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Abstract

In platform-component systems with indirect network effects, some components are so popular with consumers that they have strong bargaining positions and can be regarded as "must-have" from the point of view of the platform. For example, ESPN is a must-have component of cable TV platforms. This paper presents a theoretical model to assess how platform market structures affect the likelihood of exclusive versus non-exclusive contracts between platforms and components. The model evaluates the combined impacts of (i) the popularity of the component, (ii) the platform market share difference and (iii) platform technological compatibility on the platform-component contractual arrangements. It shows that a component provider is more likely to sign exclusive access contracts with a single platform if its popularity is high, the platform market share difference is large, and platform compatibility is low.

JEL classification: L14, L22, L82

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1 Introduction

Many products operate on the platform-component model. The broader the consumer choice of components is, the greater utility consumers can derive from the platform. This creates indirect network effects and a two-sided market. Due to superior technologies and well-known brand names, certain component providers have tremendous power in affecting the platform market. Examples of such "must-have" component providers include ESPN in the US pay-TV market, Squaresoft in the Japanese video game market and short messaging services (SMS) in the Chinese cell phone market.[1] These component providers typically bargain with the platforms in deciding the nature of platform-component contractual arrangements. Research interest in this type of industry has heightened recently, but we believe this is the first model to combine (i) strategic competition between platforms, (ii) differentiated "must-have" components, and (iii) bargaining between platforms and component providers.

Theoretical research on indirect network effects can be divided into two broad categories, namely the traditional platform-component literature and the emerging two-sided networks literature. Chou and Shy (1990, 1993 and 1996) and Church and Gandal (1992, 1993 and 2000) made significant early contributions to the platform-component literature. They analyzed how indirect network effects affect the number of components on each platform. Typically there are asymmetric market equilibria where competing platforms do not have equal market shares and are not supported

[1] The expression "must-have" is used to mean "very important," but does not imply perfect complementarity. For perfect complements, Matutes and Regibeau (1988) show different results from those presented here.

by the same number of components.

The two-sided networks literature (Rochet and Tirole 2003, Armstrong 2004) emphasizes that indirect network effects present a chicken-and-egg problem. On the one hand, it is the number of components rather than the size of the installed customer base that attracts a given consumer to purchase a platform. On the other hand, the size of the installed customer base determines how many component providers there are to join a given platform. In a two-sided network, platforms try to get the two sides of end-users on board by appropriately charging each side. In order to coordinate the demand between components and consumers, the platform often chooses one side of the market (e.g., video game developers) as the profit center and the other side (e.g., gamers) as the loss leader.

The focus of the present paper is on platform-component contractual arrangements when some components have substantial bargaining power. Katz and Shapiro (1994) discuss the importance of quality differentiation among components. Harbord and Ottaviani (2002) model premium programming in the UK pay-TV market, and Rochet and Tirole (2003) model bargaining between *end-users* and component providers. In general most network models focus on homogeneous components.

We define a *must-have component* as one that commands more than ordinary influence on platform sales and possesses significant bargaining power vis-à-vis platforms. A must-have component stands in contrast to *basic components,* which have no bargaining power. We model a must-have component provider's incentive to offer exclusive or non-exclusive access contracts to platforms under different technological and market regimes. The superior development technologies and the brand names enjoyed by a few prestigious component providers translate into considerable bargaining power. For instance, the departure of a small video game developer would have insignificant effects on Nintendo's overall market share, but the loss of Squaresoft's exclusive support cost Nintendo its dominant position in the Japanese video game industry. The US pay-TV market has also witnessed increasing bargaining power of Disney's ESPN in fee negotiations with pay-TV operators.

In section 2, we describe the model. In section 3 we add bargaining between the platforms and the components, and in section 4 we evaluate whether a must-have component should offer an exclusive or non-exclusive contract. We compare the model to three mini case studies in section 5, and conclude in section 6.

2 The Model

We base our model on Crémer, Rey and Tirole (2000) (hereafter CRT) and a later analysis of CRT by Malueg and Schwartz (2002). CRT model two Internet backbone providers competing to provide connections to many Internet service providers (ISPs). If the IBPs are not interconnected themselves, there is a direct network effect between the various ISPs all connected to one backbone, and the number of ISPs determines the number of customers of each backbone. If the backbones are interconnected (at varying quality levels), the direct network effect is expanded to the ISPs connected to the other backbone. CRT show that the larger backbone may not want to interconnect with the smaller one.

The CRT model is a good basis for our work because it includes strategic behavior by the platforms (the backbones) and partial compatibility between them (the quality of interconnection). We reinterpret the direct network effect in the CRT model as a reduced form version of an indirect network effect. Clements (2004) has pointed out that a direct network effects model can be viewed as a reduced form of an indirect network effects model. Following Rohlfs (2003), we translate the degree of interconnection into the degree of compatibility in the indirect network industries. We then introduce the must-have component and analyze how it affects the equilibrium sales, prices and profitability of competing platforms. The analysis will cover two cases: (i) the must-have component provider signs an exclusive contract with one of the platforms, and (ii) the must-have component provider signs non-exclusive contracts with both platforms.

There are two platforms, $i = 1, 2$, competing to gain access to basic components. The two platforms have installed customer bases of β_1 and β_2 respectively, where $\beta_1 \geq \beta_2 \geq 0$. Following Malueg and Schwartz's (2002) analysis of CRT, we assume that $\beta = \beta_1 + \beta_2 = 1$. The two platforms' initial market share difference is thus $\Delta_1 = -\Delta_2 = \beta_1 - \beta_2 \geq 0$. Each platform tries to enroll new customers q_i, and the population of new customers $q_1 + q_2$ equals 1. Analogous to the degree of interconnection in the CRT model, we define $\theta \in [0, 1]$ as the degree of compatibility between the two platforms. Compatibility is understood as the technological constraints that component providers face when transferring the same components from one platform to another.[2]

The number of basic components on platform i is proportional to its *effective* user base: $N_i = s[(\beta_i + q_i) + \theta(\beta_j + q_j)]$. As in CRT, we restrict $0 < s < 1/2$ to ensure stability and avoid tipping effects in the platform market. For simplicity,

[2]For example, the degree of compatibility between two video game consoles is usually determined by the programming environments of the consoles. If two consoles adopt the same software development system (e.g., Windows), then game developers will incur very low costs when they convert the same games from one console to another.

a consumer's utility from purchasing a platform is equivalent to the number of basic components available on that platform, i.e., $U_i = N_i + \tau$. We use this linear utility function in order to obtain a closed-form solution for the entire model.[3] Different values of s can be used to parameterize the utility function. The uniformly distributed taste parameter $\tau \in [0, 1]$ indicates that some consumers prefer one platform to another. Both platforms have the same marginal cost of production c. Malueg and Schwartz (2002) pointed out that it makes sense to restrict $c \leq 1$ to ensure that there will be at least some new customer enrolment, no matter how small the value of s is.

In addition to the N_i basic components, there may be certain components that enjoy enormous popularity among the consumers. To capture this, we introduce the must-have component and define μ (a constant) as the marginal utility consumers derive from the must-have component. We first assume platform 1 has exclusive access to the must-have component. For consumers who purchase platform 1, their gross utility function becomes $U_1 = s[(\beta_1 + q_1) + \theta(\beta_2 + q_2)] + \mu + \tau$.

The two platforms compete à la Cournot in the game described by CRT. Given β_1, β_2 and θ, both platforms maximize profits based on their choices of q_i. For platform 1, the profit function is

$$\pi_1^E = [1 + s(\beta_1 + \theta\beta_2) - (1 - s)q_1 - (1 - \theta s)q_2 + \mu - c]\, q_1$$

where the E denotes platform 1's exclusive access to the must-have component. For platform 2, the profit function is

$$\pi_2^{E'} = [1 + s(\beta_2 + \theta\beta_1) - (1 - s)q_2 - (1 - \theta s)q_1 - c]\, q_2$$

[3] We believe that non-linear utility functions would not change the comparative static results.

where E' denotes that there is exclusive access but that platform 2 is the one that is excluded.

Taking first order conditions and solving simultaneously gives a Cournot equilibrium quantity for platform 1

$$q_1^E = q_1^B + m^E(\theta, \mu)$$

The first term,

$$q_1^B = \frac{1}{2}\left[\frac{2(1-c)+s(1+\theta)\beta}{2(1-s)+(1-\theta s)} + \frac{(1-\theta)s\Delta_1}{2(1-s)-(1-\theta s)}\right]$$

is the "basic component effect" and is identical to the solution in the CRT model. It represents the underlying effect of basic components excluding the must-have component. The effect of the must-have component is contained in the term

$$m^E(\theta, \mu) = \frac{2\mu(1-s)}{[2(1-s)+(1-\theta s)][2(1-s)-(1-\theta s)]} \tag{1}$$

which is positive indicating that platform 1 gains from its exclusive access.

Similarly, platform 2's equilibrium quantity will be lower as a result of being excluded:

$$q_2^{E'} = q_2^B + m^{E'}(\theta, \mu)$$

where

$$q_2^B = \frac{1}{2}\left[\frac{2(1-c)+s(1+\theta)\beta}{2(1-s)+(1-\theta s)} + \frac{(1-\theta)s\Delta_2}{2(1-s)-(1-\theta s)}\right]$$

and

$$m^{E'}(\theta, \mu) = -\frac{\mu(1-\theta s)}{[2(1-s)+(1-\theta s)][2(1-s)-(1-\theta s)]} \tag{2}$$

An important result of the CRT model is that $\frac{\partial(q_1^B+q_2^B)}{\partial\theta} > 0$. A higher degree of compatibility increases the number of basic components and thus consumer utility on *both* platforms. Another CRT result is that $\frac{\partial(q_1^B - q_2^B)}{\partial\theta} < 0$. This implies that platform 1's initial market share advantage (as reflected by $\beta_1 \geq \beta_2$) fades away if the platforms become more compatible. A higher degree of compatibility tends to equalize the number of basic components on the two platforms.

