−1.329) and the positive slope interaction term with interbrand competition (0.066). We also note from Table 2 that brand differentiation (which is the reverse of *BrndSub*) is negatively related to *InterB Comp*. Therefore, when *InterB Comp* is small (i.e., brand differentiation is high), the negative main effect of *%PLP* makes structure 7 less profitable than the new channel structure. However, as *InterB Comp* increases, the positive interaction term makes structure 7's total channel profit decrease at a slower rate than that for the new structure, eventually leading to the reversal of their relative profitabilities. The bottom line of all this is that the lack of brand differentiation increases the degree of interbrand competition among the two brands. Normally this leads to lower prices and thus lower profits. However product line pricing tempers this lowering of prices. Specifically, the ability of the retailer to implement product line pricing in both the store and the Internet leads to higher prices and thus higher total channel profits in conditions of minimal brand differentiation.

Figure 6 also indicates that manufacturer profits are always larger when using the "Amazon and Walmart" type of distribution channel than when using structure 7. The results in Table 3 make it clear why this occurs, namely, the negative impact of *%PLP* (−1.352) and the negative slope coefficient associated with the interaction of product line pricing and interbrand competition (−0.056). In this case, by limiting the ability of the retailers to fully implement product

Figure 6 Comparison of "Amazon and Walmart" and Structure 7



Notes. S7, structure 7; A&W actual, numerically obtained equilibrium profits for the "Amazon and Walmart" structure; A&W predicted, profits for the "Amazon and Walmart" structure predicted by the estimated model.

line pricing across all four product offerings enables the manufacturer to capture more of the total channel profits, thereby leading to higher manufacturer profits. This holds for all levels of brand differentiation.

So far, all of our analysis has involved channel structures including two to four competing product offerings in the market. For an additional test of the robustness of our results, we analyzed another new channel structure by adding a direct Internet channel for each of the two manufacturers in structure 2, as shown in Figure 3. Note that the resulting channel structure gives three outlets for each manufacturer, a direct Internet outlet and the two physical stores, leading to a total of six product offerings. Predicted values for market coverage, interbrand competition, and intrabrand competition, and then those for total channel profit and manufacturer profit, were obtained at various levels of product and store differentiation levels using the regression results reported in Tables 2 and 3. Our comparison of the predicted total channel profit and manufacturer profit against the actual equilibrium results obtained by numerical analysis produced strong directional consistency between the two, indicated by strongly positive correlations between actual and predictive values. However, we find the predicted values consistently overestimate profits, mainly due to overestimation of market coverage with six product offerings.

The above discussion provides strong evidence of the usefulness of our general model. Not only are we able to predict the profitability of another structure with four product offerings, which was not included in the meta-analysis estimation, we also are able to use our conceptual framework to gain insights as to why one structure is better than another by understanding how some environmental factor such as brand differentiation and/or some channel coordination factor such as product line pricing affects market coverage, interbrand competition, and intrabrand competition, which ultimately affects profits. Our estimated model did not perform as well for predicting the exact levels of profits for a new structure that was outside the range of our data (i.e., six product offerings), showing the limitations of its predictive capability. Nevertheless, the qualitative findings summarized in Table 4 were found consistent, providing greater confidence in their robustness.

6. Conclusion

During the last three decades, analytical channel studies have provided many valuable insights. However, each of these studies represents just one cell of a larger set of thought experiments (Moorthy 1993), and there remains a need for studies that "allow us to pull the individual experiments together to form some overarching theories" (Staelin 2008, p. 114). This need is growing more important with the increasing adoption of complex multibrand, multioutlet, multichannel systems. However, it is not adequately addressed by the mathematically tractable simple channel models in the literature. This study represents our attempt to respond to this challenge by developing a flexible three-dimensional spatial demand model that allows us to analyze and compare numerous channel structures under a large number of various underlying market environments. Our conceptual framework in Figure 1 provided a basis for a meta-analysis that extracts generalizable patterns in all the equilibrium results.

The overarching theme of our meta-analysis result is that the complex effects of diverse channel structures and different market environments on channel member profitability can be parsimoniously captured by just two groups of three key variables. In a properly specified model, market coverage, interbrand competition, and intrabrand competition along with the three channel coordination mechanisms can describe a remarkably high proportion of the variations in channel and firm profits across several hundreds of different conditions. The positive profit impact of market coverage is straightforward and independent of channel coordination type. In contrast, we find more complex interactions between the three channel coordination mechanisms with inter- and intrabrand competition. In this way, our result expands the well-known interaction between interbrand competition and vertical integration (McGuire and Staelin 1983) to a larger domain of two competition types interacting with three channel coordination mechanisms that shape optimal multichannel structure decisions in multibrand, multioutlet markets.

For marketing practitioners, this paper highlights the challenge of strategic utilization of horizontal and vertical channel coordination mechanisms in today's multichannel market environment. In particular, we find that the well-established notion of the optimality of pure vertical integration (pure decentralization) at low (high) levels of interbrand competition holds only under no intrabrand competition. As intrabrand competition has become more pronounced with the growth of multichannel distribution systems, a certain dose of horizontal coordination becomes necessary. Consequently, the channel profit maximizing structure often involves a combination of two or three channel coordination mechanisms. Furthermore, a manufacturer's optimal channel structure decision must also consider the impact of the decision on its channel power. For instance, as seen in Figure 5, PLP is the best channel coordination type to maximize total channel profits at high interbrand competition and no to moderate degrees of intrabrand competition. Nevertheless, PLP at high interbrand competition has such a negative effect on manufacturer power (see Table 3) that it is not optimal for the manufacturer. In short, simply pursuing higher levels of market coverage or channel coordination does not always lead to higher profits for the channel system or individual channel members, as found by McGuire and Staelin (1983), Lee and Staelin (1997), and Ingene and Parry (2000) for specific channel structures and conditions.

The linkages found between industry structure characteristics and the demand characteristics also provide a helpful framework for evaluating the profitability of any channel structures. Many of the estimated effects are as expected, but some are new and interesting, such as the effect of an Internet channel entry softening intense interbrand competition prior to this entry. More importantly, our results show that changes in the characteristics of the four Cs in Figure 1 generally affect all three demand characteristics. Consequently, studies using full market coverage assumptions or assumed demand functions that capture product and store differentiation via one cross-price sensitivity parameter may limit the veracity or generalizability of the results. This also explains the discrepancy between some of our findings and those of previous studies.

Due to our focus on broad generalizable insights, this study falls short of providing potentially interesting details that can come from an in-depth analysis of a few channel structures. For example, one could explore the effects of a possible entry of a new outlet on individual channel member profits, and analyze how a channel member might change its pricing strategy to deter such an entry. Such analyses can be done either for the structures in Figure 3 or for some new structures. In particular, one can consider a market served not only by competing common retailers (structure 2), but also by multiple Internet vendors with differentiated services, a structure that is beyond the scope of this paper. We hope our flexible demand model will open doors to many future studies in this direction. Although there are some asymmetric channel structures included in this study, our model can be also easily extended to incorporate asymmetric quality levels. Analyzing such asymmetric cases will produce interesting insights into differential strategies between competing manufacturers. In addition, our study is based upon the assumption of manufacturers' Stackelberg leadership over retailers. Because the key strategic forces addressed in this study, such as double marginalization, interbrand competition, and intrabrand competition, are not highly sensitive to vertical price leadership assumptions, we believe this does not seriously limit the generalizability of our qualitative findings. However, considering other price leadership scenarios and additional marketing mix variables will lead to more generalizable results.

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