WHEN "MORE" IS NOT BETTER.
MANAGING COMPLEMENTORS
IN PLATFORM-MEDIATED MARKETS:
INTRA-PLATFORM COMPETITION, EXCLUSIVITY
AND SYSTEM DIFFERENTIATION STRATEGIES
IN THE VIDEOGAME INDUSTRY

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Abstract

This article examines the value-creation capacity of intra-platform competition (IPC) and exclusivity; two main strategies platforms use to incentivize, accumulate and extract rent from complementary content resources – *complementors*. Building on the concept of 'resource functionality' we show that, for enhanced levels of IPC, exclusive complementors have limited functional value and rareness, failing to bring differentiation capacity to the platform's system. Also, in line with the logic of 'capability equivalence', we show that platform's differentiation in terms of the composition of complementors' portfolio has a U-shaped relationship with platform performance. We test these effects in the U.S. home videogame industry.

Key Words: Complementary Resources, Intra-Platform Competition, Platform Markets, Resource Functionality, Multi-sided Markets.

A larger number of relevant industries in today's economy, including pc operating systems, digital PDA, videogames or credit-card systems are organized around platforms that function as interface between different groups of users, allowing for value-creation exchanges to take place (Evans, 2003; Roson, 2005). The recent literature on network economics (e.g., Caillaud & Jullien, 2003; Hagiu, 2005; Rochet & Tirole, 2003, 2006) refers to these industries as *multi-sided markets* since, different sides of the market – like consumers and producers of *complementors* (i.e., complementary content goods), advertisers and similar – are linked through. A platform, therefore, creates 'value network' (Fjeldstad & Haanaes, 2001; Stabell & Fjeldstad, 1998) by selling mediation service to users on the different sides of the market.

This article examines the performance effects of two main strategies that platforms can use to incentivize, accumulate and extract rent from complementors – intra-platform competition (IPC), aimed at maximizing the number of complementors, and exclusivity, aimed at securing in exclusivity complementors with differentiation capacity. We also analyze whether a differentiated system based on a structurally diverse supply of complementors – what we call system differentiation strategy – can benefit the platform beyond the effects of indirect-network externalities. Because of the peculiar dynamics of multi-sided markets, platforms with a wider portfolio of complementors are expected to succeed (e.g., Armstrong, 2006; Clements & Ohashi, 2005; Schilling, 1998, 2002). Moreover, the platform able to secure complementors in exclusivity can gain further advantage over competing platform's systems by denying rivals' access to scarce and valuable resources (Armstrong & Wright, 2007). Yet, a large number of complementors may also impose negative externalities on producers in the form of intensified competition and reduce their incentives for future releases of innovative complementors

(Boudreau, 2008; Venkatraman & Lee, 2004). Hereafter, we argue this might be particularly severe for complementors operating in exclusivity for a single platform since they cannot alleviate the enhanced market competition by selling through other interfaces.

Resource-based theory (RBT) emphasizes heterogeneity of resources and their firm-idiosyncratic value as primary source of competitive advantage (Barney, 1991; Peteraf, 1993; Wernerlfet, 1984). Since complementors are critical and heterogeneous resources for the platform, which also vary in their degree of platform specificity in that they can be exclusive to the platform or not, we integrate the insights from multi-sided literature with RBT and extend this framework to the analysis of platforms' differences in the value of complementors' portfolio and overall system configuration. We build on the concept of 'resource functionality' advanced by Peteraf and Bergen (2003) and argue that exclusive complementors may have *ex-post* limited *functional* rareness and value for a platform with an existing large portfolio of complementors. IPC and exclusivity strategies are based on different capabilities – we suggest – and present conflicting incentives for complementors. Intense intra-platform competition reduces the incentives of producers to invest in innovative high-quality products when exclusivity is demanded, with the result of integrating exclusive complementors of lower quality. Although exclusive, such complementors would lack the value and rareness necessary to differentiate the platform's system. Because of the underlying conflicting resource accumulation (and incentive) processes, multi-sided platforms are called to choose between two valid value-creation strategic approaches: Maximizing the system's size by accumulating the largest number of complementors that surpass a minimum quality standard or maximizing the overall quality of the system by tying in top quality complementors in exclusivity in exchange for limited IPC. We accordingly hypothesize

– and find empirical support for – a negative effect of the IPC-exclusivity interaction on the system's overall quality and platform's performance.

