Information Technology and Switching Costs

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Abstract

Switching costs, the real or perceived cost of changing product providers, has become increasingly important in information-intensive businesses. Reduced search and transactions costs have made it possible for customers to more readily evaluate alternative suppliers, increasing switching. At the same time, the high fixed cost structure of customer acquisition and operations in information-intensive businesses increases the impact of customer switching on profitability. Fortunately, the increasing availability of information and better decision technology has enabled firms to have greater understanding and control over switching costs, raising the ability of firms to manage switching costs. This paper presents a formal definition of switching costs, surveys the literature on information technology and switching costs, and discusses various ways firms may use to influence consumer switching costs. A framework for managing switching costs and customer retention is also provided along with a measurement framework for estimating the extent of customer lock-in.

1. Introduction

Switching costs, the perceived disutility a customer would experience from changing product or service providers, play a large and increasing role in competition and strategy in information technology markets and other information-intensive businesses. Many of these markets are characterized by a high fixed cost and a high cost of customer acquisition, but a low marginal cost of product delivery. Profitability in these markets is therefore driven by the size of the customer base and customer retention, which is at least partly determined by switching costs. As noted by Shapiro and Varian (1999):

> *"You just cannot compete effectively in the information economy unless you know how to identify, measure, and understand switching costs and map strategy accordingly*." (p. 133)

Switching costs can arise from a number of sources including contractual provisions, product characteristics, and the amount of information customers have about product alternatives. In addition, many information-based products exhibit network effects, where the value of adopting a technology increases with the number of other users adopting the same technology or the number of complementary products available. These network effects can also create significant barriers from switching to an alternative technology or network (Shapiro and Varian, 1999). To the extent that networks can exist within firms, such as when there are benefits from product compatibility among investments in the same or complementary technologies within the firm (Kats and Shapiro, 1985; Katz and Shapiro, 1994), these within-firm network effects can also act as switching costs (e.g., Greenstein, 1993).

While all markets can be affected by switching costs, there are several unique issues regarding customer retention in information or information technology based products, which we will collectively refer to as "information-intensive" markets. First, information-intensive markets often have fewer market inefficiencies that often represent the principal obstacle for customer switching. For instance, in markets with high search costs, consumers become "locked-in" because it is not efficient to search for alternatives. This is less likely to be relevant in markets where product information is readily available. Reduced information or transaction costs can

generally lower the cost of terminating or initiating a customer relationship, also affecting switching costs. Second, information-intensive products often have significant compatibility issues. On the one hand, interoperability of technology products can be extremely important, especially for complex technologies such as telecommunications gear or for enabling technologies such as operating systems or computer languages. However, the market has recognized this leading to a strong trend toward standardization, allowing users to mix-and-match products from different vendors. Thus, standards and the decisions associated with determining standardization strategies are often of special importance in information intensive industries. Finally, technologies employed in many information-intensive businesses often enable firms to obtain better information about their customers which is essential to any attempt to manage customer retention. For instance, "clickstream" data can enable the measurement of switching costs (see Section 5), and customer relationship management systems (CRM) can allow firms to tailor product offerings to enhance retention.

The literature on switching cost has been most extensively developed in economics and marketing. In economics, the emphasis has been on understanding the wide range of potential competitive implications of market-wide switching costs, principally from a theoretical perspective. For instance, switching costs have been tied to pricing, profitability, entry decisions, the formation of standards, and other issues considered in the economics of industrial organization (see e.g. Klemperer, 1995, Farrell and Klemperer, 2004). Some of the economic literature has made this more specific, such as switching costs due to product compatibility or network externalities (Katz and Shapiro, 1985) that are common in software markets (Bresnahan, 2001). There also have been a few empirical studies examining the market-wide implications of switching costs for credit cards (Ausubel, 1991; Calem and Mester, 1995; Stango, 2002), bank loans (Kim et al. 2003), bank accounts (Shy, 2002), cigarettes (Elzinga and Mills, 1998), breakfast cereal (Shum, 2002), and toll-free numbers (Viard, 2003). However, this literature has principally focused on switching costs that affect all providers in a market similarly (what we term "exogeneous switching costs") rather than placing emphasis on switching cost variations that arise from specific actions of individual firms ("endogeneous switching costs").

While not typically labeled switching costs as such, marketing scholars have also worked to understand the implications of switching cost from a customer behavior standpoint, emphasizing issues such as brand loyalty, repeat purchase behavior and customer retention. Much of the research here treats loyalty as an intrinsic characteristic of consumers and examines the implications of variations across consumers in loyalty. For example, Raju et. al. (1990) study how exogenous brand loyalty affects firms' pricing (or promotional) strategies. Recent research has also examined how loyalty impacts equilibrium prices in the setting where an intermediary ("clearinghouse") provides competitive product and price information and firms are faced with a strategic decision on whether or not to target price sensitive "shoppers" or "switchers" (Narasimhan, 1988; Baye, et. al. 2004; Baye and Morgan, 2004). Another strand of the literature, mainly empirical, focuses on the identification of loyal customers and switchers by constructing empirical models that can predict customer behavior (see e.g., Grover and Srinivasan, 1987).

Research in information systems has mostly followed the economic approach, but tends to be more application focused. For instance, researchers have considered switching cost measurement for online businesses (Chen and Hitt, 2002b), the role of product compatibility in creating switching costs in the market for telecommunications equipment (Forman and Chen, 2005; Chen and Forman, forthcoming), and the impact of switching costs and network effects on competition between online, traditional, and hybrid firms (Viswanathan, 2004).

Since comprehensive reviews of the switching costs literature already exist from both the economics (see Klemperer, 1995; Farrell and Klemperer, 2004) and marketing perspectives (Jacoby and Chestnut, 1978; Seetharam et al, 1999), our emphasis in this review will be on applications to information systems and technology issues. However, since these applications involve a blend of both economic and marketing approaches, we will also present a formal approach integrating these perspectives (drawn heavily from Chen, 2002).

The remainder of this review is organized as follows. Section 2 presents a formal definition of switching costs in an economic choice framework, which helps clarify some general points about switching costs. We review some major theoretical and empirical studies of IT and switching

cost as well as discuss related issues in Section 3. Section 4 points out the importance of endogenous switching costs in high-tech and information-intensive markets and discusses some instruments for influencing switching costs. We then provide a general framework for managing customer retention and consumer switching costs and a measurement framework for estimating the magnitudes of switching costs in Section 5, followed by general conclusions and a brief discussion on future research issues in Section 6.

2. Switching Cost: Definition and Measurement Issues

Switching cost is typically defined as the disutility a customer experiences in switching products or product providers.[1] These costs can include the cost to terminate an existing relationship, start a new relationship and any other costs, either explicit (e.g., contractual penalties) or implicit (e.g., risk aversion and uncertainty about new products) that makes deviating from past product choice more costly than staying with a previous choice.

To formally state this definition and explore its limitations we must introduce some notation. For this discussion we assume that consumers' preferences can be represented by a utility function that depends on the consumer and attributes of products. Let u_j^i to refer to the utility customer *i* receives from purchasing product *j* and use the notation S_{jk}^i to capture the switching cost of customer *i* switching from product *j* to product *k*. Here and throughout we will assume that switching costs are small relative to wealth so we can treat switching cost and utility as additively separable, and will focus on situation where there is unit demand.[2]

In a specific interval of time in a market, there are always new customers who enter the market for the first time, consumers who have adopted one or more existing products, and consumers who choose to abandon a product. We allow for the existence of costs for first adoption or market exit in our notation by defining a null product ($\varnothing$) which is also in the choice set. Although entrance and exist costs are not typically defined as switching cost in most models,

[1] To simply exposition we will refer to "products" as a product purchased from a particular product provider. Unless necessary, we will not make a separate distinction between the product and the product provider or between products and services.

[2] These assumptions are common in switching cost models. With unit demand, we avoid issues of purchase quantity for a single product as well as the possibility that multiple products are purchased. The same insights for the unit demand case generally apply to the more general case, but the notation becomes considerably more cumbersome.

these costs can also behave as switching costs. Following this setup, $S_{\varnothing k}$ can be interpreted as the adoption (or entrance) cost of product *k*, while $S_{k\varnothing}$ are the exit costs. If a consumer does not purchase a product, we normalize utility to zero ($u^i_{\varnothing} = 0$). We are interested in the implications of switching costs for customer behavior as this is the foundation for all the other competitive implications.