The novelty of the must-have component model lies in the *must-have component quantity effects* $m^E(\theta, \mu)$ and $m^{E'}(\theta, \mu)$. We now turn to some comparative statics results in this augmented model.

Proposition 1 *If the must-have component gains popularity, total demand in the platform market expands.*

Proof: $\frac{\partial(q_1^E + q_2^{E'})}{\partial\mu} = \frac{1-2s+\theta s}{[2(1-s)+(1-\theta s)][2(1-s)-(1-\theta s)]}$. Given $0 < s < 1/2$ and $\theta \in [0,1]$ then $1 - 2s + \theta s > 0$ and $[2(1-s) + (1-\theta s)][2(1-s) - (1-\theta s)] > 0$.

The gain in the total market demand, however, does not benefit platform 2 since it has no access to the must-have component. The exclusive contract between platform 1 and the must-have component provider makes platform 2 worse off.

Proposition 2 *If the must-have component gains popularity, then it increases platform 1's sales but reduces platform 2's sales.*

Proof: From equations (1) and (2), it is clear that $\frac{\partial q_1^E}{\partial\mu} = \frac{\partial m^E(\theta,\mu)}{\partial\mu} > 0$ and $\frac{\partial q_2^{E'}}{\partial\mu} = \frac{\partial m^{E'}(\theta,\mu)}{\partial\mu} < 0$.

Taken together, propositions 1 and 2 indicate that platform 2's declining sales (due to denied access to the must-have component) are partly offset by the positive impact associated with the rising number of basic component providers.

The must-have component affects equilibrium platform prices in the same direction as it affects the sales. The equilibrium prices of the two platforms are

$$p_1^E = p_1^B + g^E(\theta, \mu) \qquad\qquad p_2^{E'} = p_2^B + g^{E'}(\theta, \mu)$$

where

$$\begin{aligned} p_1^B &= 1 + s(\beta_1 + \theta\beta_2) - (1-s)q_1^B - (1-\theta s)q_2^B \\ p_2^B &= 1 + s(\beta_2 + \theta\beta_1) - (1-s)q_2^B - (1-\theta s)q_1^B \end{aligned}$$

and

$$g^E(\theta, \mu) = \frac{2\mu(1-s)^2}{[2(1-s) + (1-\theta s)][2(1-s) - (1-\theta s)]} \tag{3}$$

$$g^{E'}(\theta, \mu) = -\frac{\mu(1-s)(1-\theta s)}{[2(1-s) + (1-\theta s)][2(1-s) - (1-\theta s)]} \tag{4}$$

The terms $g^E(\theta, \mu)$and $g^{E'}(\theta, \mu)$ are the must-have component price effects.

Proposition 3 *Platform 1's equilibrium price increases in the must-have component's popularity, while platform 2's price falls by a smaller amount.*

Proof: By inspection, $\frac{\partial p_1^E}{\partial \mu} = \frac{\partial g^E(\theta,\mu)}{\partial \mu} > 0$ and $\frac{\partial p_2^E}{\partial \mu} = \frac{\partial g^{E'}(\theta,\mu)}{\partial \mu} < 0$. Also, $\left|g^E(\theta, \mu)\right| > \left|g^{E'}(\theta, \mu)\right|$ and $\left|\frac{\partial g^E(\theta,\mu)}{\partial \mu}\right| > \left|\frac{\partial g^{E'}(\theta,\mu)}{\partial \mu}\right|$.

The two platforms' operating profit functions are

$$\pi_1^E = \pi_1^B + H_1^E \qquad\qquad \pi_2^{E'} = \pi_2^B + H_2^{E'}$$

where $\pi_1^B = (p_1^B - c)q_1^B$ and $\pi_2^B = (p_2^B - c)q_2^B$ and

$$\begin{aligned} H_1^E &= g^E(\theta, \mu) \cdot q_1^B + \left[p_1^B - c\right] \cdot m^E(\theta, \mu) + g^E(\theta, \mu) \cdot m^E(\theta, \mu) \\ H_2^{E'} &= g^{E'}(\theta, \mu) \cdot q_2^B + \left[p_2^B - c\right] \cdot m^{E'}(\theta, \mu) + g^{E'}(\theta, \mu) \cdot m^{E'}(\theta, \mu) \end{aligned}$$

H_1^E is the increase in operating profit on platform 1 as a result of exclusive access to the must-have component. $H_2^{E'}$ is the decrease in operating profit on platform 2 as a result of denied access to the must-have component.

Proposition 4 *Increasing popularity of the must-have component has a positive effect on platform 1's operating profit and a negative effect on platform 2's operating profit. The sum of the profits increases.*

Proof:. $\frac{\partial \pi^E}{\partial \mu} = \frac{\partial H_1^E}{\partial \mu} > 0$ and $\frac{\partial \pi^{E'}}{\partial \mu} = \frac{\partial H_2^{E'}}{\partial \mu} < 0$. By inspection, $\left|\frac{\partial H_1^E}{\partial \mu}\right| > \left|\frac{\partial H_2^{E'}}{\partial \mu}\right|$.

Changes in compatibility, such as platform standardization (equivalent to an increase in θ) or platform differentiation (equivalent to a decrease in θ), influence the market equilibria.

Proposition 5 *A higher degree of compatibility weakens the must-have component price and quantity effects on the platform that has exclusive access to the must-have component. It works the opposite way on the platform that is denied access. The effects are larger in magnitude on platform 1.*

Proof: From equations (1) – (3), it is clear that $\frac{\partial m^E(\theta,\mu)}{\partial \theta} < 0$, $\frac{\partial m^{E'}(\theta,\mu)}{\partial \theta} > 0$, $\frac{\partial g^E(\theta,\mu)}{\partial \theta} < 0$, and $\frac{\partial g^{E'}(\theta,\mu)}{\partial \theta} > 0$. By inspection, $\left|\frac{\partial m^E(\theta,\mu)}{\partial \theta}\right| < \left|\frac{\partial m^{E'}(\theta,\mu)}{\partial \theta}\right|$ and $\left|\frac{\partial g^E(\theta,\mu)}{\partial \theta}\right| < \left|\frac{\partial g^{E'}(\theta,\mu)}{\partial \theta}\right|$.

While the must-have component works to widen the market share difference between the competing platforms, a higher level of compatibility serves to narrow such a difference. Therefore, compatibility and the must-have component effects exert opposite influences on equilibrium platform sales and prices.

We can extend the must-have component model to two other cases where the must-have component provider grants (i) exclusive access to platform 2 and (ii) non-exclusive access to both platforms. In the non-exclusive access case, both platforms enjoy increases in sales and operating profits. (Refer to the Appendix for derivations for these two cases.) The following table summarizes the equilibrium operating profits for the two platforms under three different access regimes.

	Exclusive, Platform 1	**Exclusive, Platform 2**	**Non-exclusive**
π_1	$\pi_1^E = \pi_1^B + H_1^E$	$\pi_1^{E'} = \pi_1^B + H_1^{E'}$	$\pi_1^{NE} = \pi_1^B + H_1^{NE}$
π_2	$\pi_2^{E'} = \pi_2^B + H_1^{E'}$	$\pi_2^E = \pi_2^B + H_2^E$	$\pi_2^{NE} = \pi_2^B + H_2^{NE}$

3 Bargaining Scenarios

While the must-have component provider is crucial to platform competition, the platforms command considerable bargaining power as well. Ultimately, the must-have component provider needs at least one platform as its bridge to consumers. In this section we investigate the contractual arrangements between the platforms and the must-have component provider. Specifically, if the must-have component pays the platforms transfer payments T_i, how do the popularity of the must-have component (μ), the initial market share difference ($\Delta_1 = \beta_1 - \beta_2$), and the level of compatibility (θ) affect the transfer payment? Under what circumstances are exclusive access contracts between a single platform and the must-have component provider more likely to exist?

We use the Nash bargaining solution to model negotiation between the platforms and the must-have component. We assume neither time preferences for the negotiating parties nor exogenous risk of breakdown of the bargaining process. According to Binmore, Rubinstein and Wolinsky (1986), if the negotiating parties engage in the dynamic strategic game, these assumptions would lead them to split evenly the net payoff resulting from their cooperation (i.e., the difference between the gross payoff and the outside opportunity). This cooperative approach does not prevent us from capturing the strategic decisions that exist in the platform market. Since the outside opportunities available to the negotiating parties depend upon the nature of competition in the platform market, strategic competition in the platform market is fully reflected in the outcome of the negotiation.

Two bargaining scenarios are described here. First, we analyze simultaneous bargaining with exclusive access, where the must-have component provider bargains simultaneously with platform 1 and platform 2 and makes a credible, *ex ante* commitment to being exclusive. Second, we consider simultaneous bargaining with non-exclusive access.

