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PLATFORM ENVELOPMENT

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Due to network effects and switching costs in platform markets, entrants generally must offer revolutionary functionality to win substantial market share. We explore a second entry path that does not rely upon Schumpeterian innovation: platform envelopment. Through envelopment, a provider in one platform market can enter another platform market, and combine its own functionality with that of the target in a multi-platform bundle that leverages shared user relationships. Envelopers capture market share by foreclosing an incumbent's access to users; in doing so, they harness the network effects that previously had protected the incumbent. We present a typology of envelopment attacks based on whether platform pairs are complements, weak substitutes, or functionally unrelated and we analyze conditions under which these attack types are likely to succeed. Copyright © 2011 John Wiley & Sons, Ltd.

INTRODUCTION

When can firms overcome entry barriers? We address this enduring question in the context of platform-mediated markets, where users' interactions with each other are subject to network effects and are facilitated by a common platform provided by one or more intermediaries (Gawer and Cusumano, 2002; Rochet and Tirole, 2003; Eisenmann, Parker, and Van Alstyne, 2006; Evans and Schmalensee, 2007). Platform markets comprise a large and rapidly growing share of the global economy. Examples are as diverse as barcodes, container shipping, credit cards, DVDs, health maintenance organizations, instant messaging, online dating services, real estate brokerages, shopping malls, stock exchanges, travel reservation systems, video games, and Web search services.

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In platform markets, strong network effects and high switching costs often shelter incumbents from entry by standalone rivals (Farrell and Saloner, 1985; Katz and Shapiro, 1985; Klemperer, 1987). To overcome entry barriers, new platform providers generally must offer revolutionary functionality (Henderson and Clark, 1990; Bresnahan, 1999). For these reasons, Evans and Schmalensee (2001) observed that platform markets often evolve through sequential winner-take-all battles, with superior new platforms replacing old ones, as with Sony's Playstation usurping market leadership from Nintendo's Super Nintendo Entertainment System (SNES). Playstation used a 32-bit processor and game CDs with tremendous data storage capacity to render 3D graphics, whereas SNES was limited to 2D graphics due to its slower 16-bit processor and lower-capacity game cartridges.

This paper explores a second entry path for aspiring platform providers that does not rely on Schumpeterian innovation: a strategy we call platform envelopment. Platform providers that serve

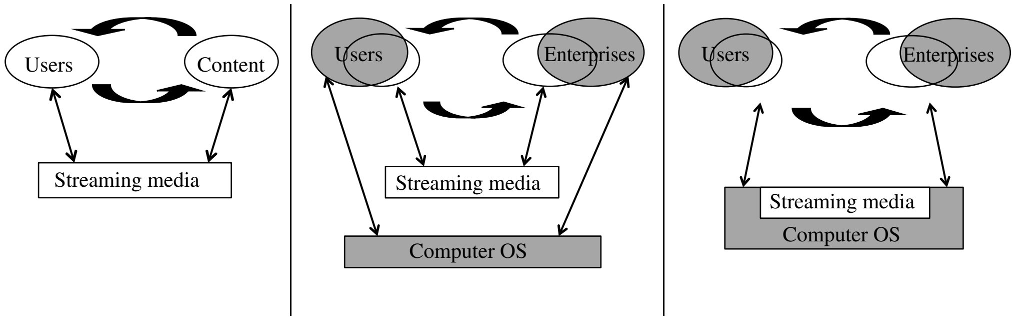

Figure 1. Microsoft's envelopment of RealNetworks

different markets sometimes have overlapping user bases and employ similar components. Envelopment entails entry by one platform provider into another's market by bundling its own platform's functionality with that of the target's so as to leverage shared user relationships and common components. Dominant firms that otherwise are sheltered from entry by standalone rivals due to strong network effects and high switching costs can be vulnerable to an adjacent platform provider's envelopment attack.

Microsoft, for example, launched an envelopment attack against RealNetworks (Real), the dominant streaming media platform with more than 90 percent market share in 1998. Real had invented the technology and successfully harnessed 'two-sided' network effects (Parker and Van Alstyne, 2000, 2005; Rochet and Tirole, 2003) by giving away free versions of its media player to end users and charging audio/video content providers for server software. Like Real, Microsoft freely supplied its Windows Media player (WMP) to consumers, bundling WMP into its Windows operating system for personal computers. Microsoft also bundled WMP server software, at no additional cost, as a standard feature of Windows NT server, an operating system for enterprise customers, including content providers. WMP offered no major functional improvements over Real's software, yet user bases heavily overlapped (see Figure 1). Consumers and content providers found Microsoft's operating system bundles appealing and Real rapidly lost market share.

Envelopment is a widespread phenomenon and a powerful force shaping the evolution of platform markets. Besides Real's streaming media platform, Microsoft has enveloped Netscape's Web browser and Adobe's Flash software. Other examples of successful envelopment include Federal Express and UPS respectively adding ground and air shipping services to compete with each other more directly; eBay's acquisition of PayPal; Blockbuster offering DVD rental-by-mail to counter a threat from Netflix; DoCoMo's move into mobile phone-based payment services; and LinkedIn adding job listings to its professional networking Web site to challenge Monster.com. Apple's iPhone/iPad platform has enveloped platform providers in several different markets, including personal digital assistants (e.g., Palm Inc.'s Pilot), handheld games (e.g., Nintendo's Gameboy), and eBook readers (e.g., Amazon's Kindle). Likewise, Google has entered many platform markets by linking new products to its search platform, including online payment services (Google Checkout), productivity software (Google Docs), Web browser software (Chrome), and mobile phone operating systems (Android).

