A Transaction-Efficiency Analysis of an Internet Retailing Supply Chain in the Music CD Industry*

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ABSTRACT

The emergence of the Internet may have fundamentally altered the mechanisms underlying information exchanges between sellers and end consumers. However, little attention has been given to the impact these mechanisms have on the efficiency of supply chain operations.

This paper begins to address this deficiency in the literature by evaluating supply chain transaction efficiency effects from Internet purchases by consumers. It develops and empirically tests a theoretical framework examining the role Internet purchases have in establishing transaction-efficiency levels in product exchanges involving sellers, placed at different supply chain echelons, and consumers. The theoretical framework integrates the transaction-cost and internet economics, inter-organizational information systems, and supply chain management literatures. Empirical testing, via structural equation modeling, is based on archival data in the Internet music CD market.

The results show that Internet-mediated purchases by consumers allow for greater transaction efficiencies when inventory ownership is postponed farther upstream in the supply chain and supply chain echelons are disintermediated. The results also indicate that channel structure configuration, defined by the supply chains’ Internet retailing echelon, moderates these transaction efficiency effects.

Subject Areas: Electronic Commerce, Structural Equation Models, and Supply Chain Management.

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INTRODUCTION

Because of its interoperability and open-standard settings for the transferal of data among organizations, the Internet has had a particularly deep impact on managerial practices by many buying and selling firms that trade products and resources, such as money and information (Bailey, 1998). This phenomenon is particularly noticeable in the retailing industry, where the gradual emergence of Internet-based sellers—that is, retailers, wholesalers, and manufacturers—participating in transactions with end consumers has underscored a shift in buyer-seller relationships.

This progression has been highlighted in previous research on Internet-facilitated consumer transactions (Bailey, 1998; Bakos, 1997; Brynjolfsson & Smith, 2000). Up until now, the research has centered on four transaction efficiency areas: product-price levels, menu costs, price-elasticity levels, and product-price dispersion (Smith, Bailey, & Brynjolfsson, 2000). Little is known about efficiency-generating decision-making mechanisms involved in product-exchange operations and transactions stemming from consumers’ Internet purchases.

Furthermore, studies on Internet transaction efficiency have exclusively concentrated on dyads spanning only consumers and Internet retailers (Bailey, 1998; Brynjolfsson & Smith, 2000). Little attention has been given to transaction efficiency in the exchange of information and goods across multiple dyads of supply chains supporting the fulfillment of online consumer orders.

This paper addresses both of these literature gaps. It evaluates transaction-efficiency-enabling decisions present in supply chains supporting the fulfillment of online consumer orders. And in so doing, it highlights avenues through which the Internet can integrate consumers into the efficient exchange of information and sourcing of products across multiple supply chain dyads. The rest of this paper is structured as follows. The next section presents the theoretical model. The section afterward presents the testable hypotheses and methodology. The final two sections discuss the statistical analysis and results, as well as the conclusions, implications, and opportunities stemming from this research.

THEORY

The management of supply chains emphasizes the need for integrating multiple echelons through information flows (Cooper & Ellram, 1993) and enabling the distribution of optimal material quantities to optimal locations in a timely manner (Simchi-Levi, Kaminski, & Simchi-Levi, 1999). The use of the Internet for retailing illustrates this principle, since it can potentially streamline supply chain information flows (Elofson & Robinson, 1998; Evans & Wurster, 1997; Hagel & Singer, 1999) and increase the efficiency of buyer-seller exchanges (Andrews & Trites, 1997; Eichhorn & Helleis, 1997; Kiang, Raghu, & Shang, 2000; Long, 1997; McKim, 1997; Sandilands, 1997; Sinha, 2000). The theoretical model addresses these concepts by (1) outlining the causal and moderating factors of supply chain transaction efficiency in traditional (non-Internet) retailing environments and (2) studying efficiency drivers in supply chains supporting Internet-retailing operations, based on these causal and moderating transaction efficiency elements.
Supply Chain Transaction Efficiency: Causal and Moderating Factors

The nature of transaction efficiency is deeply rooted in the minimization of transaction costs. The field of economics has used transaction costs to study the boundaries of the firm (Coase, 1937) and governance transactions between firms (Williamson, 1975). As transaction costs increase, market transaction efficiency decreases. These inefficiencies may result in higher market prices and promote vertical integration in the supply chain.

Transaction costs may affect the supply side of the market, the demand side of the market, or both. Some supply-side transaction costs include menu costs, customer-demand data collection outlays, marketing expenses, and inventory control costs stemming from uncertainty in the level of material supplies and product distribution operations (Blois, 1972; Levy, Bergen, Dutta, & Venable, 1997; Stigler, 1961). Some demand-side transaction costs include the existence of imperfect and costly information available to buyers (Stiglitz, 1989), search activities needed to identify sellers and discover their prices (Stigler, 1961), and resource expenditures needed to overcome location boundaries to transact with sellers (Hotelling, 1929; Smithies, 1941).

Equilibrium prices are a result of the balance of these different transaction costs. Therefore, price levels necessary to clear markets stem from supply-side (Coase, 1937; Spulber, 1996; Williamson, 1975) as well as demand-side transaction costs involving search (Diamond, 1971; Salop & Stiglitz, 1977, 1982) and location costs (Hotelling, 1929; Smithies, 1941). In individual supply chain dyads supporting traditional retailing operations, these supply- and demand-side components are dependent on four intrinsic exchange characteristics: (1) asset specificity, (2) uncertainty, (3) opportunism, and (4) frequency (Williamson, 1975).

Asset specificity relates to the degree to which inventory can be redeployed to alternative uses and by alternative users without sacrifice of productive value (Williamson, 1989). Thus, commoditized inventory exhibits low specificity since it is easily exchangeable and the transaction costs needed to transfer its ownership are low. Specificity also depends on the geographic location of inventory. It may translate into transaction costs resulting from the expenditure of either demand- or supply-side resources to search for or change the asset’s location and complete the transaction (Malone, Yates, & Benjamin, 1987). Inventory may also be considered time-specific if its value is dependent on its reaching retailing patrons within a specified time period (Malone et al., 1987). Failure to perform the transaction within a time window may translate into transaction costs and higher prices.

Uncertainty arises from unpredictable changes in consumer preferences and lack of communication among transacting entities (Koopmans, 1957). In a retailing environment, these conditions bound rationality among transacting parties (Feldman & Kanter, 1965), generate negotiation costs, make cheating opportunities available to the parties (Simon, 1991), or lead to excessive inventory carrying or backorder costs prior to transaction completion.

Opportunism involves a transacting entity’s strategic manipulation of information to extract transaction costs from its counterparts and impose higher prices through the consolidation of individual advantages (Goffman, 1969; Williamson, 1975).
Frequency results from the volume of exchanges between transacting parties. It is inversely related to fixed and short-term transaction costs associated with the monitoring, writing, and enforcing of contracts that could minimize, ex post, uncertainty and opportunistic behavior among supply chain transacting parties (Levy, 1985; Williamson, 1975).

The ultimate retail price paid by consumers stems from the accumulation of supply- and demand-side transaction costs—driven by the four intrinsic exchange characteristics outlined above—across multiple, sequentially arranged, and market-based dyads in the supply chain. These market-based sequential exchanges gradually increase the transaction-path length and the number of technologically separable interfaces needed to reach consumers. Coordinating mechanisms and transaction costs are replicated as many times as there are dyads in the supply chain.

As a result, supply chain transaction costs and prices—as absorbed by consumers—increase with the length (number of dyads) of the supply chain.

Analytically, the supply chain accumulation of transaction costs stems from the Double Marginalization Model (Spengler, 1950; Spulber, 1998). This result is derived in the first part of the Appendix, where it is assumed that multidyadic transaction costs absorbed by consumers result from comparable supply chain–wide market exchange mechanisms.

Internet Technology and Transaction Costs

The Internet may reduce transaction costs by increasing coordination among supply chain members. Because of its interoperability and open standards, the Internet may enable consumer access, at low cost, to information on products residing in upstream supply chain entities (e.g., wholesalers and manufacturers). Sellers, in turn, may offer a wide product range, without taking inventory ownership before consumer purchases occur. Through this functional competence, Internet purchases can theoretically contribute to decoupling supply chain information flows and support nonlinear and independent exchanges of data and inventory (Elofson & Robinson, 1998; Evans & Wurster, 1997; Hagel & Singer, 1999). This capability may allow retailers and upstream supply chain firms to share inventory control tasks (Evans & Wurster, 1997) and enable nonsequential exchanges in the supply chain, thereby reducing multidyad transaction costs and prices available to consumers.

Thus, Internet-mediated transactions with consumers may reduce transaction costs because they allow product ownership to be postponed farther upstream in the supply chain until consumer demand for products materializes. As a result, downstream supply chain echelons may be disintermediated from transactions with consumers, reducing the number of supply chain echelons that lead to increases in the overall level of transaction costs in the supply chain. In the context of this research, retailers may use the Internet to postpone inventory ownership to wholesalers or even producers and fulfill consumer orders without incurring stockout or backorder costs. By doing this, retailers disintermediate supply chain echelons from the inventory-ownership sequence necessary to fulfill consumer orders. The result may be greater transaction cost savings, reflected in product prices, as inventory ownership is postponed farther upstream in the supply chain until consumer demand materializes. This conclusion is analytically derived in the second part of the Appendix.
Internet technology and single-dyad transaction costs

The previously outlined multidyad transaction efficiencies are present when the disparities between $P_{pi}$ and $MC_p$, $P_{wi}$ and $MC_w$, and $P_{ri}$ and $MC_r$ in the Appendix remain equal. Conditions of asset specificity, uncertainty, opportunism, and frequency in single-dyad transactions triggered by Internet-mediated exchanges with consumers preserve this equality.

First, unlike traditional purchasing, low search costs in Internet purchasing minimize demand-side search and location liabilities (Bailey, 1998; Bakos, 1997). This property may enable consumers to locate inventory, access design and content, and purchase across many echelons, without increasing transaction costs in disintermediated exchanges between consumers and upstream supply chain sellers, such as producers and wholesalers.