3.1 Simultaneous Bargaining with Exclusive Access

Let T_i^E be the transfer payment that the must-have component provider makes to any platform that has exclusive access to the must-have component. If the transfer payment goes from the platform to the must-have component provider, then T_i^E is negative. If platform 1 signs an exclusive contract with the must-have component provider, then its payoff is equal to $H_1^E + T_1^E$, the sum of the rise in operating profits and the transfer payment. If it loses the must-have component to platform 2, it will suffer from lower sales and lower prices. This outside opportunity is equivalent to $H_1^{E'}$. Platform 2's payoff is $H_2^E + T_2^E$ and its outside opportunity is $H_2^{E'}$.

As for the must-have component provider, we assume its operating profit to be a function of the total customer base on a chosen platform: $\pi_\mu^{iE} = \gamma(\beta_i + q_i^E)$ in the exclusive access case, or $\pi_\mu^{NE} = \gamma(\beta + q_1^{NE} + q_2^{NE})$ in the non-exclusive access case. The constant $\gamma > 0$ represents per-subscriber income that the must-have component provider receives directly from the customer base.[4] Therefore, if

[4]A component provider's per-subscriber income can take the forms of fees, advertising revenues

the must-have component provider exclusively supports platform 1, then its payoff function Π_μ^{1E} is the difference between the operating profit and the transfer payment, $\Pi_\mu^{1E} = \pi_\mu^{1E} - T_1^E$. On the other hand, an exclusive contract with platform 2 allows the must-have component provider to gain $\Pi_\mu^{2E} = \pi_\mu^{2E} - T_2^E$.

Under the simultaneous bargaining assumption, the two transfer payments, i.e., T_1^E and T_2^E, are decided in the same period. As Shaked and Sutton (1984) point out, we can think of the simultaneous bargaining process as if the time taken to formulate successive proposals is negligibly small. Therefore, the bargaining outcome is independent of "who calls first." There are also two important constraints on the bargaining process. For each platform, the net payoff has to be positive: $H_1^E + T_1^E - H_1^{E'} \geq 0$ and $H_2^E + T_2^E - H_2^{E'} \geq 0$. Otherwise, it is not worthwhile for the platforms to contract with the must-have component provider.

The simultaneous bargaining process implies that when platform 1 and the must-have component provider bargain, they take T_2^E as given. The same applies to the negotiation between platform 2 and the must-have component provider. The equilibrium T_1^E is the solution to

$$H_1^E + T_1^E - H_1^{E'} = \pi_\mu^{1E} - \pi_\mu^{2E}$$

and sales of associated products. We assume that γ is not dependent on μ. The reason for this assumption is that a component provider's ability to directly charge customers usually depends on the existing state of technology and/or the industrial business model. For example, the TV broadcasting technology limits content providers' ability to receive direct payment from the viewers. On the other hand, the single game pricing scheme in the video game industry allows game developers to charge customers directly. If γ were directly associated with μ, then the comparative static result of $\partial T_i/\partial\mu$ in the following analysis would change.

while T_2^E is the solution to

$$H_2^E - H_2^{E'} + T_2^E = \pi_\mu^{2E} - \pi_\mu^{1E}$$

Under Nash bargaining, these lead to simultaneous equations

$$\begin{aligned} T_1^E(T_2^E) &= \frac{1}{2}\left\{\gamma\left[(\beta_1-\beta_2)+(q_1^B-q_2^B)\right]-\left(H_1^E-H_1^{E'}\right)+T_2^E\right\} \\ T_2^E(T_1^E) &= \frac{1}{2}\left\{\gamma\left[(\beta_2-\beta_1)+(q_2^B-q_1^B)\right]-\left(H_2^E-H_2^{E'}\right)+T_1^E\right\} \end{aligned}$$

It turns out that the simultaneous solution violates the net payoff constraint for platform 2. Thus, platform 2 is at a corner solution where its net payoff is zero: $H_2^E - H_2^{E'} + T_2^E = 0$. Imposing this condition and solving simultaneously with $T_1^E(T_2^E)$ gives

$$T_1^E = \tfrac{1}{2}\left\{\gamma\left[(\beta_1-\beta_2)+(q_1^B-q_2^B)\right]-\left(H_1^E-H_1^{E'}\right)-\left(H_2^E-H_2^{E'}\right)\right\}$$
$$T_2^E = -\left(H_2^E-H_2^{E'}\right)$$

The corner solution for platform 2 gives us an interesting result:

Proposition 6 *Under simultaneous bargaining with exclusive access, a platform with a smaller installed customer base would always need to pay to get an exclusive contract with the must-have component provider.*

It is worthwhile to point out if $\gamma = 0$, then platform 1's payment T_1^E is also negative. That is to say, if the must-have component does not charge customers directly, it will always get a subsidy from the platform. Such is the case in the pay-TV industry, where content networks are entitled to a fee per subscriber from the pay-TV operators.

Given T_1^E and T_2^E, the must-have component decides which platform to contract with by evaluating $\Pi_\mu^{1E}(T_1^E)$ and $\Pi_\mu^{2E}(T_2^E)$. We can calculate $\Pi_\mu(T_1^E) - \Pi_\mu(T_2^E) =$

$\frac{1}{2}\gamma\left[(\beta_1 - \beta_2) + (q_1^B - q_2^B)\right] + \frac{1}{2}(H_1^E - H_1^{E'}) - \frac{1}{2}(H_2^E - H_2^{E'}) > 0$, so the must-have component provider will always choose to contract with platform 1.

We can now evaluate the effect of changes in the parameters on the transfer payment. An increase in μ enhances the must-have component quantity and price effects, which in turn raises the must-have component provider's bargaining power. Hence, the must-have component provider is in a position to make a lower transfer payment to platform 1.

Proposition 7 *Under the simultaneous bargaining with exclusive access scenario, the must-have component provider makes a smaller transfer payment to platform 1 if the popularity of the must-have component increases.*

Proof: $\frac{\partial T_1^E}{\partial \mu} = -\frac{1}{2}\left[\frac{\partial (H_1^E - H_1^{E'})}{\partial \mu} + \frac{\partial (H_2^E - H_2^{E'})}{\partial \mu}\right]$. Both $\frac{\partial (H_1^E - H_1^{E'})}{\partial \mu}$ and $\frac{\partial (H_2^E - H_2^{E'})}{\partial \mu}$ are positive.

If the two platforms are more similar in starting size (lower Δ_1), platform 1 has less to gain from the bargaining process, and the must-have component provider has a larger outside opportunity. The must-have component provider thus makes a smaller transfer payment.

Proposition 8 *For fixed total starting market size β, the larger the initial platform market share difference, the higher the transfer payment from the must-have component provider to platform 1.*

Proof: See appendix.

The limiting case of proposition 8 is when $\beta_1 = \beta_2$. When the two platforms are equal sized, they are essentially undifferentiated, and they engage in Bertrand competition for the must-have component. The transfer fee is $T_1^E = -(H_1^E - H_1^{E'})$, i.e. platform 1 pays the must-have component provider its entire gain from having exclusive access. Thus with equal-sized platforms, the must-have component can capture all the rents, and the winning platform gets a net payoff of zero. The smaller Δ_1, the more closely platform competition resembles Bertrand competition, allowing the must-have component provider to play one platform against the other.

The level of technological compatibility has ambiguous effects on the transfer payment. First, a higher level of compatibility expands the overall platform market (as shown by CRT). This increases the must-have component provider's opportunity cost of going exclusive on platform 1. Second, a higher level of compatibility also weakens platform 1's initial market advantage (also shown by CRT). But third, a higher degree of compatibility weakens the must-have component price and quantity effects (Proposition 5), thus negatively affecting the must-have component provider's bargaining power. As a result, the net impact of a change in the level of compatibility on the transfer payment is ambiguous, unless we can specify in advance the relative strengths of these three effects.

Proposition 9 *A higher level of compatibility reduces the bargaining power of both the platform and the must-have component provider. Therefore, the net effect of changing compatibility on the transfer payment is uncertain.*

Proof: See Appendix.

For example, in a mature platform market where both platforms have accumulated substantial subscriber bases, the basic component expansion effect and the platform differentiation effect associated with a higher level of compatibility would be limited. Thus, in a mature market we expect that a higher level of compatibility would reduce the must-have component provider's bargaining power relative to the platforms. In a growing market, the basic component effect and platform differentiation effect would probably be strong. We expect that in a growing market, an increase in compatibility would increase the must-have component's bargaining power. Therefore, the must-have component provider would prefer low compatibility in a mature market and high compatibility in a growing market.

3.2 Simultaneous Bargaining with Non-exclusive Access

The above bargaining analysis assumes that the must-have component provider is committed to signing an exclusive access contract with only one of the platforms. While we observe this type of contractual arrangement in certain industries, such as the video game industry, non-exclusive access contracts are also prevalent in indirect network markets. There are many ways to model non-exclusive bargaining; here we focus on a process where the must-have component provider negotiates non-exclusive contracts with the platforms while carrying the threat of going exclusive.[5]

As in the exclusive access case, we assume that the must-have component provider bargains with the platforms simultaneously. If the must-have component fails to reach an agreement with either platform, the bargaining stops and the must-have provider initiates an exclusive negotiation. As shown in the previous section, the exclusive contract with platform 1 is the must-have component provider's best alternative, so its payoffs become the outside options in this scenario.