Overview and contributions

In elucidating platform envelopment, we integrate recent research from industrial organization economics on network theory and bundling. In economics, these literatures have largely evolved in parallel, despite the fact that both frequently focus on platform markets. To date, scholars of strategic management have paid little attention to either literature. Early work on network effects focused mostly on technology adoption decisions (e.g., Farrell and Saloner, 1985; Katz and Shapiro, 1985) and thus had limited relevance to general theories of strategy. Over the past decade, however, a wave of work on platform markets—motivated initially by the Microsoft antitrust trial—has led scholars of industrial organization economics to reconceive a broad range of businesses as platforms (e.g., Parker and Van Alstyne, 2000, 2005,

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2010; Rochet and Tirole, 2003; Evans, Hagiu and Schmalensee, 2006). Ranked by market value, 60 of the world's 100 largest corporations earn at least half of their revenue from platform markets (Eisenmann, 2007). Building upon Thompson's (1967) typology of long-linked, mediating, and intensive technologies, Stabell and Fjeldstad (1998) identified platforms as one of three elemental configurations through which firms generate value. Since platform markets are pervasive, have enormous economic significance, and have paradigmatic value-creation properties, we believe they warrant more attention from strategy scholars. In this paper, we explore one of the fundamental issues in strategy—when and how firms can overcome entry barriers—in the platform context.

We draw on bundling research to explain the economic and strategic motivations for platform envelopment. As noted above, bundling research has had only limited impact to date on the field of strategic management; historically, many strategy scholars have considered bundling to be a marketing or operations tactic. Recently, however, industrial organization economists—again, motivated by antitrust scrutiny of Microsoft's Windows/Explorer bundle—have studied conditions under which a monopolist could, through bundling, foreclose a complement provider's access to the monopolist's customers and thereby profitably capture the complement market (Whinston, 2001; Carlton and Waldman, 2002; Nalebuff, 2004). This research shows that bundling is salient to scholars of strategic management as well as marketing academics.

We leverage recent work on the strategic impact of bundling and add to this literature in two ways. First, research to date on market entry through foreclosure strategies has focused on the bundling of complements. In this paper, we show that market entry through foreclosure is also viable when bundling platforms that are weak substitutes or are functionally unrelated.

Second, past research has typically examined a single type of benefit from bundling, for example, economies of scope or increased profits from price discrimination. We observe that the success of an envelopment strategy will depend on the aggregate level of bundling benefits of *all* types, which in turn is determined by the functional relationship between two platforms—specifically, whether the platforms are complements, weak substitutes, or functionally unrelated. We are not aware of other research that provides a comprehensive view of how bundling benefits depend on the relationship between bundled items.

Organization of the paper

The balance of this paper is organized into five sections: the first describes our research methods; the second provides theoretical background; the third presents a typology of different envelopment attack types and posits conditions under which each type is most likely to succeed; the fourth discusses linkages between the platform perspective and the resource-based view of the firm and considers issues for future research; and the fifth concludes.

METHODS

Our research approach was principally deductive and relied upon three mutually reinforcing methods to build our understanding of entry dynamics in platform markets. To ground our analysis in prior strategy and economics literature, we assembled a database of papers on platforms and network effects. Next, to gain insight and explore the economics of envelopment strategies, we developed analytic and simulation models. In parallel, we developed a repository of case study data to populate our typology with examples and to stress test our framework. Below, we describe these efforts.

Literature survey

We collected and categorized 470 papers that focus on strategies for platforms and networks by searching keywords in economics and management journals and in the Social Sciences Research Network. A special effort was made to include recently published papers and working papers that contribute to the growing literature on two-sided networks. We then reviewed and summarized 140 of the most relevant papers. Insights from a subset of papers pertaining to platform entry are reported in the next section. We leveraged these insights in deducing our typology of envelopment attacks.

Analytic and simulation modeling

After we developed our typology, we undertook an analytic modeling exercise that built upon Nalebuff

(2004) and Salinger (1995). This exercise explored how the profitability of bundling relates to two factors: (1) the ratio of potential customers' maximum valuations for two items consumed in a bundle, and (2) marginal costs for the items. The model was helpful in assessing conditions under which weak substitutes might be profitably bundled. Substitutes are not normally attractive candidates for bundling, since their standalone valuations are not strictly additive when they are consumed in a bundle.

Due to the unusually large number of variables involved, we found it impossible to create tractable closed-form analytic models that captured the full richness of envelopment strategies. Consequently, we turned to simulation models to explore the dynamics of envelopment attacks. We developed a two-period model in which a monopolist in one platform market enters, through bundling, another monopolist's market. We analyzed scenarios varying the relative sizes and degrees of overlap of the platforms' pre-attack user bases, the correlations of potential users' valuations of the two platforms, and the magnitude of economies of scope from bundling. These analyses, available from the authors, inform the typology presented below.

Case analysis

In parallel with our modeling work, we identified 42 examples of platform envelopment by reviewing teaching cases and articles in business periodicals that featured platform markets. Our goal was not to rigorously assemble a sample for hypothesis testing; rather, we were seeking to build our understanding of mechanisms and motivations behind envelopment attacks and confirm that our typology was mutually exclusive and collectively exhaustive. The research team worked most closely with a deep repository of primary data for 14 of the 42 envelopment examples. This data was collected for other research purposes by the authors and includes archival information and interviews with 120 managers. For each example, we examined managers' motivations for envelopment; the functional relationship between platform pairs; the attacker's and target's pre- and post-attack market shares; the relative sizes and the extent of overlap in the platforms' pre-attack user bases; the magnitude of switching costs confronting the target's users; and whether the attack entailed pure or mixed bundling. Our typology was refined iteratively by testing its explanatory power for each of the examples. To aid future researchers, we judge the success of each example attack in Table 1.

THEORETICAL BACKGROUND

In this section, we review literature on network economics to more precisely define platform markets and explain why established platforms—the targets of envelopment attacks—can be difficult to displace. Then, we describe how bundling enables entry into platform markets.