The simplest illustration of how switching costs affect choices requires a market with two consumers ($i \in [A, B]$) and two goods ($j \in [X, Y]$) and two periods (*t*=0,1). Let customer A represent a customer who has previously acquired product X, while customer B has not purchased any product in this market previously (period 0). For each customer, there are three choices in period 1, purchase X, purchase Y or exit the market (represented as purchasing the null product $\varnothing$). Utilities for different choices in period 1 are given by:[3]

Action	Consumer A	Consumer B
Purchase X	u^A_X	$u^B_X - S^B_{\varnothing X}$
Purchase Y	$u^A_Y - S^A_{XY} - S^A_{\varnothing Y}$	$u^B_Y - S^B_{\varnothing Y}$
No Purchase	$-S^A_{X\varnothing}$	0

While this formulation appears somewhat complex, the literature has adopted a convention where initial adoption and abandonment costs ($S^i_{\varnothing k}$ and $S^i_{j\varnothing}$) respectively are ignored and switching costs as assumed constant across products and consumers ($S^i_{jk} = S \; \forall i, j, k; j, k \neq \varnothing$). While ignoring adoption and abandonment costs is probably reasonable in a wide variety of settings, the assumption of constant switching costs across all choices can be restrictive. In particular, a key component of "customer retention strategy" is to create firm-specific switching costs or to identify customers who have unusually high switching costs. For instance, in online brokerage the firm can charge a fee to close an account or transfer assets, offer a subsidy for new customers transferring in from specifically named competitors, offer special programs to target

[3] The separation of utility and switching cost is reasonably provided there are no significant wealth effects (that is, consumers disutility of switching does not depend on their existing wealth). See also footnote 3.

"buy and hold" investors who have large portfolios that are cumbersome to move among brokers.[4] Thus, the assumption of constant switching cost rules out strategic choices that enable firms to modify their own switching costs, an issue we will return to later in this review. Nonetheless, imposing these assumptions yields the classic switching cost analysis:

Action	Consumer A	Consumer B
Purchase X	u_X^A	u_X^B
Purchase Y	$u_Y^A - S$	u_Y^B
No Purchase	0	0

For additional insights into this framework it is useful to consider product choice behavior in a discrete choice framework (McFadden, 1974). Without introducing extraneous technical details at this point, this formulation argues that the probability of choosing product *j* is proportional to utility.[5] Take consumer A, who is an existing customer of product X. The utilities she derives from purchasing X, Y and nothing are u_X^A, u_Y^A-S and 0, respectively. If she has not purchased any product before, the utilities she gets from X, Y and nothing would be u_X^A, u_Y^A and 0. Given these two utility sets, the alternative product (Y) is relatively unattractive to consumer A in period 1 because of their prior purchase of product X, even though the underlying products are the same before and after consumer A adopts X. In another words, customers are more likely to stay with an existing product since it provides greater utility relative to other non-adopted alternatives, even if the alternative product is identical in terms of non-switching cost utility (*u*). This is why switching cost is typically associated with other informal notions such as "stickiness", "lock-in", "customer retention" or increasing "repeat purchase" propensity.

[4] Another example of this behavior is a "competitive upgrade" that is common in software markets where a firm will subsidize customers of other firms products to switch.

[5] The simplest case is the logit model where the error term is independently and identically distributed across products and consumers with the "extreme value" distribution (that is, $prob.(\varepsilon_j \le \varepsilon) = e^{-e^{-\varepsilon}}, where -\infty < \varepsilon < \infty$). The choice probability of product *j* out of a larger set of size J is then given by: $p_j = \frac{e^{u_j}}{\sum_{l=1}^{J} e^{u_l}}$.

It should be noted that even the more general framework embeds an assumption about customer behavior that can be important: it assumes that customers do not make choices based on perceived future switching costs (i.e., consumers are myopic regarding future switching events). Most insights about switching cost and competition continue to hold if customers have rational expectations about future switching behavior (Farrell and Klemperer, 2004) or share a common expectation of the probability of future switching (see Chen, 2002, Ch. 2). However it can become important if we are interested in tradeoffs between customer acquisition and retention. High switching cost might favor customer retention but deter initial purchase if consumers are fully rational; there is no such tradeoff if customers are myopic and ignore future switching. Since firms can benefit from encouraging customers to be myopic about future switching, this may explain why contractual penalties for switching are often written "in small print" on new purchase contracts. The general tradeoff between acquisition, retention and attrition has been discussed in the literature (Chen and Hitt, 2002b), although the specific issue of customers perceptions of switching cost has not been fully explored and is an opportunity for future research.

This simple framework illustrates why it can be difficult to separate out the effects of product quality (increasing utility) or creating lock-in (increasing switching costs) in empirical data since they can behave in similar ways. Improving the quality of your product increases the utility of your product relative to others. Raising switching costs lowers the utility of other products for your existing customers. Thus, a firm can be successful at retaining customers either because they offer a superior product (at least for a specific set of consumers), or because they have high switching costs. Much of the managerial literature on customer retention uses retention rate as a measure of customer loyalty or consumer switching costs and does not make a distinction between switching cost and quality in driving retention (see. e.g., Reichheld and Schefter, 2000). This is perfectly reasonable if one is trying to predict future customer retention or compare retention across firms; it becomes problematic when one in interested in the drivers of customer retention or how investments in specific practices can improve (or decrease) retention. An excellent product can have poor sales if customers face high switching costs and most customers have already adopted alternatives. Similarly, a poor product can show excellent customer

retention if switching costs are high and switching costs may not matter at all during the initial introduction of a completely new product since there are no existing customers.

The difficulty in separating out switching cost from other drivers of product choice was highlighted in economic analysis of the Microsoft anti-trust case. The key question was whether Microsoft's dominant position is due to superior quality, switching costs or anti-competitive behavior (see Liebowitz and Margolis, 1999). While being successful due to quality or switching costs are both legal, the quality explanation is welfare promoting, while the switching cost explanation may not be and might warrant some sort of market intervention if it were acquired through or leveraged by other anti-competitive behavior. We will discuss the distinction between product utility and switching in more detail in Section 5 and provide a framework to distinguish the two effects.

3. Switching Costs, Competition and Firm Strategy

3.1 Switching Costs and Competition

Most of the early literature on switching costs considers the impact or the consequences of (exogenous) switching costs. The usual analysis proceeds with exogenously determined (and usually symmetric) switching and proceeds to examine how switching costs affect pricing, entry, and firm profitability under different market conditions. Klemperer (1995) and Farrell and Klemperer (2004) provide extensive surveys on these issues from economic perspective, so we would only briefly summarize the general results pertaining to switching costs and competition in this section.

Consumer switching costs provide firms' market power over their existing customers enabling them to charge a price premium (as high as S) or strategically price to deter switching, even to superior alternatives. This result suggests that it makes sense for firms to invest to acquire new customers, even incurring losses in the process, because they may charge higher prices over their existing customers for repeat-purchases (this has been termed "*bargains-then-ripoffs"*). More broadly, in markets with switching costs, firms face tradeoffs between harvesting profits by charging higher prices over their existing customers and investing in market share by charging lower prices to acquire new customers who will be valuable repeat-purchasers in the future

(termed *harvesting vs. investing*) (Klemperer, 1995). The general observation is that in otherwise competitive markets with switching costs, firms have additional strategic options which can lead to higher prices and greater profits.

Switching costs can also act as a deterrent to entry, or alter the adoption rate of new technologies because they decrease the value of new products in markets where most customers already use an existing product. This result suggests that, when consumer switching costs are high, a vendor with initial advantages in a market may be able to parlay its advantage into a larger, lasting one (Katz and Shapiro, 1994). In addition, some authors have noted that some results about *single*-product competition over *many* periods with switching costs can carry over to *multi*-product competition in a *single* period when there exist consumer shopping costs or cross-product switching costs (Klemperer and Padilla, 1997; Farrell and Klemperer, 2004; Forman and Chen, 2005). These results suggest that a firm with larger product line has a strategic advantage over a firm offering fewer products in the presence of shopping costs and cross-product switching costs.

3.2 Endogenous Switching Costs

An important feature of much of the literature on switching costs are the dual assumptions of symmetry (all firms face the same switching costs) and exogeneity (firms cannot through their own actions affect switching costs), which we collectively refer to as "exogenous switching costs". However, the important role switching cost can play in competition strongly suggests that firms can benefit from investments or actions that affect customer switching costs ("endogeneous switching costs"). For instance, a firm will prefer switching costs *from* but not *to* its product if possible.