Second, more effective transaction-monitoring mechanisms (reflected in more timely and detailed information on demand and inventory transfers) in Internet purchasing (Clemons & Row, 1992) may allow sellers to economically spot product demand, postpone inventory-owner decisions, and exchange inventory with downstream supply chain buyers, at no additional supply-side transaction costs from stock overage and underage (Aguirregabiria, 1999; Tersine, 1994). Ultimately, this property can contribute to keeping disparities between $P_{pi}$ and $MC_p$, $P_{wi}$ and $MC_w$, and $P_{ri}$ and $MC_r$ equal.

Third, as intermediaries, Internet retailing sites allow for the aggregation of multiple, infrequent, and heterogeneous consumer orders and product offerings by suppliers (e.g., wholesalers and producers) upstream in the supply chain. Comparable to traditional retailing settings, this aggregation leads to higher transaction efficiency through the diffusion of fixed contract costs over a larger number of exchanges. However, unlike traditional settings, the Internet minimizes the intermediaries’ proclivity to behave opportunistically, regardless of their supply chain position, since it minimizes consumer search and location costs (Bakos, 1997). Thus, even though Internet intermediaries may be much more apprised of attributes of the transaction, this is of little consequence if consumers can continuously and freely search for competitive bids in the marketplace. The competitive process in these conditions makes it unprofitable for sellers to engage in opportunistic behavior (Hurwicz, 1972; Williamson, 1975) and keeps $P_{pi} - MC_p$, $P_{wi} - MC_w$, and $P_{ri} - MC_r$ disparities in the Appendix equal.

The multidyad transaction efficiency argument assumes that single-dyad transactions are based on comparable market mechanisms within each supply chain. However, mechanisms in dyadic transactions are not comparable across supply chains with divergent channel structures supporting the Internet retailing operations. Thus, some supply chains may be more dependent on market exchanges than others. To generalize research results at the industry level, this issue is addressed in the ensuing paragraphs.

Internet technology and dyadic configurations across supply chains

Economically, dyadic configurations across supply chains are driven by each participant’s incentive to optimize its costs through the allocation of functions to external firms that provide greater economies than those attained internally (Stigler, 1951). Institutionally, dyadic configurations are subject to intermediation needed to
increase fixed-asset utilization (McCammon & Little, 1965) and reduce the number of dyadic transactions (Artle & Berglund, 1959). Finally, from a functional and behavioral standpoint, dyadic configurations depend on function-allocation patterns providing the greatest benefit to either consumers (lower prices) or sellers (profits), depending on the sellers’ ability to influence consumer decisions (El-Ansary & Stern, 1972; Mallen, 1973).

These theoretical arguments are particularly important in supply chains involving Internet retailing, where channel structures are defined by consumer purchases taking place through sites managed by firms with either retail presence off the Internet—“bricks-and-clicks” retailers—or exclusive Internet presence, “pure-play” Internet retailers. These differences, along with the previously outlined theoretical principles, suggest that online consumer orders filled by pure-play Internet retailers yield greater supply chain (multidyad) transaction efficiencies than Internet purchases filled by bricks-and-clicks operators. A three-way argument supports this proposition.

First, bricks-and-clicks firms have historically handled greater purchase volumes than most pure-play Internet retailers have. Thus, economically, bricks-and-clicks firms—relative to their pure-play counterparts—are expected to maximize their internal cost efficiencies by relying more intensively on scale economies resulting from assets internally available to them than on scale economies found at supply sources upstream in the supply chain.

Also, institutionally, transactions are more dependent on sequential intermediation in supply chains concerning bricks-and-clicks retailers than in those concerning pure-play firms. First, relative to pure-plays, bricks-and-clicks must rely more closely on intermediated and sequential exchanges to reduce the number of transactions involving their larger number of retailing outlets (Bailey, 1998). Second, bricks-and-clicks firms rely more intensively on internal resources to increase asset utilization, since they depend on stores to stock inventory and require proportionally greater amounts of inventory and fixed assets (Bezos, 2000).

Functionally and behaviorally, transactions in channels supporting pure-play firms may follow functional allocation patterns that offer greater transaction efficiency to shoppers. This argument follows from evidence showing that pure-play retailers command less market influence on consumers than do bricks-and-clicks firms (Hanson, 2000). It also follows from research suggesting that customer acquisition and retention costs are reduced when sellers’ Internet presence is complemented through physical store locations (De Figueiredo, 2000).

**HYPOTHESES AND EMPIRICAL METHODOLOGY**

The measurement of transaction costs—given by the disparity between the seller’s (i.e., producer, wholesaler, Internet retailer) marginal cost, $MC_s$, and the price, $P_b$, paid by the buyer—rests on two key assumptions. First, prices quoted to consumers are based on sellers’ profit-maximization incentives. Second, prices in buyer-seller exchanges significantly depend on transaction costs. These assumptions are addressed in the empirical analysis by studying music compact disc (CD) Internet-retailing operations owned by publicly traded firms.
The profit maximization incentive assumption is supported by limiting the study to publicly owned Internet sites, with the highest levels of historical profitability in the e-commerce industry and with profit maximization incentives promoted by stockholders inside (Monsen & Downs, 1965) and outside the firm (Hindley, 1970).

The second assumption is supported by three product and market conditions for CD retailing over the Internet. First, CDs are commodity items. They are standardized, durable, and low-priced goods. Furthermore, the attributes that generate consumer utility for an individual CD title remain unchanged irrespective of where, when, how, or by whom the title is sold (Mas-Colell, Whinston, & Green, 1995). Also, pricing actions of a single CD seller are unlikely to alter market prices (Brynjolfsson & Smith, 2000). Therefore, CD sellers are likely to be price takers as opposed to price setters, to compete under Bertrand-price competition conditions, and not to pursue monopolistic pricing policies for each CD title.

Second, because of its nascent conditions, the Internet market for CDs is highly competitive. These conditions lead to a close association between transaction costs and the disparity between marginal costs and prices charged to consumers. Third, the Internet market for CDs is subject to low search costs, causing prices to converge to marginal costs. Seller attempts to reap market profits and drive retail prices above marginal costs can easily be detected by all market participants.

Internet-based CD markets also exhibit properties that facilitate the empirical measurement of transaction costs. First, Internet CD sellers’ marginal cost structures are reasonably uniform, since they share common product suppliers and a common, interoperable, and open-standard information interface with consumers. This makes available to all sellers almost identical cost-effective levels of communication with consumers. Second, the study of Internet CD markets can effectively account for any additional marginal-cost heterogeneity determinants pertaining to Internet-retailing site, products, and channel-structure attributes, as defined by the pure-play and bricks-and-clicks Internet retailer typology.

In line with the previous considerations, transaction costs result from the gap between the actual price paid by the buyer, \( P_b \), and a maximum price that the seller could possibly charge for the product, \( P_s \). Thus, transaction costs are not measured in terms of how far \( P_b \) is above \( MC_s \) across different dyadic-exchange settings. Instead, transaction costs are measured by how far below \( P_b \) is from \( P_s \). From Figure 1 and the properties exhibited by Internet-based CD markets, both of these measurement approaches result in equivalent transaction cost measures. In this case, an increase in the disparity between \( P_b \) and \( P_s \) is reflective of lower transaction costs and higher efficiencies in the seller-buyer transaction (Figure 1). This transaction measurement approach is consistent with economics literature on intermediation (Demsetz, 1968), where market transaction costs are measured as the difference between the transacted products’ upper-bound prices and mediated prices.

Price \( P_b \) is published on the CD retailing site. Furthermore, for CD titles, \( P_s \) corresponds to the item’s list price. The list price is often printed on the product itself and is also published at the retailing sites. Consistent with Bertrand competition,
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Figure 1: Transaction cost as a divergence between upper-bound and market prices.

A transaction list price is a benchmark, set by the producer, in this case the music label. In general, half of it covers transaction costs resulting from title exchanges involving publishers, wholesalers, retailers, and consumers (Kotha & Dooley, 1999).

Consequently, the Ps-Pb disparity is measured through the percentage discount of the CD title’s list price offered to consumers. The greater the title’s percentage list price discount, the higher the transaction efficiency and the lower the transaction costs in the exchange. Furthermore, from the prior section, supply chain transaction efficiency in an Internet environment, as measured by list price discounts in the case of CDs, is affected by the ownership allocation across the supply chain and involved in sourcing the products at the time the consumer purchase takes place. This supply chain ownership allocation involved in sourcing a transacted CD title (henceforth used interchangeably with the term “sourcing location”) corresponds to the supply chain echelon from where the title is transferred to the consumer once the purchasing process is completed. Consistent with transaction cost applications by Mallen (1973) and Spengler (1950) stemming from Coase (1937), this sourcing location is given by inventory ownership. Thus, inventory owned by the retailer, at the time the transaction with the shopper is executed, is sourced from the same supply chain echelon, irrespective of its physical location (e.g., retailer store or warehouse). Inventory owned by the wholesaler, at the time the transaction with the consumer is executed, is sourced from another echelon.

In Internet-based commerce, the sourcing location of CD titles in the supply chain is a function of the item’s promised shipping lead time, defined as the amount of time promised to ship the item once it is ordered by the consumer. In the case of the Internet retailers analyzed, measurements of supply chain sourcing location were linked to the promised time in shipping (rather than delivering) the product to consumers, after an order is placed. Information about the linkage between supply chain sourcing location and promised shipping leadtime was obtained from the studied Internet retailers’ shipping and handling policies, published online at the time data was collected. This information resulted in sourcing location taking on three possible ordinal values: 1 = In stock owned by the Internet retailer, 2 = In
This measurement is completely independent of the delivery method and delivery time involved in the transaction. That is, it is not a function of the amount of time involved in delivering the product after it has been shipped out to the consumer. The measurement exclusively captures product ownership information across supply chain echelons, as stated by the Internet retailer, at the time the transaction takes place. As a result, it is independent of the product’s geographical location. Furthermore, because the measurement is independent of the shipping and handling method chosen by the customer to deliver the product, it is independent of logistics quality measures in the transaction. Also, because sourcing location is measured at the time of the transaction, its causal effect on list price discount is consistent with the theory and model.

Therefore, the first empirical hypothesis is:

H1. The farther upstream in the supply chain (i.e., away from the end consumer echelon) a CD title is sourced at the time the Internet-based purchase by the consumer takes place, the higher the title’s list price discount.

