DotComs versus NotComs: Competing on Channel-Centric Value Propositions

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ABSTRACT

Technology-driven commerce channels, such as the Web, possess several unique features that enable the seamless unbundling of traditional channel functions and facilitate innovative business models for the design and delivery of novel retailing value propositions. In the process, they shift the locus of competition from product-related attributes to channel-centric ones. The interaction between firms operating across these differentiated channels involves complex and interesting competitive dynamics, which cannot be captured by isolated models of electronic markets. This paper develops a stylized game-theoretic spatial differentiation model to examine the impact of differences in channel characteristics on competition between the three corresponding categories of firms – pure online firms, pure bricks-and-mortar firms, and hybrid firms which sell both online and offline. In particular, the emphasis is on the impact of technology-driven channel-differentiating parameters including channel flexibility, network externalities and switching costs, on equilibrium outcomes. The features of the equilibrium configuration and its sensitivity to various parameters are also examined. The results provide rich insights into the impact of emerging technologies on the dynamics of competition and their significance for retailing choices. They also suggest useful policy and regulatory prescriptions, and indicate product and context specific business strategies for firms grappling with the choice between bricks, clicks and a hybrid model of commerce.

1. INTRODUCTION

The confluence of several factors over the last few years has transformed emerging technology-driven channels, such as the Web, into important and sophisticated forums for commerce. The Web differs from traditional marketing channels in several ways – it enables ease of search and comparison, personalization and customization of products and services and one-to-one marketing. As an inexpensive and interactive communications medium, it also enables rapid information dissemination and building of relationships through the creation of user communities, discussion groups and chat rooms. Besides, customer service, support and even ‘product offerings’ may mean different things on Web-based and traditional channels.

Most of the recent theoretical studies of e-commerce have analyzed online channels in isolation, focusing largely on their efficiency-enhancing features. Kambil (1997) provides a generalized model of exchange processes and describes how e-commerce has the potential to dramatically influence each of them. Of these processes, a lot of attention has been paid to the impact of electronic markets on search costs (Bakos, 1997) and their welfare-enhancing properties. However, as Bakos (1997) notes, other salient features of electronic markets such as network externalities, economies of scale and scope, and switching costs are crucial for their strategic analysis. A number of empirical studies (see, for instance, Bakos et al., 1999, Brynjolfsson and Smith, 2000) have also sought to examine the ‘efficiency’ of online channels. They find that although prices for products online are lower than in traditional channels, there is significant price dispersion among online retailers even for homogenous goods like books, CDs and stock prices, and that online channels are not as ‘efficient’ as predicted by economic models. Another stream of empirical research (for instance, see, Peterson et al., 1997, Jarvenpaa and Todd, 1997, Bellman et al., 1999, Pan et al 2001) studies the unique features of the Web and their significance for retailing.

The primary focus of these studies has been on the novel characteristics of the Web and the internecine competition among online firms[1]. This is an important and interesting issue. However, these technology-driven channels, rather than incremental improvements over traditional channels, have become a significantly differentiated choice for consumers, providing firms with a whole new opportunity to rethink the way business is conducted. In the process they shift the locus of competition from that within channels to one *across* these differentiated channels, with the focus of differentiation being *channel-centric*. The fact that online channels coexist with traditional channels and markets, and that each strongly influences

[1] In one of the few empirical studies that include online, traditional and hybrid retailers, Ancarani and Shankar (2002) find that the price levels of traditional retailers are 2% higher than the list prices of hybrid retailers, which in turn are 6% higher than those at pure-play Internet retailers. They also find significant differences in price dispersion across the two channels, highlighting the differences in the competitive characteristics of online and traditional channels.

the other, has largely been overlooked in the research literature[2]. This paper attempts to fill this gap by explicitly modeling the strategic interaction between firms operating across differentiated channels. In particular, the focus is on three key technology-enabled factors viz. *channel flexibility*, *network externalities*, and *market lock-in*, that differentiate the two channels and drive the dynamics of competition across them. While implications of technology-driven cross-channel differences have hardly been systematically studied, there has, nevertheless, been a rich body of literature analyzing the impact of network externalities as well as switching costs for consumers in a single channel setting (See Farrell and Klemperer (2001) for a recent discussion of related empirical and theoretical research on network effects and switching costs). As noted by Farrell and Klemperer (2001), both network effects and switching costs play a central role in the "new economics", and market dynamics as well as firm strategies are very different in such markets compared to conventional ones. This study apart from its primary contribution to the understanding of competition across channels, also adds to this stream of literature by analyzing the implications of the differential degree of network externalities and market lock-in on such competition.

The differences between traditional and emerging technology-driven channels gain greater significance as firms operating within these channels, as well as across channels compete by leveraging channel features to create and deliver different value propositions while selling the same physical product or commodity. Determining the optimal choice of a pricing strategy and channel mix is non trivial when there is competition across channels, and the differences across channels in the degree of channel flexibility, network externalities and market lock-in make solution to this problem even less intuitive. In addition, a number of retailers operate across both channels, with the constraint of having to balance their pricing and positioning strategies across these channels (Gulati and Garino, 2000). Several traditional firms that have moved online have been forced to match their online competitors' prices creating a conflict with their pricing strategies off-line. Gap, Wal-Mart, Office Depot, Home Depot, Circuit City, and Schwab[3] are among the several hybrid firms that have successfully synchronized their pricing strategies and operations across the two channels. Given the increasing significance of emerging technology-driven channels and the growth in the number of firms operating across multiple channels, the importance of understanding such cross-channel competition cannot be overemphasized. Yet, the business and research communities have only a preliminary understanding of this phenomenon. In an attempt to address these issues, this paper poses the following questions:

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[2] An exception is the study by Balasubramanian (1998), who examines how the entry of a direct-marketer changes the equilibrium market structure in a traditional retail market that is closed to entry for other retailers. The focus here, though, is on the significance of technology-driven channel differences for competition *within* as well as *across* channels.

[3] "As demand for eSchwab's $29.95 online trades was booming, customers with Charles Schwab's traditional brokerage still had to pay an average of $65 per trade. The two-tiered pricing was awkward. Soon Schwab decided to price all trades at $29.95, thus adopting the same pricing strategy both online and off." - "Cannibalize Yourself", Fortune, September, 1999.

- What are the implications of competition between firms operating within and across different channels, for the firms as well as for consumers?
- How do the technology-driven differences in channel characteristics affect firms' pricing strategies and equilibrium outcomes?
- What are the implications of the channel-differentiating parameters for firms' optimal channel choice and configuration as well as their integration and divestiture strategies?

A stylized game-theoretic spatial differentiation model is developed to examine these issues. The results highlight the importance of the hybrid firm's strategies and its moderating influence on the competitive intensities of the two channels. Firms' profits increase as they differentiate themselves based on features over which consumers have the maximum variety in relative valuations. The choice of the factors of differentiation, however, is crucial, as are the relative sizes of the online and offline markets. Extensions of the basic model that analyze the impact of differential network externalities and switching costs bring into question standard results from earlier research on network effects and switching costs that predict 'winner-take-all' outcomes. Our analysis indicates that while network effects (as with switching costs) lead to the tipping (extreme market shares) of markets, such tipping occurs primarily due to the moderating effects of the competing channel, rather than due to any first-mover advantages. In contrast to conventional wisdom where the winning firm benefits from the network effects, our results indicate that in a static market, consumers rather than firms benefit from increasing network externalities and the resulting competition. In the case of switching costs, the pure-play in the channel with higher switching costs gains at the expense of its rivals operating in the other channel.

These findings have direct implications for business/revenue models and strategies of firms competing across differentiated channels. As the benefits from features like personalization, search and comparison, as well as from community building activities are competed away, firms in the online channel would need to actively seek alternative revenue streams such as advertising and affiliate marketing. Also, cross-selling strategies that leverage consumer information, to provide value across disparate markets, become, not just attractive, but necessary for a firm's success. Our analysis also generates crucial insights for firms grappling with issues of channel choice as well as integration and divestiture. In particular, our analysis helps identify the dominant strategy for a firm (online pure-play, hybrid or traditional), given a combination of channel-differentiating parameters. In addition, the results also have implications for firms making decisions about integrating or spinning-off their online units.

This paper contributes to several streams of research. First, it adds to the literature on online markets and channels, emphasizing the importance of technological factors. Second, it contributes to research on multi-market competition by highlighting the importance of channel-related differences. It also contributes to the literature on network externalities and switching costs by analyzing the impact of their differences across channels as well as by modeling these phenomena in a spatial setting. Finally, this work also adds to the growing body of literature on the strategic impacts of emerging technologies. The rest of this paper is structured as follows. Section 2 introduces the key technology-driven parameters that motivate the concept of channel-centric value propositions. Section 3 describes the basic model and its variants. Section 4 analyzes the impact of differential network externalities and differential switching costs on the equilibrium outcomes in the two channels. Section 5 concludes with a discussion of managerial implications.

2. CHANNEL-CENTRIC VALUE PROPOSITIONS IN E-COMMERCE

A *value proposition* characterizes the combination of end result benefits and price to a prospective customer from purchasing a particular product (Keeney, 1999). It defines how various items of value, such as product and service features including complementary services, are packaged and offered to fulfill customer needs (Kambil et al., 1996). Traditionally, firms within an industry have typically differentiated themselves from their competitors by focusing on different value propositions such as, low prices (e.g., Wal-mart), strong brands (e.g., DeBeers, Nike, BMW) convenience (e.g., Land's End), immediacy (e.g., McDonald's, Starbucks), depth and breadth of selection (e.g., Circuit City), and customer support (e.g., Home Depot, Sears). Competition in this capacity-constrained information environment has largely centered on product or service differentiation strategies that leverage firms' physical (rather than informational) assets such as, retail outlets, storage, delivery, and fulfillment infrastructure, to deliver value to their consumers. However, emerging technologies such as the Web, have helped overcome several of the informational constraints, paving the way for more radical changes.

The Web possesses unique technological features that traditional channels for commerce lack - global access unconstrained by time and space limitations, interactivity (bilateral and multilateral communications), customization and personalization features, multimedia format (audio, video and text) for richness, ability to access, store and communicate large amounts of information inexpensively, and the ability to conduct transactions in real-time. These technological capabilities have direct consequences for businesses as well as consumers. At a fundamental level they drive three key channel parameters that differentiate the online channel from the traditional channel, viz. *channel flexibility (and value-added)*[4], *positive consumption externalities* and *market lock-in* (see Figure 1). These technology-driven parameters also help realign the logistical, transactional and informational functions that traditional channels perform; disaggregate products and services; and alter the context of interaction, as well as consumer behavior. In the process, they not only provide firms the opportunity to reconfigure existing value propositions but also,

[4] The reason for emphasizing channel flexibility and not channel value-added will become clear in the following paragraphs.

enable the design and delivery of unique value propositions in ways not feasible earlier[5]. These novel value propositions, unlike traditional ones, build on *information* and leverage the *reach*, *communication, personalization, interactivity* and *community* features of the Web. Consequently, they shift the locus of competition from traditional product and service-related attributes to channel-centric ones. Traditional value attributes like location, brands and customer service are still important; however, in industries saturated with competition based on these traditional attributes, leveraging emerging technologies to compete on channel-centric differentiators has become a critical driver of success.