The role of endogenous switching costs is gaining increasing interest in the literature. Caminal and Matutes (1990) show that firms may wish to commit to offering repeat-purchase coupons before competing in a two-period duopoly in order to soften competition. An incumbent firm will also have an incentive to create contractual switching costs through the use of long term contracts to lock-in their customers (Fudenberg and Tirole, 2000). In addition, a firm with large installed base may also prefer a technology design that is incompatible with other firms, while a smaller firm will prefer compatibility with the incumbent firm (Katz and Shapiro, 1994).

Furthermore, given that a broad product line offers an advantage when there are consumer shopping costs or cross-product switching costs, a firm may strategically invest to increase its product breadth or to manipulate cross-product switching costs so that consumers prefer to buy multiple products from the same vendor (Farrell and Klemperer, 2004). Similarly, Baye and Morgan (2004) show that each firm has a unilateral incentive to implement costly loyalty programs, even though it results in lower equilibrium profits for all firms. Demirhan et. al. (2004) also show that in the presence of rapid technological advances and declining IT costs, which may provide the late entrant a cost advantage, an early entrant will have stronger incentive to offer products that impose significant switching costs on consumers to mitigate the damage from a decline in IT cost and preserve its first mover advantage.

3.3. Switching Costs in Information-Intensive Markets

As strategic investments in switching costs become more important, a first step in understanding how firms might be able to incorporate switching costs into competitive strategy is to understand the sources of switching costs in actual markets. Most of the theory literature in economics does not distinguish between different sources of switching costs in their models or just focus on a specific form of switching costs. However, Klemperer (1995) in his classic review of switching costs lists some of the major sources of switching cost identified in economic models including: the need for compatibility with existing equipment, transaction costs of switching suppliers, the cost of learning to use new brands, uncertainty about the quality of untested brands (e.g., search costs), discount coupons and similar devices (e.g., loyalty programs), psychological costs of switching, or non-economic "brand loyalty". Several forms of these switching costs are especially relevant to information products and the digital marketplace and warrant further discussion. We build upon Klemperer's categorization of switching costs and discuss these switching costs in the context of high-tech and information-intensive markets.

Search Costs. These are the costs consumers must incur to locate an alternative seller (Stiglitz, 1989). While search costs affect even consumers' initial purchases, it can act just like consumer switching costs when a consumer has better information on her current supplier, but not other suppliers (Schmalensee, 1982; Moshkin and Shachar, 2000; Vilas-Boas, 2004). When product or price information is costly to acquire and consumers have imperfect information about

alternative products and prices, it may be optimal for consumer to engage in limited search or not to search at all, remaining with a current supplier. This is particularly problematic for differentiated product markets where the costs of acquiring sufficient information about product alternatives and the cost of consumers processing of this information can be high. Much of the literature on competition and the Internet suggests that the Internet lowers search costs and thus potentially increases switching (Bakos, 1997). However, there is some contrary evidence to this notion. Numerous empirical studies suggest that consumer search costs remain high in electronic markets or at least customers behave as if search costs are high (see the survey by Baye, et. al., 2005).

Transactions Costs. These are the costs required to initiate a new relationship, and in some cases to terminate an existing relationship. These costs may include shopping costs, transportation costs, or costs associated with opening a new account or closing an existing account. These costs contribute to $S_{\varnothing k}$ (adoption costs) or $S_{k\varnothing}$ (exit costs) introduced in Section 2. Transactions costs reduce switching even when information is costless. For example, when transaction costs are high, consumers may prefer to have all their transactions done with the same vendor, in order to save on shopping costs. The success of the "one-stop shopping" strategy adopted by Walmart and Amazon.com can be partially attributed to minimizing transaction costs. It is generally believed that the Internet and other electronic technologies have reduced these costs since much of the process of starting or terminating a relationship can be done without travel or conducted with electronic support (e.g. using identity management software to communicate user information to a new supplier). Technology can not only lower transactions costs for consumers. The same technologies can be used by suppliers to assist consumers in switching providers as is becoming increasingly common for technology-driven financial services products such as mortgages, credit cards, and retail banking transaction accounts.

Learning costs. When products or sellers are different, consumers may incur costs (time, money or other effort) to learn to work with a new product or a new seller. When these costs are seller or brand specific, they are sunk costs and non-transferable from one relationship to another. These costs can be especially high for differentiated information services such as online

brokerage (Chen and Hitt, 2002b). Indeed, Chen and Hitt (2002b) show empirically that making an information service "easy to use" may actually increase switching (although it increases acquisition) which they attribute to the reduced need for sunk investments in learning. It has also been noted that even using a web site has a learning curve – Johnson et. al. (2003) found that visit duration declines the more often a site is visited, indicating a learning effect. In addition, having learned to use a site raises its attractiveness relative to competing sites for the consumers. Thus, the site will be more likely to be used than its competing alternatives, all other things being equal. Thus, learning costs can represent a significant barrier to product switching in many information-intensive markets.

Complementary investments. Many information products are such that they require complements to be useful. For instance, digital music players require purchase of compatibly formatted digital music. Switching to another player may make this content unusable. For many digital products and services, complementary assets are created by use. For instance, Microsoft Word and word-compatible files, eBay and user ratings, online networking web sites and "friend lists" all represent complements created by use. In some cases, such costs can be mitigated by the presence of "converters" (e.g., Farrell and Saloner, 1992; Choi, 1997), but many service providers deliberately make it difficult to utilize complementary assets when the relationship is terminated.

In commercial relationships, firms often encourage sunk investments in coordination technologies (Clemons et al., 1993). Technologies such as the American Airlines SABRE system (airline ticket distribution) or the Baxter Healthcare ASAP system (hospital supply ordering) owe some of their success to the fact that firms that invested in these technologies not only made sunk expenditures on the systems and associated training, but redesigned business operations around these technologies. These effects may be especially strong in enterprise software markets such as Enterprise Resource Planning (ERP) systems where the complementary investments may be several times the size of the actual technology expenditure (Brynjolfsson, Fitoussi and Hitt, 2005). However, not all technology investments have these characteristics – the McKesson Economost system (inventory management for drugstores) was easy enough to duplicate for other suppliers that it conveyed limited advantage. Moreover, the initial

investments in redesigning business processes to accommodate Economost gave firms the needed knowledge to efficiently switch suppliers in the future.

Network Effects and Compatibility. Closely related to complementary investments, some products exhibit network effects that arise when a user desires compatibility with other users or where increased consumption of addition units of the same good creates additional value. In the presence of network effects, users benefit from adopting products (and staying with adopted products) with the most users. Even in the presence of a superior technology, the coordination costs of changing all users to a new technology may outweigh the advantage of a new technology (this is referred to as "excess inertia" in the network economics literature).

Network effects can create switching costs when they exist across the choices of a single economic actor (either an individual or a firm). An example is a firm's investment in network switches used to manage communications in local area networks. There are significant interoperability benefits to having all switches in a firm purchased from the same manufacturer (see discussions in Chen and Forman, forthcoming, and Forman and Chen, 2005). Since converting a switch to another network provider changes the value of all other switches that had been purchased by the firm previously, this behaves as a switching cost. Moreover, switch manufacturers have strong incentives to preserve these differences and do so by creating proprietary "extensions" to the technology, even when the base technology is trending toward standardization (Chen and Forman, forthcoming). However, not all network effects are truly switching costs. For instance, general network externalities present in the market as a whole as a result of standardization, such as the adoption of TCP/IP networking standards on the Internet, provide a benefit but not switching costs because they affect overall utility by raising the value of the product. The critical difference is whether an individual decision making unit (e.g. a firm) has control over the size of the "network" through their own choices.

Contractual switching costs. These are pecuniary incentives provided for customers to make repeat purchases from the same provider, be it a store, a service or a manufacturer, for a certain period of time. These can be positive (e.g., "reward points" or "frequent flier programs") or negative ("penalty for early withdrawal" for deposit banking or an "early termination fee" for a

wireless phone contract). While these costs apply to a wide range of products, they appear to be unusually common for certain types of information products or services – especially those that involve some sort of new user subsidy for adoption. Contractual switching costs have some unusual properties such as the fact that they are often time limited (e.g., frequent flier miles expire, contracts exist for a specified duration). However, most importantly, they represent a source of switching costs which can be (more) easily varied by firm and thus can represent a major source of cross firm variation in switching costs. Kim et al (2001) have studied incentives to offer reward programs that create pecuniary switching costs.

3.4 Empirical Evidence

The empirical literature on switching costs is much smaller and more recent than the theory literature, due primarily to the difficulty in obtaining detailed data on individual- or firm-specific decisions required to test hypotheses related to switching costs. For instance, conventional market share data does not enable product quality and switching cost to be distinguished. For market share data to be useful in retention studies, it would have to distinguish between share of new customers and share of customers acquired through switching which is rarely available for more than a single firm. However, the increased availability of micro-level consumer behavior data, especially for technology products and services, has greatly expanded the ability to do research in this area. In this section, we review major empirical studies on IT and switching costs.