Beyond the monetary component, transaction efficiency is inversely dependent on the amount of time needed to complete the transaction (Demsetz, 1968). In Internet-based purchases of CDs, transaction delay is directly related to the title’s sourcing location in the supply chain at the time consumer orders are received. Furthermore, both measures (supply chain echelon sourcing locations and product list price discounts) are dependent on common product and retailing-site attributes.

From this consideration, the supply chain sourcing location/list price discount relationship, in H1, measures transaction efficiency gains in list price discount terms. However, as discussed in the next section, these gains are measured above and beyond independent transaction-efficiency effects, in terms of both supply chain sourcing location and list price discounts, given by independent retail and product determinants.

Secondary Variables: Product and Retail Determinants of Transaction Efficiency

Product and retail determinants of transaction efficiency involve: (1) CD-title demand conditions, (2) market scope, and (3) value-adding services provided to consumers. The variables’ transaction-efficiency effects and their measurements are outlined below.

Title demand conditions

Compact discs are hedonic items: their consumption is driven by the experience they provide and, as such, they are not substitutable among themselves (Moe & Fader, 2001). As a result, each CD’s demand conditions and associated intrinsic dyadic transaction characteristics and pricing strategies are a function of factors
directly attributable to each individual CD. Two primary factors are the amount of time in the market and the popularity of the title (Moe & Fader, 2001).

The amount of time a title has been in the market is measured by the difference (in days) between its release date and the data collection date. Release-date information is generally available from all Internet-retailing sites and wholesaling firms. It is expected that the time length a CD has been in the market will be linked to a lower level of title demand uncertainty associated with future demand for that product. Thus, for newly released CDs, supply chain participants are, from a supply perspective, likely to internalize transactions associated with these items and rely on intermediated supply chain exchanges to reach consumers (Williamson, 1975). Ultimately, this procedure will reduce list price discounts and associated transaction efficiencies.

From a demand perspective, and consistent with the Salop and Stiglitz (1977) model of informed and uninformed customers, the amount of time a CD has been in the market is expected to positively affect transaction efficiency because consumers are more informed (more certain) about the attributes and pricing conditions for the product. As a result, list price discounts for these products are likely to increase.

Furthermore, price discounts stem from the need to eliminate overage costs that are generated by increased risk in inventory obsolescence (Latcovich & Smith, 2001). In an Internet-retailing environment, this effect results in lower price discounts for newly released CDs and higher discounts for old releases.

Finally, from Sobel (1984), Internet retailers may price discriminate customers by providing lower price discounts for newly released CDs and higher discounts as CDs’ time in market increases, to capture sales of more patient customers. Consistent with the research model, the previous theoretical arguments suggest that:

H2a. Greater title demand uncertainty leads to lower list price discounts.

From a supply perspective, titles for which demand uncertainty is high are likely to be internalized by supply chain participants in their own inventory (Williamson, 1975). In the specific case of new CD releases, with high demand uncertainty, inventory is likely to be internalized upstream in the supply chain to mitigate detrimental effects of demand variability (Netessine & Rudi, 2001; Van Hoek, 2001) and leverage scale and scope economy advantages (Mallen, 1973). Therefore,

H2b. Greater title demand uncertainty leads to supply chain sourcing locations at echelons farther away from the end consumer echelon.

Second, title popularity may reduce asset specificity in the transaction. This effect, combined with discount policies that are influenced by a decreased Internet seller ability to collude when demand is temporarily high (Rottemberg & Saloner, 1986; Smith et. al, 2000) and discounts that are inversely proportional to market price elasticity levels (Bliss, 1988), yields greater discounts and associated transaction efficiency. Therefore,
H3a. Greater title demand popularity leads to greater list price discounts.  

A decrease in asset specificity caused by a growth in popularity positively affects sellers’ ability to transact CDs in the market. Thus, carrying popular items in their own inventory minimizes risk for Internet retailers. On the other hand, drop-shipping unpopular items shifts obsolescence risk to upstream-channel participants, who may be able to utilize scale economies to reduce obsolescence by pooling demand from many sources and utilizing salvage channels more effectively (Majumdar & Ramaswamy, 1995). Therefore,

H3b. Greater title demand popularity leads to supply chain sourcing locations at echelons closer to the consumer echelon.

The title demand popularity measure follows from a confirmatory factor analysis (CFA) with three indicators: the CD’s sales ranking at Amazon.com, the title’s number of customer reviews at Amazon, and the number of merchants selling the CD, as listed by MySimon.com (Figure 2). Note that to account for covariation exclusively related to Amazon’s operations and not captured by the latent variable measuring popularity, the error terms for the indicator variables measuring Amazon’s CD sales ranking and Amazon’s number of customer reviews were allowed to covary.

As data sources for the first two indicators, Amazon’s measures allow for generalizability because its music CD market share surpasses that of any other Internet site (Collura & Applegate, 2000, 2001). Sales rankings at Amazon are specific to CDs and are updated regularly. The top 10,000 sellers are updated each hour to reflect sales over the preceding 24 hours and the next 100,000 are updated daily. Thus, the ranking yields an instantaneous popularity measure, where a change in demand immediately causes a title to move in the sales rankings. On the other hand, customer reviews at Amazon have been collected since Amazon opened for business. The number of customer reviews at Amazon, for any given CD, therefore represents a historic measure of CD popularity. Prior title popularity increases are directly reflected in the number of customer reviews for that item at Amazon.

MySimon is a shopping robot that enables comparison shopping for a variety of products, including CDs, at more than 2,000 online stores. MySimon tracked
the largest possible number of industry-recognized retailing sites at the time data was collected ("Shop Bots Rule," 2000). Thus, the number of merchants offering a given CD title and listed at MySimon account for an industry-wide measure of popularity. An increase in demand popularity for a given CD title is expected to increase the number of merchants listed at MySimon offering that specific CD title.

**Market scope**

Internet traffic, as a measure of market scope, is increasingly becoming a scarcer and, consequently, a more valuable resource to Internet sellers (Hanson, 2000). Therefore, a wider market scope may better position sellers in the supply chain to extract demand-side transaction costs and offer, on average, lower list price discounts for CD titles or to source the products sold to consumers from upstream echelons in the supply chain (Bailey, Faraj, & Yao, 2002; Shapiro & Varian, 1999).

On the other hand, increases in market scope, as a function of Internet traffic (Brynjolfsson & Smith, 2000) and the number of product segments in which Internet retailers compete (Coughlan, Anderson, Stern, & El-Ansary, 2001; Mallen, 1973), may yield lower inventory acquisition costs to Internet retailers. This effect will ultimately yield greater list price discounts stemming from reductions in both Internet retailing marginal costs and, under competitive conditions, prices.

Furthermore, a wider market scope leads to lower supply chain distribution costs, per unit, resulting from statistical economies in inventory-carrying costs and scale economies in transportation and ordering costs (Rabinovich, 2001). This increase in efficiency is expected to generate lower marginal costs and greater average list price discounts for CDs. As well, market scope–related distribution efficiencies are anticipated to enable entities upstream in the supply chain to source products in echelons closer to the consumer echelon.

From the opposing arguments outlined above, and in terms consistent with the empirical model in this research:

**H4a (alt.).** An increase in the Internet-based market scope leads to higher (lower) list price discounts

**H4b (alt.).** An increase in the Internet-based market scope leads to supply chain sourcing at echelons closer to (farther away from) the consumer echelon.

The seller-level construct capturing *market scope* is given by a latent variable measured through CFA, reflected in three indicators: Alexa visits, annual revenues, and market breadth (Figure 3). These same three variables along with analogous measures have been used in previous research work as measures of market scope for Internet retailing sites (Bailey et al., 2002; Brynjolfsson & Smith, 2000).

Alexa visits are provided by Alexa.com—an Internet-navigation service and collaborative filter. Alexa visits are based on the amount of times registered Alexa users have visited a site in the past six months. The visits account for multiple Internet host names associated with a top-level Internet domain and for multiple Internet host names associated with a single Internet top-level page.
Annual revenues are the total sales reported by the Internet sellers studied during the fiscal year 1999. Finally, market breadth corresponds to the level of assortment of products offered by Internet sites. Market breadth measures the number of product segments in which sellers compete. These segments are defined by the number of unique SIC (standard industrial classification) code categories at the four-digit level.

**Value-adding service**

Three dimensions are considered here: *convenience of shopping experience*, retailing site *reliability*, and retailing site *visibility* (Smith et al., 2000). Greater levels in each of these measures and, consequently, in the value-adding services available to consumers through the Internet sites may better position sellers to extract demand-side transaction costs (Smith et al., 2000). This suggests that value-adding service diffusion of product content could result in lower title list price discounts and in a greater reliance on sourcing locations upstream in the supply chain.

However, in music CD markets, where products are information intensive, value-adding services can contribute to diffuse product-content information prior to the completion of the buyer-seller transaction. Furthermore, the diffusion of product-content information (e.g., lyrics, sound-track samples, expert reviews, and customer reviews) involves minimum demand-side transaction costs—in the form of search costs—and minimum supply-side transaction costs, in the form of marketing-based information transmission costs. Thus, the value-adding-service diffusion of product-content information could lead to lower levels of opportunism and uncertainty and, consequently, lower market friction in dyadic exchanges. The opposite arguments outlined above lead to hypotheses:

**H5a (alt.).** Higher levels of value-adding service provided to consumers lead to lower (higher) title list price discounts.

**H5b (alt.).** Higher levels of value-adding service provided to consumers lead to supply chain sourcing locations at echelons farther away from (closer to) the consumer echelon.

*Convenience of shopping experience* measures the informational quality of transactions of individual CDs between sellers and online shoppers (Brynjolfsson & Smith, 2000). That is, it accounts for transaction-efficiency conditions stemming from the level of informational service associated with each title and bundled
with transaction-efficiency conditions determined by attributes of each title (Brynjolfsson & Smith, 2000; Smith et al., 2000). It also accounts for vertical product differentiation effects, stemming from quality in consumers’ browsing experience, that soften price competition (Shaked & Sutton, 1982) and allow Internet retailers to price products above their own marginal costs.

*Convenience of shopping experience* is measured by a title-level emergent construct encompassing four standardized variables. The first variable identifies the number of customer reviews available for a given CD at the corresponding Internet retailing site. The second variable incorporates the number of editorial reviews available for a given title at the Internet site. The third variable measures, for each CD, the number of other CD titles previously purchased by customers who have also bought the CD at hand through the corresponding Internet site. The fourth variable measures the percentage of tracks in a CD title for which sound clips are available at the Internet site.