In line with the logic of 'capability equivalence' in Peteraf and Bergen (2003), we also find that system differentiation strategy has a U-shaped relationship with platform performance. Slight levels of differentiation in terms of the composition of complementors' portfolio may position the platform ambiguously in the competitive arena and fail to provide distinctive character and value to the system; whereas large degrees of differentiation benefit the platform. Peteraf and Bergen (2003:1032) hold indeed that rival firms with comparable resource bundles "in terms of their ability to satisfy similar customer needs" have equal or functionally similar capability; accordingly, the differentiation capacity, hence rareness and value, they can derive from their resources is limited. This is also consistent with the economics and management literature on differentiation, which shows that only for large degrees of dissimilarity of a firm's offer, competitive pressure is reduced and performance boosted (e.g., Hotelling, 1929; D'Aspremont et al., 1989; Degryse, 1996; Kim et al, 2004; Porter, 1980, 1985; Tirole, 1988).

This paper adds to the recent literature of multi-sided platform markets (e.g., Armstrong, 2006; Armstrong & Wrigth, 2007; Boudreau, 2008; Clements & Ohashi, 2005; Corts & Lederman, 2009; Hagiu, 2008) by being the first study, to our best knowledge, that inspects the interrelation between different management strategies of complementors and provides a theoretical rationale for and empirical evidence of a tradeoff between acclaimed value-enhancing strategies – IPC and exclusivity. Our study can also contribute to the literature on RBT. By examining the value of complementors in terms of their *functionality* in different platform's systems we advance an explanation for why a platform can fail to leverage on its network's size and corner the market, at least in our research context. We show that the characteristic and type of a resource (i.e., exclusivity) are not sufficient for value-creation. It is ultimately its use in the integrated system that makes a difference in terms of the value of the product for the final customers. This, together with the finding that platforms can benefit from a system differentiation strategy, provide a first explanation for why, despite network externalities, multiple incompatible systems can coexist – which is also the area in technology adoption and network externalities literature less studied (Shankar & Bayus, 2003).

The rest of the paper is structured as follows. In the next section we briefly summarize recent studies on complementors' value for platform's success in multi-sided markets. Building on these findings and RBT, we then present our theory on the strategic tradeoff between IPC and exclusivity strategies, and the performance effects of system differentiation strategy. Next, we describe our empirical approach and analysis of the U.S. home videogame industry (1995-2008). The paper concludes with discussion of the findings and implications for practice and future research.

THE VALUE OF COMPLEMENTORS IN MULTI-SIDED MARKETS

Network economics theory on multi-sided markets (e.g., Armstrong, 2006; Hagiu, 2005; Rochet & Tirole, 2003, 2006) predicts that growth in customers' installed base and complementary product availability are main mechanisms driving platform's adoption as well as product value (Brynjolfsson and Kemerer, 1996; Clements & Ohashi, 2005; Dew & Read, 2006). This is due to the indirect network-effects characterizing multi-sided markets: the value a customer realizes from the platform on one side increases with the number and variety of complementors on the other side (Evans, 2003). At the same time, the profits an individual firm can attain by providing complementary products to a platform are greater the larger the base of consumers currently using the platform or expected to in the near future. So, the participation of at least one group (e.g., producers of complementors) raises the value of participating for the other group (e.g., final users) and can help surmounting the classical 'chicken-and-egg' problem characterizing these markets (Caillaud & Jullien, 2003; Roson, 2005). Platform providers are called to devise effective strategies to manage these cross-market network effects, and attract and integrate valuable complementors into the platform's system (Cusumano & Gawer, 2002; Yoffie & Kwak, 2006).

In markets characterized by "winner-takes-all" or "takes-most" dynamics, companies with a larger network's size and a larger number of complementors are expected to win the competitive battle and become the *de facto* standard in the industry (e.g., Arthur, 1989, 1996; Shapiro & Varian, 1999). As Katz and Shapiro suggest, "systems that are expected to be popular – and thus have widely available components – will be more popular for that very reason" (1994:94). This explains why we frequently observe intense races between competing platforms to quickly accumulate complementors and customers (e.g., Cusumano & Gawer, 2002; Suarez, 2004). In this sense, Schilling (2002) finds that technological standard-based products with large installed bases are likely to attract more developers of complementary goods, which, in turn, influences the size of the installed base. Shilling concludes that a "technology for which the availability of complementary goods is poorer than that of competing technologies is, other things being equal, less likely to be adopted by customers" (Schilling, 2002: 389). Results of Clements and Ohashi's (2005) analysis of the U.S. videogame industry also show the importance of wide availability of complementary goods along with penetration pricing to increase platform's adoption rate. Corts and Lederman (2009) add further evidence to this effect and find that indirect network-effects might not only exist between the two sides of the individual system but also across competing systems when a major part of high-quality complementors is not exclusive.