From platform i's perspective, the payoff to a non-exclusive bargain is the

[5] We experimented with (i) simultaneous bargaining with no exit options and (ii) sequential bargaining, but these do not give the must-have component as strong a threat as the process we describe here. In these alternative structures, the weak bargaining position of the must-have component guarantees that it is never advantageous to offer a non-exclusive contract.

profit increase and the transfer payment: $H_i^{NE} + T_i^{NE}$ (where NE denotes "non-exclusive"). Platform 1's outside opportunity is the payoff function under the exclusive scenario, $H_1^E + T_1^E$. For platform 2 the outside opportunity is the loss associated with no access to the must-have component, $H_2^{E'}$.

If the non-exclusive negotiation is successful, the must-have component provider's payoff function is $\Pi_\mu^{NE} = \pi_\mu^{NE} - T_1^{NE} - T_2^{NE}$. If it fails, the must-have component provider's outside opportunity is $\Pi_\mu^{1E} = \pi_\mu^{1E} - T_1^E$.

The solution to this bargaining problem is worked out in the appendix. The transfer payments are:

$$\begin{aligned} T_1^{NE} &= \frac{1}{3}\Big[\Big(\pi_\mu^{NE} + \frac{1}{2}\pi_\mu^{1E} - \frac{3}{2}\pi_\mu^{2E}\Big) - \Big(-\frac{1}{2}H_1^E + 2H_1^{NE} - \frac{3}{2}H_1^{E'}\Big) - \\ &\qquad \Big(\frac{3}{2}H_2^E - H_2^{NE} - \frac{1}{2}H_2^{E'}\Big)\Big] \\ T_2^{NE} &= \frac{1}{3}\Big[\Big(\pi_\mu^{NE} - \pi_\mu^{1E}\Big) - \Big(H_1^E - H_1^{NE}\Big) - \Big(2H_2^{NE} - 2H_2^{E'}\Big)\Big] \end{aligned}$$

It follows that the must-have component provider's net profit is

$$\begin{aligned} \Pi_\mu^{NE} &= \frac{1}{2}\Big[\Big(\frac{2}{3}\pi_\mu^{NE} + \frac{1}{3}\pi_\mu^{1E} + \pi_\mu^{2E}\Big) + \Big(\frac{1}{3}H_1^E + \frac{2}{3}H_1^{NE} - H_1^{E'}\Big) + \\ &\qquad \Big(H_2^E + \frac{2}{3}H_2^{NE} - \frac{5}{3}H_2^{E'}\Big)\Big] \end{aligned}$$

In the appendix we show that all of the comparative static results from the exclusive case carry over to the non-exclusive case. Namely, $T_1^{NE} + T_2^{NE}$ decreases in μ, increases in Δ_1 (for constant β), and changes ambiguously in θ.

4 Choosing Exclusive Versus Non-Exclusive Contracts

By comparing the results under the two bargaining scenarios, we can evaluate the must-have component provider's incentives to go exclusive or non-exclusive. The provider's contractual decision will be based on the net payoff difference between the two bargaining scenarios:

$$\Pi_\mu^{NE} - \Pi_\mu^{1E} = \frac{1}{3}\left[(\pi_\mu^{NE} - \pi_\mu^{1E}) + (-H_1^E + H_1^{NE}) + H_2^{NE} - H_2^{E'}\right]$$

If this is positive, then the must-have component provider will sign non-exclusive contracts with both platforms. Otherwise, the must-have component provider will go exclusive on platform 1. The sign of $\Pi_\mu^{NE} - \Pi_\mu^{1E}$ is indeterminate. Therefore, we will use two numerical examples to illustrate how the must-have component provider's contractual decision changes with respect to the variations in its popularity, μ, and platform market share difference, Δ_1. We investigate this question under two compatibility regimes, incompatibility ($\theta = 0$) and perfect compatibility ($\theta = 1$).

We parameterize $s = 0.25$, $c = 0.2$ and $\gamma = 0.5$. With incompatibility ($\theta = 0$), tipping occurs if the platform that is denied access to the must-have component cannot enroll any new subscribers. We limit consideration to values of μ that do not induce tipping, i.e. $\mu \in [0, \bar{\mu}]$ where $\bar{\mu}$ satisfies the condition that $q_2^{E'} = q_2^B - \frac{\mu(1-\theta s)}{[2(1-s)+1-\theta s)][2(1-s)-(1-\theta s)]} = 0$. For our parameter values, $\bar{\mu} = 0.4625 - 0.3125\Delta_1$.

Figure 1 shows the relationship between $\Pi_\mu^{NE} - \Pi_\mu^{1E}$ and μ with incompatibility. Each curve has a unique upper bound on μ so as to avoid market tipping. Given Δ_1, it is more likely for the must-have component provider to go exclusive if μ increases. This is consistent with the hypothesis that high μ enables the must-have component provider to leverage its popularity and to demand a higher transfer payment.

Given μ, the must-have component provider is more likely to go exclusive when Δ_1 is larger. In Figure 1, the $\Pi_\mu^{NE} - \Pi_\mu^{1E}$ curve shifts downward when Δ_1 increases. When Δ_1 is large, the must-have component provider has less bargaining power (Proposition 8). Offering exclusive contracts gives the must-have component

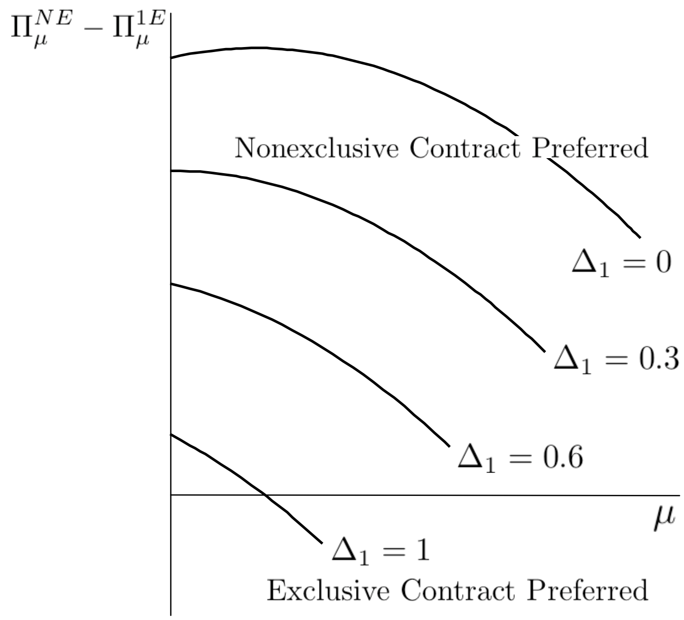

Figure 1: Contracts Under Incompatibility

an additional bargaining chip since it can induce the platforms into differentiated Bertrand competition. Thus, offering exclusive contracts to a high Δ_1 platform is actually a sign of weakness. When Δ_1 goes to zero, the must-have component provider will go non-exclusive for any value of μ. There exists a threshold Δ_1^* such that the must-have component provider never goes exclusive if $\Delta_1 < \Delta_1^*$. In the present case, $\Delta_1^* = 0.78$.

Figure 2 shows the relationship between $\Pi_\mu^{NE} - \Pi_\mu^{1E}$ and μ with perfect compatibility ($\theta = 1$). In this case, tupping occurs at $\overline{\mu} = \frac{21}{20}$ regardless of Δ_1. The curves actually increase up to $\mu = \frac{3}{8}$, and decrease thereafter. As in the incompatibility case, the curve shifts downward as Δ_1 increases. Moreover, the must-have component provider always goes non-exclusive under this set of parameters.

Comparing the $\Pi_\mu^{NE} - \Pi_\mu^{1E}$ functions under the two compatibility regimes re-

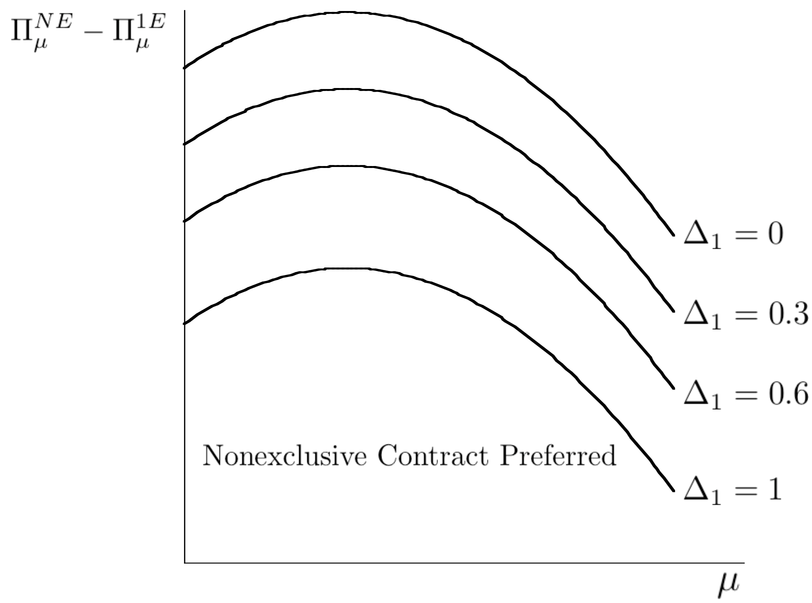

Figure 2: Contracts Under Perfect Compatibility

veals how the must-have component provider's contractual decision changes with respect to θ. The must-have component provider goes non-exclusive if compatibility is perfect. This theoretical result carries an interesting policy implication. In many cases, government antitrust and regulatory authorities mandate open engineering standards, adaptors and documentation to level the *technological* playing field.[6] Our model shows that there is an additional impact on the *contractual* arrangement between the platforms and the must-have component provider. The likelihood that the must-have component provider signs an exclusive contract will decrease, even though the government policy may just expand compatibility among basic components. In other words, a mandated perfect-compatibility regime may achieve the same purpose of regulating the must-have component provider's contractual choice.