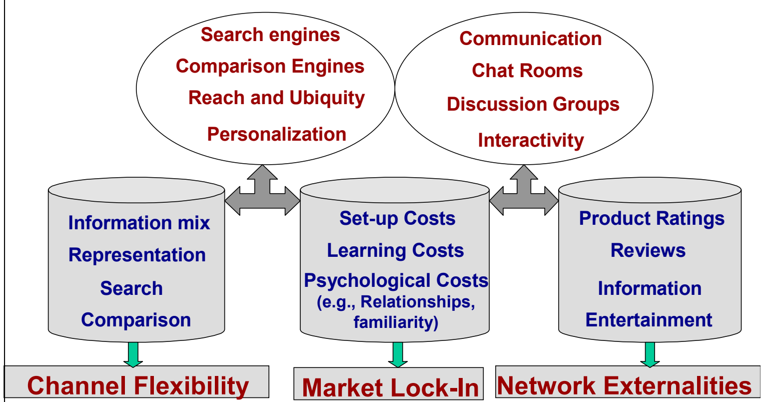

Figure 1: Technology-Driven Channel Differentiating Parameters

Firms can use a number of channel features to not only add consumer value but also, differentiate themselves from their rivals. As noted earlier, in saturated product markets with firms selling identical physical products, the competitive emphasis shifts from product/service related variables to channel-related ones. This is precisely the kind of situation that is modeled in this paper. Take the familiar case of books, where the basic physical product sold by all booksellers (online or offline) is identical. However, firms in each channel can typically combine a bundle of complementary value-added features that influence consumer choice and define their competitive position. Web-centric channel features that firms can leverage for value-addition and differentiation include, the information mix, product representation and layout, personalization and customization features, product comparison and evaluation systems, pre-purchase help and support (perhaps from a live salesperson), site design and user interfaces, transaction processing and ease of purchase (for instance, one-click ordering), delivery, shipping and handling, online customer service, security and service guarantees. Correspondingly, channel features that traditional

[5] Even for firms that sell commodities the value adding (as well as the interactivity and community-building) features of the Web offer excellent opportunities to break out of the 'commoditization trap' by creating novel ways to offer value. Lee (1998), Evans and Wurster (1997), and Rayport and Sviokla (1994) provide additional examples that highlight these novel value propositions.

'brick-and-mortar' firms can leverage include location and access, ambiance, customer service and support, product assortment and organization, among others. It is precisely these channel-related features that enable firms to emphasize different aspects of the customer's buying experience and consequently separate the competing offerings of firms within a channel as well as across channels.

It is crucial here to highlight the subtle difference between value addition and flexibility. While channel features affect the value that consumers derive from product bundles, not all features necessarily form a basis of differentiation among firms *within* the channel, as all firms within the channel provide these benefits. Thus, since all traditional outlets allow consumers to touch and feel the books, browse through them and facilitate immediate fulfillment of the purchase, these features cannot serve as effective differentiators between traditional booksellers[6] although they add value to consumers. However, features such as store location, assortment, categorization, and layout force firms to make choices that, while being closer to the requirements (or tastes) of some consumers are less valuable to other consumers with different requirements. In the case of online firms, features such as website layout and navigation, richness of information (multimedia product representation), use of consumer tracking technologies, among others, serve as effective differentiators[7]. Consumers with slower Internet connections might face higher disutility due to long wait times and uncertain fulfillment from information and rich-media intensive websites, while others with fast connections might find them highly valuable. Likewise, some consumers might benefit from personalized recommendations and live support enabled by consumer tracking and personalization technologies, while others might find these features to be intrusive.

In other words, feature choice by firms while adding value, also imposes *misfit costs* on some consumers who desire a different combination of these features than the one provided by a firm. It is these misfit costs, rather than the value-added aspect of channel features, which enable a firm to segment a market and create a differentiated offering that better serves the requirements of the target segment (while being less valuable to other consumers)[8]. A channel with *lower misfit costs* imposes less disutility on consumers whose ideal combination of channel features is not available, and can thus be considered *more flexible*. Since the channel-centric features of differentiation supported by the online and traditional channels are different, the misfit costs for consumers across these two channels also vary. Advances in

[6] These features however can serve as effective differentiators *across* channels and hence drive channel choice. For instance, consumers who place a high priority on the physical aspects of book buying and immediacy will shop offline, while consumers who prefer to shop in the convenience of their homes and find abundant information valuable, will shop online.

[7] According to a recent empirical study by Pan et al (2001), online firms choose to differentiate themselves from their online rivals based on just one or two of the several value-adding online channel features (These features include search, navigation, product representation, information, transaction processing, delivery time, shipping and handling as well as online service).

[8] This is reflected in the dimensions used by some of the leading online performance-measurement and tracking firms such as Gomez Inc., and Bizrate.com to rate the offerings of different online retailers, viz. Web-site functionality, on-site resources, security features, response time, usage and transaction performance, among others.

technologies such as user profiling, recommendation systems and dynamic generation of Web pages permit extensive customization of Websites, thereby reducing misfit costs and making the online channel much more flexible than the offline channel.

In addition, technological capabilities such as interactivity and real-time communications enable the creation of virtual communities and networks. In particular, brand-based online communities (see McWilliam, 2000), including those in health-care and online gaming have witnessed a significant growth in recent years, while firms like Amazon.com have leveraged their large customer base to add value through user ratings, reviews and feedback. These user communities generate significant direct as well as indirect *positive consumption externalities,* and the two channels distinctly differ in their ability to facilitate the creation and sustenance of these externalities.

Added to the differential value adding features and positive consumption externalities, channel-centric features such as set-up and personalization costs, learning costs as well as psychological costs differentiate the two channels in their ability to enable firms 'lock-in' consumers by creating *switching costs* for consumers that initially purchase from them[9]. The relative degree of channel flexibility, network externalities and market lock-in that the two channels facilitate would depend on the specifics of the industry, the product offerings, and technology, among others[10].

3. OVERVIEW OF THE BASIC MODEL

To begin with, this paper models competition across differentiated channels using a variant of Salop's (1979) model. The *basic* model, a stylized spatial differentiation model, examines the impact of the interactions between pricing and demand in these two channels with differing channel flexibilities. There are three types of firms – a pure online firm, a traditional 'brick-and-mortar' firm, and a hybrid firm, which operates in both channels. Each firm sells a commodity product, but differentiates itself from its rivals by leveraging the characteristics of its own channel and innovating on the features of the buying experience associated with the products, to offer different value propositions. The set of possible differentiated value propositions in each channel is modeled by representing the channel characteristics by a unit circle[11] and a firm's choice of the channel-related propositions determines its location on the circle. However, this model departs from Salop's (1979) standard model in that the online and the traditional channel are each

[9] Chen and Hitt (2002) develop an approach for measuring the magnitude of customer switching costs at online brokerages and identify system, firm and customer characteristics that contribute to switching costs. Of particular interest is their finding that the information provided by brokerages is an important driver of switching costs for online brokerages.

[10] For instance, Lee and Png (2002), based on data collected from some of the largest online and traditional book retailers, find that the switching costs for consumers are lower online than in conventional markets.

[11] The circular spatial model (mathematically equivalent to a linear market model of infinite length) has been widely used since Salop (1979) as it avoids the 'end point problems' associated with a line segment of finite length.

represented by adjacent unit circles (for instance see Cooper, 1989), with the hybrid firm situated at the point of intersection of the two circles (see Figure 2). The online channel (channel *A*) has n_A consumers while the tradition channel (channel *B*) has n_B consumers[12].

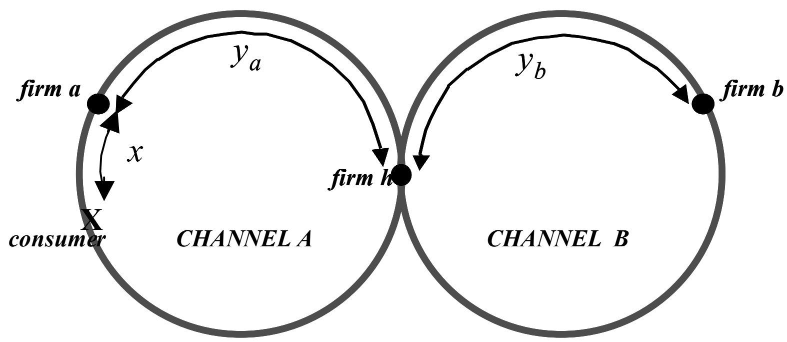

Figure 2

Consumers are utility-maximizers and each consumer is in the market for one unit of a product in each period. Each consumer has an ideal configuration of channel-related features (for instance, information-mix, multi-media representation, e-mail notifications, and active salesperson involvement) that gives her the highest utility. Consumers are uniformly distributed on each unit circle according to the position of the peak of their utility functions. Consumers are assumed to have an inelastic demand i.e., a high reservation price $\check{r}$, in comparison with their total costs. High reservation prices ensure that consumers always purchase a product, so the problem focuses purely on the competitive aspects of the channel (Economides, 1989). A consumer incurs a loss of utility when she buys a bundle other than her ideal one, and this drives the channel *misfit cost*[13], which differs across the two channels. Since the problem of utility maximization for consumers is equivalent to cost minimization, the model focuses on the misfit (loss of utility) a consumer incurs. The channel misfit costs vary linearly with distance. The total cost incurred by a consumer when she purchases a bundle is the sum of the price she pays for the bundle and the channel misfit cost. Table 1 summarizes the parameters of the basic model.

Firms choose pricing strategies that maximize their profit functions. The firms are located diametrically opposite each other in both channels ($y_a = y_b = 0.5$). Given their locations, each firm decides on the choice of its price, given price of the other firms in its channel.

[12] As noted earlier, differences in consumers' preferences for *value-added* features drives their channel choice and is thus reflected in the size (n_A, n_B) of the two channels.

[13] As described earlier, the channel *misfit cost* is formally the reciprocal of channel *flexibility*. In other words, the higher (lower) the channel flexibility, the lower (higher) the channel misfit costs.

Table 1: Model Parameters	
A, B	Online and traditional channels respectively.
a, b, h	Firms in these channels. Firm *a* sells exclusively in channel *A*, firm *b* sells exclusively in channel *B*, and firm *h* sells in both channels.
n_i	Size of market served by channel *i*, $i \in \{A, B\}$
t_i	Cost of channel misfit in channel *i*, $i \in \{A, B\}$
p_i	Price set by firm *i*, $i \in \{a, b, h\}$
k	Firm *h*'s discount (markup) in channel *B* relative to channel *A*
x	Distance between the location of the consumer and the firm.
y_a, y_b	Locations of firms *a* and *b* relative to firm *h*.

The *basic* model assumes that each channel serves a distinct market, i.e., consumers are either online or offline and consumers in a particular channel purchase products only from firms using that channel. This implies that the online and traditional channels cater to different customer segments, with differing needs[14]. The hybrid firm's prices in the online and traditional channels are related by a factor *k*, which captures the markup (or discount) (due to factors like shipping costs, sales tax etc.) in the traditional channel over the online channel. These constraints are later relaxed to examine the implications of consumers switching *across* channels, as well as that of the hybrid firm being able to price discriminate across channels.

We analyze the case in which firms, given their locations, simultaneously choose prices[15]. The unique equilibrium for the price game is stated in Propositions 1a and 1b. The proofs are available in Appendix A.

Proposition 1a: *When the hybrid firm is restricted in its ability to price discriminate across the two channels that differ in their channel flexibility, the hybrid firm always prices between that of the online and the hybrid firm.*

Proof: The optimal prices charged by the online firm (firm a), the traditional firm (firm b) and the hybrid firm (firm h), at equilibrium, are given by,

$$p_a(p_h) = \frac{1}{4}\left(2p_h + t_A\right) \qquad -1.1$$

$$p_b(p_h) = \frac{1}{4}\left(2kp_h + t_B\right) \qquad -1.2$$

$$p_h(p_a, p_b) = \frac{n_A t_B (2p_a + t_A) + kn_B t_A (2p_b + t_B)}{4(k^2 n_B t_A + n_A t_B)}\,. \qquad -1.3$$

[14] This is in line with earlier work by Alba et al. (1997) who find that consumers' shopping behavior online is fundamentally different from that in traditional channels. Also, according to Forrester (Huf, 2000), consumers can be segmented into two broad categories - *technology optimists*, the early adopters of online shopping and *technology pessimists,* who avoid new technologies.

As is evident from the reaction functions, the prices of the pure-plays in both channels depend only on their own channel characteristics (t_A or t_B). Naturally, firms in the channel with higher channel flexibility (lower channel-misfit costs) end up competing more fiercely with each other as consumers find their products to be relatively close substitutes, forcing the firms to maintain lower prices. However, hybrid firm's price is a demand-weighted average of parameters (t_A and t_B) of both these channels (see Appendix A for detailed proof). Thus, the hybrid firm exerts a moderating influence on the competitive intensities of both channels.