*Reliability* is especially important, since an Internet transaction does not typically involve the simultaneous exchange of money and goods (Brynjolfsson & Smith, 2000; Smith et al., 2000). *Reliability* is incorporated as a site-level variable defined by the number of years the Internet retailing site has been in operation. It is anticipated that the greater the site’s longevity, the higher the perceived level of reliability by end consumers regarding the seller.

*Visibility* is a site-level construct measuring the availability of content to consumers, in accordance with the retailing site’s prominence on the Internet (Smith & Brynjolfsson, 2001). Consistent with seminal research in retailing power and market performance in consumer goods industries (Butters, 1977; Grossman & Shapiro, 1984; Porter, 1974), *visibility* also captures the ability of Internet retailers to build market power relative to upstream members of the supply chain. This power stems from retailers’ increased ability to influence consumers’ buying decisions. It also stems from having a strong and visible market image that can create demand for products sold by retailers and, consequently, assures profits to upstream supply chain members when selling their products through Internet retailers.

*Visibility* controls for transaction efficiency conditions in the model through an emergent construct determined by standardized measures of the site’s annual advertising expenditures (Smith et al., 2000) and the number of Internet sites with links pointing to the Internet site’s hostname (Bailey et al., 2002; Palmer, Bailey, & Faraj, 2000). Generalizability in the measurement of the number of Internet sites with links pointing to sites’ hostnames, also known as *links in*, is addressed by retrieving data from six different search engines: altavista.com, google.com, hotbot.com, infoseek.com/go.com, northernlight.com, and webtop.com, providing the greatest coverage of records (web pages and web sites) as of November 1, 2000 (Search Engine Watch, 2000).

**Moderating Variable: Channel Structures in Supply Chains Involving Internet Retailing**

A two-category variable accounts for channel-structure differences in supply chains involving Internet CD retailing, as defined by either bricks-and-clicks retailing sites or pure-play Internet retailing sites. From the theory section, it is expected that
Table 1: Internet retailing site sample.

<table>
<thead>
<tr>
<th>Internet Retailer</th>
<th>Pure-Play or Bricks-and-Clicks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazon.com</td>
<td>pure-play</td>
</tr>
<tr>
<td>Barnesandnoble.com</td>
<td>bricks-and-clicks</td>
</tr>
<tr>
<td>Borders.com</td>
<td>bricks-and-clicks</td>
</tr>
<tr>
<td>Gohastings.com</td>
<td>bricks-and-clicks</td>
</tr>
<tr>
<td>Artistdirect.com</td>
<td>pure-play</td>
</tr>
<tr>
<td>Bestbuy.com</td>
<td>bricks-and-clicks</td>
</tr>
<tr>
<td>Cduniverse.com</td>
<td>pure-play</td>
</tr>
<tr>
<td>Cdnow</td>
<td>pure-play</td>
</tr>
<tr>
<td>Netradio.com</td>
<td>pure-play</td>
</tr>
<tr>
<td>Samgoody.com</td>
<td>bricks-and-clicks</td>
</tr>
<tr>
<td>Tweec.com</td>
<td>bricks-and-clicks</td>
</tr>
<tr>
<td>800.com</td>
<td>pure-play</td>
</tr>
<tr>
<td>Cdworld.com</td>
<td>pure-play</td>
</tr>
<tr>
<td>Buy.com</td>
<td>pure-play</td>
</tr>
</tbody>
</table>

Multiday transaction efficiency, as defined by the causal relationship between list price discount and sourcing location, is more prominent in supply chains involving pure-play retailing sites than in supply chains involving bricks-and-clicks Internet retailers. This is summarized in H6:

H6. List price discount effects resulting from the title’s sourcing echelon in the supply chain are higher when Internet purchases are placed through pure-play retailers than when they are placed through bricks-and-clicks retailers.

Sampling and Data Collection Methodology

Archival data was collected, and it spanned a two-level research design including Internet retailing sites and CD titles. To that end, a sample of 14 U.S.-based CD-retailing sites, in Table 1, was assembled from listings provided by two preeminent Internet-based market agents: Gomez.com and Bizrate.com (Hamilton, 2000). Gomez and Bizrate offer comprehensive listings of representative and stable Internet sites. They list those U.S. retailers providing comprehensive customer service and selling CDs across the widest range of genres.

To address profit maximization conditions underlying the theoretical model, the sampled CD-retailing sites were limited to those owned by publicly traded firms. In terms of industry generalizability, these sites account for 91.39% of all Alexa visits to all retailing sites listed by Gomez and Bizrate. Moreover, to test H1 and H6, the retailing sites in the sample offered CD titles sourced from sellers across multiple supply chain echelons and included pure-play and bricks-and-clicks Internet retailers.

To ensure generalizability at the title level and account for portfolio-purchasing trends typical of hedonic products (Moe & Fader, 2001), a sample of 840 CDs was gathered. The CDs are uniformly available across the sites studied. They were randomly sampled in part from a catalog published by EveryCD.com,
which includes 115,000 titles, released over the past 20 years, produced by 600 record labels, and spanning 300 genres.

The EveryCD catalog was last published in March 2000. Since data collection was carried out from October 25 to December 12, 2000, complementary CD sampling sources were used to ensure consistency with purchase patterns by end consumers involving newly released and popular titles. Therefore, as part of the 840 titles, 235 titles released from November 7 to December 12, 2000, were also sampled from ICE Magazine—a monthly publication that compiles all new CD releases in the United States. Furthermore, the Billboard Top-100 titles for the week of December 2, 2000, were included as part of the sample of 840 CDs.

To ensure independence across observations, each retailing site was exclusively assigned 60 randomly selected titles from the 840-title sample. In allocating the titles to the retailing sites, 20 out of the 60 titles in each retailing site corresponded to units released over the previous 18 months. This title distribution reproduces demand conditions in the music CD industry (Reilly, 1997). Information on the titles, artist names, sound tracks, labels, catalog codes, and universal product codes ensured that each of the titles assigned to the 14 sites matched the titles in the EveryCD catalog, the Billboard Top-100 list, and ICE Magazine and the product information obtained from the Internet retailing sites and MySimon.

STATISTICAL ANALYSIS AND RESULTS

Given the nature of the empirical model, the statistical analysis uses a multilevel SEM (structural equation model), spanning titles and retail sites, and a maximum likelihood estimation method, while following Anderson and Gerbing’s (1988) two-step procedure. Figure 4 presents the structural equation model’s measurement and structural portions. The model’s parameter values are estimated using EQS 5.7 (Bentler, 1995; Bentler & Wu, 1995). Thus, consistent with EQS notation, Figure 4 includes asterisks denoting the unknown parameters and abbreviated labels for each of the observed variables, latent factors, and emergent constructs.

From guidelines by Mueller (1997), Byrne (1994), and Wolfe (1985), the theoretical relationships developed above form the basis for the model’s structural portion. The causal effects in the model are based on the hypothesized influences of seven determinants on transaction efficiency, defined by list price discount. As part of the group of seven determinants, sourcing location—a title-level variable capturing the titles’ supply chain position at the time Internet-based consumer purchases take place—is the determinant of interest in the model. The remaining six determinants are control variables.

The model also accounts for sourcing-location endogeneity—from the six exogenous transaction efficiency determinants. It also includes a covariance path from latent variable title demand popularity to convenience of shopping experience. It is expected that as title popularity increases, the amount of information offered by the Internet site and, consequently, the levels of convenience of shopping experience increase as well. Also, it includes covariance paths among the variables measuring value-adding service—visibility, reliability, and convenience of shopping experience—and the retail-level variables.
**Figure 4:** Structural equation model in EQS notation†.

- **V1**—List Price Discount
- **V2**—Sourcing Location
- **F1**—Title Demand Popularity
- **V3**—Amazon’s CD Sales Ranking
- **V4**—Amazon’s Number of Customer Reviews
- **V5**—Number of MySimon Merchants
- **V6**—Title Demand Uncertainty
- **V7**—Convenience of Shopping Experience
- **F2**—Market Scope
- **V8**—Alexa Visits
- **V9**—Annual Revenues
- **V10**—Market Breadth
- **V11**—Reliability
- **V12**—Visibility

†Model is overidentified with 39 degrees of freedom (78 unique variance-covariance coefficients minus 39 unknown parameters)
Table 2: Title-level measurement model: Title demand popularity.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Loading on Title Demand Popularity (F1)</th>
<th>R^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amazon’s CD Sales*</td>
<td>1.000**</td>
<td>0.381</td>
</tr>
<tr>
<td>Amazon’s Number of Customer Reviews</td>
<td>0.883 (9.996***)</td>
<td>0.270</td>
</tr>
<tr>
<td>Number of MySimon.com Merchants</td>
<td>1.213 (11.178***)</td>
<td>0.507</td>
</tr>
</tbody>
</table>

Z statistics are in parentheses.

*Mirror image of Amazon’s CD Sales Ranking. This measure prevents indeterminacy from developing in the CFA.

**The loading was fixed to 1 to scale the factor.

***Denotes loading statistical significance at the 0.05 level.

The accurate measurement of sampling variance under the research design’s multilevel conditions requires hypothesis evaluation across two variability components (Hox, 1998; Kish, 1965). The first component involves title-level variability within each of the retail sites and pooled across all sampled SKUs (stock keeping units). This intra-Internet-seller covariance analysis accounts for deviation of title-level variables from their corresponding seller mean and across all sellers under consideration. The second component corresponds to retail-level variability. It assesses variability among Internet sellers of the averaged title-level variables within each site and the individual values of the retail-level variables. Thus, two covariance models are studied to test the hypotheses: one at the title/intraseller level and a second at the retail/interseller level of covariation. In following Anderson and Gerbing’s (1988) procedure, the measurement models at both levels are first assessed.

Measurement Model

A CFA was first performed for the title-level model, which contains a single latent construct, title demand popularity. Preliminary results suggest a statistically reliable level of predictability and measurement quality in the CFA (Table 2). All R^2 values are above 0.27 and all factor loadings are significant (p < 0.0001). The significant factor loadings provide evidence of convergent validity (Anderson & Gerbing, 1988). Further, none of the standardized residuals is above 2.0 or below −2.0, providing evidence of construct unidimensionality (Steenkamp & Van Trijp, 1991).