[6]This was the focus of the antitrust case against Microsoft in the USA.

5 Case Studies

In this section we consider three mini case studies that illustrate the model. We describe the US pay-TV market, the Japanese video game market, and the Chinese text message market. For each case, we first examine whether the contractual arrangements between the platform(s) and the must-have component provider confirm the model predictions. We then use the results of the bargaining model to interpret some industry events.

5.1 The US Pay-TV Market

Pay television programming (i.e. cable and satellite TV) reaches more than 80 million households in the USA. The pay-TV industry consists of two types of businesses, pay-TV operators and content providers. Pay-TV operators compete by purchasing the rights to programs from content providers and then selling subscriptions to viewers. Currently, pay-TV operators deliver programs through either cable or satellite service.

The relationship between pay-TV operators and programming channels matches the platform-component model. Content providers offer highly differentiated programming channels whose popularities differ widely. Each pay-TV operator typically carries more than 50 channels in its basic service package. Among these channels, many have very small viewership and thus have practically no bargaining power in negotiating fee arrangements with the pay-TV operators. They can be considered basic components. Moreover, new programming channels compete ferociously for the top pay-TV operator's endorsement. For example, the programming investments department at Comcast scans about 200 pitches from programming entrepreneurs each year.[7] This fact is consistent with the basic component model where a bigger platform has access to more basic components.

But certain content networks do receive high transfer payments from pay-TV operators. Disney's ESPN, in particular, enjoys tremendous bargaining power vis-à-vis pay-TV operators. ESPN alone accounts for more than 15% of Disney's bottom line and is valued by analysts between $15 billion and $20 billion.[8] As of 2003, it received an average fee of $1.76 per subscriber per month from pay-TV operators, 50% higher than its nearest rival.[9]

This two-tiered market suggests that ESPN (and some of the other very popular cable channels) are must-have components. Any pay-TV operator without ESPN will lose out in competition with other cable or satellite TV-operators. In fact, the recent squabble between the pay-TV operators and Disney confirms ESPN's the must-have component status. Relations between pay-TV operators and Disney have been strained for years because of fights over how much Disney charges to carry ESPN. The usually private grumbling became public in the fall of 2003, when Cox publicly protested ESPN's costs of access.[10] Indeed, ESPN has had strong growth in the per-subscriber fee it gets from pay-TV operators – about a 16% compound annual growth rate since 1997.[11]

ESPN has long been offering non-exclusive access contracts to pay-TV operators.

[7] George Anders, "Want to Start a TV Channel? See Amy Banse," *Wall Street Journal*, Jan. 19, 2004.

[8] Emily Nelson and Joe Flint, "Comcast's Big Play for Micky," *Wall Street Journal*, February 12, 2004.

[9] *Kagan World Media*, 2003.

[10] Peter Grant, "Cox to Blame Cable Sports for Rate Surge," *Wall Street Journal*, Oct. 6, 2003.

[11] Chris Isidore, "ESPN Break Could Hurt Disney's Appeal," *CNN Money*, Feb. 23, 2004.

The model implies that given its popularity, ESPN is more likely to offer non-exclusive contracts if (1) the market share difference among pay-TV operators is small and (2) pay-TV operators are highly compatible. Both conditions are evident in the US pay-TV market.

There are about 80 million cable subscribers in the USA. Philadelphia-based Comcast is the largest cable operator in the USA, with over 22 million subscribers at the end of 2003. All cable companies are facing increasing competition from satellite TV. Newscorp's satellite distribution network DirectTV and Echostar's Dish Network Satellite TV have been competing nationally against every cable company in the country. Each had approximately 10 million subscribers at the end of 2003.[12] Thus, of the 100 million pay-TV subscribers, cable has an 80% market share and satellite a 20% share. Roughly speaking, this is consistent with $\Delta_1 = 0.8 - 0.2 = 0.6$.

The marginal cost for content providers to broadcast the same programs on mulitple pay-TV operators is negligibly small. Therefore, the pay-TV operators are highly compatibile with each other (high θ). Based on the results illustrated in Figure 2, ESPN's offering of non-exclusive contracts is predicted by the model.

Since the late 1990s, the US media industry has witnessed a spate of conglomerate and horizontal mergers. The most dramatic deals involve Time merging with Warner, buying Turner Broadcasting, and then selling itself to America Online. Also noteworthy are Disney buying ABC, Viacom buying CBS, and Vivendi buying Universal. Top pay-TV operators are inclined to go upstream and acquire premium content networks. Under Rupert Murdoch's leadership, News Corp has become the most comprehensive pay-TV player, integrating satellite TV distribution DirecTV

[12] "Cable Vision," *Wall Street Journal*, Feb. 12, 2004.

with the second most popular programming network Fox. Time Warner also unites cable with television programming and film studios. It has interests in TNT as well as movie providers New Line Cinema and Warner Brothers Entertainment.

On February 11, 2004, Comcast made an unsolicited, hostile takeover bid for Disney. The deal was valued on February 12, 2004 at $47.97 billion plus the assumption of $11.9 billion in Disney debt.[13] A combined Comcast-Disney would have a market value of $125 billion and employ 179,000 people.[14] The must-have component model provides context to understand Comcast's move.

Since their debuts, DirecTV and Dish Network Satellite TV have been experiencing explosive expansion. After enjoying consecutive quarters of double-digit growth rates, both operators had a combined subscriber base in excess of 20 million in 2003. This increasingly competitive situation implies that ESPN is able to extract better deals from Comcast. The reason is that the smaller is Δ_1, the easier it is for the must-have component provider to induce the platforms to enter Bertrand competition. Hence, one motivation to propose a merger is to stop ESPN from playing Comcast off against the satellite-TV operators in search of higher fees.

5.2 The Japanese Video Game Market

The structure of the video game industry nicely fits the platform-component model, where consoles are platforms and games are components. A large user base is crucial for a console provider to get support from game developers. The abundance of game titles and auxiliary products in turn leads to greater consumer utility and higher console demand. Economic analysis of the video game industry has traditionally seen

[13] Joe Flint, "Why Comcast Covets ESPN," *Wall Street Journal*, February 13, 2004.

[14] Nelson and Flint, *ibid.*

games as being competitively supplied by game developers (Shankar and Bayus, 2002). Here we argue that certain games exert must-have component effects on console competition.

In the early 1980's Nintendo, a small Japanese playing card manufacturer, popularized video games and brought millions of game consoles to households in Japan. Nintendo first released its Family Computer (hereafter FC[15]) in 1984 with the backing of such in-house games as Donkey Kong and Mario Brothers. The unprecedented success of the FC quickly transformed Nintendo into one of the most successful companies in the history of Japan.[16]

During the 1980s, attempts by Sega and NEC to challenge Nintendo's dominance failed. In 1993 and 1994, Sega, Panasonic and Sony released new 32-bit game consoles named Saturn, 3DO and Playstation (hereafter PS) respectively. Having released its own system only 3 years earlier, Nintendo chose to delay the release of its new game console, the 64-bit Nintendo 64 (hereafter N64), to 1996. However, consumers grew impatient and started to purchase alternative consoles. Despite its aggressive pre-sale advertising campaign, Nintendo lost its decade-long market leadership in the Japanese video game industry. The N64 was a distant second to the PS, never capturing more than 30% of the Japanese market.[17]

Console providers usually sell consoles as a loss leader in order to build up a

[15]The US version of FC was called Nintendo Entertainment System (NES).

[16]David Sheff, *Game Over: How Nintendo Zapped an American Industry, Captured Your Dollars, and Enslaved Your Children* (New York, 1993), p. 34.

[17]The most recent console war started in 1999, with Sega's 128-bit Dreamcast, and now includes Sony's Playstation 2 (PS2), Microsoft's Xbox, and Nintendo's Gamecube. Neither Dreamcast nor Xbox are strong contenders in the Japanese market, and the PS2 has been outselling the second-place Gamecube at a 3:1 ratio.

sufficiently large customer base. Once a consumer acquires a console, he is captive to that platform and can be induced to buy more games. Game licensing fees are the primary source of revenue for console producers. An independent game developer pays a royalty fee to a console provider for every unit of a game title sold.

In the Japanese video game market, Squaresoft's Final Fantasy series enjoys enormous popularity. Squaresoft started as a small game developer for Nintendo's FC in 1987. Over the next 17 years, Squaresoft's distinct style of Role Playing Games (in which players traverse virtual worlds, learn fighting skills, and complete a quest) revolutionized the nature of video games. They incorporate comprehensive story lines into game play and became extraordinarily popular among Japanese gamers. As a result, Squaresoft has sold 18 platinum games (games that sell more than 1 million copies), half again as many as second-place Enix.[18] Today, Squaresoft is a multi-national entertainment corporation, standing on a par with the US game giant Electronic Arts.

Squaresoft's most popular series of games, known as Final Fantasy, has sold 23 million copies in Japan. Final Fantasy games have consistently outsold other platinum games; for example the average sales volume of platinum games on the PS was 1.49 million copies, while the PS Final Fantasy games VII, VIII, and IX) sold 3.28 million, 3.62 million and 2.86 million copies respectively.[19]

More important than the sales figures is Final Fantasy's unique association with the winning consoles in Japan. Nintendo's FC and SFC and Sony's PS and PS2 all enjoyed exclusive access to the Final Fantasy series. It is widely reckoned by industry insiders that Squaresoft's defection from Nintendo was vital to the success

[18]Square and Enix merged in 2003, strengthening their lead in the Japanese video game market.