Nonetheless, managing complementors, evaluating their potential *ex-post* value and effectively integrating them into the existing portfolio are critical and complex strategic tasks for the platform (Yoffie & Kwak, 2006), which go beyond maximizing the size of the portfolio (e.g., Boudreau, 2008; Suarez, 2005). This becomes evident if one looks at complementors not just as final products but as critical resources the platform must effectively accumulate and structure in order to build a coherent and successful system.

Complementors as Platform's Resources

The economics and management literature on standard battles converge on the importance of considering the whole system (platform-complementors) when analyzing competition between standards and the factors affecting its dynamics (e.g., Katz & Shapiro, 1994; Shapiro & Varian, 1999; Suarez, 2004; Wade, 1995). Taking the system as unit of analysis, complementors can be naturally conceived of as valuable resources of the system. Some of these resources are internally developed by the platform itself (e.g., Nintendo's *Super Mario* in the videogame sector; Microsoft's *Office* in the pc operating system and similar); yet, the bulk of complementors is generally produced by third-party firms. The challenge a platform faces in building a valuable system is to stimulate (provide incentives for) the production of such resources, evaluate and select the most valuable for the system and effectively integrate them into the system.

Resource-Based Theory (RBT) conceptualizes the firm as a collection of resources tied 'semi-permanently' to the firm (Barney, 1991; Peteraf, 1993; Wernerlfelt, 1984). Relevant resources that are specific to the firm and not capable of easy imitation by rivals are sources of Ricardian rents that constitute firm's competitive advantage (Barney, 1991). It is this character of firm's idiosyncratic resources (and its accumulation process) that contributes to firms' heterogeneity: firms are endowed with different resources and capabilities, and these differences are reflected in performance and competitive advantage differentials. According to Barney (1991), sustainable competitive advantage derives from firm-specific resources that are valuable, rare, inimitable and non-substitutable.

Lavie (2007) points out that, for firms embedded in networks, a richer portfolio of resources can provide the firm with greater value-creation opportunities. This ought to be particularly true in platform-mediated markets wherein a larger number of complementors increases value-exchanging opportunities for users of the platform. Also, as first advanced by Dierickx and Cool (1989), the value of a resource may highly depend on the existing stock of assets (i.e., resource bundles) a firm possesses. Asset interconnectedness plays major role also in platform markets. First, an individual complementor may be of intrinsically high value, and yet offer no value-enhancing capacity to the platform if it stands alone. The platform has to put together a balanced portfolio of complementors in order to build an appealing system and extract the *potential* value from its complementors. Indeed, Penrose suggests that "[no] resources … are of much use by themselves; any efficient use for them is always viewed in terms of possible combinations with other resources" (1959:86). Second, developers of complementors generally have little incentives to produce and tie their products to a platform with a low customers' installed-base (e.g., Venkatraman & Lee, 2004; Wade, 1995). Since platform's adoption by customers is function of the availability of wide complementors, the platform with an existing number of complementors provides higher incentives to developers for producing and licensing their products to it (e.g., Schilling, 2002; Wade, 1995). Therefore, the existing stock of complementors influences developers' incentives to produce and license the resources the platform would need, and, at the same time, also affects its type and characteristics, along with its value. Since complementors represent unique resource bundles when tied to the specific platform, which are difficult to replicate in the short term also because of indirect network effects, path-dependency and asset interconnectedness, they are potential source of platform's competitive advantage (e.g., Shankar & Bayus, 2003).

THEORY DEVELOPMENT

In our research context – the videogame industry – platforms usually employ two main strategies to attract, accumulate and integrate complementor resources: intra-platform competition **(IPC)** and exclusive licensing (**exclusivity**). By promoting internal competition the platform aims at stimulating the production of a greater number of complementors and of higher innovative content. Because of enhanced competition, complementors' providers have powerful incentives to innovate and differentiate their products (Boudreau, 2008). Armstrong (2006) suggests that a platform can maximize profits by allowing for increasing levels of competition on the retail side since this can stimulate the production of a larger variety of complementors and, by force of indirect network effects, drive to increased users' adoption.

Exclusivity, on the other side, is aimed at securing rare resources the platform can use to enhance complementors' quality-based differentiation capacity vis-à-vis rival platforms, and limit rivals' value-creation opportunities by denying them access to these resources. Armstrong and Wright (2007), for instance, show that under certain conditions (mostly important, consumers' pure preferences among platforms, which induce them to join only one of the competing systems) the emerging dominant platform can successfully corner the market (the classical 'winner-take-all' scenario) if able to secure a large part of complementors in exclusivity.