Network economics

In platform-mediated networks, interactions between individuals or firms—collectively, the network's users—are facilitated by a common platform. The platform, created and maintained by one or more intermediaries, encompasses components and rules employed by users in most of their interactions (Gawer and Cusumano, 2002; Rochet and Tirole, 2003; Eisenmann *et al.*, 2006; Evans and Schmalensee, 2007). Users' interactions are subject to network effects, which are demand-side economies of scale: the value of platform affiliation for any given user depends upon the number of other users with whom they can interact (Farrell and Saloner, 1985; Katz and Shapiro, 1985; Economides, 1996).

In traditional manufacturing industries that rely on long-linked technologies (Thompson, 1967), bilateral exchanges follow a linear path as vendors purchase inputs, transform them, and sell output. By contrast, platform exchanges have a triangular structure. Users transact with each other and they simultaneously affiliate with platform providers. For example, video game networks have two distinct groups of users: players and developers. Developers sell games to players—the first set of exchanges in a video game network. Developers must also contract with the platform's provider (e.g., Nintendo) for permission to publish games—the second set of exchanges. Finally, players must procure a console from the platform provider—the third set of exchanges.

Platforms are two-sided when they serve two distinct and mutually attracting groups of users, as with video game players and developers (Parker and Van Alstyne, 2000, 2005; Rochet and Tirole, 2003). Two-sided networks often have a supply side that encompasses vendors who offer

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Table 1. Envelopment examples (attacker/target)

	Complements	Weak substitutes	Functionally unrelated
Target largely or fully displaced	- Windows Media Player/RealPlayer - Windows Explorer/Netscape - Apple iTunes/Odeo - Smartphone/PalmPilot PDA		
Entry successful but target maintained position	- Apple OS X/Adobe PDF - Microsoft Silverlight/Adobe Flash - Google Reader/FeedDemon - Google Checkout/PayPal - Motorola set-top box/TiVo - Windows Malicious Software Removal Tool/Symantec - Apple Safari/Internet Explorer - Google Chrome browser/Internet Explorer - Google Android/iPhone - Google Base/eBay - Google Maps/Mapquest - Google Blog Search/Technorati	- Facebook Chat/AOL IM - Facebook News Feed/Twitter - Federal Express/UPS* - LinkedIn/Monster.com* - Windows Mobile/Symbian - Google Talk/Skype - Cisco IOS/IBM SNA - Rakuten Auctions/Yahoo Japan	- Cable TV/phone service* - Playstation/DVD player - Smartphone/standard cell phone - iPhone/Gameboy - iPhone + iPad/Amazon Kindle - Xbox Music Player/iTunes - DoCoMo Felica/Visa - Google Gmail/web-based email - Google Docs/Microsoft Office
Failed entry or trending poorly	- eBay Billpoint/PayPal** - Google Video/YouTube** - Google Buzz/Twitter - Google Orkut/Facebook - Google Knol/Wikipedia	- Yahoo By Phone/Tellme - Blockbuster/Netflix	- Nokia N-Gage/Gameboy - Google Lively/Second Life

* Reciprocal envelopment, that is, target subsequently entered attacker's market.
** After failed direct entry, attacker acquired target.

complements to demand-side users. Users on one side of the market typically fill the same roles in transactions rather than switch roles. By contrast, in one-sided networks all users are similar—as with telephone networks, where all users fill both call originator and recipient roles.

Every platform-mediated network has a focal platform at its core, although other platforms can play subordinate roles in the network as supply-side users or component suppliers. The network might be served by a proprietary platform, that is, it might have one firm as its sole provider (e.g., Nintendo's Wii). Alternatively, multiple providers might offer competing but compatible versions of a shared platform (e.g., Ubuntu Linux vs. Red Hat Linux). If users switch between rival providers of a shared platform, they do not forfeit platform-specific investments in complements or in learning the platform's rules (Eisenmann, 2008).

Platform markets comprise sets of competing platforms that each serve distinct networks. For example, the video game market includes the Xbox, Playstation, and Wii platforms. Platform markets are typically served by only a few competing platforms; in many cases, almost all users rely on a single platform (e.g., Microsoft's Windows, Adobe's PDF, eBay's online auctions). The number of platforms serving a market tends to be small when network effects are strong, individual users face high costs when multi-homing (i.e., affiliating with multiple platforms), and user demand for differentiated platform functionality is limited (Arthur, 1989; Caillaud and Jullien, 2003; Ellison and Fudenberg, 2003; Noe and Parker, 2005).

When network effects are positive and strong, users will converge on fewer platforms; a subscale platform will have little appeal unless it provides the only way to interact with certain transaction partners. Likewise, users are less likely to multi-home when it is expensive to establish and maintain platform affiliations. Finally, fewer platforms

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will be viable if users have relatively homogeneous needs. By contrast, if various user segments have distinct preferences and no single platform can profitably satisfy all segments' needs, then the market is more likely to be served by multiple rival platforms.

With few rivals, established platform providers enjoy market power. High returns would normally attract entrants, but incumbent platform providers are often well protected. Factors that restrict the number of platforms in the first place can make it difficult and expensive to develop a new platform. Confronted with these barriers, most standalone entrants can only succeed if they offer significant improvements in platform performance and if they invest heavily to shift users' expectations and absorb switching costs (Katz and Shapiro, 1985; Henderson and Clark, 1990; Lieberman and Montgomery, 1998; Shapiro and Varian, 1999; Bresnahan, 1999; Evans and Schmalensee, 2001). However, as shown in the next section, bundling offers an entry path that does not require significant performance improvement.

Bundling

Through bundling, a market entrant—the attacker—can foreclose a target's access to customers and thereby reduce the target's scale (Whinston, 1990; Carlton and Waldman, 2005). A foreclosure strategy is more viable when the target's business is subject to strong scale economies. Since platform markets engender economies of scale both through network effects and leveraging fixed costs, they are particularly good candidates for foreclosure attacks.