Proposition 1b: *The optimal profits at equilibrium for the online firm (firm a), the traditional firm (firm b) and the hybrid firm (firm h) are given by*,

$$\pi_a^* = \frac{n_A t_A [2n_A t_B + k^2 n_B (t_A + t_B)]^2}{16[k^2 n_B t_A + n_A t_B]^2} \qquad \text{- 1. 4}$$

$$\pi_b^* = \frac{n_B t_B [2k^2 n_B t_A + k n_A (t_A + t_B)]^2}{16[k^2 n_B t_A + n_A t_B]^2} \qquad \text{- 1. 5}$$

$$\pi_h^* = \frac{t_A t_B (n_A + k n_B)^2}{4[k^2 n_B t_A + n_A t_B]} \qquad \text{- 1. 6}$$

The expressions in Propositions 1a and 1b are better understood through figures A1 and A2 that illustrate the impact of varying channel flexibility (misfit costs) in channel *A* on firm prices and profits. As the online channel-misfit costs decreases, relative to that of the traditional channel (i.e. the online channel becomes more flexible relative to the traditional channel *B*), consumers in the online channel become less sensitive to the offerings of the individual firms in their channel, resulting in intensified price competition in channel A. In other words, the offerings of competing online firms become closer substitutes. However, the hybrid firm, due to its presence in both channels, is sensitive to the competitive conditions in both channels. Thus, although the hybrid firm would rather price higher in the traditional channel with lower flexibility, where consumers incur a higher channel-misfit costs, it has to take into consideration the competition in the online channel in setting its price. Hence, despite the fact that the pure online and the traditional firms do not compete for the same set of consumers, the presence of the hybrid firm reacting to competitive conditions in both the channels, introduces strategic interdependence between these firms. Also, the channel that offers greater value-addition has higher demand and greater influence on the prices and profits of all firms. Consequently, as the more flexible channel (with lower misfit costs) grows in size and significance, the hybrid firm competes more intensely with the 'pure-play' in this channel, and prices move closer to that in independent channels, adversely affecting the pure-play in the alternate channel.

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[15] There exists no equilibrium in pure-strategies in a 1-stage game involving simultaneous determination of prices and locations with either linear or quadratic cost functions (proofs available upon request). The 2-stage game is more realistic as firms' choice of positioning usually preceeds their choice of prices. Also firms' positioning and channel choices are harder to change than prices.

Independent and Overlapping Channels: While we have restricted the ability of the hybrid firm to price discriminate freely across both channels (by making *k* exogenous), we can compare this to the case where the hybrid firm is free to choose *k,* to highlight how the presence of the 'hybrid' firm alters the competitive characteristics of the two channels.

Proposition 2a: *When the hybrid firm is free to choose the value of 'k', it chooses 'k' such that the two channels effectively become independent.*

See Appendix A for proof of this proposition.

Proposition 2b: *The profits of the pure-play in the channel with greater flexibility are substantially lower when the two channels are independent.*

Proof: When the two channels are independent, the profit of the pure-play in the channel with higher flexibility (i.e. lower misfit costs, say, channel A) is $\pi_a = \frac{n_A t_A}{4}$. Comparing this with the profits of firm *a* (equation 1.4), from the base model where the value of *k* is restricted, illustrates the result (see figure A2, where $k = t_A/t_B$). Equation 1.4 can be rewritten as,

$$\pi_a^* = \frac{n_A t_A}{4}\left(\frac{2n_A t_B + k^2 n_B (t_A + t_B)}{2(k^2 n_B t_A + n_A t_B)}\right)^2$$

Substituting $n_A = n_B = 1$ and $k = 1$, and rearranging the terms we have

$$\pi_a^* = \frac{t_A}{4}\left(\frac{t_B}{(t_A + t_B)} + \frac{1}{2}\right)^2.$$

Since $\left(\frac{t_B}{(t_A + t_B)}\right)$ is always greater than $\frac{1}{2}$ as long as $t_A < t_B$, the term inside the parentheses in the equation for π_a^* is greater than 1 and hence π_a^* is greater than $\frac{n_A t_A}{4}$. This concludes the proof.

Proposition 2c: *Consumers in the channel that offers greater flexibility benefit more when the two channels are independent, relative to the case where the hybrid firm is restricted in its pricing across channels. On the other hand, the welfare of consumers in the less flexible channel improves when the hybrid firm's choice of 'k' is restricted.*

Proof: As earlier, we compare the prices charged by firm *a* when the channels are independent i.e., $p_a = \frac{t_A}{2}$ with firm *a*'s price from the base model (equation 1.1). Substituting $n_A = n_B = 1$ and, and rearranging the terms we have,

$$p_a^* = \frac{t_A}{2}\left(\frac{t_B}{(t_A + t_B)} + \frac{1}{2}\right).$$

When $t_A < t_B$, p_a^* is greater than $\frac{t_A}{2}$, firm *a*'s price in the case of independent channels.

p_h^*, firm *h*'s price (equation 1.3) is greater than firm *a*'s price and hence greater than $\frac{t_A}{2}$. Thus, consumers in the channel with greater flexibility face lower prices from both firms in the channel, when the two channels are independent, than when firm *h* is restricted in its choice of *k* (see figure A1, where $k = t_A/t_B$). However, total consumer surplus is greater when the hybrid firm is restricted in its ability to price discriminate across the two channels. When consumers are channel-specific and when firm *h* is able to freely price discriminate across the two channels, the two channels become disjoint. At the other extreme, where the two channels completely overlap and there is no cost to consumers for switching across channels, consumers are no longer channel-specific,[16] but make buying choices across both channels, leading all firms to compete for the same set of consumers. The optimal prices and profits for firms in both channels are given by Propositions 2a and 2b.

Proposition 2d: *When both channels completely overlap, the optimal prices of the three firms are,*

$$p_a^* = p_b^* = p_h^* = \frac{[t_A t_B (n_A + n_B)]}{2[n_B t_A + n_A t_B]} \qquad \text{- 2. 1}$$

Proposition 2e: *When both channels completely overlap, the optimal profits of the three firms are,*

$$\pi_a^* = \frac{[n_A t_A t_B (n_A + n_B)]}{4[n_B t_A + n_A t_B]}\ ;\quad \pi_b^* = \frac{n_B t_A t_B (n_A + n_B)}{4[n_B t_A + n_A t_B]}\ ;\ \pi_h^* = \frac{t_A t_B (n_A + n_B)^2}{4[n_B t_A + n_A t_B]}.$$

Proof: For proofs of propositions 2d and 2e, see Appendix A.

The optimal firm prices in the case of overlapping channels, is the same as the hybrid firm's (with *k*=1) price, when the two channels are interdependent (see eq. 1.3). When the two channels completely overlap, each firm faces a weighted average of the misfit costs of both channels rather than the misfit cost of its

[16] Improvements in technology such as in-store kiosks, virtual dressing rooms and live online customer support are making it possible for one channel to duplicate the offerings of the other, reducing the differences (in channel value-added and flexibility) between them and enabling them to offer similar value propositions.

own channel – similar to that of the hybrid firm that is restricted in its choice of *k*, in the case where consumers are channel-specific. The results indicate that the prices and the total profits for all firms are the highest when the two channels cater to completely different segments and the prices and total profits are the lowest when the two channels deliver the same value propositions and cater to the same market. The prices and the total profits for all firms, when the channels are interdependent due to the presence of the hybrid firm, fall in between these two extremes.

4. IMPACT OF NETWORK EXTERNALITIES AND SWITCHING COSTS

Besides channel flexibility, other key parameters that differentiate the online channel from the traditional channel are the degree of *positive consumption externalities* that the channel facilitates and the level of *switching costs* for consumers[17]. The *basic* model is extended two ways – one to incorporate the presence of *positive consumption externalities* in the online channel and the other to incorporate the presence of *switching costs* for consumers in the online channel. Depending on the product, firm, and industry features, the level of these parameters could be higher or lower in either channel. As the focus is primarily on the differential level of these features across the two channels, we assume (without loss of generality) that the traditional channel does not facilitate any network externalities or switching costs.

Fig. 3 - Dynamics of Network Externalities

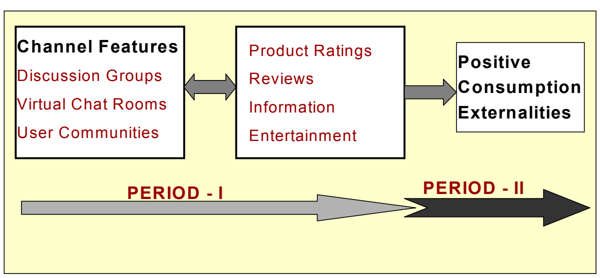
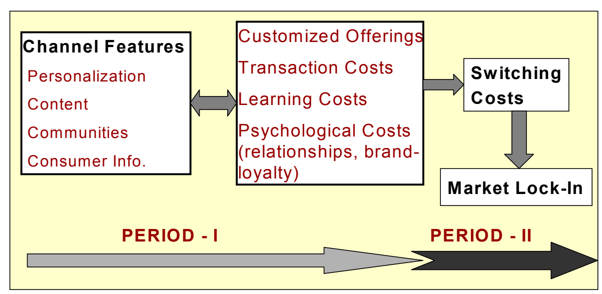


Fig. 4 - Dynamics of Market 'Lock-In'



In the case with *positive consumption externalities*, in addition to the utility derived from the bundle, consumers also derive utility from the 'network' of consumers who purchase from the same firm (see Figure 3). This is captured by a two-period model, in which a firms' consumer base (demand) in period-I confers utility to the firm's consumers in period-II - the value to a consumer being directly proportional to

[17] See Katz and Shapiro (1985, 1986) for a discussion of network externalities. See Klemperer (1986, 1987, 1995), Farrell (1985), Wernerfelt (1985), and Von Wiezsacker (1984), for related research on consumer switching costs.

the number of consumers her firm has in period I. Thus, a consumer in channel *A,* who purchases a bundle from firm *a* at price p_a^2, located at a distance *x* from her ideal bundle faces a utility function given by,

$$U_i = \check{r} - p_a^2 - t_A(x) + \delta_A . q_a^1$$

where, δ_A is the degree of externalities in channel *A* and q_a^1 is the period-I demand for firm *a*. Naturally, a firm with a larger period-I demand is more attractive to a consumer in period-II, ceteris paribus.

In the case with *switching costs*, consumers face a cost of switching firms in period II, which dampens a consumer's propensity to switch between firms *within* a channel. In addition to the channel-misfit costs the online consumer faces a switching cost ψ_A, of purchasing a product that is different from the one purchased in the first period. Thus, a consumer in channel *A,* who has purchased a bundle from firm *h* in period-I, but purchases from firm *a* in period II at price p_a^2, located at a distance *x* from her ideal bundle faces a utility function given by,

$$U_i = \check{r} - p_a^2 - t_A x - \psi_A$$

where, ψ_A is the level of switching costs in channel *A*. Switching costs include transaction costs, learning costs, psychological costs including 'brand-loyalty' as well as "frequent-flyer" programs (Farrell and Klemperer, 2001). In addition, the "community effect" and "personalized" offerings as well uncertainty in product quality introduce substantial switching costs for online consumers (see Figure 4). As for personalization effects, there may be transaction costs of "subscribing" to a competitor's offerings as well as forgoing the benefits that accrue from "learning" effects for the firm, which enables it to provide more personalized services.

Table 2: Additional Model Parameters

A, B	Online and traditional channels respectively.
a, b, h	Firms in these channels. Firm *a* sells exclusively in channel *A*, firm *b* sells exclusively in channel *B*, and firm *h* sells in both channels.
t_i	Cost of channel misfit in channel *i*, $i \in \{A, B\}$
δ_A	Degree of positive consumption externality in channel *A*.
ψ_A	Degree of switching costs in channel *A*.
p_i^k	Price set by firm *i* in period *k*, $i \in \{a, b, h\}$; $k \in \{1,2\}$
q_i^k	Market share for firm *i* in period *k*, $i \in \{a, b, h\}$; $k \in \{1,2\}$
π_i^k	Profits for firm *i* in period *k*, $i \in \{a, b, h\}$; $k \in \{1,2\}$

As in the basic model, consumers seek to maximize utility (minimize cost) and firms seek to maximize profits. The unique equilibrium is derived for second stage of the game where firms simultaneously choose their prices given their locations[18]. Both firms and consumers have rational expectations and consumers cannot store the product between periods. Firms choose to maximize total future undiscounted profits. Each consumer purchases one unit of the product in each period and seeks to maximize their net utility over both periods. Firms' second period choice of prices and profits depend on their second period demand, which in turn depend on the demand in the first period. We begin by analyzing how the second period prices and profits depend on the demand in the first period.