In addition to these strategies, a platform may choose to configure the system in a structurally different manner from its competitors so to focus on and meet new specific customers' needs. We call this approach **system differentiation strategy**. Here, platform's capability resides in discovering new profitable market niches and develop a tailored made system that provides customers of the niche with higher value than competing systems. For instance, in the pc operating system, Apple has developed a superior knowledge and capability in delivering a hardware-software system that better satisfies customers with needs and preferences for editing media files (music, video, photos…). Similarly, Sega successfully challenged the dominance of Nintendo in the 16 bit videogame console market by developing hit software titles based on popular sports like basketball or football that were absent in Nintendo's supply of game titles. Since the battle for dominance may be severe and lead to rent dissipation in networked markets (e.g., Sheremata, 2004; Suarez, 2004), a system differentiation strategy may limit this risk and prove beneficial for performance (provided a platform has the necessary capability of identifying profitable market niches and effectively deploying complementors to serve these niches). In what follows, we develop specific hypotheses on the potential value-creation and performance effects of these system-structuring strategies.

Competition versus exclusivity

RBT suggests that firms with valuable resources will attain competitive advantage if rivals are denied access to resources of the same type. In this sense, since console's exclusive game titles are complementors of a scarce and non-imitable *type*, the platform that secures them is expected to gain advantage. And because of indirect network effects, this advantage should be greater for the platform with larger number of (exclusive and non-exclusive) complementors. In short, IPC and exclusivity would have a complementary value-adding effect. However, as RBV theorists have come to clarify more recently, "it is not the resource type *per se* that matters, it is the functionality of the resource and how the resource is employed" (Lockett, Thompson and Morgenstern, 2009:13). Peteraf and Bergen have indeed proposed such a shift in perspective and contend that "resource scarcity should be assessed in terms of resource functionality rather than resource type…[since] the value of a resource derives from its application in product markets" (2003:1028). Following these lines, resources that are *ex-ante* of a rare type (e.g., exclusive complementors) may *ex-post* prove of limited value if they increase only marginally the value-creation capacity of the existing assets. Resources of the same type may indeed assume different value in different firms according to their idiosyncratic bundling, which in turn is function of firm's specific resource-capabilities combinations (e.g., Newbert, 2008; Sirmon et al., 2007).

We argue that exclusive complementors have *ex-post* limited functional value for the system with enhanced intra-platform competition since (a) they are, on average, of inferior quality because of the limited incentives implied by high levels of IPC that cannot be alleviated with sales in competing platforms, and (b), because of that, they can bring very limited differentiation capacity, if any, to the platform's system. Our main contention is that platforms need to choose between two alternative viable approaches to manage complementors in multi-sided markets: Either concentrate their strategic efforts on maximizing the number of complementors that qualify for a minimum quality standard and therefore promote *de facto* intense levels of intra-platform competition; or focus on maximizing the overall quality of complementors' offer and compete with platforms offering a larger number of complementors by tying in top quality complementors that in return of accepting an exclusivity agreement will enjoy some degree of intra-platform market power. Competition may induce platforms to update continuously their complementors management strategies; yet, platform providers that do not take a clear position between these two alternative approaches may fail to build a coherent system and face serious competitive disadvantages from the consequent inability to structure an appealing bundle of resources. On one hand, these firms will fail to attract sufficient volume and variety of complementors since the exclusivity requirement will deter some of them from joining the platform. Additionally, they will fail to achieve the level of complementors quality necessary to obviate the need for a large number (and variety) of complementors because of relatively high levels of IPC. Though all platforms will show some degree of exclusivity in their complementors, IPC- and exclusivity-based strategies imply different resource accumulation processes, and are for this reason at tradeoff. In the video game industry, as in other markets of similar dynamics (e.g., pc-operating system, internet browsers), sales of complementors are highly skewed towards popular game titles (Clements & Ohashi, 2005; Corts & Lederman, 2009). Although a wider variety of complementors increases platform's value by appealing to customers' heterogeneous preferences, platform's adoption is usually driven by sales of 'hit' complementors. Therefore the functional value of a game, being it exclusive or not, is ultimately function of its capacity to appeal on a large base of customers. Our central contention is that exclusive titles lack this capacity and are, on average, of inferior value for systems with enhanced levels of IPC.