Below, we analyze foreclosure opportunities in terms of their impact on both platform user net utility and attacker profitability. Throughout, we assume that the attacker offers a pure bundle, AT′, which comprises its core platform A and a new platform T′ that offers functionality similar to that of the target's platform T. A foreclosure strategy is more likely to succeed with a pure bundle, which reciprocally ties the purchase of A and T′ to each other, than with a mixed bundle, which allows the separate purchase of A or T′ in addition to the AT′ bundle. With a mixed bundle, a customer who prefers to continue consuming the attacker's A platform and the target's T platform can simply ignore the AT′ bundle. With a pure bundle, however, a T customer who also has a high valuation for A is forced to switch to the AT′ bundle in order to continue consuming A.

Platform user net utility

Under the standard assumption that consumers maximize their net utility, in considering whether to purchase a platform, potential users will compare its price, denoted as P, plus any switching costs incurred by moving from a rival or earlier version of the platform, denoted SC, to their total utility from consuming the platform, denoted V, which equals the sum of the platform's value that arises from applications that are independent of network transactions, such as using a fax machine as a photocopier, and its network effect, denoted N. We use the same notation to evaluate purchase decisions for an AT′ bundle and assume that switching costs are relevant only for customers who move from T to T′.

Customers who initially purchased only platform T as well as customers who initially purchased both platform A and platform T will buy the AT′ pure bundle if the following condition holds:

$$V(AT', N_{AT'}) - P(AT') - SC(T \rightarrow T') > V(T, N_T) - P(T).$$

In this equation, the network effect for the target, N_T, reflects post-attack reductions in the target's customer base described below.

A customer who initially purchased only A will buy AT′ if the following condition holds:

$$V(AT', N_{AT'}) - P(AT') > 0.$$

Because the attacker offers a pure bundle, A is no longer available as a standalone platform. Consequently, to motivate an existing customer of platform A to buy AT′, the attacker need only ensure that the customer's net utility from the pure bundle is positive.

Tying

Through bundling, an attacker can foreclose its target's access to overlapping customers and thereby diminish the target's scale. In particular, the attacker seeks to capture T customers who were also previously purchasing A by reciprocally tying the purchase of A and T′ in an AT′ pure bundle. Now,

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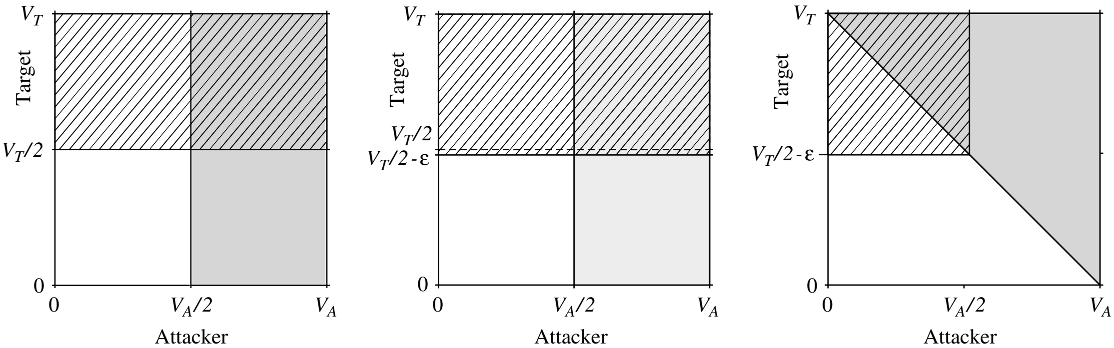

Figure 2. Independent sales; standalone attack; bundle attack

customers who want to consume A also get T′ and no longer need to consume T separately. The effect can be seen in Figure 2, illustrating in sequential panels: (1) the independent sales of platform A by the attacker and of platform T by the target, prior to the attacker's entry into the target's market; (2) an entry scenario in which the attacker sells T′ without bundling; and (3) entry with an AT′ pure bundle. The figures assume that potential customers' utilities from consumption in each platform market are uniformly distributed between zero and a maximum value and that potential customers' valuations of the two platforms are uncorrelated. Positive correlation would increase the attacker's market share gains.

The target's sales decline from Panels 1 to 3 in Figure 2.[1] In Panel 1, independent monopoly goods are optimally priced at half their values V_A and V_T, respectively. Each firm sells to potential customers with higher valuations for its platform: those on the right for the attacker and on top for the target. Customers with high valuations for both platforms overlap in the top right quadrant.

In Panel 2, if the attacker enters the T market with a standalone T′ platform (i.e., if T′ is not bundled with A) and matches the target's monopoly price, $P_{T'} = V_{T'}/2$, the target can respond with a discounting strategy of $P_T - \varepsilon$ to preserve market share. By contrast, in Panel 3, consider an attacker who offers an AT′ pure bundle at price $(V_{T'} + V_A)/2$. The upper right triangle reflects the set of customers who value the bundle more than its price. Now, only customers with a low value for platform A but a high value for the platform T remain with the target platform. These are the customers in the upper left quadrant of Panel 3, and their numbers fall by half, compared to Panel 2. By tying A and T′, the attacker blunts the target's defensive discounting strategy.

Price discrimination

The analysis above shows that an attacker can capture significant share in the target's market simply through tying, without discounting below monopoly pricing levels. Specifically, the analysis above sets the bundle's price equal to the sum of a monopolist's optimal prices for the two platforms sold separately. However, an attacker's share gains are even greater when the analysis is extended to reflect discounting that exploits the familiar price discrimination benefits of bundling.

Bundling reduces heterogeneity in consumers' aggregate valuations for a set of items, allowing a firm with market power to set a price for the bundle that is lower than the sum of the optimal prices for the items sold separately. This 'bundling discount' (Nalebuff, 2004) in turn allows the firm to extract a larger share of available consumer surplus than it would earn from selling the items separately, thereby increasing the firm's profits (Schmalensee, 1984; McAfee, McMillan, and Whinston, 1989; Salinger, 1995).