Period-II: All consumers who purchased a bundle from a particular firm (say firm *a*) in period-I, face identical consumption externalities as well as identical cost of switching to a different firm (within the same channel) in period-II. Each firm maximizes its period-II profits given the prices of other firms in period-II as well as in period-I.

Period-I: In period-I, while consumers do not enjoy any benefits from network externalities (nor are 'locked-in'), each firm sets its price while taking into consideration not only the impact on its period-I demand and profitability, but also the effect of its period-I demand on its profitability in period-II. Consequently, a firm chooses its period-I price so as to maximize its total future discounted profits, while taking the prices of other firms in its channel as given. Thus, for instance, in channel A, firm *a* chooses p_a^1 so at to maximize it total future discounted profits, while taking firm *h*'s price in period-I as given.

$$\pi_a(p_a^1, p_h^1) = \pi_a^1(p_a^1, p_h^1) + \pi_a^2(q_a^1(p_a^1, p_h^1))$$

At equilibrium we have,

$$\partial\pi_a / \partial p_a^1 = \partial\pi_a^1 / \partial p_a^1 + \partial\pi_a^2 / \partial q_a^1 \times \partial q_a^1 / \partial p_a^1 = 0$$

In both cases (network externalities as well as switching costs) we solve for period-I optimal prices and profits for all three firms analytically[19].

4.1. IMPACT OF NETWORK EXTERNALITIES

Proposition 3a: *When the online channel (channel A) has positive network externalities, the online, hybrid, as well as the traditional firm compete more intensely in period-I, compared to the base model with no network externalities. Also the firms' period-I prices decrease with increasing network externalities.*

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[18] As in the basic model, it is assumed that firms are located opposite each other and the unique equilibrium is derived for prices that maximize firms' profits. For mathematical tractability the values of n_A, n_B and k are restricted to 1.

[19] Some of the expressions are complex and do not provide additional insights and are therefore omitted for the sake of brevity. Detailed mathematical analysis is available upon request.

Proof: The optimal prices charged by the firms in period-I are derived in Appendix B. Rearranging the terms and comparing these prices with the optimal prices in the basic model (with n_A, n_B and k =1 in equations A.3a, and A.3c, in Appendix A),

$$p_a^1 = \frac{36(p_a^*) - 15\delta_A - 25p_h^1(\delta_A)^2}{36 - 25(\delta_A)^2}; \qquad p_h^1 = \frac{18\left(p_h^*\right) - 3\delta_A - 2p_a^1(\delta_A)^2}{18 - 2(\delta_A)^2}; \qquad p_b^1 = \frac{1}{4}\left(2p_h^1 + 1\right);$$

$$\text{where,} \quad p_a^* = \frac{1}{4}\left(2p_h + t_A\right) \text{ and } p_h^* = \frac{t_B(2p_a + t_A) + t_A(2p_b + t_B)}{4(t_A + t_B)}.$$

As evident from the above equations that the period-I prices for firms *a* as well as *h* (and consequently for firm *b*) in the case with positive network externalities is lower than their optimal prices in the basic model without externalities. It is also evident from the above equations that, as δ_A, the degree of externalities in the online channel increases, firm prices decrease (the denominator (numerator) increases (decreases)).

Proposition 3b: *The pure-play (firm a) in the channel with higher network externalities is able to increase its prices in period-II compared to its period-I prices. Its period-II prices are also higher than the corresponding price in the basic model. Also, its prices are higher with higher network externalities.*

Firm *a*'s optimal period-II price (see Appendix B for detailed analyses), is given by,

$$p_a^2 = \frac{1}{4}\left(2p_h^2 + t_A - 2\delta_A + 4.\delta_A.q_a^1\right).$$

Rearranging the terms and comparing this with firm *a*'s price in the basic model (without network externalities), we have,

$$p_a^2 = p_a^* - \delta_A\left(\frac{1}{2} - q_a^1\right), \quad \text{where } p_a^* = \frac{1}{4}\left(2p_h + t_A\right).$$

From proposition 3a, we know that $p_a^1 < p_a^*$. Since $t_A < t_B$, we have $q_a^1 > q_a^* > \frac{1}{2}$, which implies that that $p_a^2 > p_a^*$ (as the term in the parentheses in the expression for p_a^2 above is positive). It follows that firm *a*'s period-II prices increase with increasing network externalities.

Proposition 3c: *The optimal period-II prices of both the hybrid firm as well as the traditional firm, are lower in the case with network externalities compared to their corresponding prices in the basic model. Also their optimal period-II prices decrease with increasing network externalities in the online channel.*

Proof: This follows from the optimal period-II prices of firms *h* and *b* (for derivations of these optimal prices see Appendix B)

$$p_h^2 = p_h^* + \frac{t_B}{\left(t_A + t_B\right)}(\delta_A)(q_a^1 - \frac{1}{2})\,; \quad p_b^2 = \frac{1}{4}\left(2p_h^2 + t_B\right)$$

As stated in proposition 3a, $q_a^1 > \frac{1}{2}$, making the second term in the above equation for p_h^2 negative. Hence p_h^2 *and consequently* p_b^2 are lower than their corresponding prices p_h^*, and p_b^* in the basic model. More importantly, as δ_A increases, both p_h^2 and p_b^2 decrease.

Proposition 3d: *Despite higher prices in period-II, firm a is unable to fully appropriate the additional surplus from the network externalities.*

Proof: This follows from the expression for firm *a*'s optimal price in period-II, as in proposition 3a. Rearranging the terms we get,

$$p_a^2 = p_a^* - \frac{\delta_A}{2} + \left(\delta_A q_a^1\right).$$

$\delta_A q_a^1$ is the additional utility consumers in period-II gain (from firm *a*'s demand in period-I) due to the presence of network externalities, while p_a^* is firm *a*'s price in the basic model. However, as is evident from the above expression, firm *a* is unable to fully appropriate this additional surplus and its period-II price is lower by an amount $\frac{\delta_A}{2}$, which represents the loss from externality-induced competition.

Figures B1-B5 illustrate the impact of increasing network externalities in the online channel on firms' prices, demand and profits. As illustrated in Figures B-1 and B-2 the firm in the channel with higher network externalities (firm *a*) prices the lowest in period-I, with the prices (demand) decreasing (increasing) with increasing network externalities in its channel. While the hybrid firm also prices lower in period-I, its presence in channel *B* (with no network externalities), constraints its ability to drop prices. Firm *b*, reacting to firm *h*, is also forced to lower prices despite no gains from externalities in its channel.

In period-II firm *a* is able to increase its price substantially over its period-I price and this price increase is higher with higher network externalities in its channel. Firm *b* also prices higher in period-II relative to period-I, but substantially lower than firm *a*'s prices in period-II. However, the hybrid firm is constrained in its ability to raise prices significantly in period-II and unable to take full advantage of the externalities in channel *A*. In fact, the hybrid firm prices the lowest of the three in period-II (see Figure B1). Also, the prices of the hybrid and the traditional firm decrease with increasing externalities in channel *A*. The impact of network externalities is most evident in the period-II demand and profits of firm *a*, which increase with increasing externalities, despite firm ***a*** high prices in period-II (see Figures B2 and B3). The average firm prices (across both periods) though, decrease with increasing network externalities, with the hybrid firm always pricing between those of the pure-plays. However, the traditional as well as the hybrid firm's demand *decrease* in both periods, with increasing externalities, despite lower prices. As illustrated in figure B2, while the hybrid firms' low prices helps it gain a larger market share in the traditional channel, with increasing network externalities in the online channel, the hybrid firm loses a *greater* share of its demand in the online channel, than it gains in the traditional channel.

While the profits of the pure online firm (firm *a*) are higher in period-II and increase with increasing network externalities in its channel, its *total* profits (across both periods), as well as those of the hybrid and the traditional firm, *decrease* with increasing network externalities in the online channel. The hybrid firm is the most adversely affected by differing network externalities across its two channels and the total profits of the hybrid firm decrease the fastest with increasing network externalities in channel *A* (see figure B4). Also, at low to moderate differences in the degree of network externalities between the two channels, the total profits of the pure-plays (firms *a* and *b*) are very similar (see figure B4). This changes as the two channels begin to differ substantially in the degree of network externalities they facilitate. Also, the inter-temporal prices and profits of the pure-play in the channel with higher network externalities exhibit significantly greater volatility than those of its rivals.

4.2. IMPACT OF SWITCHING COSTS

Period-II: This section analyzes the second period of the market with switching costs after consumers have attached themselves to firms in the first period. The firms' optimal prices are computed as functions of their first period market shares. Proposition 4a derives the three feasible scenarios.

Proposition 4a: *When consumers switch from one firm to another in period-II, there are three possible cases:*

Case I: *Consumers switch from the pure online firm to the hybrid firm in period-II iff*

$$(p_h^1 - p_a^1) > (p_h^2 - p_a^2) + \psi_A$$

Case II: *Consumers switch from the hybrid firm to the pure online firm in period-II iff*

$$(p_h^1 - p_a^1) < (p_h^2 - p_a^2) - \psi_A$$

Case III: *Consumer do not switch across firms in period-II iff*

$$(p_h^2 - p_a^2) + \psi_A > (p_h^1 - p_a^1) > (p_h^2 - p_a^2) - \psi_A$$

Proof: See Appendix C for proof of this Proposition.

Proposition 4b: *There exists no equilibrium in pure strategies where consumers switch firms in period-II (cases I and II).*

Proof: It can be shown that, under certain regularity conditions, firm prices satisfy Case III in Proposition 4a and no consumers switch firms in period-II, at equilibrium. The proof of this proposition sheds no additional insights to the analysis and hence is omitted. However, the proofs are available upon request.

Proposition 4c: *The optimal prices and profits for firms a, b and h in period-II (in terms of their period-I market shares) are given by,*

$$p_a^2 = \frac{1}{12}\left(12p_a^1 - 12p_h^1 + 3t_B + 4q_{ha}^1 t_B + 12\psi_A\right)$$

$$p_b^2 = \frac{1}{12}\left(3t_B + 2q_{hA}^1 t_B\right); \qquad p_h^2 = \frac{1}{12}\left(3t_B + 4q_{hA}^1 t_B\right)$$

$$\pi_a^2 = q_a^1 \times p_a^2 \qquad \pi_b^2 = \frac{4(p_h^2 - p_b^2) + t_B}{2t_B} \times p_b^2 \qquad \pi_h^2 = \left(q_{ha}^1 + \frac{4(p_b^2 - p_h^2) + t_B}{2t_B}\right) \times p_h^2$$

For proofs of this proposition, see Appendix C.

Proposition 4d: *The optimal prices and profits for firms a, b and h in period-I are given by,*

$$p_a^1 = \frac{36p_h^1 t_A + 6(t_A)^2 + 16p_h^1 t_B - 3\, t_A . t_B - 12t_A \psi_A}{16\,(3t_A + t_B)}$$

$$p_b^1 = \frac{1}{8}\left(4p_h^1 + t_B\right)$$

$$p_h^1 = \frac{18p_b^1 (t_A)^2 + 18p_a^1 t_A t_B + 9(t_A)^2 t_B - 16p_a^1 (t_B)^2 - 10(t_B)^2 t_A}{4\left(9(t_A)^2 + 9t_A t_B - 4(t_B)^2\right)}$$

$$\pi_a^1 = \frac{4(p_h^1 - p_a^1) + t_A}{2t_A} \times p_a^1 \qquad \pi_b^1 = \frac{4(p_h^1 - p_b^1) + t_B}{2t_B} \times p_b^1$$

$$\pi_h^1 = \left(\frac{4(p_a^1 - p_h^1) + t_A}{2t_A} + \frac{4(p_b^1 - p_h^1) + t_B}{2t_B}\right) \times p_h^1$$

For a proof of this proposition see Appendix C.