Platforms might inevitably need to trade the benefits of the IPC strategy for the capacity of attracting high-value exclusive complementors. Enhanced competition might indeed lower the incentives of high-quality producers to develop and lunch new games for the crowded console (Boudreau, 2008; Venkatraman & Lee, 2004). Although IPC can expand platform's market (i.e., customer base), high degrees of IPC deprive sales of individual complementors, shrinks the size of the potential market for each platform's application and reduces revenue-margins. Boudreau (2008), for instance, shows that in the market for PDA's applications, as the number of a platform's complementors grows large, the intensity of price competition across complementors in the same category increases and reduces incentives for innovation. Developers might not reach the efficient scale and/or returns required for up-front large investments in high-quality titles. Also, Venkatraman and Lee (2004) find that developers are more likely to choose newer platforms to launch their innovative products as these offer, despite their smaller initial network, better market opportunities compared to crowded platforms. These disincentives are more severe for exclusive complementors that cannot relieve the effects of intensified competition with sales on other platforms. In summary, IPC and exclusivity strategies imply different structuring and bundling approaches that have limited complementary value. IPC offers limited incentives for complementors of superior quality when contingent upon exclusivity: Under increasing levels of IPC, exclusive complementors with lower functional value are more likely of being attracted. The quality of the overall system may accordingly be negatively affected.

(Hypothesis 1a): The number of high-value exclusive complementors will be negatively related to the joint implementation of intra-platform competition and exclusivity strategies.

(Hypothesis 1b): The overall quality of a platform's system will be negatively related to the joint implementation of intra-platform competition and exclusivity strategies.

Peteraf and Bergen (2003) maintain that the value of a resource is ultimately defined by what the firm can derive from its application in product markets. We have argued above that platforms with a joint focus on IPC and exclusivity would attract and accumulate exclusive titles of inferior value. The joint implementation of IPC and exclusivity might accordingly prove detrimental to platform's performance, also because of its negative effect on the overall quality of the system. Notwithstanding the key influence of network externalities, quality is still important to consumers even in networked-markets (Liebowitz & Margolis, 1999; Schilling, 2003; Zhu & Iansiti, 2007). Zhu & Iansiti's (2007) model advances that although indirect network effects' mechanism determines the market outcome, the platform's relative quality on both sides of the market is likely to affect long-run market shares. If, in fact, consumers value also the quality of the system when making their platform's adoption decision, present the limited functional value and rareness, and the negative effect on system quality, we should expect enlarged IPC *and* exclusivity to affect negatively platform performance. In their recent models on the role of platform's access to exclusive content, both Lee (2007) and Mantena *et al.* (2007) suggest that dominant platforms, in fact, might derive limited differentiation benefits from exclusive content goods. Accordingly, we hypothesize a negative effect on performance when exclusivity is contingent upon high levels of IPC.

(Hypothesis 1c): Platform performance will be negatively related to the joint implementation of intra-platform competition and exclusivity strategies.

System Differentiation

Firms can show differences on performance not because they possess different types of resources, but because they integrate and combine them in different ways (Sirmon et al., 2007). Moreover, resources' value-creation potential may be contingent on the value of resource-competencies (Newbert, 2008). To the extent that functional heterogeneous resources across firms serve different customers' needs (i.e., find different market applications), firms gain differentiation capacity in the product market space (Peteraf & Bergen, 2003). As resource functional heterogeneity increases, firms can become more unique and specialized in their market segment. We advance here that a platform that configures the supply of complementors in a structurally different manner from rivals – what we have referred to as system differentiation strategy – can gain differentiation capacity.

Although a given complementor may be present on multiple systems, it might nonetheless serve a different use in those systems: for example, a family-genre game might 'simply' adds variety for the larger platform, whereas for a smaller platform focusing on that specific niche of the market it may represent the leading/driving application, and assume greater strategic use. The value of such application for each system is accordingly different. A platform with a differentiated system may face lower degrees of competition since its complementor bundles find different application in the market by serving a different base of customers. In this sense, a system differentiation strategy can increase the value and rareness of the platform's portfolio of complementors and contribute to systems' heterogeneity.

However, differentiating platforms run the risk of having their niche markets covered by the offer of 'generalist' platforms. Similar configurations can blur the differences between the differentiated system and rivals'. For small levels of system differentiation, using the words of Peteraf and Bergen (2003:1032), rival platforms have "capability equivalence", that is, complementor bundles that are comparable to those of the differentiating platform "in terms of their ability to satisfy similar customer needs". In such cases, the system might fail to gain differentiation value. This is in line with models of spatial competition (e.g., D' Aspremont et al., 1979; Economides, 1986; Hotelling, 1929; Salop, 1979) where differentiation is conceived in terms of spatial distance between competing firms. Firms located in proximity to each other share to a greater extent resources and customers which they fight for (Chung & Kalnins, 2001);

higher levels of differentiation would accordingly reduce competition for both resources and customers by increasing the underlying distance. Differentiated firms enjoy less fierce competition for local customers, as their offerings are based on distinct functions in which they hold a competitive advantage (Chung & Kalnins, 2001; Kalnins, 2003). However, since differentiation is risky and its costs – missing the demand of the mass market (Economides, 1986; Tirole, 1988); large cost gap with low-cost offer (Porter, 1985); evolution of buyers' needs and competitors' imitation (Porter, 1985) – can dwindle its benefits, these models predict that benefits can be attained only when the differentiation distance is maximized; namely, when firms successfully locate at the extremes of the competitive space.