[19]www.the-magicbox.com.

of the PS. Figure 3 visualizes the "Final Fantasy effect" on PS sales. It shows that the growth rate of the PS sales climaxed following the release of Final Fantasy VII in January 1997.

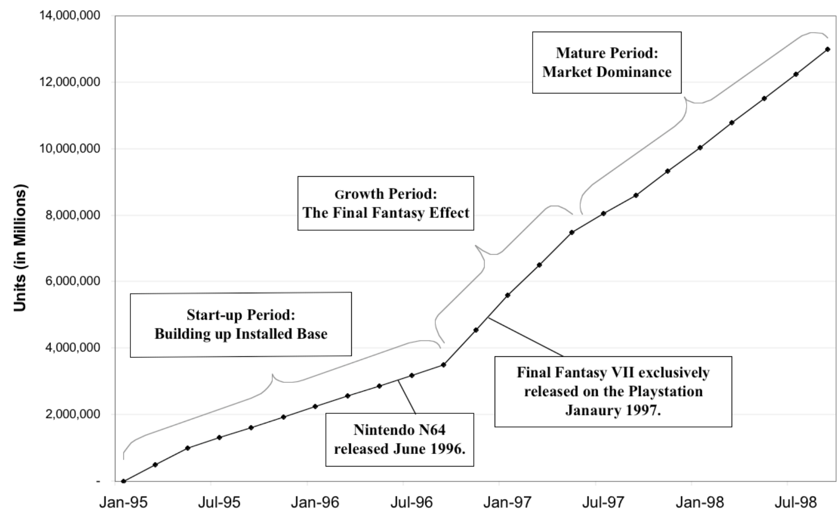

Figure 3: Cumulative Playstation Sales in Japan

Source: www.absolute-playstation.com/api_faqs/faq20.htm

Indeed, 1997 should have been an extremely difficult year for Sony as Nintendo released the N64 in June 1996. Several N64 blockbuster games were released between December 1996 and March 1997 in order to challenge the PS's increasing popularity. However, Final Fantasy VII sold nearly 3 million copies in January alone. One of every two PS owners purchased Final Fantasy VII at that time.

Squaresoft has always offered exclusive access contracts to the game consoles. This means that each Squaresoft game is available on only one console in each generation. In the early 1990's, while other game developers flocked to Sega, Squaresoft remained exclusive to Nintendo. Since the late 1990's, Squaresoft has become exclusive to Sony. Given the market and technological realities in the video game industry, Squaresoft's decision to adopt exclusive contracts is consistent with the theoretical model. First, the video game market has been characterized by large market share differences, i.e., large Δ_1. Historically, the console market quickly tipped into one console in the early stage of competition. Second, the game consoles are all incompatible with each other (low θ). Console incompatibility is reflected in three aspects: storage, software, and game controllers. In storage, console providers always choose to use different means of storage. For example, in the 64-bit era, Sony chose CD-ROM, but Nintendo used cartridges. In software, consoles adopt different development platforms for game developers, so converting a game from one console to another requires game developers to re-code it. The different game controllers of the different systems also make it more difficult to port games from one platform to another. As we have seen, high market share differences and low compatibility is consistent with a must-have component provider's decision to offer exclusive access.

Squaresoft's defection from Nintendo to Sony in 1996 was widely considered a key factor in the ultimate success of the PS. Having helped Nintendo dominate the Japanese video game market for more than a decade, Squaresoft announced that it would forge an exclusive alliance with Sony in February 1996. The split between Nintendo and Squaresoft was so bitter that Nintendo President Yamauchi said he would refuse to work with Squaresoft forever.[20] According to the official announcement, Squaresoft's decision to switch to Sony was largely due to aesthetic considerations. In a 1997 interview, Hironobu Sakaguchi, Squaresoft's top game designer, explained that Sony's CD-ROM format allowed for more artistic freedom. With the seemingly unlimited storage of CD-ROM, Sakaguchi was able to increase

[20] Steven L. Kent, *The Ultimate History of Video Games* (California: 2001), p.542.

the artistic qualities of his games.[21]

While recognizing Squaresoft's aesthetic concern, we also see a bargaining explanation related to this storage issue. In the 32-bit era, there were two game console storage media: Sony's PS, Sega's Saturn and Panasonic's 3DO all took advantage of the latest technology and adopted CD-ROM as the medium of storage. Nintendo, on the other hand, stuck to the traditional cartridge as the medium of storage. Due to limited storage space on the cartridge,[22] full motion video and some special sound effects could not be produced on the N64. Developing N64 games also required game designers to use certain storage optimization techniques not applicable to other CD-ROM-based consoles. Hence, it was almost technically impossible for game developers to convert games between CD-ROM-based consoles and Nintendo's N64. This storage space issue, if interpreted in the theoretical framework, implies that the video game industry would face a low-compatibility regime if the cartridge format survived. Otherwise, higher compatibility, albeit imperfect, would exist in video game industry.

The model showed that the must-have component provider makes a higher transfer payment when compatibility is lower. That is to say, Squaresoft would end up paying more royalty fees if it adopted the cartridge over the CD-ROM format. Thus, it was logical for Squaresoft to abandon Nintendo and join the high-compatibility regime. This bargaining explanation seems to be confirmed by industry news. Although there is no way to know the exact royalty fee arrangements between consoles and game developers, some industry sources revealed that Nintendo charged about $10 to $20-per-unit royalties on the sale of third-party games. This was compared

[21] Ibid., p.542.

[22] A CD-ROM can store 650MB of data, whereas a cartridge's maximum capacity is 256MB.

with \$5 to \$10-per-unit royalties for the PS.[23]

5.3 Short Message Service in China

Short message service (hereafter SMS) refers to the transmission of text messages and other value-added services to and from mobile phones. The content of the text messages is varied, ranging from commercial advertisements to sports game results. The value-added services include downloadable ring tones, computer wallpaper, interactive online games, and pop songs. Wireless phone carriers and SMS content providers have a platform-component relationship. The explosive growth of SMS usage has made SMS a must-have component for domestic cell phone carriers.

SMS gains its popularity in China primarily because it is a lot cheaper relative to voice calls. Each message costs RMB0.10 (approximately US\$0.012), whereas a voice call costs RMB0.4 (approximately US\$0.05) per minute.[24] Internet portals Netease, Sina, and Sohu constitute the main content providers of SMS. Launched as web search engines in China in the late 1990s, Netease, Sina and Sohu are widely recognized as China's premier online brands. Their SMSs offer a variety of content through their phone-to-phone, phone-to-web, and web-to-phone interfaces. They regularly conduct internal development and external acquisition of value-added services. News updates, self-tailored wallpapers and new ring tones are extraordinarily popular among Chinese cell phone subscribers. Recently released services include colored text messages and short message dating services.

A cell phone subscriber simply needs to register her cell phone number with the Internet portals and will be granted access to all the transferable content. The

[23]These estimates are mentioned on gaming websites IGN.com and the-magicbox.com.

[24]Ibid.

content is usually available both in the Internet portals' web-pages and through a specified phone number. Netease, Sina, and Sohu are heavily reliant on revenues from SMS provision: an average of 56% of revenue was from SMS-related services for these three firms in 2003.[25] The stock prices of these Internet portals have appreciated tremendously since early 2002. Between January 2002 and July 2003, Sohu, Sina, and Netease's stock prices rose 33.67 times, 20.48 times and 49.78 times respectively. Over the same period, the Nasdaq Composite Index declined by 12%.

All the Internet portals sign non-exclusive access contracts with China's leading mobile phone companies, China Mobile and China Unicom. China Mobile and China Unicom have access to customer billing information and receive SMS usage fees directly from cell phone subscribers, so Netease, Sina and Sohu rely on them for fee collection. In return for the billing service, China Mobile and China Unicom receive 15% of total SMS revenues.[26]

Given the industrial structure and the degree of compatibility in the Chinese cell phone market, the non-exclusive contractual arrangement is consistent with the must-have component model. First, China Mobile captures two-thirds of the Chinese cell phone market, while China Unicom takes the remaining one-third.[27] This market share difference was there even before the introduction of SMS. Thus, it amounts to a Δ_1 of $1/3$ between the two wireless platforms. Second, China Mobile and China Unicom are perfectly compatible in terms of voice calls ($\theta = 1$). The perfect-compatibility case from Section 3 predicts that, given high θ and relatively low Δ_1, the SMS providers will be more likely to offer non-exclusive access contracts.

[25] Bambi Francisco, "China Nets Have Priced in a Strong Q3," *CBS Market Watch*, Oct. 7, 2003

[26] The firms' annual reports give this information.

[27] Doug Young, "China Mobile Takes Unicom Market Share in Feb," *Reuters*, March 29, 2004.

The model suggests that a change in the popularity of the must-have component (μ) has an impact on the transfer payment. However, it is difficult to observe and measure a change in μ in reality. The SMS market in China provides a testing ground for this hypothesis since we can observe a drop in μ after the Chinese government implemented content restrictions on Internet portals.