The expressions in Propositions 4c and 4d are better understood through figures C1-C5 that illustrate the impact of increasing switching costs in channel *A* on firms prices, demand and profits. As with network externalities, switching costs lead firms to compete fiercely with each other in period-I (see Figure C1), and while firms in the channel (online) with switching costs have an incentive to adopt a 'loss-leader' pricing strategy to gain a larger market share in period-I, the traditional firm is forced to price lower in period-I, despite no switching costs for consumers in its channel. But unlike in the case of network externalities, both the hybrid as well as the traditional firm's prices do not change substantially with increasing switching costs in channel *A* (see Figure C1). However, at any given level of switching costs their lower prices (and profits) in period-I are compensated by higher prices (and profits) in period-II. The online firm prices the highest in period-II, with its price (and profits) increasing with increasing switching costs in the online channel (see Figure C1). The prices as well as profits of both the hybrid as well as the traditional firm decrease with increasing switching costs in channel *A* (see Figure C1 and C3).

Contrary to the case with network externalities, the *total* price (across both periods) charged by the online (hybrid) firm is the highest (lowest) of the three, with the online firm's price increasing with increasing switching costs in the online channel (see Figure C5). Also, unlike with network externalities, the *total* profits of the online firm increases with increasing switching costs in its channel (see Figure C4).

4.3. COMPARISON OF EQUILIBRIA AND CONSUMER WELFARE

As noted earlier, comparing the basic model, where the hybrid firm is restricted in its ability to price discriminate across the two channels, with the case where the hybrid firm is free to price discriminate, shows that total consumer welfare is the higher in the former compared to the latter.

When the network externalities are higher in the online channel relative to the traditional channel, the *average* price (as well as total profits) of all firms decrease with increasing network externalities (see Figure B4 and B5). This is despite all three firms being able to charge a higher price in period-II, relative to their period-I prices. Thus, the competitive effects of network externalities overwhelm the surplus extraction abilities of the firms. More importantly, positive consumption externalities in one channel make *both* the channels more competitive. The results indicate that while consumers in the online channel clearly benefit from the positive consumption externalities enabled by the channel, consumers in the traditional channel also benefit, irrespective of which firm they purchase from. In contrast, in the case of markets with switching costs, while average price (across both periods) charged by the online firm, as well as its total profits increase, with increasing switching costs, the average prices of both the traditional as well as the hybrid firm, as well as their total profits decrease (see Figures C4 and C5). Given that, at equilibrium, no consumer switches firms in period-II, firm *a*'s consumers are worse-off with increasing switching costs in the online channel, unlike those of the hybrid and the traditional firm.

Comparing the effect of positive consumption externalities with that of switching costs indicates that, while the online pure plays' consumers always benefit from higher levels of network externalities in their channel, the firm itself benefits only if it is able to increase switching costs for consumers in its channel. In the case of the hybrid firm, the results depend on the level of the switching costs and the degree of network externality in the online channel.

5. MANAGERIAL IMPLICATIONS AND CONCLUSIONS

With the growing importance of emerging technology-driven channels such as the Web and mobile devices, firms increasingly seek to leverage the novel features enabled by these technologies to add value to their offerings. While technology-enabled channel features (personalization and customization, information-mix and content, product representation, among others) add consumer value and consequently influence consumer choices, they also affect channel flexibility thereby directly affecting firms' abilities to differentiate themselves from their rivals within a channel. As our results indicate, new channels that provide greater flexibility, while benefiting consumers, lead to more intense rivalry among firms resulting in lower profits. In addition to the implications of channel flexibility, a systematic analysis of the impacts of network externalities and switching costs on firms' pricing and profits provides some very interesting insights. Both network externalities as well as switching costs intensify price competition in the initial periods and enable firms to price higher in the later periods. However, higher positive externalities result in lower average prices and lower total profits for all firms as the resultant competitive effects outweigh surplus extraction abilities of firms. Consumers benefit disproportionately – in addition to the direct benefits from positive externalities that the channel facilitates, they also benefit from the resulting price competition. Firms in channels with network externalities, are locked in a 'prisoner's dilemma' and are unable to appropriate the benefits from the externalities. However, in the case of switching costs, the pure-play in the channel with higher switching costs gains at the expense of its hybrid and traditional rivals.

These findings have significant implications for business/revenue models and strategies of firms competing across differentiated channels. First, the emergence of new channels with different features portends significant changes for traditional channel participants. Second, the network externalities and switching costs features of the online channel could lead to 'winner take-all' outcomes. However, with significant network externalities a large market share does not translate into high profits. These results explain why several online firms adopt business models and strategies that leverage alternate revenue streams viz. advertising revenues and affiliate marketing. Also, cross-selling strategies that leverage consumer information, to provide value across different and disparate markets, become not only attractive but also necessary for a firm's success. Investments in personalization, search and comparison, interactivity and community building do not necessarily imply higher profits for firms. On the contrary, these investments become strategic necessities with the benefits being dissipated by increased competition. Alternatively, firms would need to leverage these technologies in innovative ways to increase 'stickiness' and to 'lock-in' consumers[20]. Particularly, given the high costs of customer acquisition for online firms ($82 compared to $12 for hybrid firms), online firms require effective strategies to not only attract, but more importantly to retain the right customer segments.

In addition to the insights into the dynamics of competition across differentiated channels, our analysis also generates significant implications for firms grappling with issues of channel choice and configuration as well as issues of integration and divestiture. Figures D3 and D4 illustrate the regions where a particular pure-play or hybrid strategy dominates the others. As indicated in Figure D3 and D4, when the online channel flexibility is high (i.e. the traditional channel misfit costs are higher relative to the online channel) *but* the ability to lock-in consumers *or* the benefit from consumption externalities is low online (as represented in the y-axis) firms benefit by being a traditional pure-play. In other words, when the online channel is more competitive than the traditional channel and consumers differ in their channel preferences, traditional firms may, well be best served by specializing in, and highlighting their real-world strengths, rather than a hybrid strategy. As the network externalities (see Figure D3) as well as the ability to lock-in consumers (see Figure D4) online increase, a hybrid strategy becomes increasingly attractive. However, when the benefits from externalities and the 'market lock-in' features of the online channel are very high, an Internet pure-play strategy dominates the others. The video gaming industry, for instance, is on the throes of significant change stemming from the Web. Currently dominated by stand-along console games, traditional firms like Sony (PlayStation), Nintendo (Gamecube) and Microsoft (Xbox) are increasingly moving online to create multiplayer versions, to leverage the significant positive network externalities that the online channel facilitates. Unlike stand-alone games the success of multiplayer online games is largely based on their ability to create and sustain a large community of users. The differences in these firms' strategies for stand-alone and online games reflect the differential channel parameters that these firms attempt to leverage. As indicated by the figures D1 and D2, given the high positive network externalities and switching costs online for games, it is likely that online games will dominate traditional ones.

One of the hotly debated issues has been whether to integrate or spin-off firms' online operations. While, several analysts and technology vendors touted the benefits of tight integration of a firm's online and offline operations, some firms preferred to spin-off their online operations. Figures D3 and D4 provide useful pointers to firms making decisions about integrating or spinning-off their online units. As illustrated by Figures D3 and D4, the total profits of the combined (offline and online) units are significantly higher

[20] Our results highlight the importance for firms understanding the tradeoffs between investments in features that generate consumption externalities and those that help lock-in consumers. For instance, Chen and Hitt (2002) find that features including 'ease of use' as well as 'personalization' appear to have no effect on switching costs for consumers.

than that of a 'hybrid' firm. This implies that when the two channels differ substantially in their ability to generate network externalities or in their ability to facilitate market 'lock-in' for firms, traditional firms benefit from spinning-off their online divisions adopting independent pricing and positioning strategies for each, rather than being a tightly integrated hybrid with similar pricing and positioning strategies across the two channels. While this does not take into account the costs of integration or the added benefits that consumers' might perceive, the analysis shows that as long as the added benefits (such as reduction in costs or increase in value to consumers) is not greater than that indicated (see shaded area in Figures D3 and D4), spinning-off the Web-based unit results is more beneficial. This is particularly true when the costs of integration are very high, and the benefits not readily apparent. More generally, when the two channels differ substantially in any of the key channel parameters, firms benefit from adopting different pricing and positioning strategies across the two channels, rather than providing integrated offerings. This has significant implications for strong offline brands that have a loyal customer base. If these firms can extend their offline brand-equity to the online channel, they would benefit from providing different value bundles across the two channels and adopting different pricing and positioning strategies in keeping with the differential channel features. Firms should exploit opportunities to segment customers based on their channel preferences and choose their value propositions and channel strategies accordingly.

Technologies such as the Web not only offer firms unprecedented opportunities to create superior value, but also threaten traditional value propositions. Consequently, it is imperative for firms to gain a good understanding of the crucial issues involved in the choice of emerging technology-driven channels and how these new technologies impact their existing industry structure and competition. Firms need to reexamine their existing value propositions, their approach to customers, assets and capabilities, products and services, in the light of disruptive technologies such as the Web and understand how they can best exploit the features of these channels to benefit from them. Many traditional firms view the Web as just another channel, using it to replicate their traditional business strategies. To effectively capitalize on the opportunities unleashed by emerging technology-enabled channels, firms will need to design, deliver and manage channel-based propositions independently, while at the same time taking advantage of the complementarities between the various channels. The importance of technology driven differences between channels cannot be overemphasized.

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APPENDIX A

BASIC MODEL AND VARIANTS

Proof of Proposition 1a

Since the firms are located diametrically opposite each other in their own channels, we derive the optimal prices for the firms, given their locations. Firms choose their prices simultaneously, given their locations.

Equilibrium: Let firms *a* and *b* be located at a distance $y_a = 1/2$ and $y_b = 1/2$ from firm *h*. Consider a consumer situated at a distance *x* from firm *a* (between firm *a* and firm *h*) in channel *A* (see figure 1). Total cost to the consumer of purchasing from firm *a* is $p_a + t_A x$, and that of purchasing from firm *h* is $p_h + t_A\left(\frac{1}{2} - x\right)$. Therefore, the consumer purchases from firm *a* if:

$$p_a + t_A x \le p_h + t_A\left(\frac{1}{2} - x\right),$$

or if:

$$x \le \frac{2(p_h - p_a) + t_A}{4t_A}.$$

The total demand faced by firm *a* in market *A* is therefore:

$$q_a = 2q_{a1} = n_A\left(\frac{2(p_h - p_a)}{2t_A} + \frac{1}{2}\right).$$

Similarly, the demand for firm B in channel B (given, hybrid firm's price kp_h in channel B) is,

$$q_b = n_B\left(\frac{2(kp_h - p_b)}{2t_B} + \frac{1}{2}\right).$$

Firm *h* has a presence in both markets. Given the assumptions about consumer reservation prices and that each consumer purchases from exactly one of the three firms, the total demand for firm *h* is simply $(n_A - q_a) + (n_B - q_b)$, which simplifies to:

$$q_h = n_A\left(\frac{1}{2} + \frac{2(p_a - p_h)}{2t_A}\right) + n_B\left(\frac{1}{2} + \frac{2(p_b - kp_h)}{2t_B}\right).$$

Given the prices p_a, p_b, and p_h, the profits for the three firms are therefore:

$$\pi_a = p_a n_A\left(\frac{2(p_h - p_a)}{2t_A} + \frac{1}{2}\right), \qquad \text{- A.1a}$$

$$\pi_b = p_b n_B \left(\frac{2(kp_h - p_b)}{2t_B} + \frac{1}{2} \right), \qquad \text{- A.1b}$$

$$\pi_h = p_h n_A \left(\frac{1}{2} + \frac{2(p_a - p_h)}{2t_A} \right) + kp_h n_B \left(\frac{1}{2} + \frac{2(p_b - kp_h)}{2t_B} \right). \qquad \text{– A.1c}$$

At equilibrium, each firm i chooses price p_i to maximize its profits, given the price choices of the other firms. First order conditions yield the following reaction functions.

$$p_a(p_h) = \frac{1}{4}(2p_h + t_A) \qquad \text{- A.3a}$$

$$p_b(p_h) = \frac{1}{4}(2kp_h + t_B) \qquad \text{- A.3b}$$

$$p_h(p_a, p_b) = \frac{n_A t_B (2p_a + t_A) + kn_B t_A (2p_b + t_B)}{4(k^2 n_B t_A + n_A t_B)}. \qquad \text{– A.3c}$$

Solving, we have the following equilibrium prices:

$$p_a^* = \frac{t_A[2n_A t_B + kn_B(kt_A + t_B)]}{4[k^2 n_B t_A + n_A t_B]},$$

$$p_b^* = \frac{t_B[2k^2 n_B t_A + n_A(kt_A + t_B)]}{4[k^2 n_B t_A + n_A t_B]},$$

$$p_h^* = \frac{t_A t_B (n_A + kn_B)}{2[k^2 n_B t_A + n_A t_B]}.$$

It is easily verified from the second derivatives that the each firm's profit function is strictly concave in its own price (for positive t_i). This concludes the proof.