Following this logic, bundling A and T′ can give an attacker pricing advantages not available to a target that only sells T. The bundling discount is depicted in Figure 3 below. With a lower price than the dotted line (which reflects the sum of a monopolist's optimal prices for the two platforms

[1] Our analysis is based on Nalebuff (2004). Prices do not reflect the optimal competitive response by both firms, but rather assume a limited best response only by the target. Under a full but more complicated Bertrand-Nash analysis, the target's market share still drops dramatically. Results are quite general and hold for nonuniform distributions, correlated values, multi-item bundles, and product complementarity.

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sold separately), the AT′ bundle becomes even more attractive, further reducing the customer base for T.

The magnitude of the bundling discount shrinks as the correlation of potential customers' valuations for the two platforms becomes more positive (Bakos and Brynjolfsson, 1999). At the extreme, with perfect positive correlation, no bundling discount is available; a bundle's price will equal the sum of the optimal prices for the platforms sold separately. However, with perfect positive correlation, tying is extremely effective: customers with the highest valuation for A will by definition also have the highest valuation for T. In this scenario, the A and T user bases overlap exactly, as do their respective nonuser bases. The attacker can capture the entire T market with an AT′ pure bundle and can do so without discounting—provided that the target is not able to match the attacker's multi-platform bundle.

Network effects

Network effects also amplify the share gains that are available to an attacker who pursues market entry through a foreclosure strategy. When an attacker harnesses the tying and price discrimination advantages described above, the customer base for its AT′ bundle will exceed that of its original A platform. As a result, due to network effects, the maximum willingness to pay (WTP) for platform A will increase, shifting the right border of

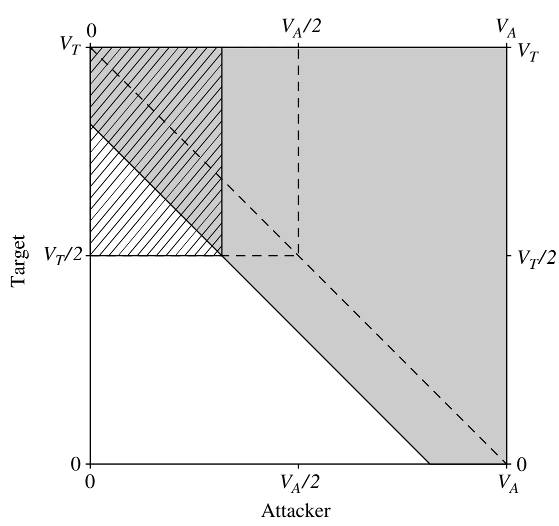

Figure 3. Bundling discount effect

Panel 1 in Figure 4 below outward and expanding the overall size of the A market.

Likewise, the AT′ bundle will have far more customers than the post-attack T platform. Consequently, due to network effects, the maximum WTP for T′ will significantly exceed the maximum WTP for post-attack T. This implies that some customers with a very high valuation for T′ but a low valuation for A (i.e., the rectangle in the extreme upper left of Panel 1) will now buy AT′ instead of T. Furthermore, under a broad set of conditions, the AT′ bundle will have more customers than *pre-attack* T. This implies that the maximum WTP for T′ will be greater than that of pre-attack T due to network effects, shifting the top border of Panel 2 outward and expanding the overall size of the T′ market. Simultaneously, the customer shift from T to T′ reduces network effects in the original T market.

Platform provider profit

An attacker's profit π equals the difference between its total revenue (i.e., price P × demand D) and total cost, with variable and fixed costs denoted VC and FC, respectively.

$$\pi(AT') = [P(AT') - VC(AT')]D(AT') - FC(AT')$$

When the profit from selling an AT′ bundle is greater than the profit from selling only A, that is, when $\pi(AT') > \pi(A)$, platform provider A should mount an envelopment attack. However, envelopment may not be profitable if the target has the requisite skills and resources to counterattack the core A market with a comparable bundle. Bundle-versus-bundle competition can be exceptionally fierce (Bakos and Brynjolfsson, 2000; Nalebuff, 2000), so the risk of reciprocal entry may deter an envelopment attack.

Economies of scope

Compared to selling separate items, bundling can harness economies of scope when cost-sharing opportunities are available in producing and marketing distinct items (Davis, MacCrisken, and Murphy, 2001; Evans and Salinger, 2005). An integrated design can reduce production costs by leveraging common components. For example, video

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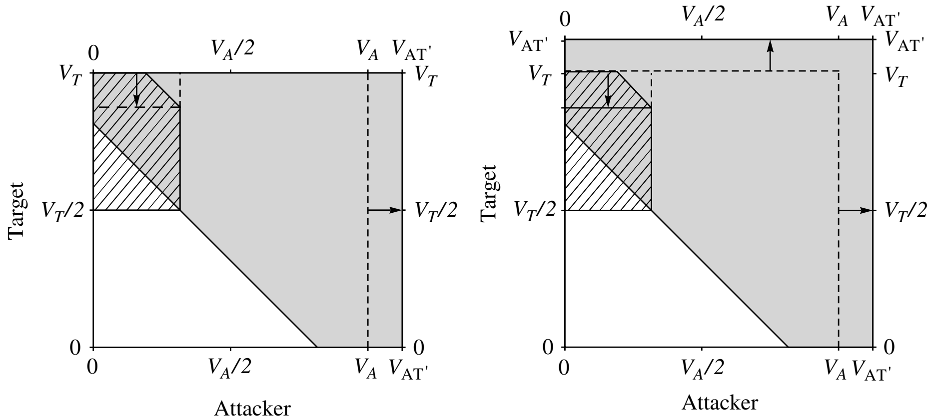