These logics suggest that only when the degree of dissimilarity in complementor bundles grows large the system can gain differentiation capacity and better satisfy consumer needs within the targeted market segment. The differentiated platform offers greater value to the niche's consumers in that it provides greater complementors' variety and specificity for that niche compared to rival 'generalist' systems. Accordingly, we hypothesize that a system differentiation strategy can affect positively platform performance to the extent that rival systems do not have capability equivalence; this happens for large levels of system differentiation. Slight levels of differentiation will rather be detrimental since platforms will miss the demand from the mass-market and, yet, fail to provide enough distinctive character that creates value for niche market's consumers.

(Hypothesis 2) System differentiation strategy will have a U-shaped relationship with platform performance: low levels of complementor bundles dissimilarity decrease platform performance; high levels of complementor bundles dissimilarity increase platform performance

THE VIDEOGAME INDUSTRY

We empirically test our hypotheses in the framework of the U.S. videogame industry. This is a young and dynamic sector that, starting in the early 1970s has grown to reach $18.8 billion in revenues in 2007, with about 65% of American households playing computer or videogames.[1] Standing the complementarity of the hardware-software products, the console's value to the user adopting a specific platform increases with the number of videogames available for that console. By the same token, producers of these complementary products have incentive to develop games for consoles with an existing large installed base or a high potential network of users (Venkatraman & Lee, 2004). The building and size of such network is therefore the classical "chicken-and -egg" problem (Caillaud & Jullien, 2003) created by indirect network externalities, which characterize multi-sided markets (Rochet & Tirole, 2006; Roson, 2005). Three recent studies (Clements & Ohashi, 2005; Corts & Lederman, 2009; Shankar & Bayus, 2003) have indeed shown the importance of indirect network effects in the videogame industry.

Data

Our dataset consists of monthly observations on console and game-title sales, which comes from the NPD Group, a US-based leading market research firm. We have compiled information of a total of 15 home-video consoles for the period from January 1995 to June 2008, 5 of which introduced prior to 1995; and 5,865 unique videogame titles, for a total of 944 platform-month observations[2].We know the introduction date of each game title and console, the quantity sold in units and dollars terms, the average

[1] This figure comprises sales of both console videogame hardware and software, along with PC videogame software. In details, $5.12B from console videogame hardware, $8.64B from console videogame software, $0.91B from PC videogame software and the rest from accessories. *NPD Group;* and *Entertainment Software Association 2008 Sales, Demographic and Usage Data*.

[2] We truncate a platform-time series at the month where the platform has no longer active sales and titles entry. Each observation is at the month-title-platform combination level.

selling price and other descriptive information such as game genre. These data are compiled by the NPD Group through the surveying of approximately 65% of game retailers[3] in the United States; from this data, NPD Group subsequently formulates estimates of figures for the entire U.S. market. Sales to rental outlets (e.g. Blockbuster) are excluded from these estimates. Clements and Ohashi (2005), Lee (2007), Venkatraman and Lee (2004) also use NPD data for their analysis. We integrate this rich dataset with additional information on consoles' and titles' characteristics, which we draw from console manufacturers' and other specialized websites.

Measures

Dependent Variables:

Platform Market Share is defined as console's unit sales in a given month over total unit sales of active consoles that month. This variable better gauges the performance progress of the console relative to other active platforms, capturing the monthly competitive dynamics of the industry and the overlap of incumbent and new generation consoles. Clements and Ohashi (2005) also use this variable to account for competition overtime in their estimation of the cross-sides network effects.