Proof of Proposition 1b

The profit functions can be obtained by direct substitution.

<u>Independent and Overlapping Channels</u>

Proof of Proposition 2a:

In this case, since firm h also chooses k, solving for the four first order conditions (three with respect to prices and one with respect to k) yields, in addition to the three reaction functions A.3a – A.3c,

$$k = \frac{(2p_b + t_B)}{4p_h}.$$

Solving, we have:

$$p_a^* = \frac{t_A}{2}; \quad p_b^* = \frac{t_B}{2}; \quad p_h^* = \frac{t_A}{2}; \quad k^* = \frac{t_B}{t_A}.$$

The prices of the three firms are dependent on just their channel misfit costs, but independent of each other. This concludes the proof.

Proof of Proposition 2d

Consumers in one channel have access to firms in the other channel and incur a switching cost η when they switch between channels. This leads to the imposition of the constraint that the price differential between the two firms (firm *a* and firm *b*) cannot be greater than η. Thus, in addition to the profit functions from Proposition 1b, we impose the additional constraint

$$p_b - p_a \le \eta$$

Incorporating the additional constraint into the profit function in Proposition 1c gives us the required profits for the three firms as,

$$\pi_{a'} = p_a n_A \left(\frac{1}{2} + \frac{2(p_h - p_a)}{2t_A} \right) - \lambda\left(\eta - p_b + p_a\right)$$

$$\pi_{b'} = p_b n_B \left(\frac{1}{2} + \frac{2(p_h - p_b)}{2t_B} \right) - \lambda\left(\eta - p_b + p_a\right)$$

$$\pi_{h'} = p_h n_A \left(\frac{1}{2} + \frac{2(p_a - p_h)}{2t_A} \right) + p_h n_B \left(\frac{1}{2} + \frac{2(p_b - p_h)}{2t_B} \right) - \lambda\left(\eta - p_b + p_a\right),$$

where, λ is the lagrangian multiplier.

First order Kuhn-Tucker conditions yield the following equilibrium values,

$$p_a^* = \frac{t_A(n_A t_B + n_B t_B - n_B \eta)}{2[n_B t_A + n_A t_B]}$$

$$p_b^* = \frac{t_B(n_A t_A + n_B t_A - n_A \eta)}{2[n_B t_A + n_A t_B]}$$

$$p_h^* = \frac{t_A(n_A t_B + n_B t_B)}{2[n_B t_A + n_A t_B]}$$

$$\lambda^* = \frac{n_A n_B\left(\left(t_B - t_A\right) + 4\eta\right)}{[n_B t_A + n_A t_B]}$$

When the switching costs for consumers is zero (i.e., η=0) the two channels completely overlap. Substituting η=0 in the above expressions for the optimal prices gives us the optimal prices charged by the three firms when the two channel completely overlap.

$$p_a^* = p_b^* = p_h^* = \frac{[t_A t_B (n_A + n_B)]}{2[n_B t_A + n_A t_B]}.$$

Proof of Proposition 2e

The profit functions can be obtained by direct substitution.

APPENDIX B

IMPACT OF NETWORK EXTERNALITIES

Proof of Proposition 3a

Proof: As a reminder, p_i^k is the price charged by firm *i* in period *k*, q_i^k is the demand faced by firm *i* in period *k* and π_i^k is the profit for firm *i* in period *k*. As described in section 4.1, the value from network externalities to firm *a*'s consumer in period-II is $\delta_A . q_a^1$. The utility for a consumer in channel *A,* who purchases a bundle from firm *a* at price p_a^2, located at a distance *x* is given by

$$U_i = \check{r} - p_a^2 - t_A(x) + \delta_A . q_a^1$$

In channel *A*, q_a^2 is the demand faced by firm *a* in period-II and q_{hA}^2 is the market share of firm *h* in channel *A* in period-II. So, in period-II, a consumer located at a distance *x* from firm *a* would be indifferent to purchasing a bundle from either firm in her channel if the following condition holds:

$$p_a^2 + t_A(x) - \delta_A q_a^1 = p_h^2 + t_A(0.5 - x) - \delta_A q_{ha}^1$$

where q_a^1 is the total demand for firm *a* in period-I and q_{ha}^1 is the demand for firm h in period-I.
Restricting $n_A = n_B = 1$, and $k = 1$, the total demand for firm *a* in period-II is given by

$$q_a^2 = \frac{2(p_h^2 - p_a^2) + t_A - 2\delta_A + 4\delta_A q_a^1}{2t_A}.$$

Since there are no network externalities in the traditional channel (channel *B*), the total demand for firm *b* and firm *h* in period-II are:

$$q_b^2 = \frac{2(p_h^2 - p_b^2) + t_B}{2.t_B}.$$

$$q_h^2 = \frac{2(p_a^2 - p_h^2) + t_A - 2\delta_A + 4.\delta_A q_{ha}^1}{2t_A} + \frac{2(p_b^2 - p_h^2) + t_B}{2t_B}.$$

Each firm maximizes its period-II profits given the prices of other firms in period-II as well as in period-I. First order conditions yield

$$p_a^2 = \frac{1}{4}\left(2p_h^2 + t_A - 2\delta_A + 4.\delta_A.q_a^1\right); \qquad p_b^2 = \frac{1}{4}\left(2p_h^2 + t_B\right);$$

$$p_h^2 = \frac{\left(2p_b^2 t_A + 2p_a^2 t_B + 2t_A t_B + 2.t_B\delta_A - 4.\delta_A.t_B.q_a^1\right)}{4\left(t_A + t_B\right)}.$$

Optimal Prices

Period-I: There are no positive consumption externalities in period-I and the total demand for firms *a*, *b* and *h* in period-I are given by,

$$q_a^1 = \frac{2(p_h^1 - p_a^1) + t_A}{2t_A}; \; q_b^1 = \frac{2(p_h^1 - p_b^1) + t_B}{2t_B}; \; q_h^1 = \frac{2(p_a^1 - p_h^1) + t_A}{2t_A} + \frac{2(p_b^1 - p_h^1) + t_B}{2t_B}.$$

Firm *a* chooses p_a^1 so at to maximize it total future profits, while taking firm *h*'s price in period-I as given.

$$\pi_a(p_a^1, p_h^1) = \pi_a^1(p_a^1, p_h^1) + \pi_a^2(q_a^1(p_a^1, p_h^1))$$

Profits for firms *a*, *b* and *h* in period-I are given by,

$$\pi_a^1 = \frac{2(p_h^1 - p_a^1) + t_A}{2t_A} \times p_a^1; \quad \pi_b^1 = \frac{2(p_h^1 - p_b^1) + t_B}{2t_B} \times p_b^1;$$

$$\pi_h^1 = \left(\frac{2(p_a^1 - p_h^1) + t_A}{2t_A} + \frac{2(p_b^1 - p_h^1) + t_B}{2t_B}\right) \times p_h^1.$$

First order conditions yield

$$p_a^1 = \frac{9t_A{}^2(2p_h^1 + t_A)(t_A + t_B)^2 - 3(t_A)^2(3t_A + 2t_B)(t_A + 3t_B)\delta_A - 4p_h^1(3t_A + 2t_B)^2(\delta_A)^2}{36(t_A)^2(t_A + t_B)^2 - 4(3t_A + 2t_B)^2(\delta_A)^2}.$$

$$p_h^1 = \frac{9(t_A)^2(t_A + t_B)\left((p_b^1)t_A + (p_a^1 + t_A)t_B\right) - 12(t_A)^2(t_B)^2\delta_A - 8p_a^1(t_B)^2(\delta_A)^2}{18(t_A)^2(t_A + t_B)^2 - 8(t_B)^2(\delta_A)^2}$$

Since there are no externalities in the traditional channel *B*, the optimal period-I prices for firm b is dependent only on firm *h*'s optimal period-I prices, and is given by,

$$p_b^1 = \frac{1}{4}\left(2p_h^1 + t_B\right)$$

Solving for q_a^1 and q_{ha}^1, and substituting these into the expressions for p_a^2, p_b^2 and p_h^2, gives the optimal prices for period-II. At the unique profit maximizing equilibrium, the prices charged by the three firms in period-II are given by,

$$p_a^2 = \frac{3t_A(t_A + 3t_B) + 2\left((3t_A + 2t_B)(-1 + 2q_a^1)\right)\delta_A}{12(t_A + t_B)}.;$$

$$p_b^2 = \frac{t_B\left(9t_A + 3t_B + (2 - 4q_a^1)\delta_A\right)}{12(t_A + t_B)}.; \qquad p_h^2 = \frac{t_B\left(6t_A + (2 - 4q_a^1)\delta_A\right)}{6(t_A + t_B)}.$$

This concludes the proof.

APPENDIX C

IMPACT OF SWITCHING COSTS

Proof of Proposition 4a

Case I: *Consumers switch from firm a in period-I to firm h in period-II iff:*

$$(p_h^1 - p_a^1) > (p_h^2 - p_a^2) + \psi_A$$

Proof: From proposition 1A we know,

$$q_a^1 = \frac{2(p_h^1 - p_a^1) + t_A}{2t_A}.$$

However, in period-II, a consumer who initially purchased a bundle from firm *a* in period-I and, wishes to switch to firm *h* in period-II, faces an additional switching cost ψ_A. Thus, in period-II, a consumer will purchase from firm *a* iff:

$$p_a^2 + t_A x \le p_h^2 + t_A(0.5 - x) + \psi_A$$

Therefore total demand for firm *a* in period-II is given by

$$q_a^2 = \frac{2(p_h^2 - p_a^2) + t_A + 2\psi_A}{2t_A}$$

From the expressions above, $q_a^1 > q_a^2$ implies $(p_h^1 - p_a^1) > (p_h^2 - p_a^2) + \psi_A$. Hence the proof.

Case II: *Consumers switch from firm h in period-I to firm a in period-II only iff:*

$$(p_h^1 - p_a^1) < (p_h^2 - p_a^2) - \psi_A$$

Proof: Similar to Case I.

Case III: *No consumer switches firms in period-II iff,*

$$(p_h^2 - p_a^2) + \psi_A > (p_h^1 - p_a^1) > (p_h^2 - p_a^2) - \psi_A$$

Proof : This trivially follows from Cases I and II.

Proof of Proposition 4c

q_a^2 is the demand faced by firm *a* in period-II in channel A and q_{ha}^2 is the period-II demand for firm *h* in channel *A*. Proposition 4b yields

$$q_a^2 = q_a^1 \text{; and } q_{ha}^2 = q_{ha}^1$$

In channel *B*,

$$q_b^2 = \frac{2(p_h^1 - p_b^1) + t_B}{2t_B}; \quad q_{hb}^2 = \frac{2(p_b^2 - p_h^2) + t_B}{2t_B}.$$

Therefore the total demand for firm *h* in both channels in period-II is given by,

$$q_h = q_{ha}^1 + \frac{2(p_b^2 - p_h^2) + t_B}{2t_B}.$$

Profits for firms *a*, *b* and *h* in period-II are given by,

$$\pi_a^2 = q_a^1 \times p_a^2$$

$$\pi_b^2 = \frac{2(p_h^2 - p_b^2) + t_B}{2t_B} \times p_b^2; \quad \pi_h = \left(q_{ha}^1 + \frac{2(p_b^2 - p_h^2) + t_B}{2t_B} \right) \times p_h^2.$$

First order conditions[C1] yield

$$p_a^2 = (p_a^1 - p_h^1) + \frac{1}{6}(7 - 4q_a^1)t_B + \psi_A; \quad p_b^2 = \frac{1}{6}(5 - 2q_a^1)t_B; \quad p_h^2 = \frac{1}{6}(7 - 4q_a^1)t_B + \psi_A.$$

This concludes the proof.