Figure 4. Bundling to harness network effects

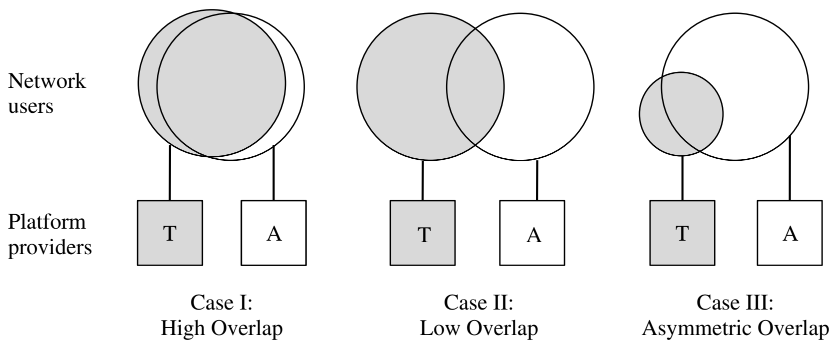

Figure 5. User base overlap between attacker and target platforms

game consoles and DVD players both incorporate optical disk readers, circuitry for outputting video, a power supply, and many other common components. Firms that bundle should also realize economies of scope in customer acquisition because they can sell the bundle with a single message. Likewise, bundling should reduce distribution costs compared to shipping and stocking items that are sold separately. These economies of scope serve to reduce both variable and fixed costs for bundled items, compared to the sum of costs for the items sold separately.

User overlap

Consistent with the analysis above, an important factor driving the profitability of a multi-platform bundle is the overlap in the platforms' users. When users largely overlap, as in Case I in Figure 5 below, then the bundle price can be close to the sum of optimal prices for the platforms (i.e., P(AT′) ∼ P(A) + P(T)), and this bundle price should still appeal to most customers, provided that switching costs are minimal.

Contrast the high overlap situation of Case I with the lower overlap settings of Cases II and III. In Case II, few existing users of A and T will be willing to pay a price for AT′ that approaches the sum of optimal prices for the platforms sold separately. In Case III, a large fraction of T users would pay a price for AT′ that approaches the sum of optimal prices for the platforms sold separately, but only a modest fraction of A users would do so. Consequently, in these lower overlap situations, attackers are not likely to be able to profitably offer an AT′ pure bundle unless (1) the incremental cost of combining T′ with A is very low and the attacker can thus afford to discount the bundle deeply, and/or (2) weak correlation of potential users' valuations for the two platform yields a large bundling discount.

Table 2. Bundling benefits by functional relationship of platforms

	Complements	Weak substitutes	Functionally unrelated
Opportunity for tying at an attractive price, due to high user base overlap	High for reciprocally specific complements	Typically minimal; opportunity greatest when many users multi-home	High for mature platforms widely adopted by a common set of users
Price discrimination benefits	Minimal	Minimal	High
Economies of scope	Minimal	Moderate	Typically minimal, but high in some cases

High user base overlap is most likely when: (1) the target and attacker platforms are both relatively mature and have been adopted by a large fraction of a common set of potential customers (e.g., cable TV and telephone service among mass market consumers; word processing and spreadsheet software among knowledge workers), and/or (2) most uses of the target platform are associated with use of the attacking platform in a system of complements (e.g., Web browsers and PC operating systems; email payment service and online auctions).

To summarize, leverage in an envelopment attack can come from the *revenue side,* in the form of: (1) share gains and pricing power for a pure bundle sold to overlapping user groups; or (2) share gains through a bundling discount when overlap is limited but the correlation of users' valuations for platform pairs is weak. Leverage also can come from the *cost side*, in the form of significant economies of scope. Which factors dominate depends in large part upon the functional relationship between the two platforms, which forms the basis for our typology of envelopment attacks, described next.

TYPOLOGY OF ENVELOPMENT ATTACKS

Any two platforms must be related in one of three ways: they must be complements, substitutes, or functionally unrelated. In this section, we present a typology of envelopment attacks based on these relationships. For each type of platform envelopment we offer examples and discuss the mechanisms through which bundling can facilitate profitable entry into platform markets (see Table 2 for a summary of this analysis).

Envelopment of complements

Platform markets often comprise systems of complements organized in layers. The same firm simultaneously can serve as a platform provider in one network and either a supply-side user or a component supplier in another. For instance, eBay is the platform provider for its online auction network, and is, at the same time, one of the World Wide Web's millions of supply-side users. Likewise, PayPal is the platform provider for its Web-based payment network, and is, at the same time, a component supplier to the eBay auction platform.

Due to strong economies of scale in platform markets, a single firm often comes to dominate each layer. The dominant firm in a given layer, vying for a greater share of the industry's profits and control of its technology, is likely to seek to supplant or diminish adjacent layers' leaders (Fine, 1998; Bresnahan, 1999; Casadesus-Masanell and Yoffie, 2007; Gawer and Henderson, 2007). In many cases, challengers enter an adjacent layer through the envelopment of a complementary platform, as with Microsoft's respective attacks on Real's streaming media software, Netscape's browser, and Adobe's Flash standard.

As explained in the previous section, an envelopment attack most often succeeds when: (1) the target's and attacker's users overlap significantly, or (2) the attacker can harness price discrimination benefits, or (3) economies of scope are high. Due to positive correlation of users' valuations for complements, attackers who target complementary platforms should not expect to realize a large price discrimination-based bundling discount. Likewise, due to product designs that are optimized to reduce functional overlap (Ulrich, 1995; Sanchez and Mahoney, 1996), attackers who target complements will not normally realize significant

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economies of scope. Consequently, the envelopment of complements is most likely to succeed with high overlap in platforms' user bases.

For some pairs of complements, user base overlap will be high and symmetrical, as with Case I of Figure 5; these complements are *reciprocally specific* to each other. For example, a majority of eBay users are also PayPal users, and vice versa. Likewise, a large fraction of Microsoft Office users are also Microsoft Windows users, and vice versa. For other pairs of complements, overlap will be asymmetrical; a majority of one platform's users will also use the other platform, but the reverse will not be true, as with Case III of Figure 5. These complements are *unilaterally specific* to each other. For example, most users of Intuit's Quicken software are Windows users, but only a small fraction of all Windows users are Quicken users.