Switching Costs in Software and Other "High-tech" Markets

One of the first empirical studies on IT and switching costs is Greenstein (1993), who studied mainframe procurement decisions in government agencies. He found that users of IBM mainframes are more likely to buy mainframes from IBM in the future than are users of other vendors' products, even when controlling for buyer characteristics that might influence vendor choice. This result suggests that buyers face significant switching costs from past investments due to the need of compatibility within the firm, and points out the importance of switching costs in influencing users' purchase decisions.

Forman and Chen (2005) consider a similar question of vendor choice in the context of networking equipment such as routers and switches. Their research strategy further enables them to decompose switching costs into those created by the costs of learning new products and those created by the need of compatibility with past investment. Using detailed data they show that switching costs may arise from prior investments made at the same establishment as well as investments made at other establishments within the same firm. In addition, they show the installed base advantage of one product (network routers) can spill over to other products (network switches) as technology evolves. Chen and Forman (forthcoming) further extend this research by examining possible vendor actions in creating switching costs, including manipulating "horizontal" compatibility between comparable rival products and "vertical" compatibility between complementary products, maintaining a broader product line, creating product suites, and targeting specific market segments. Kauffman, et al. (2000) examine how prior investments in proprietary networking technology influence incentives to adopt a multi-bank electronic network. Similarly, Zhu et al (forthcoming) investigate firms' migration from proprietary or less open inter-organizational systems (IOS) to open-standard IOS (i.e., the Internet) and show that experience with older standards may create switching costs and make it difficult to shift to open and potentially better standards.

Research on technology prices also supports a notion that switching costs arising from learning and compatibility can create market-wide effects on pricing. For instance, Brynjolfsson and Kemerer (1996) find that products that adhered to the dominant standard for spreadsheet software commanded prices which were higher by an average of 46%. Gandal (1994) found a similar result using different data. Overall, this literature has shown that there exist significant switching costs in high-tech and software markets, and that a purchase decision today can have a far-reaching impact in the future.

However, new IT innovations may decrease switching costs arising from prior investments when buyers of the innovation must make new sunk cost investments to take advantage of the new innovations (Brynjolfsson and Kemerer 1996; Bresnahan and Greenstein, 1999). For instance, Breuhan (1997) demonstrates that firms switching from the DOS to Windows operating system had lower switching costs of changing word processing and spreadsheet vendors than firms that

retained the same operating system. Chen and Forman (forthcoming) also find that the introduction of new products (network switches) lead to a temporary "window" of lower switching costs away from network routers. The introduction of the new product forced firms to redesign and rebuild their network infrastructure, effectively "freeing" them from the switching costs arising from their installed base. However, even though switching costs may be reduced with new IT innovation, they find that there still remain significant switching costs.

Switching Costs in Online Markets

Although electronic markets are believed to have low switching costs since a competing firm is "just a click away" (Friedman, 1999), recent research suggests that there is significant evidence of switching costs and brand loyalty in online markets. For example, Smith and Brynjolfsson (2001) found, using data from a price comparison service (the DealTime "shopbot"), that a consumer's past purchase experience has significant predictive power of her future store choice and that customers are willing to pay premium prices for books from the retailers they had dealt with previously. Similarly, Lee and Png (2004) showed that consumers bear significant shopping costs, which represents another source of switching costs, for shopping books online. Johnson, et. al. (2004) showed that customers engaged in limited across-site search and tended to search fewer sites as they become more experienced with online shopping. Moe and Fader (2004) have also explored the relationship between visit frequency and website experience and found evidence supporting the fact that people who visit a store more frequently (indicating greater lock-in) are more likely to buy. Bucklin and Sismeiro (2003) also found evidence in support of the "lock-in" phenomenon.

Several marketing papers further compare brand loyalty in online shopping environments and their offline counterparts and conclude that consumer brand loyalty is not necessarily lower online, and in many cases, brand loyalty is actually stronger online than offline. Danaher et al. (2003) used data on 100 grocery brands and found that higher share (and therefore better-known) brands have greater-than-expected loyalty when bought online compared with an offline environment. Degeratu et al. (2000) also note that there is less brand switching online, especially when online consumers use a pre-set personal list. In addition, Andrews and Currim (2004)

report that online grocery shoppers consider only brands they have purchased before and form a smaller consideration set, thereby remaining loyal to a smaller number of brands.

There is also evidence of firms making firm-specific switching costs investments. Chen and Hitt (2002b) find that switching costs vary significantly across different online brokerages even after controlling for customer heterogeneity, suggesting that firms have considerable control over switching costs through a number of firm practices. Similarly, Goldfarb (2005) reports evidence of switching costs at Internet portals after controlling for unobserved heterogeneity (i.e., "spurious" state dependence).[6] All these studies suggest that switching costs and brand loyalty remain high in digital markets, even though search costs are reduced and information can be easily gathered in these markets, and that a significant source of this variation is due to firm practices.

4. Endogenous Switching Costs and Firm Strategy in Information-Intensive Markets

As discussed above, information technology is often associated with a reduction in market "frictions", frictions that can represent a significant portion of switching costs. Search technology has enabled firms to identify and to evaluate trade counterparties more efficiently. Inter-organizational systems enable firms to minimize the cost of interacting with a broader group of suppliers. Increased standardization of both the communications protocols (e.g., TCP/IP) and application interfaces (e.g., XML/SOAP) make these and other "coordination" technologies less costly and more broadly available to the mass market. Collectively, these arguments suggest that for high-technology products such as information products or services, the inherent level of market wide (exogenous) switching cost is lower. The removal of market inefficiencies makes the market more competitive and vendors more vulnerable to competition, creating incentives for firms to deliberately create firm-specific switching costs (endogenous switching costs) to restore their market power.

In addition to lowering search and coordination costs, some have further argued that information systems reduce the degree of product differentiation among firms (Porter, 2001). He argues that

[6] Although these switching costs estimates drive only 11-15% of market share on a choice-to-choice basis, which is much smaller than the effects found by Shum (2004) in breakfast cereals and that by Keane (1997) found in Ketchup.

that technology enables firms to more rapidly imitate each other, either due to flexible manufacturing or imitation of software innovations, or by enabling entrants to source from the same (or similar) pool of global suppliers with reduced transaction risk. Of course, the counterargument to this observation is that these same technologies enable firms to innovate more rapidly and to better meet customer needs enabling greater product differentiation (see e.g. Tapscott, 2002; Clemons et al., 2003). Regardless of which perspective prevails, it is clear that imitation of technology-enabled innovations is much more rapid.

When firms enjoy a smaller period of near-monopoly position on a new product, creating switching costs becomes an important part of strategy. For instance, Capital One Financial initially gained considerable advantage by novel product designs that help them targeting "profitable" customers in the credit card industry. However, it became apparent that many of these designs were easily imitated. This encouraged them to make large investments in "retention specialists" who worked to retain customer accounts and reduce switching. While the product designs were easily copied, the organizational and human assets involved in customer retention proved hard to duplicate, and may have been a key source of competitive advantage for Capital One (Clemons and Thatcher, 1998). While attracting profitable customers is always an important strategy, in markets with rapid innovation and imitation, how to keep these profitable customers will be the key to a firm's long term profitability. To better manage customer acquisition and retention, Blattberg and Deighton (1996) have introduced the concept of "customer equity" that balances spending on obtaining and keeping customers.

Switching costs have also become important in some technology-enabled markets, especially Internet-based products and services, simply because of the high cost of customer acquisition. At the peak of the "Internet bubble" firms were actively spending up to $1000 per new customer with the expectation of converting this up-front investment into an offsetting stream of revenue with inherently high margin. While this type of activity has considerably decreased, referral rates on the order of $20-$80 per customer[7] are still common. Given the competitiveness of

[7] A common example in 2005 is the existence of services that provide "free" products such as iPods, computers, designer handbags, or digital cameras when a customer signs up for one or more trial services and encourages other customers to do the same. This entire business is based on the presence of referral fees as high as $80 per new customer to offset the cost of these products.

online markets and the attendant low margins, this leaves length of relationship as a key driver of overall customer profitability. Using this type of analysis, Reichheld and Schefter (2000) calculate that by retaining 5% more customers, online companies can boost profits by 25-95%

As exogenous, market-wide switching costs are reduced, endogeneous switching costs have the potential to play a much greater role in competition. While the literature in this area is still developing, a number of studies have identified mechanisms for how firms can either restore switching costs eroded by external forces, or alter their own switching costs.