Proof of Proposition 4d

In period-I consumers are not 'locked-in' to any firm and do not face any switching costs. Hence, the total demand for firms *a*, *b* and *h* in period-I are given by,

$$q_a^1 = \frac{2(p_h^1 - p_a^1) + t_A}{2t_A}; \quad q_b^1 = \frac{2(p_h^1 - p_b^1) + t_B}{2t_B}; \quad q_h^1 = \frac{2(p_a^1 - p_h^1) + t_A}{2t_A} + \frac{2(p_b^1 - p_h^1) + t_B}{2t_B}$$

Firms seek to maximize the total undiscounted profits over both periods. Firm *a* chooses p_a^1 taking firm *h*'s price in period-I as given. Since,

[C1] The optimal prices for firm *a* are not defined and hence are bounded by the constraint.

$$\pi_a(p_a^1, p_h^1) = \pi_a^1(p_a^1, p_h^1) + \pi_a^2(q_a^1(p_a^1, p_h^1))$$

Profits for firms *a*, *b* and *h* in period-I are given by,

$$\pi_a^1 = \frac{2(p_h^1 - p_a^1) + t_A}{2t_A} \times p_a^1\,;\ \pi_b^1 = \frac{2(p_h^1 - p_b^1) + t_B}{2t_B} \times p_b^1\,;$$

$$\pi_h^1 = \left(\frac{2(p_a^1 - p_h^1) + t_A}{2t_A} + \frac{2(p_b^1 - p_h^1) + t_B}{2t_B} \right) \times p_h^1$$

First order conditions yield

$$p_a^1 = \frac{18 p_h^1 t_A + 6(t_A)^2 + 8 p_h^1 t_B - 3t_A t_B - 6t_A \varphi_A}{8(3t_A + t_B)}\,;\quad p_b^1 = \frac{1}{4}\left(2p_h^1 + t_B\right);$$

$$p_h^1 = \frac{9p_b^1 (t_A)^2 + 9p_a^1 t_A t_B + 9(t_A)^2 t_B - 8p_a^1 (t_B)^2 - 10(t_B)^2 t_A}{2\left(9(t_A)^2 + 9t_A t_B - 4(t_B)^2\right)}.$$

Solving the above expressions yields

$$p_a^1 = \frac{81(t_A)^3 + 27(t_A)^2(10t_B - 3\psi_A) - 12t_A t_B(16t_B + 9\psi_A) + 8(t_B)^2(6\psi_A - 7t_B)}{6\left(54(t_A)^2 + 63t_A t_B + 4(t_A)^2\right)};$$

$$p_b^1 = \frac{t_B\left(243(t_A)^2 - 22(t_B)^2 + 24t_B\psi_A - 9t_A(2t_B + 3\psi_A)\right)}{6\left(54(t_A)^2 + 63t_A t_B + 4(t_B)^2\right)};$$

$$p_h^1 = \frac{t_B(9t_A - 8t_B)(36t_A + 7t_B - 6\psi_A)}{6\left(54(t_A)^2 + 63t_A t_B + 4(t_B)^2\right)};$$

Solving for q_a^1, q_{ha}^1 and substituting these expressions into p_a^2, p_b^2 and p_h^2 yields

$$p_a^2 = \frac{27(t_A)^3 + 2(t_B)^2(7t_B - 2\psi_A) + 9(t_A)^2(10t_B + 9\psi_A) + 2t_A t_B(52t_B + 45\psi_A)}{2\left(54(t_A)^2 + 63t_A t_B + 4(t_B)^2\right)}$$

$$p_b^2 = \frac{3t_B\left(27(t_A)^2 + t_A(26t_B - 3\psi_A) + t_B(3t_B - 2\psi_A)\right)}{2\left(54(t_A)^2 + 63t_A t_B + 4(t_B)^2\right)}$$

$$p_h^2 = \frac{t_B(3t_A + 2t_B)(36t_A + 7t_B - 6\psi_A)}{2\left(54(t_A)^2 + 63t_A t_B + 4(t_B)^2\right)}.$$

This concludes the proof.

Fig. A1 - Optimal Prices with Varying Online Channel Misfit Costs

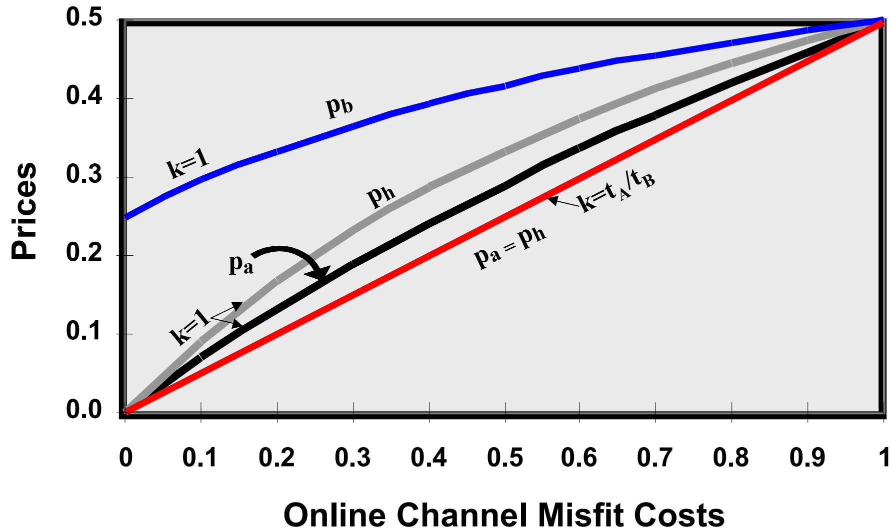

Fig. A2- Optimal Profits with Varying Online Channel Misfit Costs

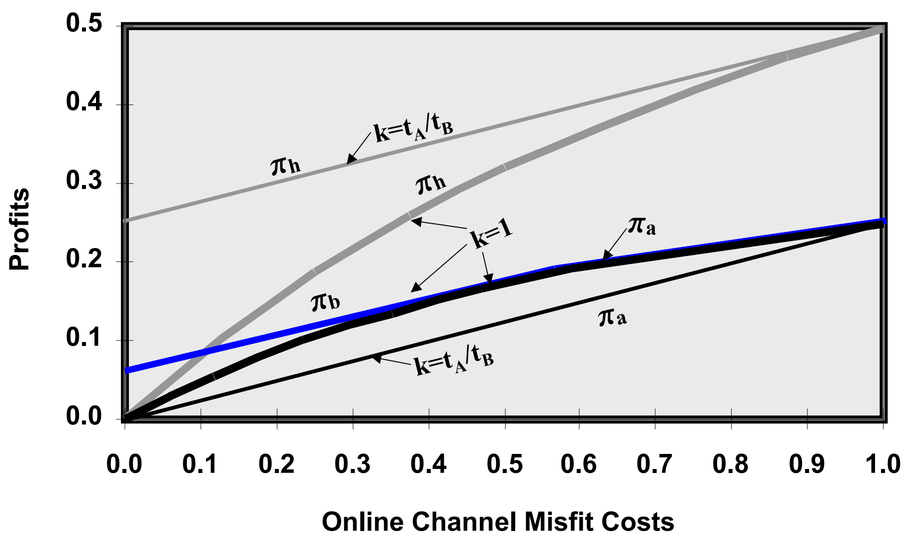

Fig. B1- Optimal Inter-Temporal Prices with Network Externalities
($t_A=t_B=1$)

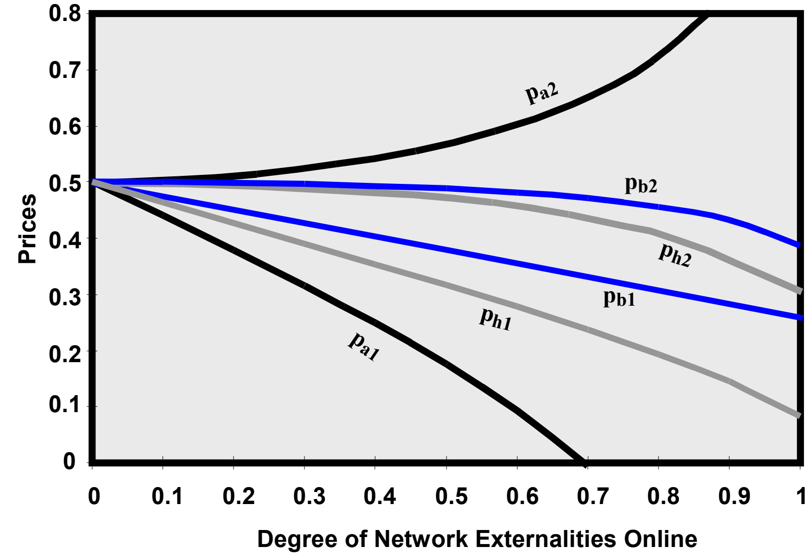

Fig.B2-Optimal Inter-Temporal Demand with Network Externalities
($t_A=t_B=1$)

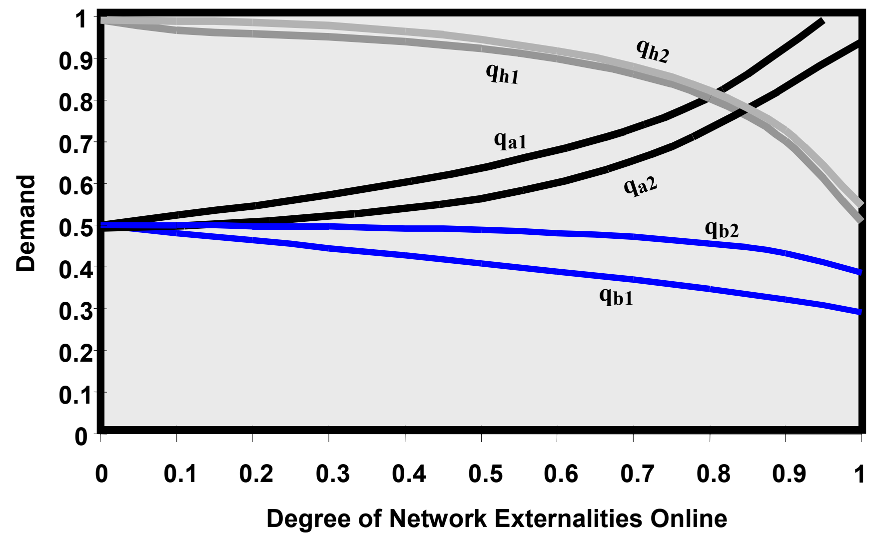

Fig. B3 - Optimal Inter-Temporal Profits with Network Externalities
($t_A=t_B=1$)

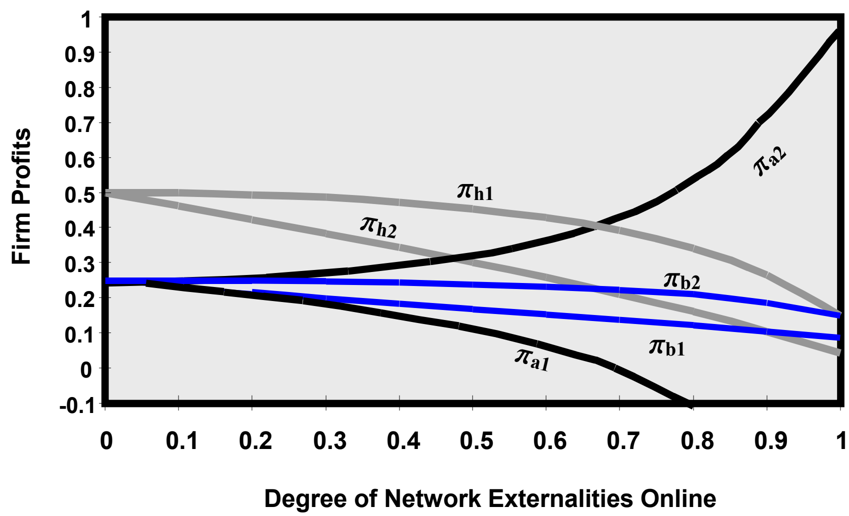

Fig. B4 - Total Profits with Network Externalities

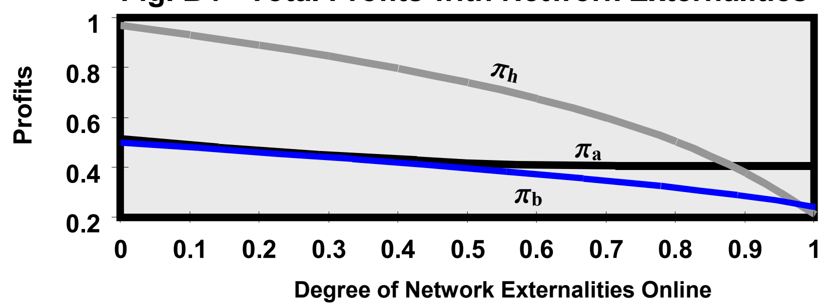

Fig. B5 - Average Prices with Network Externalities

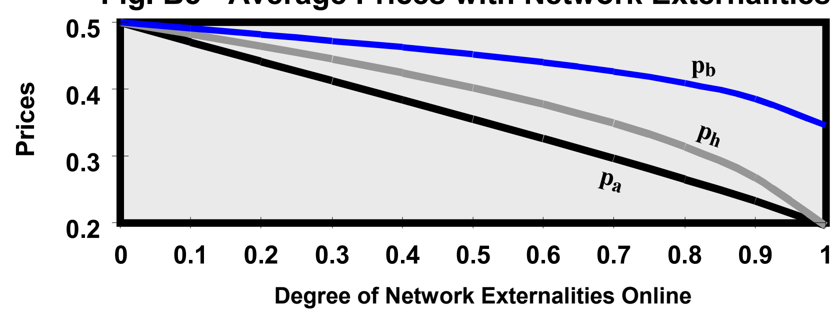

Fig. C1 - Optimal Inter-temporal Prices with Switching Costs
(t_A=t_B=1)