High-Value Exclusive Titles. We follow Peteraf and Bergen's (2003) suggestion that resource's value should be assessed in terms of its market application. With this in mind, we construct this variable that captures the functional value of exclusive titles by measuring the extent of their market popularity. We gauge this by following Corts and Lederman's (2009) identification procedure of "hits" titles, except that we are interested in exclusive titles. We consider only those platforms for which we

[3] These are the 12 largest videogame retailers in the US market. More details on the data collection methodology of the NPD Group are provided in its webpage, in the entertainment market research section (http://www.npd.com/corpServlet?nextpage=entertainment-categories_s.html).

can track the entire history of titles' release (i.e., those launched after January 1995). We compute, for every platform of generation five, six and seven, the total dollar-sales each exclusive title generates over its entire life-period on that platform and divide this figure by the total platform's installed base at the end of the generation period [4]. This gives us an estimate of the platform per-user dollars spent on that title. We then take the distribution of this variable over all exclusive titles of generation five, six and seven and identify the 75th percentile of this distribution. We use this cut-off point to construct our generation relative measure of the value of each exclusive complementor, as expressed by its popularity. We accordingly assign a dummy equal to 1 to each exclusive title falling above this threshold and count, each month for each platform, the number of such titles.

System Quality. We use the score assigned to each title by *IGN.com*, a website specialized in reviews of videogame's software and hardware, and take the average score of platform's active titles each month as measure of system quality. *IGN.com* assigns each game a value on the scale from 1 to 10 on the basis of consumers' feedback and experts' reviews. Unfortunately, information on titles' rating is not available for generations 3 and 4 and for the platforms Jaguar, 3DO, and Saturn of generation 5. This restricts our sample to 578 platform-month observations. Also, we were not able to perfectly match all of the titles present on our data base with the *IGN.com* scores: out of the 6047 titles of the platforms within the restricted sample, we have information on 5016 titles, about 83%, with this figure ranging from 70% (Playstation1) to 99% (Playstation3) at the platform level.

Independent variables:

[4] Corts and Lederman (2009) compute this variable for the 12 months after title's release. Although large part of a title's sales accrue during the first months after its release, titles that prove popular have active and large sales for an extended period of the platform generation compared to average titles. Accordingly, we deem more appropriate for our purposes considering the whole title's selling-period rather than just the 12 first months after its launch on the platform.

Intra-platform competition (IPC). IPC is the monthly number of platform's titles over the total monthly number of titles of all platforms active that month. An alternative measure that could capture the degree of competition across complementors for a given platform would be the cumulative number of titles released for that console up to each month. Both Clements and Ohashi (2005) and Corts and Lederman (2009) use this measure in their estimations of the indirect-network effects. However, such variable does not take into account the interdependence among platforms. A game producer may decide to release a new title for a platform despite its high number of existing titles if other platforms are even more crowded. We think a better way to gauge IPC is by using a relative measure, given also our interest in the value of complementors relative to competitors. However we have replicate all our results with this alternative variable of IPC achieving the same qualitative results.

Exclusivity refers to the extent to which game titles are available only on a given platform. We define a title as exclusive if it has never been released for any other platform during our observation period. Similarly to IPC, we measure exclusivity in relative terms, as the number of platform's exclusive titles over total exclusive titles of all active platforms each month.

System Differentiation. One way a console provider could shape differently its system is by differentiating their games' offer. This is evident in table 1 where the distribution of titles by genre of consoles in the same generation varies for some platforms. A notable case, for the last generation for instance, is Nintendo's Wii.

Table 1
Software Distribution by Genre§

Platform	ACTION FIGHT	ACTION	SPORT	CHILDREN GAMES	CLASSIC ARCADE	GENERAL GAMES	STRATEGY	PLATFORM CHARACTER	OTHERS
Generation 4									
SNES	17%	9%	21%	2%	2%	5%	3%	36%	4%
GENESIS	19%	9%	25%	2%	2%	4%	3%	34%	3%
Generation 5									
JAGUAR (ATARI)	29%	21%	16%	0%	8%	7%	3%	17%	0%
N64	24%	22%	26%	2%	2%	7%	1%	11%	3%
3DO	33%	20%	12%	9%	1%	14%	3%	4%	4%
PLAYSTATION	24%	21%	24%	3%	2%	7%	2%	8%	8%
SATURN	34%	15%	24%	0%	2%	3%	4%	14%	5%
Generation 6									
DREAMCAST	27%	33%	19%	0%	2%	5%	1%	5%	7%
GAMECUBE	17%	23%	41%	1%	0%	6%	1%	8%	2%
PLAYSTATION 2	19%	31%	23%	2%	1%	7%	2%	6%	10%
XBOX	23%	33%	25%	1%	1%	4%	1%	6%	6%
Generation 7									
PLAYSTATION 3	28%	26%	31%	0%	0%	3%	1%	5%	6%
WII	15%	39%	15%	1%	0%	14%	2%	9%	5%
XBOX 360	30%	27%	26%	0%	0%	4%	3%	3%	8%

§ Figures for NES (generation 3) not reported due to missing values on the genre variable. Percentages reported are platform means over the observed period of number of titles in each genre over total number of titles for the platform each month.