Discriminant validity assessment between title demand popularity and convenience of shopping experience involved a chi-square difference test on the values obtained for two models (Anderson & Gerbing, 1988). In the first model, the estimated correlation parameter between title demand popularity and convenience of shopping experience was constrained to equal 1.0. In the second model, the correlation parameter was allowed to take on any value. The chi-square difference test between these two models showed that the fit measure of the first (constrained) model was significantly worse (at the 0.05 level) than the fit measure of the second (unconstrained) model. This result provides a strong indication of discriminant validity in the factor analysis model. Reliability was assessed by examining the
Table 3: Pooled variance-covariance matrix: Title-level variables and covariation.

<table>
<thead>
<tr>
<th>Scaling Factor</th>
<th>V1</th>
<th>V2</th>
<th>V3</th>
<th>V4</th>
<th>V5</th>
<th>V6</th>
<th>V7</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.500</td>
<td>V1-List Price Discount</td>
<td>0.309</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.200</td>
<td>V2-Sourcing Location</td>
<td>0.005</td>
<td>0.635</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.3 x 10^-6</td>
<td>V3-Amazon’s CD</td>
<td>-0.062</td>
<td>0.105</td>
<td>0.310</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 x 10^-3</td>
<td>V4-Amazon’s Number of MySimon Merchants</td>
<td>0.056</td>
<td>-0.049</td>
<td>-0.065</td>
<td>0.341</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.077</td>
<td>V5-Number of MySimon Customers</td>
<td>0.045</td>
<td>-0.112</td>
<td>-0.138</td>
<td>0.134</td>
<td>0.343</td>
<td></td>
</tr>
<tr>
<td>3.3 x 10^-4</td>
<td>V6-Title Demand Uncertainty</td>
<td>0.061</td>
<td>-0.046</td>
<td>0.002</td>
<td>0.041</td>
<td>-0.003</td>
<td>0.346</td>
</tr>
<tr>
<td>0.500</td>
<td>V7-Convenience of Shopping Experience</td>
<td>0.050</td>
<td>-0.128</td>
<td>-0.157</td>
<td>0.135</td>
<td>0.208</td>
<td>-0.027</td>
</tr>
</tbody>
</table>

ratio between the amount of standardized variance/covariance explained by title demand popularity and total variance. This ratio of 0.652 compares favorably with the 0.50 benchmark prescribed by Fornell and Larcker (1981).

Next, a CFA was performed at the retail level. Two latent variables were examined: title demand popularity and market scope (F1 and F2 in Figure 4). In this instance, the title-level indicators for title demand popularity are averaged at the retail site level, while the market scope indicators are individually measured at the retail site level. With a comparative fit index (CFI) of 0.995 and a root mean square error of approximation (RMSEA) of 0.005, this portion meets the fit criteria furthered by Hu and Bentler (1999). Evidence of convergent validity (Anderson & Gerbing, 1988) is provided by all factor loadings being significant (p < 0.0001). None of the standardized residuals is above 2.0 or below −2.0, providing evidence of construct unidimensionality (Steenkamp & Van Trijp, 1991). Finally the reliability ratios, 0.48 and 0.83 for title demand popularity and market scope compare favorably with the 0.50 benchmark proposed by Fornell and Larcker (1981).

Structural Analysis at the Title Level

Having confirmed the adequacy of the title-level measurement model, this section studies the impact of title demand uncertainty, convenience of shopping experience, title demand popularity, and sourcing location on list price discount. Also, it assesses the effect of title demand uncertainty, convenience of shopping experience, and title demand popularity on sourcing location. Finally, it identifies moderation in the sourcing location—list price discount link, resulting from alternate channel structures.

The title-level analysis tests the hypotheses in accordance with the model in Figure 5 and based on omnibus variance and covariance coefficients among the seven observed title-level variables, pooled across the retail sites (Table 3). The coefficients were calculated using Muthén’s Pseudobalanced Approach (Hox, 1995; Muthén, 1989). They measure covariance among all title-level-variable observations across all titles and with reference to the mean of the title-level observations.
**Figure 5:** Title-level structural equation model.
in the Internet retailer where each title was assigned. To obtain similar standard deviations across the seven observed variables and facilitate a more efficient fitting of the model-implied covariance matrix, the scaling factors presented in the first column of Table 3 were used.

The results from the title-level analysis are presented in Figure 6. With a CFI of 0.955, a standardized root mean squared residual (SRMSR) of 0.032, and an RMSEA of 0.060, the model fits the data quite well according to standards by Hu and Bentler (1999).

The statistical results of the hypothesis testing are briefly summarized next, while a discussion of the results and their implications is presented in the next section. The standardized path coefficients (in Figure 6) represent the strength of the potential relationships between constructs, and are used to test the study’s hypotheses, as outlined in Figure 5.

The path coefficient from sourcing location to list price discount is positive and significant, providing support for H1. This implies that Internet-mediated purchases by consumers allow for greater transaction efficiencies—in terms of list price discounts—as product ownership is postponed to echelons upstream in the supply chain (i.e., farther away from the consumer echelon) until demand for the product is received. This effect represents a transaction-efficiency improvement above and beyond intrinsic transaction efficiencies determined by Internet-site and product attributes.

The analysis also supports H3a and H3b. The path coefficients from title demand popularity to list price discount and to sourcing location are, respectively, positive and negative and both are significantly different from zero at the 0.05 level.

The path coefficients between convenience of shopping experience and list price discount and sourcing location are not statistically significantly different from zero. They do not support H5a and H5b. Nevertheless, the positive and significant covariance path coefficient between convenience of shopping experience and title demand popularity suggests, a posteriori, that convenience of shopping experience can have a positive effect on supply chain transaction efficiency, but only in association with title demand popularity.

The positive and significant path coefficient from title demand uncertainty to list price discount is contrary to H2a. This finding, which suggests that increases in CD times in market may lead to reductions (as opposed to increases) in list price discounts, may result from industry-wide transaction efficiency, based on reduced seller opportunism, and stemming from a limited ability by sellers to collude during the earlier demand stages for a CD, when product supply and price elasticity are high (Bliss, 1988; Latcovich & Smith, 2001; Rottemberg & Saloner, 1986).

It is important to note that the resulting path coefficients in Figure 6 do not account for potential pricing effects related to the level of supply chain power posed by each of the retailing organizations and by the music labels producing the 840 CD titles analyzed. It can be argued that, relative to small and market niche-oriented Internet retailers and music labels, large and mainstream Internet retailers and music labels have a greater ability to extract transaction costs from other members of the supply chain, including consumers.
Figure 6: Standardized structural equation model results: Structural analysis at the title level.

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Variance</th>
<th>Dependent Variable</th>
<th>R² Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>0.273*</td>
<td>List Price Discount</td>
<td>0.114</td>
</tr>
<tr>
<td>E2</td>
<td>0.564*</td>
<td>Supply Chain Sourcing Location</td>
<td>0.111</td>
</tr>
<tr>
<td>E3</td>
<td>0.192*</td>
<td>Amazon’s CD Sales</td>
<td>0.381</td>
</tr>
<tr>
<td>E4</td>
<td>0.249*</td>
<td>Amazon’s Number of Customer Reviews</td>
<td>0.270</td>
</tr>
<tr>
<td>E5</td>
<td>0.169*</td>
<td>Number of MySimon Merchants</td>
<td>0.507</td>
</tr>
<tr>
<td>Title Demand Uncertainty</td>
<td>0.346*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title Demand Popularity</td>
<td>0.118*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convenience of Shopping Experience</td>
<td>1.020*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dashed arrows denote paths for which coefficients are not significantly different from zero at the 0.05 level. The model was also analyzed while partialing out for effects of music label and Internet retailer power in the supply chain. No significant changes with respect to the results from the model presented in this paper were detected.

*p < 0.05

**Path coefficient was originally set equal to 1 in order to scale the latent factor.

***To avoid indeterminacy problems, Amazon’s CD Sales—a mirror image of Amazon’s CD Sales Ranking—was used.
In the economics literature, power has been associated with market share (e.g., Clarke, Davies, & Waterson, 1984; Rhoades, 1985). Similarly, power has been expressed in the strategic management literature as a function of seller concentration (Burgess, 1982; Cowley, 1985). Correspondingly, to account for this effect, a measure of power exhibited by each music label was incorporated in the title-level analysis through the number of units sold online by each label during the second semester of 2000 through Baker and Taylor—one of the two major music wholesalers (along with Ingram) in the United States. A higher sales volume measure by a music label would be reflective of a higher level of supply chain power by the label. Furthermore, a measure of Internet retailer power was incorporated in the title-level analysis through a measure capturing the percentage of total sales volume for each sampled Internet retailer in fiscal year 1999.

The title-level analysis was repeated, while partialing out for effects on the title-level model stemming from the measured level of power leveraged by each label producing each of the CD titles sampled. Independently, the title-level model was replicated, while partialing out for effects stemming from the measured level of power leveraged by each sampled Internet retailer. As indicated at the bottom of Figure 6, the results in both of these analyses did not provide statistically significantly different structural path coefficients, relative to the model in Figure 6. These sets of results are available from the authors upon request.

To test the differences in the structural path coefficient proposed by H6, a two-group structural equation model was analyzed using the variance-covariance matrices among the seven observed title-level variables in Figure 5 and pooled across each of two sample groups: bricks-and-clicks and pure-play internet retailing sites. This methodology follows from Bollen (1989) and Byrne (1994). Its results for both group models are presented in Figure 7.

Each group’s fit adequacy was separately evaluated based on the model in Figure 5 (Byrne, 1994). The resulting chi-square measures are 19.699 and 31.025 for the bricks-and-clicks and the pure-play Internet retailing groups, respectively. With CFIIs of 0.951 and 0.955, SRMRs of 0.036 and 0.039, and RMSEAs of 0.058 and 0.072, respectively, both structural equation models for the bricks-and-clicks and pure-play group samples fit the data quite well according to standards by Hu and Bentler (1999).