In August 2003, the Chinese government banned Internet users from paying for certain services, mostly related to pornography, on their cell phones.[28] This policy effectively reduced the popularity of the SMS, which was equivalent to a drop in μ. According to the model, a decline in μ will increase the must-have component provider's transfer payments to the platforms in the non-exclusive access case.

Developments in the SMS industry following the content restriction policy confirm the above predictions. First, the cell phone carriers were believed to raise the transfer payment, albeit in an indirect way. According to Paul Waide of Pacific Epoch, a research boutique focusing on China business, signs emerged in September 2003 that the wireless carriers were holding back SMS fees owed to the portals. It was reported that China Mobile owed the leading portals nearly US$18.7 million.[29] This was equivalent to a reduction of cash inflow in the Internet portals.

Second, since the Internet portals' contracts with China Mobile and China Unicom would expire at various times from November 2003 to May 2004, Wall Street grew concerned about the new contractual arrangement. Ethan McAfee, an Internet analyst with hedge fund firm Capital Crossover Partners, warned in October 2003 that the cell phone carriers would have the power to ask for more favorable terms

[28] Bambi Francisco, "Is Netease Worth $2 Billion?" *CBS Market Watch*, October 29, 2003.

[29] Bambi Francisco, "China Portals Face Challenging Month," *CBS Market Watch*, Oct. 1, 2003.

during contractual re-negotiation.[30]

These concerns were immediately reflected in the three Internet portals' share prices. From August to December 2003, these stocks' rising momentum came to a full stop. Figure 5.3 shows that while the Nasdaq Composite Index rose by 13.96%, Sohu and Netease declined by 19.56% and 3.52% respectively. Only Sina beat Nasdaq by a modest 4.73%. Both industry news and the stock price movements tend to confirm the theoretical prediction.

6 Conclusion

This paper has combined strategic platforms, "must-have" component providers, and bargaining in the platform-component paradigm. The major theoretical findings can be summarized into three areas of inquiry.

In the area of platform competition, the model predicts: (i) In the exclusive access case, the platform that has access to the must-have component experiences higher sales, price and profitability, whereas the platform that is denied access suffers from lower sales, price and profitability. (ii) In the non-exclusive access case, both platforms enjoy higher sales, prices and profitability as a result of a new must-have component.

Regardless of the access mode, the predictions for the transfer payment are: (iii) If the must-have component provider gains in popularity, then it will make a smaller transfer payment to the platform(s). (iv) For any given platform market, the larger the initial market share difference, the higher the transfer payment from the must-have component provider to the platform(s). (v) The level of compatibility has an

[30] Paul R. La Monica, "The China Bubble," *CNN Money*, October 23, 2003.

ambiguous effect on the transfer payment. We conjecture that in a growing platform market, a higher level of compatibility is associated with a lower transfer payment, while in a mature platform market it is associated with a higher transfer payment.

As for exclusivity, (vi) A must-have component provider is more likely to sign an exclusive contract if the level of compatibility is low and the initial market share difference between the platforms is high.

Given the fact that these theoretical results concern inter-party transfer payments and contractual arrangements, it is difficult to test the hypotheses by using a statistical method. But we showed that the model can shed light on three very different mini case studies. As a summary, the following table shows that the contracts between the must-have component provider and the platform(s) in three different markets are arranged in the same way as predicted by the theory.

Market	Must-Have	Market Conditions	Predicted	Actual
Pay-TV (USA)	ESPN	Low Δ_1 and High θ	non-exclusive	non-exclusive
Video Games (Japan)	Final Fantasy	High Δ_1 and Low θ	exclusive	exclusive
Cell Phone (China)	SMS	Low Δ_1 and High θ	non-exclusive	non-exclusive

This model suggests a key policy implication in indirect network industries – a mandated increase in technological compatibility can induce the must-have component provider to sign non-exclusive contracts with platforms. It has been common knowledge, as CRT's model implies, that an increase in platform compatibility is often favorable for consumer welfare because it expands the number of components available. Consumers who purchase the smaller platform will not lose severely if compatibility is high. According to this traditional policy perspective, a regulatory mandate on technological compatibility has a direct, market-oriented impact.

The must-have component model adds a new result: *technological* compatibility causes a *contractual* impact as well. The must-have component is more likely to sign non-exclusive contracts under the perfect-compatibility regime than under the zero-compatibility regime. This means that policies requiring greater technological compatibility between platforms will encourage a contractual change towards non-exclusivity between the platforms and the must-have component provider. In other words, while the government may implement high-compatibility policies with the intent opening technological standards, its effect can spill over to the contractual arena. Therefore, the must-have component model shows a "hidden" policy tool in addition to standard disclosure requirements.

There are several directions for future research on must-have component bargaining relations. One extension is a simultaneous bargaining framework that deals with multiple must-have components. Our model is arguably capable of dealing with multiple must-have components in a sequential game where must-have components join the platforms one by one.[31] But we expect that it is more typical for must-have component providers to engage in a simultaneous jockeying for position on multiple platforms. Empirical testing could consist of further case studies, and more of these will continue to appear as new technologies arise. Ideally, it would be possible to obtain enough data on enough separate cases to perform an econometric analysis.

[31] Each component will translate previous decisions into different values of β_1 and β_2. The bargaining process between the individual must-have component provider and the platforms is thus the same as the single must-have component case.

Appendix

Platform Operating Profits in Alternative Cases

If the must-have component exclusively supports platform 2, then we have

$$q_1^{E'} = q_1^B + m^{E'}(\theta,\mu) \qquad q_2^E = q_2^B + m^E(\theta,\mu)$$

$$p_1^{E'} = p_1^B + g^{E'}(\theta,\mu) \qquad p_2^E = p_2^B + g^E(\theta,\mu)$$

Platform 1's operating profit is $\pi_1^{E'} = \pi_1^B + H_1^{E'}$, where

$$H_1^{E'} = g^{E'}(\theta,\mu)\cdot q_1^B + \left[p_1^B - c\right]\cdot m^{E'}(\theta,\mu) + g^{E'}(\theta,\mu)\cdot m^{E'}(\theta,\mu)$$

Platform 2's operating profit is $\pi_2^E = \pi_2^B + H_2^E$, where

$$H_2^E = g^E(\theta,\mu)\cdot q_2^B + \left[p_2^B - c\right]\cdot m^E(\theta,\mu) + g^E(\theta,\mu)\cdot m^E(\theta,\mu)$$

Similar to the case where the must-have component is exclusive on platform 1, we can show that $\frac{\partial H_1^{E'}}{\partial \mu} < 0$, $\frac{\partial H_2^E}{\partial \mu} > 0$ and $\left|\frac{\partial H_1^{E'}}{\partial \mu}\right| < \left|\frac{\partial H_2^E}{\partial \mu}\right|$.

If the must-have component is non-exclusively on both platforms, then we have

$$q_1^{NE} = q_1^B + m^E(\theta,\mu) + m^{E'}(\theta,\mu) \qquad q_2^{NE} = q_2^B + m^E(\theta,\mu) + m^{E'}(\theta,\mu)$$

$$p_1^{NE} = p_1^B + g^E(\theta,\mu) + g^{E'}(\theta,\mu) \qquad p_2^{NE} = p_2^B + g^E(\theta,\mu) + g^{E'}(\theta,\mu)$$

Platform 1 and 2 will enjoy profit increases simultaneously. Platform 1's profit is $\pi_1^{NE} = \pi_1^B + H_1^{NE}$, where

$$\begin{aligned} H_1^{NE} &= \left[g^E(\theta,\mu) + g^{E'}(\theta,\mu)\right] q_1^B + \left[p_1^B - c\right]\left[m^E(\theta,\mu) + m^{E'}(\theta,\mu)\right] + \\ &\quad \left[g^E(\theta,\mu) + g^{E'}(\theta,\mu)\right]\left[m^E(\theta,\mu) + m^{E'}(\theta,\mu)\right] \end{aligned}$$

Platform 2's profit is $\pi_2^{NE} = \pi_2^B + H_2^{NE}$, where

$$\begin{aligned} H_2^{NE} &= \left[g^E(\theta,\mu) + g^{E'}(\theta,\mu)\right] q_2^B + \left[p_2^B - c\right]\left[m^E(\theta,\mu) + m^{E'}(\theta,\mu)\right] + \\ &\quad \left[g^E(\theta,\mu) + g^{E'}(\theta,\mu)\right]\left[m^E(\theta,\mu) + m^{E'}(\theta,\mu)\right] \end{aligned}$$

Proof of Proposition 8

$$\begin{aligned}
\left.\frac{\partial T_1^E}{\partial \Delta_1}\right|_\beta &= \frac{1}{2}\left[\gamma\frac{\partial(\beta_1-\beta_2)}{\partial\Delta_1}+\gamma\frac{\partial(q_1^B-q_2^B)}{\partial\Delta_1}-\frac{\partial(H_1^E-H_1^{E'})}{\partial\Delta_1}-\frac{\partial(H_2^E-H_2^{E'})}{\partial\Delta_1}\right]\\
&= \frac{1}{2}\left[\gamma+\gamma\left(\left.\frac{\partial q_1^B}{\partial\Delta_1}\right|_\beta-\left.\frac{\partial q_2^B}{\partial\Delta_1}\right|_\beta\right)\right.\\
&\quad -\left[g^E(\theta,\mu)-g^{E'}(\theta,\mu)\right]\cdot\left(\left.\frac{\partial q_1^B}{\partial\Delta_1}\right|_\beta+\left.\frac{\partial q_2^B}{\partial\Delta_1}\right|_\beta\right)\\
&\quad \left.-\left[m^E(\theta,\mu)-m^{E'}(\theta,\mu)\right]\cdot\left(\left.\frac{\partial p_1^B}{\partial\Delta_1}\right|_\beta+\left.\frac{\partial p_2^B}{\partial\Delta_1}\right|_\beta\right)\right]
\end{aligned}$$

Since $\left.\frac{\partial q_1^B}{\partial\Delta_1}\right|_\beta=-\left.\frac{\partial q_2^B}{\partial\Delta_1}\right|_\beta$ and $\left.\frac{\partial p_1^B}{\partial\Delta_1}\right|_\beta+\left.\frac{\partial p_2^B}{\partial\Delta_1}\right|_\beta=0$, the final two terms are zero. And since $\left.\frac{\partial q_1^B}{\partial\Delta_1}\right|_\beta-\left.\frac{\partial q_2^B}{\partial\Delta_1}\right|_\beta>0$, the first two terms must be positive.