With reciprocally specific complements, as with Microsoft's Windows and Real's streaming media software, attackers can gain share through tying. The Chicago School's 'One Monopoly Profit Theorem' (OMPT) predicts that bundling complements should not increase profits for a monopolist attacker (Posner, 1976; Bork, 1978). By this logic, the price of a bundle cannot exceed the sum of independent prices. If the complement is competitively supplied, profits on the bundle should not exceed profits on the components sold separately. However, Whinston (1990) showed that OMPT is only valid under restrictive conditions: (1) the complement is supplied in a perfectly competitive market; (2) the monopolist attacker's product is essential for all uses of the complement; and (3) the complement is not subject to economies of scale. According to Whinston (2001), when a monopolist's product is not essential for all uses of a complement whose suppliers have market power, the monopolist has an *incentive* to capture the rents earned by the suppliers from alternative uses. When the complement market is subject to increasing returns, the monopolist may have the *ability* to capture rents through bundling and denying scale to the complement suppliers.

Platform markets routinely violate Whinston's (1990) conditions, so we should expect to observe profitable bundling of complements by monopoly platform providers. Consider, for example, Microsoft's envelopment of Real, described in the Introduction. Real enjoyed market power (condition 1) and increasing returns due to network effects (condition 3). Also, Window's near-monopoly in PC operating systems was not essential for all uses of Real's software (condition 2), which also was available for Macintosh computers.

Thus, we have:

Proposition 1: Given a target platform market sheltered from standalone entry, an entrant that bundles a complementary platform is most likely to succeed when the platforms' users overlap significantly. Overlap facilitates share gains through tying at a bundle price that approaches the sum of the optimal prices for the platforms sold separately.

Envelopment of weak substitutes

The maximum price a customer would pay for a bundle of two perfect substitutes should equal the price he or she would pay for either item sold separately. However, bundling *weak* substitutes can create value. Weak substitutes serve the same broad purpose but satisfy different sets of user needs because they rely on different technologies. For example, Blockbuster's brick-and-mortar stores provided quicker access for physical DVD rentals, but a smaller selection than Netflix's mail delivery service. Likewise, Monster.com and LinkedIn.com use different approaches in helping users find and fill jobs: searchable listings and social networking, respectively. These approaches provide distinct advantages: listings are valuable when parties wish to conduct a comprehensive search, whereas social networks provide a mutually trusted third party's assessment of fit.

The user bases of weak substitutes are likely to overlap to some extent, as with Case II of Figure 5. When two platforms satisfy distinct needs, and when some individuals exhibit both needs on different occasions, those individuals may multi-home —for example, before streaming, using Blockbuster in-store browsing for some DVD rentals and Netflix online mail ordering for others. Other individuals whose occasion-specific needs are weaker will chose a single platform, especially if multi-homing costs are high. With only moderate overlap between platforms' user bases, we would not expect an enveloper targeting a weak substitute to realize significant share gains through tying alone.

With moderate user base overlap, it is also more difficult to price a pure bundle at the sum of the

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optimal prices for the platforms sold separately. The nature of weak substitutes makes this pricing problem even more acute. With weak substitutes, a user's valuation for the bundle will exceed his or her standalone valuation for the most preferred item, but *only* to the extent that the second item provides unique functionality. Hence, deep discounting will typically be required to sell the bundle.

Furthermore, since weak substitutes serve the same broad purpose, we would expect demand for each platform's unique functionality to be positively correlated. For example, film fans will value both the wide variety uniquely available through DVD-by-mail services and the instant access uniquely offered by Internet streaming services. Positive correlation of demand will limit the enveloper's opportunity to harness price discrimination to offer bundling discounts.

Consequently, to deliver deep discounts for a bundle of weak substitutes, an enveloper must realize significant economies of scope. Some economies should be available. In addition to economies of scope in marketing to multi-homing users, bundling weak substitutes typically will offer cost savings in production and operations. By their nature, weak substitutes overlap to some extent in functionality, and hence should share some common components and activities. For example, compared to firms offering DVD-by-mail and Internet streaming platforms separately, Netflix can save costs by bundling these platforms then relying on a single unit to procure films.

Based on this analysis, we have:

Proposition 2: Given a target platform market sheltered from standalone entry, an entrant that bundles a weak substitute platform is most likely to succeed when bundling offers significant economies of scope. These economies make affordable the deep discount (relative to the sum of the optimal prices for the platforms sold separately) required to sell a bundle when platforms have partially duplicated functionality.

Envelopment of unrelated platforms

Even if two platforms are designed to serve fundamentally different purposes, as with mobile phones and handheld gaming devices, the platforms may still have common users and employ similar components. For example, a mobile phone and a handheld gaming device each require a display, battery, microprocessor, and keys for input. And, many consumers own both a mobile phone and a handheld gaming device. By leveraging common components and users, the envelopment of unrelated platforms in industries that produce, process, and distribute digital information frequently fuels convergence, which unifies in a single device the functions performed by previously distinct products (Greenstein and Khanna, 1997; Yoffie, 1997). For example, handheld devices like Apple's iPhone now bundle the functionality of mobile phones, video game players, PCs, media players, navigation systems, eBook readers, and credit cards.

We cannot generalize about the degree of user base overlap for functionally unrelated platforms. Overlap will be significant for some pairs of mature platforms that have achieved a high penetration of a common set of potential customers, as with cable TV and phone service among mass market consumers, or word processing and spreadsheet software among knowledge workers. In such cases, since most potential customers already purchase both platforms, there should be significant opportunity for share gains through tying at a bundle price that approaches the optimal price for the platforms sold separately.

Furthermore, regardless of the extent of overlap between functionally unrelated platforms' user bases, users' valuations of the platforms should not exhibit strong positive correlation, so an enveloper should be able to offer a significant bundling discount by leveraging price discrimination benefits.