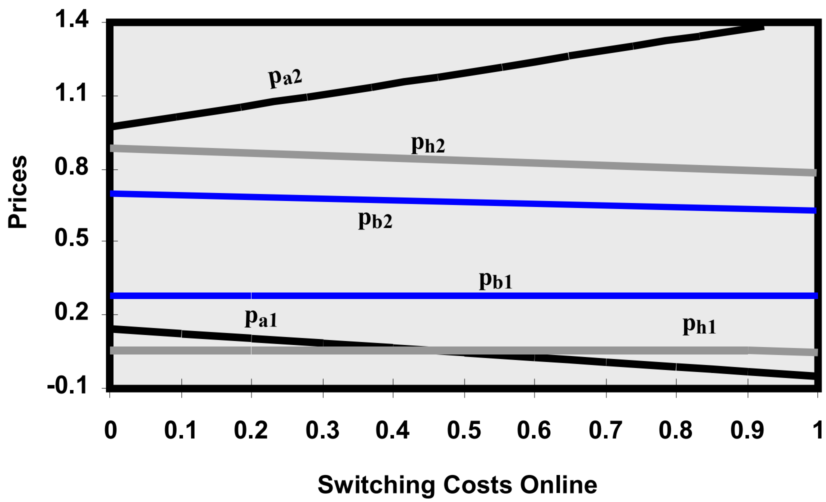

Fig. C2 - Optimal Inter-temporal Demand with Switching Costs
(t_A=t_B=1)

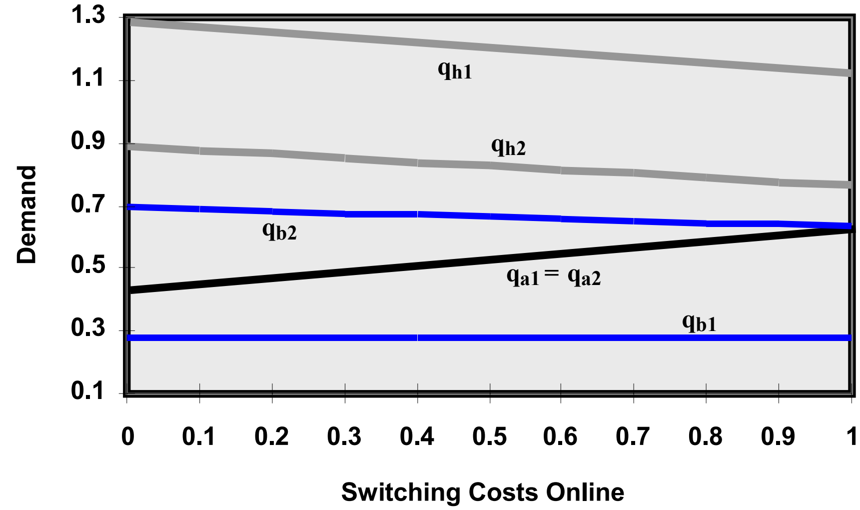

Fig. C3 - Optimal Inter-temporal Profits with Switching Costs
(t_A=t_B=1)

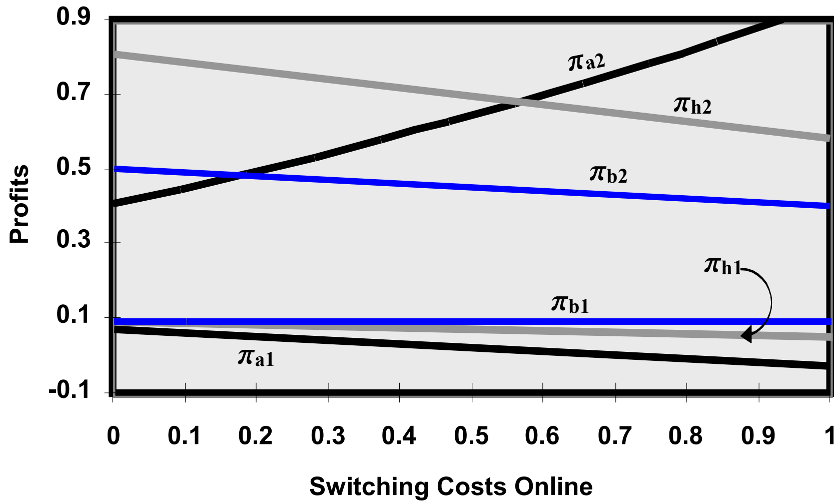

Fig. C4 - Total Firm Profits with Switching Costs

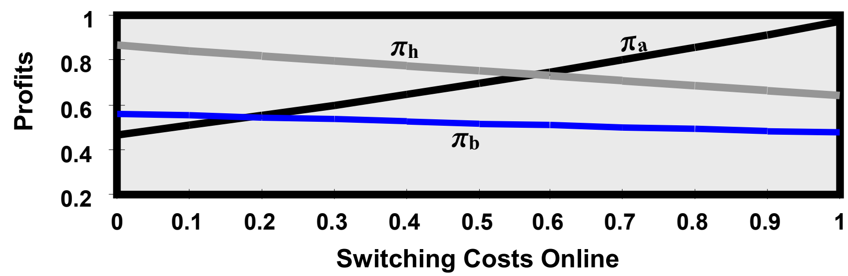

Fig. C5 - Average Firm Prices with Switching Costs

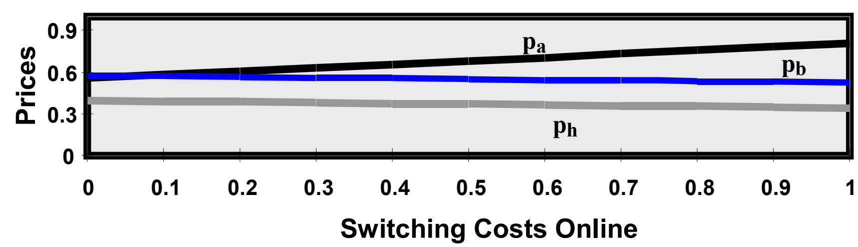

Fig. D 1- Zone of Dominance
(With Externalities in the Online Channel; t_A=1)

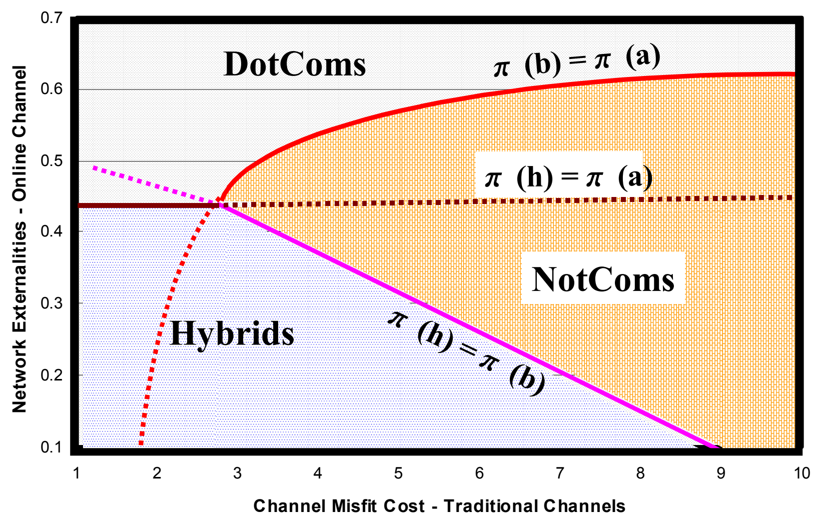

Fig. D2 - Zone of Dominance
(Switching Costs in the Online Channel, t_A=1)

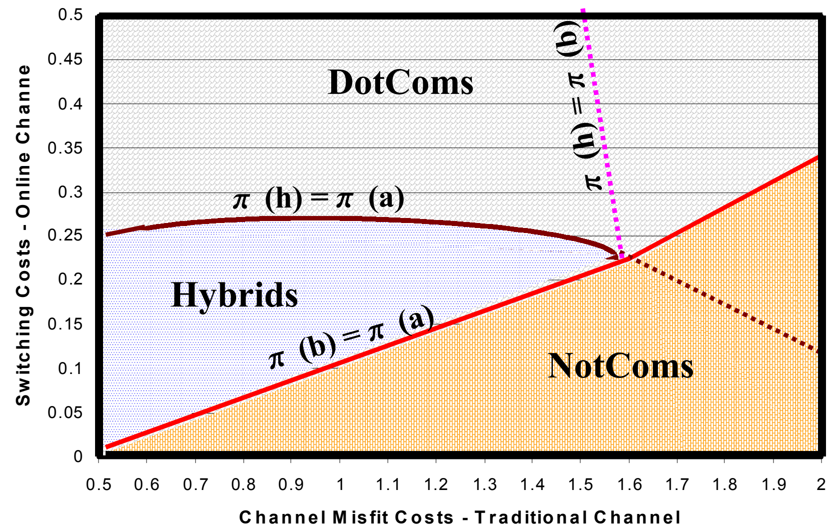

Fig. D 3 - Comparison of Total Profits with Network Externalities

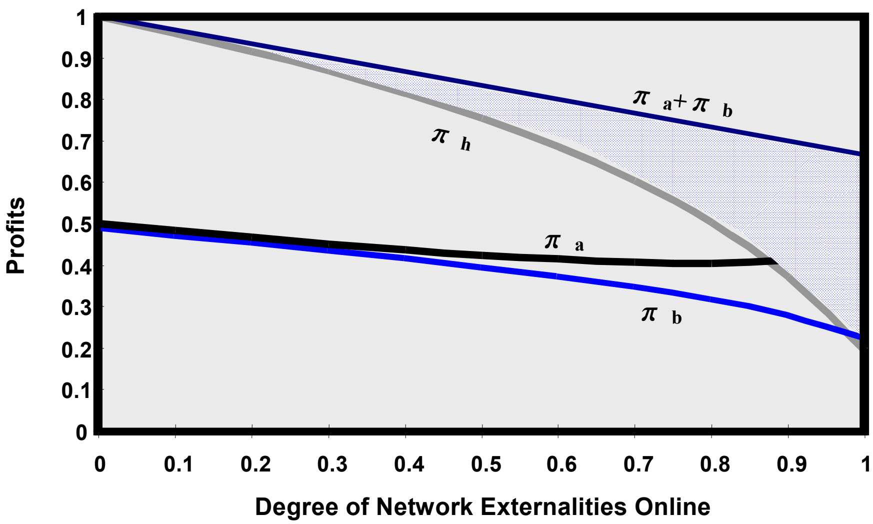

Fig. D4 - Comparison of Total Profits With Switching Costs