Strategic restoration of search costs. As search costs for prices and product information are reduced with the use of search and shopping engines, firms may have additional incentives to differentiate their products in order to induce search costs (Kuksov, 2004). Indeed, we do observe many retailers strategically introduce myriad variations of a product, which in turn lead to consumer search costs to locate a product of their interest (Bergen et al., 1996). Ellison and Ellison (2001) have also noted that firms try to adopt a number of strategies that make search more difficult. Many firms also use rapid and unpredictable price changes to prevent consumers from consistently learning about the identity of the low-price provider and also to prevent competitors from systematic undercutting (Baye, Morgan and Scholten, 2005). For example, airlines have responded to increased price transparency provided by computerized reservation systems (CRS) but creating large numbers of constantly changing fares, so many that finding best fare for a customer can be problematic even with technological support (Clemons, Hann and Hitt, 2002). Studies of online price show considerable price dispersion, perhaps even more so than offline stores (Brynjolfsson and Smith, 2002; Baye, Morgan and Scholten, 2005).

Product design. Firms may also induce switching costs through product design, such as adopting proprietary standards. For example, Sony has adopted a proprietary technology (e.g., the memory stick) for its digital camera. An incompatible or different product design may also lead to learning costs that are brand-specific and can not be transferred. In the case where complementary products are also needed, a customer is essentially locked in to the vendor for all other complementary products when the vendor adopts an incompatible product design for all its products. However, it is important to note that the decision of proprietary or incompatible

product design can only be profitable when enough demand can be sustained, which is often difficult to predict ex-ante. For instance, there is considerable debate about whether Apple's strategy of closed standards have helped or hurt their market position in personal computers.

Even in markets where standardization has eliminated switching costs from incompatibility, it has been a common practice for vendors to "extend" standards by adding proprietary enhancements to their products. Although these proprietary enhancements may be added to improve functionality and add value to customers, these changes also make compatibility and interoperability among competing products more difficult to achieve (Farrell and Saloner, 1992; Wickre, 1996). In addition, vendors may also extend standards in ways that affect the "vertical" compatibility (or interoperability) between complementary products, thereby discouraging consumers from "mix-and-match" purchases. For example, even though Cisco's Internetworking Operating Systems (IOS) software has published standards, Cisco itself has claimed that there is enough proprietary code within IOS to allow Cisco products to "work better when they talk to each other, rather than machines made by rivals" (Thurm, 2000).

Product line design and bundling strategy. Klemperer and Padilla (1997) have demonstrated that selling an additional product can provide strategic benefits for a firm in the market for its current products if consumers have shopping costs. The strategy of maintaining a broader product line has also been empirically found to be associated with reduced consumer switching (Chen and Hitt, 2002b; Chen and Forman, forthcoming). Another advantage of multiproduct firms is that they may "bundle" products, which lead to contractual shopping costs between products (Farrell and Klemperer, 2004) which can be an effective strategy to deter new entry (Nalebuff, 1999). Microsoft has pioneered this strategy in both their operating system and office software product lines. In markets for communications equipment, vendors commonly include heterogeneous products in a single "product suite" designed to serve many buyer needs (e.g., 3Com's OfficeConnect or Bay Networks BayStack product lines). These product suites lower buyers' costs of identifying and adopting complementary products while simultaneously creating switching costs.

Customer profiling and personalized services. The use of advanced information technology, such as the use of cookies, log files, data mining technologies, customer profiling techniques, collaborative filtering technologies (e.g., recommendation systems) and other personalization technology, also allows firms to "identify" their customers and their needs and to act accordingly. Many of these efforts to restore switching costs also add value to the customer even if they were intended principally to reduce switching. Personalized services and products tailored to customer needs may improve customer satisfaction, which in turn, lead to consumer switching costs if another firm can not offer similar services or products (perhaps due to lack of relevant data). The benefits of personalized services or product offerings may increase over time as the firm has more information about customers. For instance, recommendation systems become more precise as the consumer visits the site more often, makes more purchases and provides more product reviews. Thus, customers concentrating their purchases at a single online retailer may receive greater value and are more likely to return. In addition, the ability of firms to track customers' usage patterns also make it easier to identify different customer types, and allow firms to identify potential switchers and act accordingly before they actually switch (Chen and Hitt, 2002b). Customer recognition also allows firms to engage in "behavior-based price discrimination" (Acquisti and Varian, 2005; Fudenberg and Villas-Boas, 2005), although the customer uproar over Amazon's attempt to offer higher prices to loyal customers has made firms cautious about implementing highly transparent and purely redistributive strategies for "exploiting" loyalty.

Virtual network effects and brand-specific investments. Switching costs arising from network effects can arise even for products without technical compatibility issues if past investment or frequency of use influences future value. For example, recommendation systems can become more precise not only when a user visits a site more often (as discussed earlier), but also when more users visit or make purchases at the site because with a large installed base there are likely to be more people with similar tastes who have rated other products. Rating systems in consumer or commercial electronic markets (e.g., eBay's "positive", "negative", "neutral" system) also become more trustworthy as more transactions are recorded. Moreover, ratings are generally not portable across services or sites, thus encouraging users to concentrate their

transactions at a single site. This is a type of lock-in that is analogous to own-choice network effects, similar to the mainframe computer and network switchgear settings discussed earlier.

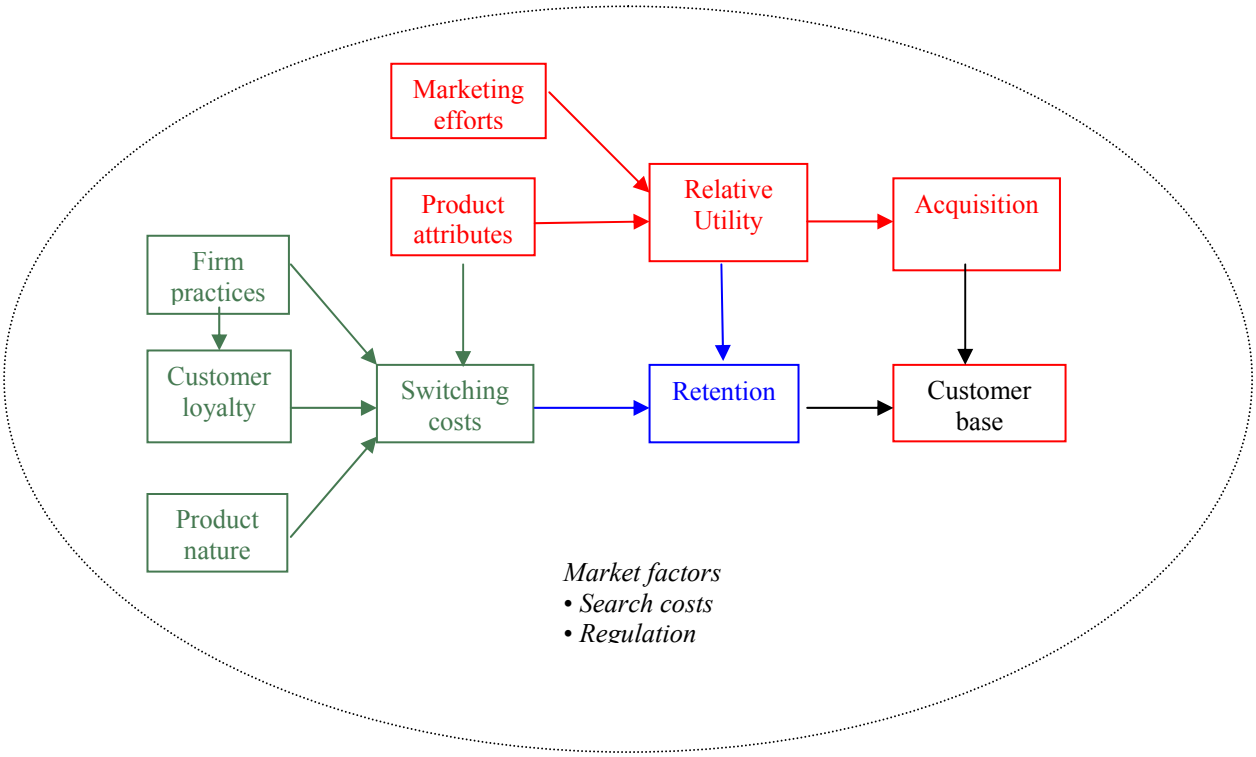
Market segmentation and loyalty programs. While firms may invest to increase firm-specific switching costs, switching costs may differ across buyers for reasons unrelated to vendor product strategy. The fact that much of customer loyalty is due to latent customer traits is a central tenet of most marketing models of retention and repeat purchase. For example, previous literature has demonstrated that larger firms (Kauffman et al. 2000) and those with more complicated infrastructure (Bresnahan and Greenstein 1996; Forman 2005; Forman and Goldfarb, 2005) will be slower to adopt new IT innovations and face higher switching costs because of the difficulty of integrating new systems. This is true even though these firms are more technologically sophisticated (Raymond and Paré 1992). The marketing literature has shown for a wide range of consumer products that customers tend to show considerable brand loyalty. Technologies such as CRM (Customer Relationship Management) systems and other data analysis technologies can help reveal these differences among customers which can be coupled to retention investments. One commonly used customer retention strategy is to offer incentives and rewards to customers to make it worthwhile to return. Bell and Lal (2002) note that a successful implementation of a loyalty program should (1) reduce price competition and increase their profits due to switching costs, and (2) reduce marketing expenses by focusing attention on retaining the loyal customers and capturing an increasing share of their wallet.