Since functions depend on components, functionally unrelated platforms will not normally share common components. Thus, economies of scope in production typically will be limited. However, for some pairs of functionally unrelated platforms, component overlap is meaningful and economies of scope are significant. For example, both cable TV and phone companies have utilized their existing fiber optic and copper lines to deliver additional services without duplicating the huge upfront investment required to wire households.

Proposition 3: Given a target platform market sheltered from standalone entry, an entrant that bundles a functionally unrelated platform is most likely to succeed when the platforms'

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users overlap significantly and when economies of scope are high.

Table 2 summarizes the potential benefits of bundling pairs of platforms that are complements, weak substitutes, and functionally unrelated.

DISCUSSION

One goal of this paper is to encourage scholars of strategic management to devote more attention to platform-mediated networks. Platforms play an important role in the global economy and represent one of three elemental configurations through which firms create value (Stabell and Fjeldstad, 1998). A more familiar configuration—the value chain of long-linked technologies used in traditional manufacturing industries—has, to date, been the central focus of the resource-based view (RBV), the dominant paradigm in strategic management research (Wernerfelt, 1984; Barney, 1991; Amit and Schoemaker, 1993; Peteraf, 1993). As such, strategy scholars have spent little time considering how RBV's precepts apply to platforms.

Some of RBV's seminal papers mention in passing that customer bases can be valuable resources (e.g., Barney, 1986: 1235; Dierickx and Cool, 1989: 1508). Consistent with this view, due to network effects, a platform that accumulates a larger user base will deliver greater value (Peteraf and Bergen, 2003). Furthermore, due to positive feedback induced by network effects, growth in a platform's asset base fuels further growth. Following the RBV precept that 'success breeds success,' when firms enjoy asset mass efficiencies (Dierickx and Cool, 1989: 1507) they build self-reproducing resource position barriers (Wernerfelt, 1984: 173). User bases with network effects can play this role.

The role of resources in facilitating market entry has been a central concern in RBV research (Wernerfelt, 1984; Dierickx and Cool, 1989; Barney, 1991). Firms possessing resources that are valuable in one market can leverage those resources to enter another market that shares use of those resources (Wernerfelt, 1984). Platform envelopment follows this logic: an enveloper leverages its existing user base—a valuable resource in its original market due to network effects—to enter another platform market in which network effects require a critical mass of users. Markets with two-sided networks (Parker and Van Alstyne, 2000, 2005; Rochet and Tirole, 2003) represent especially good candidates for strategic envelopment. Attacks that absorb one user group often succeed at absorbing the other.

Extending the notion that platform user bases are valuable resources, the process of managing platform envelopment can be viewed as a *dynamic capability*. Dynamic capabilities entail recombining resources to generate new value-creating strategies (Eisenhardt and Martin, 2000). Platform envelopment fits this definition: attackers secure strategic advantage by recombining valuable resources—user bases—into multi-platform bundles. We note that some firms have become serial envelopers. Microsoft, Apple, and Google, for example, each have attacked many adjacent platforms. We speculate that such firms are building strategic routines—for example, approaches to promoting cross-unit coordination—that they can leverage when they target additional platform markets for envelopment.

Issues for future research

Econometric analysis could test the hypotheses presented above about conditions that improve the odds of success with different envelopment attack types. Likewise, analytic and simulation modeling could shed more light on these conditions. Beyond empirical and additional theoretical research on the effectiveness of envelopment attacks, researchers could study strategies that firms use to defend against such attacks and organizational challenges posed by envelopment.

Defensive strategies

Firms that are vulnerable to envelopment can pursue two defensive strategies: opening the platform to enlist new allies and matching the attacker's bundle. Firms can transform a proprietary platform that is vulnerable to envelopment into a shared platform, inviting other parties to co-invest in its development and to create compatible versions of the platform (West, 2003; Eisenmann, 2008; Eisenmann, Parker and Van Alstyne, 2009; Parker and Van Alstyne, 2010). The availability of compatible versions should attract more users by encouraging price competition and reducing switching costs. Also, new platform partners can create differentiated versions of the platform that meet the needs of previously underserved customers. Finally, opening a platform enlists new allies committed to its defense. These benefits must be balanced against the fact that opening a platform exposes its creator to increased competition.

Firms also can counter an envelopment attack by assembling a comparable bundle. The target can cross parry if it has the requisite skills and resources to enter the attacker's core market and if entry barriers are not insurmountable due to intellectual property protection, high switching costs, strong network effects, or other factors. However, as noted above, bundle-versus-bundle competition can be intense (Bakos and Brynjolfsson, 2000; Nalebuff, 2000). So, under certain conditions, accommodating entry may be more profitable than matching the enveloper's bundle.

Organizational issues

Launching an envelopment attack requires a high level of cross-unit coordination. Engineers must integrate two platforms' functionality and marketers must formulate joint pricing and targeting strategies. Most companies find that achieving cross-unit cooperation is difficult because managers will fight for autonomy and strive to advance their units' interests (Garud and Kumaraswamy, 1995; Galunic and Eisenhardt, 2001).

Future research could focus on optimal organizational structures for encouraging cross-unit cooperation in the context of envelopment, in particular, the appropriate degree of structural separation between new and old units (Tushman and O'Reilly, 1996; Christensen, 1997) and the ideal level of centralization of shared functions. Researchers also could study the organizational systems, processes, and cultural values that successful envelopers use to promote cross-unit cooperation.

CONCLUSION

In this paper, we introduce the concept of envelopment to explain entry into platform markets where incumbents are otherwise sheltered due to strong network effects and high switching costs. By leveraging shared user relationships and common components in a multi-platform bundle, firms can enter without Schumpeterian innovation. Envelopment forecloses a target's access to users and harnesses demand- and supply-side scale economies. We deduce a typology of envelopment attack types based on the set of possible relationships between target and attacker platforms—complements, weak substitutes, or functionally unrelated—and describe the economic and strategic motivations for each attack type.

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