With the model fit adequacy validated, the two-group structural equation model was then evaluated while constraining the path coefficient between sourcing location and list price discount to be equal across both group samples (Bollen, 1989; Byrne, 1994). The sum of the chi-square fit measures for the individual models involving the pure-play (31.025) and the bricks-and-clicks (19.699) retailing groups is 50.694 (with df = 18), while the chi-square fit measure for the two-group structural equation model with the constrained path coefficient between sourcing location and list price discount is 79.557 (df = 19). Together, these values suggest that the models’ fit measures are significantly different from each other ($\chi^2_{\text{difference}} = 79.557 - 50.694 = 28.863$, 1 df, $p < 0.0001$). Further, from the standardized path coefficients in Figure 7 the coefficient from sourcing location to list price discount equals 0.338 for pure-play Internet retailers and $-0.045$ (not significantly different from zero) for bricks-and-clicks retailers when analyzing both sampling groups’ models separately. Together, these results provide support for H6. The causal effect
Figure 7: Standardized structural equation model results: Title-level models for bricks-and-clicks and pure-play Internet retailers.

Standardized path coefficients corresponding to the bricks-and-clicks Internet retailer group are underlined. Standardized path coefficients corresponding to the pure-play Internet retailer group are in bold font.

*Path coefficient was originally set equal to 1 in order to scale the latent factor.

*To avoid indeterminacy problems, Amazon’s CD Sales—a mirror image of Amazon’s CD Sales Ranking—was used.

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Variance</th>
<th>Variance</th>
<th>Dependent Variable</th>
<th>R² Value</th>
<th>R² Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>0.363*</td>
<td>0.169*</td>
<td>List Price Discount</td>
<td>0.094</td>
<td>0.290</td>
</tr>
<tr>
<td>E2</td>
<td>0.756*</td>
<td>0.400*</td>
<td>Supply Chain Sourcing Location</td>
<td>0.137</td>
<td>0.115</td>
</tr>
<tr>
<td>E3</td>
<td>0.180*</td>
<td>0.193*</td>
<td>Amazon’s CD Sales</td>
<td>0.367</td>
<td>0.404</td>
</tr>
<tr>
<td>E4</td>
<td>0.178*</td>
<td>0.297*</td>
<td>Amazon’s Number of Customer Reviews</td>
<td>0.195</td>
<td>0.310</td>
</tr>
<tr>
<td>E5</td>
<td>0.139*</td>
<td>0.192*</td>
<td>Number of MySimon Merchants</td>
<td>0.537</td>
<td>0.489</td>
</tr>
<tr>
<td>Title Demand Uncertainty</td>
<td>0.550*</td>
<td>0.193*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title Demand Popularity</td>
<td>0.105*</td>
<td>0.130*</td>
<td></td>
<td>0.342*</td>
<td>0.326*</td>
</tr>
<tr>
<td>Convenience Shopping Exp.</td>
<td>0.587*</td>
<td>1.344*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
from sourcing location to list price discount is statistically significantly stronger for pure-play sellers than for bricks-and-clicks sellers.

Secondary statistically significant differences between pure-play and bricks-and-clicks retailers were assessed both multivariately—following the chi-square fit approach outlined above—and univariately, through Lagrange multiplier (LM) tests (Bollen, 1989). The results from the two-group structural equation model suggest that, relative to bricks-and-clicks competitors, pure-play Internet retailers have developed a closer link between convenience of shopping experience and title demand popularity. On the other hand, bricks-and-clicks retailers exhibit a closer association between title demand popularity and sourcing location than pure-play Internet retailers do. That is, CD popularity levels are more important in the sourcing decisions by bricks-and-clicks retailers than in the sourcing decisions by pure-play Internet sellers. Finally, title demand uncertainty exhibits a heavier influence on list price discount in the pure-play group than in the bricks-and-clicks group. Specifically, the amount of time a title has been in the market is a major determinant of transaction efficiency for pure-play Internet retailers, but not for bricks-and-clicks retailers.

**Structural Analysis at the Retail Level**

This stage evaluates variability among Internet sellers across the title-level and retail-level variables. Specifically, it is verified whether retail-level variability moderates (amplifies or lessens) the values of list price discount and sourcing location, and whether it validates or rejects their corresponding testable hypothesis. To accomplish this goal, this stage of the analysis incorporates a covariance structure that accounts for interseller variability of the title-level variables, averaged at the retail-site level. Also, the covariance structure accounts for interseller variability of the individual retail site–level variables. This covariance structure is synthesized in the correlation matrix in Table 4.

Following guidelines by Hox (1995), the remainder of this section presents the null model. This model assesses the importance of interseller covariation in explaining causal relationships among the title-level variables in the model defined in Figure 5. Subsequently, this section presents the between-retailing-site model assessing structural interseller-level covariation based on both title-level and retail-level variables, in accordance with Figure 4.

**The null model**

This model evaluates how significantly the tests for H1, H2a (H2b), H3a (H3b), and H5a (H5b) diverge between interseller covariation and intraseller covariation measures. To that end, the null model relies on a two-group SEM with a path configuration involving only title-level variables, linked in accordance with the model in Figure 5.

Two different groups of path coefficients are compared. The first group is defined by covariation among sellers and it is based on the correlation-coefficient matrix in Table 4. The coefficients in this matrix were calculated using Muthén's pseudobalanced approach (Hox, 1995; Muthén, 1989). They provide, for each Internet retailer, a measure of covariance for the title-level variables with respect
Table 4: Retail-level correlation matrix: Title-level and retailing site–level variables.

<table>
<thead>
<tr>
<th></th>
<th>V1</th>
<th>V2</th>
<th>V3</th>
<th>V4</th>
<th>V5</th>
<th>V6</th>
<th>V7</th>
<th>V8</th>
<th>V9</th>
<th>V10</th>
<th>V11</th>
<th>V12</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1-List Price Discount*</td>
<td>1.000</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>V2-Sourcing Location*</td>
<td>0.315</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>V3-Amazon's CD Sales Ranking*</td>
<td>−0.046</td>
<td>−0.393</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>V4-Amazon's Customer Reviews*</td>
<td>0.177</td>
<td>−0.130</td>
<td>−0.388</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>V5-Number of MySimon Merchants*</td>
<td>0.371</td>
<td>0.198</td>
<td>−0.143</td>
<td>0.254</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>V6-Title Demand Uncertainty*</td>
<td>0.138</td>
<td>0.349</td>
<td>−0.264</td>
<td>0.256</td>
<td>−0.094</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V7-Convenience Shop. Experience*</td>
<td>−0.351</td>
<td>−0.137</td>
<td>0.299</td>
<td>−0.200</td>
<td>0.081</td>
<td>0.054</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V8-Alexa Visits**</td>
<td>−0.398</td>
<td>0.011</td>
<td>−0.009</td>
<td>−0.018</td>
<td>0.129</td>
<td>0.014</td>
<td>0.762</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V9-Annual Revenue**</td>
<td>−0.487</td>
<td>−0.230</td>
<td>0.101</td>
<td>−0.339</td>
<td>−0.471</td>
<td>0.150</td>
<td>0.104</td>
<td>−0.071</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V10-Market Breadth**</td>
<td>−0.348</td>
<td>−0.181</td>
<td>−0.255</td>
<td>0.097</td>
<td>0.230</td>
<td>−0.229</td>
<td>0.456</td>
<td>0.669</td>
<td>−0.011</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V11- Reliability**</td>
<td>−0.512</td>
<td>−0.169</td>
<td>0.302</td>
<td>−0.432</td>
<td>−0.114</td>
<td>0.198</td>
<td>0.603</td>
<td>0.249</td>
<td>0.397</td>
<td>−0.060</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>V12- Visibility**</td>
<td>−0.505</td>
<td>−0.014</td>
<td>0.079</td>
<td>−0.252</td>
<td>−0.058</td>
<td>0.094</td>
<td>0.639</td>
<td>0.820</td>
<td>0.186</td>
<td>0.620</td>
<td>0.389</td>
<td>1.000</td>
</tr>
</tbody>
</table>

*Title-level variables
**Retail-level variables
Table 5: Comparison of path coefficients at title and retail levels of covariation.

<table>
<thead>
<tr>
<th>Constrained Path</th>
<th>Stand. Path Coefficient (Title Level)</th>
<th>Stand. Path Coefficient (Retail Level)</th>
<th>$\chi^2$ Value</th>
<th>Probability*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title Demand Popularity $\rightarrow$ Sourcing Location</td>
<td>-0.312</td>
<td>0.249</td>
<td>0.046</td>
<td>0.829</td>
</tr>
<tr>
<td>Convenience of Shopping Experience $\rightarrow$ Sourcing Location</td>
<td>-0.017</td>
<td>-0.176</td>
<td>0.174</td>
<td>0.677</td>
</tr>
<tr>
<td>Title Demand Uncertainty $\rightarrow$ Sourcing Location</td>
<td>-0.093</td>
<td>0.382</td>
<td>0.481</td>
<td>0.488</td>
</tr>
<tr>
<td>Title Demand Popularity $\rightarrow$ List Price Discount</td>
<td>0.311</td>
<td>0.384</td>
<td>0.625</td>
<td>0.202</td>
</tr>
<tr>
<td>Convenience of Shopping Experience $\rightarrow$ List Price Discount</td>
<td>-0.028</td>
<td>-0.368</td>
<td>1.650</td>
<td>0.199</td>
</tr>
<tr>
<td>Title Demand Uncertainty $\rightarrow$ List Price Discount</td>
<td>0.192</td>
<td>0.151</td>
<td>1.176</td>
<td>0.278</td>
</tr>
<tr>
<td>Sourcing Location $\rightarrow$ List Price Discount</td>
<td>0.126</td>
<td>0.133</td>
<td>2.059</td>
<td>0.151</td>
</tr>
</tbody>
</table>

*Probability that the difference in each path coefficient across the two covariation groups is equal to zero.

to the overall sample mean. This analytical approach is suitable when observations are independent from each other. The data in the analysis meets this condition, as titles are exclusively assigned to one and only one Internet retailer.

The second group is defined by title-level covariation within sellers, as specified by the matrix in Table 3. Although both groups of path coefficients are based on two separate sets of variance-covariance coefficients, to facilitate a more efficient fitting of the model-implied covariance matrix for both covariation groups, the standard deviations for the title-level variables—defined by covariation among and within sellers—were rescaled using the same corresponding factors listed in Table 3 (Hox, 1995).