5. A Framework for Managing Switching Costs

5.1 Introduction

In order to effectively manage customer retention, it is important to have a framework for managing customer retention and methods of measuring switching costs and understand the factors that influence them. In this section, we propose a conceptual framework for understanding the role of product strategy and switching cost, and integrating the switching cost (economic), customer loyalty (marketing) and systems perspectives of switching cost in electronic markets, as depicted in Figure 1.

Figure 1: Integrated View of Switching Cost Strategy



In this conceptual model, a firm's customer base is driven by two major factors: 1) the share of new customers which is determined by the overall attractiveness of the product relative to other competing products (factoring influencing customer acquisition may include price and other non-price attributes, as well as other marketing variables such as advertising, place and promotion) and 2) the degree of retention of existing customers, which is affected by both product utility and switching costs. Switching costs, in turn, can be driven by firm practices (which result from retention investments, such as loyalty programs), customer loyalty (which result from intrinsic customer characteristics and firms' success in targeting/segmentation of loyal customers), and the fundamental nature of the product (such as purchase frequency, learning or customer co-investment). In addition, product design may also influence consumer switching costs.

Regardless of firms investments in creating switching costs, there are large and significant market-wide switching costs in most markets. While these factors do not enable firms to differentiate themselves, they provide a source of market inefficiency that reduces competition overall and enables strategies (such as price discrimination) to be employed that can only be

profitably used when markets are imperfectly competitive. Search costs play an important role in determining market-wide switching costs – when search costs are high, consumers do not evaluate alternatives and are therefore much less likely to switch product providers.

This framework offers an integrated model for studying retention ability and switching cost of firms. It differs from traditional approaches by the incorporation of customer and firm-specific switching components into the same model, and separating switching costs and product utility in determining retention level. We now develop a simple analytical model based on this conceptual framework to explore some competitive implications of switching cost, especially how market characteristics affect firms' incentives to make retention investments and how these investments affect equilibrium market outcomes.

5.2. A Model of Customer Retention

Consider a market with multiple customers (who may have different preferences) and multiple firms (who may offer different products and have different levels of switching cost). We assume that customers choose among firms with a stochastic process based on the random utility framework. Customers' utilities (u) are comprised of two parts: a systematic component related to the observable and unobservable characteristics of the good (v), and a random component which is idiosyncratic to an individual customer and arises due to specific tastes or random error in selection (ε). To simplify the mathematical structure of our model we adopt the discrete choice, multinomial logit formulation (MNL) to describe customer behavior, which will be described in more detail below. We allow firms to change their switching cost level through investment and presume that customers do not incorporate switching costs into their initial product adoption choices.

Our model will focus on predicting short run (two period) firm behavior in transitioning from some initial state (market share, product quality, prices and switching cost level for each firm) to a new state where allowable transitions are defined by a technology. There is no requirement that the initial state represent any sort of equilibrium as it could arise from a variety of situations (different fixed cost of entry, previous period growth, nature of competition, etc.) which could yield a wide variety of potential initial equilibria. However, given an initial state we require that

firms make optimal pricing and investment choices to maximize second period profits. Extensions to multiple future states (including multi-period stable equilibria) and a complete characterization of potential equilibria for the initial states are beyond the scope of this analysis.

The MNL choice formulation suggests that for a set of N consumers choosing among M firms,[8] we can write the utility of a particular consumer if she chooses firm j ($j \in [1,2,...M]$) as:

$$u_j = v_j + \varepsilon_j \qquad (5\text{-}1)$$

If we observe a customer choosing firm *j*, we can infer that this choice provides the consumer with the highest utility over the set of M firms. That is, the probability that a consumer will choose firm j is determined by the relative utility level:

$$p_j = prob.(u_j \geq u_k, \forall k) \qquad (5\text{-}2)$$

Under MNL, the error term is assumed to be independent and identically distributed with a double exponential distribution (that is, $prob.(\varepsilon_j \leq \varepsilon) = e^{-e^{-\varepsilon}}, where -\infty < \varepsilon < \infty$). Assuming these error terms are independent and identically distributed this yields a very simple expression for choice probability:

$$p_j = \frac{e^{v_j}}{\sum_{l=1}^{M} e^{v_l}} \qquad (5\text{-}3)$$

We have assumed that a firm could invest to build switching cost to prevent its customers from switching. For a consumer who chose firm *j* in period 1, her utility from choosing to stay with firm *j* in period 2 remains the same (except for the random component):

$$u_{jj} = v_j + \varepsilon_j \qquad (5\text{-}4)$$

(as before, the notation u_{ab} denotes the utility a customer gets if she chooses firm *a* in period 1 and then switches to firm *b* in period 2; when *a*=*b*, the customer stays with her existing provider).

[8] We assume the market is covered, and every customer will choose one and exactly one firm.

If the customer decides to replace product *j* with another (product *k*), she incurs a disutility or switching cost. We allow for firm variation in switching costs, but impose a simplifying assumption that switching cost is only determined by your existing choice, not any new product choice.[9] We use S_j to indicate the costs of switching out of product (or provider) *j*. With this setup, the utility of choosing a firm other than *j*, say *k*, will be reduced by S_j:

$$u_{jk} = v_k - S_j + \varepsilon_k \tag{5-5}$$

This yields a retention rate (*r*) for firm (*j*) of:

$$r_j = p_{jj} = \frac{e^{v_j}}{e^{v_j} + \sum_{l \neq j} e^{v_l - s_j}} \tag{5-6}$$

We also define a firm's relative ability to attract switchers from other firms as p_j^s, which may or may not be the same as p_j. For example, experienced customers (who have been in the market before) may value different attributes more or less than new customers. However, while p_j^s can be different from p_j they are determined by the same underlying attributes. Consequently, improving an attribute will increase both choice probabilities proportionally. Since a customer switching out of firm *k* will not include *k* in the choice set, the acquisition rates for firm *j*, where $j \neq k$, is given by $\frac{p_j^s}{1 - p_k^s}$.

Given any initial market share distribution (a vector *ms*, with components $ms_j \forall j$) for *J* firms (indexed $j = 1..J$), the vector of market shares for next period (*ms'*) is determined by the market growth rate (*g,* a percentage growth from previous state*)*, the rate of customer retention for firm *j* (r_j from 5-6), and the rate of customer acquisition for firm *j* (p_j from 5-3 and p_j^s). Note that according to our framework p_j^s and p_j are functions of product attributes (*v*), and retention (*r)* is a function of product attributes and switching costs (*s*) which can be altered by investment at

[9] As discussed earlier, programs such as competitive upgrades can create differing switching costs among any two firms (which need not be symmetric). We will ignore the switching destination in this analysis.

the firm level. This yields the following expression for future market share as a function of previous market share:[10]

$$ms'_j = \frac{ms_j}{1+g} \cdot r_j + g \cdot p_j + \sum_{l \neq j} \frac{ms_l}{1+g}(1-r_l) \cdot \frac{p_j^s}{1-p_l^s} \qquad \text{(5-7a)}$$

Alternatively, we can express this in terms of the total number of customers (N_j) and number of new customers (n):

$$N'_j = N_j \cdot r_j + n \cdot p_j + \sum_{l \neq j} N_l(1-r_l) \cdot \frac{p_j^s}{1-p_l^s} \qquad \text{(5-7b)}$$

One implication of this formulation is that a firm's utility has two effects on market share, a direct effect in that better products will be purchased by more customers initially (from 5-3), and an indirect effect in that better products will have higher retention rates (from 5-6). Thus, a high retention rate does not necessarily indicate high switching costs but maybe just a result of high utility level (due to superior quality or lower price) from the product.