Proof of Proposition 9

$$\begin{aligned}
\frac{\partial T_1^E}{\partial\theta} &= \frac{1}{2}\left[\gamma\frac{\partial(q_1^B-q_2^B)}{\partial\theta}-\frac{\partial(H_1^E-H_1^{E'})}{\partial\theta}-\frac{\partial(H_2^E-H_2^{E'})}{\partial\theta}\right]\\
&= \frac{1}{2}\left[\gamma\frac{\partial(q_1^B-q_2^B)}{\partial\theta}\right.\\
&\quad -(g^E(\theta,\mu)-g^{E'}(\theta,\mu))\left(\frac{\partial q_1^B}{\partial\theta}+\frac{\partial q_2^B}{\partial\theta}\right)\\
&\quad -(m^E(\theta,\mu)-m^{E'}(\theta,\mu))\left(\frac{\partial p_1^B}{\partial\theta}+\frac{\partial p_2^B}{\partial\theta}\right)\\
&\quad -\frac{\partial g^E(\theta,\mu)}{\partial\theta}(q_1^B+q_2^B+2m^E)+\frac{\partial g^{E'}(\theta,\mu)}{\partial\theta}(q_1^B+q_2^B+2m^{E'})\\
&\quad -\frac{\partial m^E(\theta,\mu)}{\partial\theta}(p_1^B+p_2^B-2c+2g^E(\theta,\mu))\\
&\quad \left.+\frac{\partial m^{E'}(\theta,\mu)}{\partial\theta}(p_1^B+p_2^B-2c+2g^{E'}(\theta,\mu))\right]
\end{aligned}$$

We need to decompose the terms in $\frac{\partial T_1^E}{\partial\theta}$ to delineate the three effects θ has on the platform-component contractual arrangement. The first term is negative and captures the fact that a higher θ reduces the initial market share difference between the two platforms, thus reducing platform1's bargaining power. The second and third terms are negative and capture the fact that a higher θ expands the overall platform market and increases the must-have component provider's opportunity cost of going exclusive. The last four terms are positive and show the inverse relationship between the level of compatibility and the must-have component quantity and price effects. A higher θ reduces the must-have component provider's bargaining power. Thus, the first two effects are negative, but the last is positive.

Solving for Simultaneous Bargaining with Non-exclusive Access

T_1^{NE} is the solution to $(H_1^{NE} + T_1^{NE}) - (H_1^E + T_1^E) = \Pi_\mu^{NE} - \Pi_\mu^{1E}$, which leads to $2T_1^{NE} + T_2^{NE} = (\pi_\mu^{NE} - \pi_\mu^{1E}) - (H_1^{NE} - H_1^E) + 2T_1^E$ subject to the bargaining constraint of $(H_1^{NE} + T_1^{NE}) - (H_1^E + T_1^E) \geq 0$.

T_2^{NE} is the solution to $(H_2^{NE} + T_2^{NE}) - (H_2^{E'}) = \Pi_\mu^{NE} - \Pi_\mu^{2E}$, which leads to $T_1^{NE} + 2T_2^{NE} = (\pi_\mu^{NE} - \pi_\mu^{1E}) - (H_2^{NE} - H_2^{E'}) + T_1^E$ subject to the bargaining constraint of $(H_2^{NE} + T_2^{NE}) - (H_2^{E'}) \geq 0$.

Substituting the values of T_1^E and T_2^E from Section 3 into the above equations and simplifying gives the expressions in the text. It can be verified that both T_1^{NE} and T_2^{NE} pass their respective bargaining constraint tests.

Comparative Statics for non-exclusive Case

The total transfer payments in the non-exclusive access case are

$$\begin{aligned} T_1^{NE} + T_2^{NE} &= \frac{1}{6}\left[\left(4\pi_\mu^{NE} - \pi_\mu^{1E} - 3\pi_\mu^{2E}\right) - \left(H_1^E + 2H_1^{NE} - 3H_1^{E'}\right)\right. \\ &\qquad \left.\left(3H_2^E + 2H_2^{NE} - 5H_2^{E'}\right)\right] \end{aligned}$$

The relationship between the popularity of the must-have component and the total transfer payments is:

$$\begin{aligned} \frac{\partial\left(T_1^{NE} + T_2^{NE}\right)}{\partial\mu} &= \frac{1}{6}\left[\left(4\frac{\partial\pi_\mu^{NE}}{\partial\mu} - \frac{\partial\pi_\mu^{1E}}{\partial\mu} - 3\frac{\partial\pi_\mu^{2E}}{\partial\mu}\right)\right. \\ &\qquad - \left(\frac{\partial H_1^E}{\partial\mu} + 2\frac{\partial H_1^{NE}}{\partial\mu} - 3\frac{\partial H_1^{E'}}{\partial\mu}\right) \end{aligned}$$

$$-\left(3\frac{\partial H_2^E}{\partial \mu}+2\frac{\partial H_2^{NE}}{\partial \mu}-5\frac{\partial H_2^{E'}}{\partial \mu}\right)\Bigg]$$

The first term is equal to $4\frac{\partial m^E(\theta,\mu)}{\partial \mu}+8\frac{\partial m^{E'}(\theta,\mu)}{\partial \mu}$ which is negative. The second term is negative, and so is the third, so the total transfer payments decrease in μ.

The relationship between the initial platform market share and the total transfer payments is:

$$\begin{aligned}
\left.\frac{\partial\left(T_1^{NE}+T_2^{NE}\right)}{\partial \Delta_1}\right|_\beta &= \frac{1}{6}\Bigg[\left(4\left.\frac{\partial \pi_\mu^{1\&2NE}}{\partial \Delta_1}\right|_\beta-\left.\frac{\partial \pi_\mu^{1E}}{\partial \Delta_1}\right|_\beta-3\left.\frac{\partial \pi_\mu^{2E}}{\partial \Delta_1}\right|_\beta\right)\\
&-\left(\left.\frac{\partial H_1^E}{\partial \Delta_1}\right|_\beta+2\left.\frac{\partial H_1^{NE}}{\partial \Delta_1}\right|_\beta-3\left.\frac{\partial H_1^{E'}}{\partial \Delta_1}\right|_\beta\right)\\
&-\left(3\left.\frac{\partial H_2^E}{\partial \Delta_1}\right|_\beta+2\left.\frac{\partial H_2^{NE}}{\partial \Delta_1}\right|_\beta-5\left.\frac{\partial H_2^{E'}}{\partial \Delta_1}\right|_\beta\right)\Bigg]\\
&= \frac{1}{6}\Bigg[\left(3\gamma-3g^E(\theta,\mu)+g^{E'}(\theta,\mu)\right)\left.\frac{\partial\left(q_1^B+q_2^B\right)}{\partial \Delta_1}\right|_\beta\\
&+\left(-3m^E(\theta,\mu)+m^{E'}(\theta,\mu)\right)\left.\frac{\partial\left(p_1^B+p_2^B\right)}{\partial \Delta_1}\right|_\beta\\
&+\left.\frac{\partial q_2^B}{\partial \Delta_1}\right|_\beta\left(-2\gamma-2g^E(\theta,\mu)+2g^{E'}(\theta,\mu)\right)\\
&+\left.\frac{\partial p_2^B}{\partial \Delta_1}\right|_\beta\left(-2m^E(\theta,\mu)+2m^{E'}(\theta,\mu)\right)\Bigg]
\end{aligned}$$

The first two terms equal zero because the partial derivatives are both zero when β is held constant. Each term within the third and fourth terms is negative. Therefore, the total transfer payments increase in Δ_1.

The relationship between the level of compatibility and the total transfer payments is

$$\frac{\partial\left(T_1^{NE}+T_2^{NE}\right)}{\partial \theta} = \frac{1}{6}\Bigg[\left(4\frac{\partial \pi_\mu^{1\&2NE}}{\partial \theta}-\frac{\partial \pi_\mu^{1E}}{\partial \theta}-3\frac{\partial \pi_\mu^{2E}}{\partial \theta}\right)$$

$$-\left(\frac{\partial H_1^E}{\partial \theta}+2\frac{\partial H_1^{NE}}{\partial \theta}-3\frac{\partial H_1^{E'}}{\partial \theta}\right)$$
$$-\left(3\frac{\partial H_2^E}{\partial \theta}+2\frac{\partial H_2^{NE}}{\partial \theta}-5\frac{\partial H_2^{E'}}{\partial \theta}\right)\Bigg]$$

The signs of the second and third terms are both indeterminate, and so is the overall relationship.

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