The null model constrained all structural path coefficients across both groups. That is, path coefficients among sourcing location, list price discount, title demand popularity, convenience of shopping experience, and title demand uncertainty were forced to be equal across the path coefficients defined by interseller covariation and intraseller covariation.

From a multivariate perspective, the path coefficients linking the title-level variables in the model do not differ significantly across both covariation groups. The null model’s fit indices suggest an appropriate fit between the data and the model (CFI = 0.957, RMSEA = 0.035). Further, the difference between the chi-square values from the null model and the structural analysis at the title level is not significantly different from zero ($\chi^2_{\text{difference}} = 14.719, 16$ df). Finally, from a univariate perspective, statistical results from LM tests also indicate that the path coefficients do not differ significantly across both title- and retail-level covariation groups, at the 0.05 level. Table 5 presents standardized path coefficients for both covariation groups, along with the results from the LM tests.
Thus, in terms consistent with the empirical objectives of this research, the results from the null model confirm that pricing strategies and sourcing policies by each of the sampled Internet retailers do not moderate the relationship between list price discount and transaction efficiency. First, the results suggest that there is not a multivariate or a univariate significant divergence between retail-level and title-level covariation in empirically validating H1. That is, in online consumer purchases, transaction efficiency increases as product-sourcing locations are postponed farther upstream in the supply chain, at the time of the transaction. This efficiency effect holds for the sampled CD titles, irrespective of the Internet retailers sampled. Thus, each of the sampled retailers’ policies regarding the overall sourcing and pricing of music CDs do not appear to affect the impact on list price discounts from postponing supply chain sourcing locations of titles transacted with online shoppers.

The results from the null model also suggest that there is not a multivariate or a univariate significant divergence between retail-level covariation and the covariation at the title level of analysis in empirically validating H3a and H3b. Compact disc popularity leads to greater list price discounts and supply chain sourcing locations in echelons closer to the online consumer, irrespective of the sampled retailers’ policies on CD popularity assortment.

**Between-Retailing-Site Model**

The between-retailing-site model extends the null model by empirically evaluating the testable hypotheses involving retailing site-level variables, exclusively. To that end, it evaluates H4a (H4b) and H5a (H5b), based on the causal linkages from (1) market scope and (2) visibility and reliability to sourcing location and list price discount (Figure 4).

The model builds on a matrix with covariance coefficients among all observed title- and retail-level variables. The coefficients result solely from interseller correlation in Table 4. Also, as was the case in the title-level analysis, standard deviations across the variables were rescaled to facilitate a more efficient fitting of the model-implied covariance matrix.

The structural model, along with the standardized path coefficients, correlation coefficients, independent variable variances, and error paths did not empirically validate H4a (H4b) and H5a (H5b) at the retail level of analysis. The path coefficients stemming from market scope, visibility, and reliability were not significantly different from zero.

Thus, market scope—reflected in Internet traffic, number of product segments in which Internet retailers compete, and revenues—was not found to be a determinant of the overall efficiency of transactions with consumers over the Internet. Furthermore, the level of experience of Internet retailers, a measure of reliability, was not found to affect the overall level of list price discounts offered to online shoppers or retailers’ decisions on the echelons from where titles transacted with online shoppers are sourced. Finally, the visibility of Internet retailers, and its associated level of content availability to online consumers and market power relative to upstream supply chain members, did not appear to be relevant in retailers’ decisions regarding the level of discounts and supply chain sourcing locations for titles transacted with online shoppers.
Table 6: Summary of empirical tests: Title-level and retail-level hypotheses.

<table>
<thead>
<tr>
<th>Summarized Testable Hypotheses</th>
<th>Title-Level Covariation</th>
<th>Retail-Level Covariation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H1:</strong> Upstream supply chain sourcing location leads to higher list price discount</td>
<td>Validated</td>
<td>Validated</td>
</tr>
<tr>
<td><strong>H2a:</strong> Higher title demand uncertainty leads to lower list price discount</td>
<td>Not Validated</td>
<td>Not Validated</td>
</tr>
<tr>
<td><strong>H2b:</strong> Higher title demand uncertainty leads to upstream supply chain sourcing location</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>H3a:</strong> Higher title demand popularity leads to higher list price discount</td>
<td>Validated</td>
<td>Validated</td>
</tr>
<tr>
<td><strong>H3b:</strong> Higher title demand popularity leads to downstream supply chain sourcing location</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>H4a (alt.):</strong> Greater market scope leads to higher (lower) list price discount</td>
<td>Not Applicable*</td>
<td>Not Validated</td>
</tr>
<tr>
<td><strong>H4b (alt.):</strong> Greater market scope leads to downstream (upstream) supply chain sourcing location</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>H5a (alt.):</strong> Higher value adding service leads to lower (higher) list price discount</td>
<td>Not Validated</td>
<td>Not Validated</td>
</tr>
<tr>
<td><strong>H5b (alt.):</strong> Higher value adding service leads to upstream (downstream) supply chain sourcing location</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>H6:</strong> List price discount effects from supply chain sourcing location are higher for pure-play than for bricks-and-clicks Internet retailers</td>
<td>Validated</td>
<td>Validated</td>
</tr>
</tbody>
</table>

*The hypothesis cannot be tested at the title level, because it involves an effect from a retail-level variable, market scope.

Table 6 summarizes the outcomes of the empirical evaluation for the model’s six testable hypotheses. Overall, support for H1, H3a, H3b, and H6 was found at either the title or the retail levels of covariation. No support for H2a (H2b) and H5a (H5b), at either the title or the retail levels of covariation, was obtained. Finally, H4a (H4b) could not be validated at the retail level of covariation.

CONCLUSION

By focusing on the music CD retailing industry on the Internet, this paper extends prior research in four ways. First, it empirically examines transaction efficiency originating from consumers’ Internet-based purchases in a supply chain setting, as opposed to a dyadic setting. Second, in measuring supply chain transaction efficiency it accounts for differences in channel structures involved in the fulfillment of Internet-based purchases. Third, methodologically, it provides the highest possible level of result generalizability at both the transaction (title-level) and the seller (retail-level) unit of analysis. Hypotheses were evaluated through a
two-level structural equation model, involving title- and seller-level covariation. This transaction-efficiency assessment simultaneously controls for title-level transaction efficiency effects from demand uncertainty, popularity (capturing asset specificity in the transactions), and convenience of shopping experience (capturing opportunism and frequency of transactions) pertaining to each of the titles in the sample. Finally, the two-level analysis enables hypothesis testing at the retail level of analysis while simultaneously accounting for transaction-efficiency-related measures of market scope, visibility, and perceived reliability concerning each of the studied retail sites.

Five conclusions emerge from this paper. First, in online consumer purchases, transaction efficiency increases as the ownership of inventory involved in the transaction is postponed farther upstream in the supply chain, at the time the transaction takes place. Inventory-ownership postponement facilitates the disintermediation of downstream supply chain echelons from Internet retailing transactions with consumers, minimizing the number of echelons and, consequently, the overall level of transaction costs in the supply chain. In the context of this research, retailers may use the Internet to postpone inventory ownership to wholesalers or even music labels and fulfill consumer orders without incurring stockout or backorder costs. By doing this, retailers disintermediate echelons from the inventory-ownership sequence necessary to fulfill online consumer orders. The empirical results in this paper show that this supply chain management practice generates greater transaction cost savings, reflected in higher list price discounts, offered to consumers. Furthermore, this conclusion is analytically consistent with transaction cost and disintermediation theory.

Second, the paper found no evidence to suggest that the sampled retailers’ policies regarding the overall sourcing and pricing of music CDs affect the impact on list price discounts from postponing supply chain sourcing locations of titles transacted with online shoppers. Thus, a retailer’s reliance on drop-shipped inventory (owned by upstream supply chain firms) versus in-stock inventory (owned by the Internet retailer) to fulfill online orders was not found to be a moderating factor in the transaction-efficiency effect from inventory-ownership postponement to upstream supply chain echelons.

Third, supply chain power by each of the retailing and music label organizations involved in the empirical analysis was found to have no impact on transaction efficiency and list price discounts, in particular, offered to online shoppers. Thus, no evidence was found to suggest that the level of supply chain power exhibited by either an Internet retailer or a music label will alter Internet-enabled transaction-efficiency effects stemming from the postponement of inventory ownership to upstream supply chain echelons.

Fourth, the studied retailers’ market scope, level of experience—a measure of reliability—and on- and off-line visibility did not appear to be relevant in their decisions regarding the level of discounts and supply chain sourcing locations for titles transacted with online shoppers. It is possible that these attributes may provide retailers with lower marginal costs in their operations. However, this advantage does not appear to translate into higher title list price discounts than those provided for inventory owned by wholesalers and music labels.

Fifth, transaction efficiency is larger when consumers buy from a pure-play Internet retailer instead of a bricks-and-clicks retailer. From the empirical model,
the effect of inventory-ownership postponement to upstream supply chain echelons on the level of list price discount offered to consumers is statistically significantly stronger for pure-play sellers than for bricks-and-clicks sellers.

These five conclusions provide valuable technology and supply chain management implications regarding the application of the Internet as an interface to transact with end consumers.

**Technology Management Implications**

Fundamentally, the results in this paper imply that the implementation of the Internet as a mediating technology in transactions with consumers provides decision makers in retailing organizations with important avenues for realizing higher transaction efficiencies across their supply chains. Thus, through inherent transaction-efficient attributes associated with Internet-mediated exchanges with consumers, decision makers in retailing organizations can achieve higher supply chain transaction efficiencies through order fulfillment policies based on multi-echelon inventory sourcing. These efficiencies become most evident when Internet-mediated transactions with consumers are fulfilled through inventory sourcing at echelons located at the upstream end of the supply chain.

This managerial practice can be conducive to not only firm-level sustainable competitive advantages, but also increased firm profitability. This is of special value in light of the fact that, at a market level, the Internet can subject participating retailing organizations to intense price competition (Bailey, 1998). This paradox exists because potential transaction-efficiency benefits of the Internet—making information widely available to all members in the supply chain, enabling sellers and buyers to find each other more easily, reducing the difficulty of transacting and purchasing, decreasing menu costs, and enabling product demand and prices to fluctuate in a more coordinated fashion—also make it more difficult for companies to capture those benefits as profits since these same benefits exacerbate price-based competition among firms (Bailey & Rabinovich, 2001; Porter, 2001). This competitive scenario, along with high levels of product standardization and homogeneity prevalent in the CD industry, underscores the importance of developing competitive advantages pertaining to the adoption of the Internet, based on lower supply chain management costs, in general, and multidyad transaction efficiency in particular.