To model search cost we follow the approach of Salop and Stiglitz (1977) in dividing the customer population into informed customers with zero search costs (a proportion μ) and uninformed customers with identical positive search costs (a proportion 1-μ). Presumably, electronic markets enable more consumers to become informed which leads to an increase in μ. For simplicity, we assume that the search costs for uninformed customers are sufficiently large to deter search.[11] This implies that customers with zero search costs always buy the product with highest utility given the product utility levels and idiosyncratic preferences (in the form of the residual in the random utility framework), and reevaluate their preferences each period based on utility levels and switching costs. Uninformed customers choose products at random and do not switch (since they have no information about alternatives). This yields the following variants of Equation 4-7a and 4-7b, incorporating the two customer types:

[10] Note that we can incorporate attrition rates in this model. As long as attrition rates are the same across firms, the market share of each firm after accounting for attrition rates will not change. In addition, we have implicitly assumed that each sale is equally profitable. However, in cases where not each sale is equally profitable, we can easily extend our model by incorporating a weight to indicate different profitability or segment customers into different profitability gradient and apply the model for each segment.

[11] If we know that customers face a specific amount of search cost, then it becomes switching cost.

$$ms_j' = \mu[\frac{ms_j}{1+g} \cdot r_j + g \cdot p_j + \sum_{l \neq j} \frac{ms_l}{1+g}(1-r_l) \cdot \frac{p_j^s}{1-p_l^s}] + (1-\mu)[\frac{ms_j}{1+g} + \frac{1}{J} g] \quad (5\text{-}8a)$$

$$\text{or } N_j' = \mu[N_j \cdot r_j + n \cdot p_j + \sum_{l \neq j} N_l(1-r_l) \cdot \frac{p_j^s}{1-p_l^s}] + (1-\mu)[N_j + \frac{1}{J} n] \quad (5\text{-}8b)$$

This equation offers a framework for obtaining optimal retention level for firms if given cost and price information. The effect of exogenous factors can also be straightforwardly determined by differentiating this expression.

Several interesting results could be obtained from this equation (all results are stated without proof; the proofs are available from the authors upon request):

<u>"Own-firm" effects:</u>

1. *Without superior product or high switching cost, reductions in search cost have a negative impact on firms with a large market share.*[12]

This result suggests that it becomes more difficult to sustain market share advantage as search cost goes down, and the market may become more unstable. In digital markets where transaction costs and search costs are greatly reduced, it implies that firms with large market share in the traditional market will not be able to guard their market share if they do not improve their product value or invest in switching costs. This argument is supported by Clemons et. al. (1996) and is consistent with much of the discussion of competition between "bricks and mortar" and online retailers.

2. *The marginal value of both investments in quality and retention is increasing as search cost goes down (that is, μ goes up) and as market share goes up* ($\frac{\partial(\frac{\partial ms_j'}{\partial v_j})}{\partial \mu} \geq 0, \frac{\partial(\frac{\partial ms_j'}{\partial s_j})}{\partial \mu} \geq 0$

[12] For example, assume that $p_i = p_i^s = \frac{1}{J}$ *and* $s_i = 0 \ \forall i$, we can show that $\frac{\partial ms_j'}{\partial \mu} < 0$ *for* $ms_j' > \frac{1}{J}$.

and $\frac{\partial(\frac{\partial ms_j'}{\partial v_j})}{\partial ms_j} \geq 0, \frac{\partial(\frac{\partial ms_j'}{\partial s_j})}{\partial ms_j} \geq 0$*). Moreover, retention investment becomes relatively more important when growth is slow or market share is high.*

3. *All others factors being equal, the minimum retention level required to sustain a firm's market share is increasing in market share, number of firms in the market and competitors' investment in retention. The minimum retention level required to sustain a firm's market share is also increasing in market growth when the firm's market share is greater than average.*

Result 2 suggests that quality investments and retention investments are more important in markets with lower search costs (e.g., online retailing). Result 3 suggests that these investments are more important for firms with a large market share to defend. This provides another reason why initially dominant firms in online retailing are often also the most aggressive in offering technologies such as personalization or recommendation systems that encourage customer retention.

"Cross-firm" effects:

4. *The marginal value of product quality investments is a decreasing function of competitors' switching costs (*$\frac{\partial(\frac{\partial ms_j'}{\partial v_j})}{\partial s_k} \leq 0, \forall k \neq j$*).*

This result suggests that retention investments and product investments are strategic substitutes. In specific, it suggests that investments in switching costs construct not only entry barriers, but also make competitors less aggressive in acquiring new customers or improving their product offerings. Although we don't know the exact reasons, we do observe that BarnesandNoble.com was less aggressive in their investments in both website design and recommendation systems, while Amazon.com has been the pioneer in technology investments for customer retention.

Collectively, these results suggest a close linkage between investments in product utility and investments in retention. In high growth markets, firms have greater incentive to invest in product utility and customer acquisition than retention. These effects tend to be more important for incumbents than entrants who need not consider the impact of their actions on their existing customer base.

5.3 Measuring Switching Costs

The choice framework proposed in previous section and the associated discussion can also be utilized for empirical work where the underlying goal is to estimate switching costs for multiple firms and identify the factors that affect switching behavior. As noted in Section 2, using retention rate as proxy for firm's switching cost is misleading because product attributes and marketing variables affect retention rates as well. Building upon the random utility modeling framework, Chen and Hitt (2002a) develop a simple strategy that allows us to quantify switching costs by filtering out the effect from other types of investments, such as product improvement or price reductions. We briefly describe the measurement strategy here.

As before, we model the buyer *i* for vendor choice *j* as $u_j^i = v_j^i + \varepsilon_j^i$, which is comprised of two parts: it contains a component (v_j^i) which captures the measured preference of buyer *i* for a particular vendor *j* and a random component (ε_j^i) which summarizes the contribution of unobserved variables. We extend the earlier discussion by expressing v_j^i, the systematic utility component, as a function of customer characteristics and product attributes. Depending on customers past behavior (using notation introduced in Section 2), this yields a set of utilities for different choices:

$$u_{\varnothing j}^i = \gamma_j^i + X_j \beta_j^i + Z^i \lambda_j^i - S_{\varnothing j}^i + \varepsilon_j^i$$
$$u_{jj}^i = \gamma_j^i + X_j \beta_j^i + Z^i \lambda_j^i + \varepsilon_j^i$$
$$u_{kj}^i = \gamma_j^i + X_j \beta_j^i + Z^i \lambda_j^i - S_{\varnothing j}^i - S_{k\varnothing}^i - S_{kj}^i + \varepsilon_j^i$$
$$u_{k\varnothing}^i = -S_{k\varnothing}^i$$
$$u_{\varnothing\varnothing}^i = 0$$

γ_j^i captures buyer *i*'s unobserved inherent tastes for product j (or unobserved buyer-seller match). X_j is a vector of firm or product attributes including price or cost index and a collection

of other relevant attributes, which may include marketing variables. β_j^i is a vector of relative weights customer *i* puts on different firm or product attributes. Z^i is a set of observed customer characteristics and vector λ_j^i captures customer preference parameters to justify that customers may have heterogeneous preference over the choices she has. $S_{\varnothing j}^i$ is the initial adoption cost of product *j* (beyond the price paid). Note that adoption cost can be negative if a firm subsidies new customers for adoption. S_{kj}^i is the costs incurred by customer *i* from switching from *k* to *j*, and $S_{k\varnothing}^i$ the exit cost. Finally, ε_j^i, the random component summarizes the contribution of all other unobserved variables as well as customer *i*'s idiosyncratic, specific tastes or random error in selection.[13] Each consumer will choose the product which maximizes her utility, that is, a customer (*i*) will choose product *j* if and only if $u_{\bullet j}^i > u_{\bullet k}^i, \forall k \neq j$, which implicitly defines the set of consumer attributes that lead to the choice of good *j*.

However, the estimations of the most general framework requires extensive data on customer and firm characteristics and over time, so most empirical models are simplified by putting a number of restrictions. For example, many models examine buyer choices conditional on customers making a purchase decision (i.e., do not consider customers who do not make any purchases). Moreover, almost all, if not all, models assume $S_{\varnothing j}^i$=0 and $S_{k\varnothing}^i$=0 and put restrictions on S_{kj}^i. The economics literature typically assumes $S_{kj}^i = S \; \forall i, j, k$. Chen and Hitt (2002b) and Chen and Forman (forthcoming) assume $S_{kj}^i = S_k \; \forall i, j$, where switching cost depends on only where the customer is from but not where she switches to. In addition, it is not always possible to estimate $\gamma_j^i, \beta_j^i \; or \; \lambda_j^i$ (which collectively determines consumer demand absent switching costs): the estimation of which usually requires many observations from the same individual. As an alternative, it is often assumed that unobserved individual attributes are random draws from a known distribution (e.g., random-coefficients logit model).