**Supply Chain Management Implications**

The results also suggest that sellers’ level of reliance on the Internet, as a medium for conducting transactions with consumers, can yield configurations that are conducive to greater supply chain transaction efficiency. Specifically, relative to partial Internet adopters (bricks-and-clicks retailers), firms that fully rely on Internet-mediated exchanges with consumers (i.e., pure-play Internet retailers) appear to be better positioned to achieve greater transaction efficiencies stemming from the use of Internet technology. This is because supply chains supporting pure-play retailers depend on fewer structural and physical-asset distribution limitations and, consequently, allow for higher flexibility in transactions with consumers.

Also, pricing policies offered online by pure-play retailers are not bounded by pricing policies in offline retailing outlets. Bricks-and-clicks retailers, on the
other hand, may need to align their online and offline prices and, consequently, their list price discounts, in order to avoid cannibalization of sales from one channel to another. This alignment in pricing policies across channels may prevent bricks-and-clicks retailers from fully leveraging transaction efficiencies stemming from the use of Internet technology.

Consequently, the findings imply that a higher degree of freedom is present in inventory-sourcing decisions involved in the fulfillment of end consumer orders under a pure-play Internet retailing environment. This flexibility allows supply chain managers in this environment to more effectively pull inventory from upstream sources, coordinate pricing policies, and, therefore, position themselves as price setters, as opposed to price takers, in their transactions with consumers.

Also, the findings imply that multidyad transaction and operational efficiencies are both inextricably dependent on the channel configuration of the supply chain itself. Because transaction costs are reduced as firms eliminate exchanges through intermediaries in the supply chain, products that traverse a disintermediated supply chain will likely exhibit lower transaction costs. Further, this effect is amplified by the fact that the Internet may reduce transaction costs. However, because operational efficiency changes as the supply chain configurations change, supply chain managers involved with Internet retailing operations also need to consider their physical distribution channels’ structural configurations, as influenced by bricks-and-clicks versus pure-play Internet retailing, before changing the structure of multidyad exchanges in their supply chains.

Finally, the Internet-enabled benefits of disintermediating supply chain structural configurations depend on the nature of the product. As this research implies, product popularity often determines the sourcing of products at different points in the supply chain. Specifically, this research shows that transaction-efficiency advantages, in terms of list price discounts, across distribution channel structures supporting pure-play and bricks-and-clicks Internet retailing operations are reduced for highly popular products. Therefore, to reach the highest potential transaction efficiency effects from Internet-mediated transactions, managers should consider emphasizing pull-driven sourcing mechanisms—through relationships between sellers placed nonsequentially in the supply chain—for those products with low to moderate market demand levels.

**Further Research**

Although the empirical results provide a substantive performance analysis of the transaction mechanisms in supply chains supporting Internet retailing, this study nonetheless has several limitations. First, the research is performed at a relatively early stage in the development of the Internet as a medium for conducting retailing and wholesaling transactions. As a result, some of the industry conditions and transaction attributes considered may not correspond to the realities of Internet commerce in the future. Because they measure short-run, not long-run effects of the Internet, the evolution of these factors may modify the role that Internet purchases by end consumers have on the realization of supply chain transaction efficiencies.
Future longitudinal research efforts may concentrate on studying how changes in industry conditions and supply chain transaction attributes relate to the transaction-efficiency mechanisms analyzed. For example, research extensions may assess whether the transaction-efficiency conditions highlighted in this paper have contributed to the high failure-rate levels among Internet retailers observed in the past. Future research may also consider the long-run effect that the Internet-enabled transaction efficiencies studied in this paper have on the ability of upstream supply chain firms to develop new business processes that overlap with, or replace altogether, those processes initially developed by downstream supply chain firms. For example, research may study the role that transaction-efficiency mechanisms and conditions exposed in this paper have in the enhanced ability of music wholesalers to increasingly take responsibility for fulfillment services initially under the control of Internet retailers as an incentive to sell CD titles through the Internet retailers’ sites.

Second, the empirical evaluation is exclusively based on standardized, low-cost, and durable goods. Future research may analyze whether variable product and market segment characteristics generate disparities in transaction-efficiency levels in supply chains supporting Internet-based retailing operations.

Third, no direct insights are provided into the effects that Internet retailing site attributes, such as market scope, visibility, and reliability have on transaction efficiencies in Internet purchases. Given this study’s comprehensive coverage at the CD and the retailing site level, future research could extend to other markets analogous to the CD market, in terms of product standardization, costs, and durability conditions.

Fourth, the analysis does not consider the effect that logistics components of the value-adding service portfolio offered by Internet retailers have on transaction efficiency. It could be argued that logistics quality (e.g., faster, more reliable product delivery), brought about by supply chain coordination practices, enables Internet retailers to increase the disparity between their marginal costs and the prices they charge for products. Future research could address this issue by focusing on logistics service quality in Internet markets that involve commodity, standardized, and homogeneous products and that are prone to Bertrand competition.

Analogously, online purchasing decisions may heavily depend on distinctive logistics-service benefits offered by bricks-and-clicks retailers. For example, the ability to pick up products at nearby stores or the convenience of returning products to these stores may sway online shoppers to transact with bricks-and-clicks retailers and even pay a premium for the products transacted. Future research in this area could evaluate the relationship of these logistics service benefits and the divergence between product prices and marginal costs in Internet transactions between bricks-and-clicks retailers and consumers. [Received: December 17, 2001. Accepted: December 3, 2002.]

REFERENCES


**APPENDIX**

**Transaction Costs and Exchange Configurations: Single and Multidyad Settings**

Consider the sequential exchange among a wholesaler, a retailer, and an end consumer (Figure A1). The wholesaler, with predefined marginal costs, $MC_w$, supplies to the retailer $Q_w$ units—given by the intersection between $MC_w$ and the wholesaler’s marginal revenue curve ($MR_w$)—at a price $P_w$. This price is defined by the intersection of $Q_w$ with the wholesaler demand curve, $D_w$. The magnitude of the deviation of $D_w$ from $MR_w$ and, consequently, the $MC_w - P_w$ difference are directly proportional to the demand-side transaction costs incurred by the retailer when buying the product from the wholesaler. In turn, $P_w$ becomes the retailer marginal costs, $MC_r$. The retailer output, $Q_r$, results from the intersection between $MC_r$ and the retailer marginal revenue curve, $MR_r$. In turn, the price, $P_r$, that the retailer charges end consumers for $Q_r$ is defined by $Q_r$’s intersection with the retailer demand curve ($D_r$). The magnitude of the $D_r - MR_r$ divergence and, consequently, the difference between $MC_r$ and $P_r$ is proportional to the demand-side transaction cost level at the end consumer-retailer dyad.

The sequential transaction cost model could be analogously extended to include the producer-wholesaler exchange in Figure A1. In this case, the difference between the producer’s marginal costs, $MC_p$, and $P_r$ denotes the supply chain–long transaction costs. This value corresponds to the transaction costs accumulated through the product’s exchange process across the supply chain, starting from the producer and ending with the end consumer.

This is summarized in Equation (A1), where $d$ is the number of dyadic exchanges in the supply chain and $P_r - MC_p$ is the supply chain–long transaction costs. These costs result from intrinsic transaction characteristics and the
combination of market and hierarchy mechanisms at all dyads and are ultimately included in the price the end consumer pays for the product, $P_r$.

$$P_r - MC_p = \sum_{i=1}^{d} P_i - MC_i$$

$$= (P_p - MC_p) + (P_w - MC_w) + (P_r - MC_r) \quad (A1)$$

Furthermore, since $MC_p < MC_w$, the difference between $MC_p$ and $P_r$ is greater than the difference between $MC_w$ and $P_r$, denoted in Equation (A2):

$$P_r - MC_p > P_r - MC_w \quad (A2)$$

**Internet Technology and Multidyad Transaction Costs**

Figure A2 involves an Internet exchange between an end consumer and a wholesaler. In this case, the intersection between $Q_w$—given by $MC_w$ and $MR_w$—and $D_w$ define the per-unit Internet price charged to the consumer, $P_{wi}$.

The disparities between $MR_w$ and $D_w$ and $P_{wi}$ and $MC_w$ are proportional to the demand-side transaction costs in the wholesaler-end consumer exchange. Also, the $P_{wi} - MC_w$ disparity (in Figure A2) is expected to approach the magnitude of the initially defined $P_r - MC_r$ difference (in Figure A1), now on the Internet. This relationship, in Equation (A3), may result from Internet-enabled interoperable and open-standard communication settings that moderate intrinsic determinants of single-dyad transaction costs, for example, information asymmetry levels and opportunism (Arrow, 1969; Williamson, 1975).

$$P_{wi} - MC_w \approx P_{ri} - MC_r \quad (A3)$$
**Figure A2**: Nonsequential transaction costs: Internet-based exchanges between end consumers and wholesalers.

Furthermore, transaction costs originating in the wholesaler-retailer echelon (corresponding to the difference $P_w - MC_w$) may be minimized. Combined with Equation (A3), this aspect of Internet-based purchases by end consumers leads the authors to posit that, in an Internet environment, the resulting value of $P_{wi}$ is lower than the value of $P_{ri}$:

$$P_{wi} < P_{ri} \quad \text{(A4)}$$

Analogously, in Internet exchanges between end consumers and producers, interoperable and open-standard communication conditions are expected to preserve the magnitude of the difference between the Internet price charged by the producer, $P_{pi}$, and $MC_p$ close to the initially defined $P_r - MC_r$ difference (in Figure A1), now in an Internet setting:

$$P_{pi} - MC_p \approx P_{ri} - MC_r \quad \text{(A5)}$$

However, unlike end consumer–wholesaler exchanges, the exchange between the end consumer and the producer may minimize transaction costs originating in the producer-wholesaler echelon and the wholesaler-retailer echelon. Thus, the value of $P_{pi}$ is hypothesized to be lower than both the value of $P_{ri}$ and the value of $P_{wi}$:

$$P_{pi} < P_{wi} < P_{ri} \quad \text{(A6)}$$

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