[13] Note we can further decompose ε_j^i into two or more variables capturing effects from unobserved factors (e.g., unobserved product attributes or demand shift) and customers' idiosyncratic tastes. This strategy is often adopted when there are suitable instruments to capture the effects of some unobserved factors (see Berry et al., 1995 and Nevo, 2000).

The simplest case to estimate consumer demand for differentiated products is the standard logit model, which assumes that unobserved individual heterogeneity enters the model only through the error term, ε_j^i, i.e., $v_j^i = v_j$ (or equivalently, $\gamma_j^i = \gamma_j$, $\beta_j^i = \beta_j$ and $\lambda_j^i = \lambda_j$), and the error term is independently and identically distributed across products and consumers with the "extreme value" distribution (that is, $prob.(\varepsilon_j \le \varepsilon) = e^{-e^{-\varepsilon}}, where -\infty < \varepsilon < \infty$). The market share (or the choice probability) of product *j* in the absence of switching costs is given by $p_j = \frac{e^{v_j}}{\sum_{l=1}^{M} e^{v_l}}$.

However, this type of error structure is governed by independence of irrelevant alternatives (IIA) – that is, the ordinal ranking of any two products does not depend on the attributes of other alternatives or even the presence or absence of an alternative choice. This assumption can produce unreasonable substitution patterns. The MNL framework can be generalized using the McFadden (1978) generalized extreme value (GEV) model that allows for richer patterns of substitution among alternatives. One such example is the nested logit model, where choices are grouped into different clusters and choices within a cluster are better substitutes for each other than choices across clusters (this has been applied by Chen and Forman, forthcoming). Alternatively, mixed logit models can be used (McFadden and Train, 2000) which allow the parameter associated with each observed variable (e.g., its coefficient) to vary randomly across customers, thus allowing for more complex demand elasticities across products and possibly price endogeneity (see Berry (1994) and Nevo (2000) for applications of these approaches). Forman and Chen (2005) apply the mixed logit model to the network switchgear industry.

The framework introduced in this section can be used to measure switching costs using any data source that has multi-period customer choice data, even when customer or product characteristics are not known for these customers. Indeed, since the resulting choice probabilities in large samples are equivalent to market shares, Chen and Hitt (2002a) have shown that, when the preferences for new customers and existing customers are drawn from the same distributions, switching cost estimates can be made at an aggregate level, only knowing the starting market share of each product and the breakdown of next period market share into new customers, switchers and existing customers for each firm.

When more detailed data on customers and firms is available, we can estimate a more general demand model and also distinguish between different sources of switching costs. Chen and Hitt (2002b) estimated a logit model with data from online brokerage usage derived from Media Metrix, a firm that tracked customers' usage of the Internet. They found considerable variation in switching costs across online brokers, and that switching cost and product quality were not perfectly correlated. These two observations suggest that at least in this industry, different strategies pursued by different firms yield different marketplace outcomes in terms of switching cost and the resultant impact on overall market share. Using more detailed data on customer and firm characteristics, they found that switching was lower for firms that had minimum investment requirements to open an account and that offered a broader product line. Customers who were frequent users were also more loyal, while customers who changed their usage pattern or had adopted multiple brokers at one time were much more likely to switch.

Forman and Chen (2005) utilize this framework, adopting a mixed logit model to estimate the impact of network effects and other sources of switching costs on vendor choice in the market for routers and switches. Their results show that the size of a firm's network as well as learning costs significantly increases the switching costs of changing vendors. They also demonstrate that although new IT innovation (i.e., switches) did temporarily lead to lower switching costs, there still remained significant costs of switching vendors.

6. Conclusion

Previous theoretical work has shown that the presence of switching costs can have a substantial effect on profitability. In this paper, we survey prior literature on information technology and switching costs and argue that switching costs management becomes more important in high-tech and information-intensive markets. However, the creation of switching costs requires substantial and deliberate investments by the firm in customer retention. Only by understanding the sources and magnitude of these switching costs it is then possible to understand tradeoffs between investments in loyalty and retention programs and other types of investments such as advertising (for building new customer acquisition rates), technologies, and service level improvements, and price reductions which raise both the acquisition and retention rates simultaneously.

In this paper, we describe several sources of switching costs, especially those relevant in high-tech and information-intensive markets, and discuss several strategies that have the potential to influence consumer switching costs. We further provide an integrated framework for the management of switching costs and customer retention. Based on the framework, we have shown that in markets with low search costs and slowing growth (common to most retail and some commercial internet-mediated markets) customer retention investments become more important in determining the degree of competition and overall market structure. Overall, we have concluded that conditions exhibited in electronic markets like reductions in search cost and entry barriers have strengthened firms' incentives in strategic retention investments. Moreover, lowered barriers to entry introduce new competitors and many asymmetries into the market; thus creating different incentives in retention investment across firms and result in heterogeneous switching costs. In addition, we provide a framework for measuring switching costs. The ability to measure switching costs not only allows firms to understand the effectiveness of existing retention investments and to measure the outcomes of new customer retention initiatives.

In closing this survey, we would like to point out a few opportunities for future research. First of all, the availability of more extensive data on both customers and firms makes it possible to estimate the magnitudes and drivers of consumer switching costs more directly and more precisely. As noted in Section 2 and also from previous literature (e.g., Heckman, 1981), one major challenge in identifying switching costs lies in the difficult to separate true switching costs (or "true state dependence") from spurious state dependence. Spurious state dependence occurs when a buyer continues to purchase the same product for reasons unrelated to real switching costs (e.g., the product has a better "fit"). With more extensive data on products and customer behavior, it becomes possible to estimate real switching costs with proper controls for spurious state dependence. The ability to measure switching costs and their sources has important strategic implications. It allows firms to better evaluate their investments and various strategies. For example, it becomes possible for firms to estimate the amount of switching costs associated with adopting a broad product line strategy or a particular loyalty program. The ability to measure switching costs also offers great opportunities in testing hypotheses from previous theory literature. For example, Nilseen (1992), predicts that there is a difference between switching costs that are incurred each time a consumer changes supplier (or transactional costs),

and "learning" costs that are incurred each time a consumer uses a supplier for the first time. Transactional switching costs give consumers less incentives to switch than do learning switching costs and lead to lower prices for new consumers and higher prices for loyal consumers. The ability to unpack switching costs thus makes it possible to test this prediction. Moreover, previous theory has shown that a firm with large installed base would prefer to adopt an incompatible technology (i.e., choosing high switching costs), while firms producing differentiated products would prefer compatibility (i.e., choosing zero switching costs). It would also be interesting to see whether this holds true empirically. In addition, how switching costs affect entry and product differentiation may also be answered empirically.[14] It would also be interesting to investigate whether and when a firm is better off charging lower or prices to loyal customers with real data.

On the other hand, several conditions that are present in traditional markets have been changed as technology advances, which may render many previous predictions invalid and therefore provide new research opportunities. In particular, the advances of the Internet and communication technologies have also brought along new business opportunities and made new strategies possible: new markets (for example, Ebay.com, Priceline.com, search markets) emerge; new "products" (such as search results and recommendations, automatic agent services, customized offerings) are created, and new business strategies (e.g., pay-per-use, customized bundling such as creating your own CDs) are also made possible. The relationship of these strategies to customer retention is largely unknown. In some cases, the effects are theoretically ambiguous. For example, personalization technologies allow firms to serve individual customer needs better, which many have argued could lead to higher consumer switching costs. However, as technology allows firms to identify and serve customer needs more perfectly, it can also increase competition and undermine differentiation (Chen, Narasimhan and Zhang, 2001; Wattal, Chen and Telang, 2004). Thus, much of the relationship between new Internet-enabled strategies and customer retention must be examined empirically. What is clear, however, is that customer retention is becoming increasingly important component of strategy and that understanding and

[14] Previous theory suggests that switching costs can either discourage or promote entry and that switching costs may lower firm incentives to differentiate (see the survey by Farrell and Klemperer, 2004).

managing retention is especially critical in information-intensive markets. This also suggests that the design of loyalty programs under different market conditions will be an important subject.

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