Wii has been the first console to offer games as diverse as those on brains-training, food-recipes, fitness-centered, music composing and the like. Also, in the *action* segment, because of its revolutionary controller, it has spawn the production of various new games that differ from those offered on competing platforms, focused more on the *action-fight* segment. One way to gauge such a differentiated composition of system's complementors is by considering the percentage of titles offered by a platform in each genre out of its total number of titles and compare this figure with the generation mean. Accordingly, we define platform differentiation for each month-platform as:

$$\sum_{g=1}^{9}\left|t_g - \bar{t}_g\right|$$

where g represents the different titles' genres, t_g is the percentage of platform titles in genre g and t_g upper-bar is its generation-industry mean. We take the sum across genres of the absolute value of these differences and use this index as measure of system differentiation. This variable measures then the distance between the focal platform's system composition and the generation mean (i.e., competitors system composition), and assumes value of zero when the distribution of platform titles across genres coincides with its competitors average, and increases the larger the deviation from the generation's mean. This value would be at its maximum for the extreme case wherein the platform's offer does not overlap at all with peers'. In our sample, a maximum value of 1.12 is reached by the Nintendo's N64 console in October 1996.

Control variables:

Platform price can be an important driver of platform penetration capacity, especially in multi-sided markets (e.g., Hagiu, 2005; Rochet & Tirole, 2003). It is defined here as the average price of each console in each month and computed by dividing the console's dollar sales by its unit sales. We then use the log- linear transformation of such variable in the analysis. ***Platform age*** is the difference between a given month date and the console's launch date, adjusted so that the first month of console's sales, platform age takes value 1 rather than 0. Controlling for platform age is particularly important in our setting. It can capture consumers' expectations about the number of new games that can be released for that console and/or the launch time of the next generation of consoles; and thus affect console's adoption decision. Also, while platform age might be negatively related to platform market share due to the small amassed network of users in the early life-cycle, as time passes and the platform keeps selling, its installed base would be growing larger and this will further activate the positive indirect network effects. Henceforth, we can expect an “older” platform to have an advantage over new consoles – the network inertia effect. Because of this potential curvilinear effect, we also control for the squared value of platform age. ***Generation Competition****,* defined here as the number of rival consoles in the same technological generation active each month, is another important factor that may affect platform’s capacity to attract users. One would expect that as this number grows larger, competition among platforms gets more intense and affect negatively performance. Corts and Lederman (2009) show, though, the possibility of positive externalities across platforms at the generation level when the majority of complementors is not exclusive. Finally, time (in quarters) and platform fixed-effects are also used to further control for unobserved factors. Platform fixed-effects capture unobserved heterogeneity across platforms that are constant overtime, such as might be differences in technological features (for instance, compatibility), perceived quality by consumers that may be attributed to marketing campaigns and the like. These platform-specific characteristics, although not observed by the researcher, are likely to affect the intrinsic value of a platform, hence its performance. We also account for unobserved time-effects such as seasonal trends by including three dummies for the different quarter periods of the year. This is particularly relevant for our setting as, for instance, sales of consoles and videogames are usually much higher in the last quarter of the year. Also, it is generally in this period that new consoles are introduced in the market. Table 2A and 2B present summary statistics and correlation table of the variables used in our empirical analysis.

Table 2A
Summary Statistics

Variable	N Obs.	Mean	Std. Dev.	Min	Max
Platform Price	944	4.59	0.81	1.39	6.39
Exclusivity	944	0.15	0.13	0.00	0.47
IPC	944	0.16	0.12	0.00	0.44
Exclusivity x IPC	944	0.04	0.05	0.00	0.21
Differentiation	895	0.14	0.13	0.00	1.12
Differentiation squared	895	0.04	0.08	0.00	1.26
System Quality	578	7.01	0.44	5.50	9.00
High-Value Exclusive Titles	648	57	36	2.00	120
Platform Market Share	944	0.17	0.19	0.00	0.71
Platform Age	944	55	37	1.00	154
Platform Age squared	944	4441	4999	1.00	23716
Generation Competition	944	2.70	1.16	1.00	5.00

TABLE 2B
CORRELATION TABLE

		1	2 3		4	5	6	7 8		9	10	11	12
1	*Platform Market Share*	1											
2	*High-Value Exclusive Titles*	-0.41*	1										
3	*System Quality*	-0.06	-0.32*	1									
4	*Exclusivity*	-0.04	0.81*	-0.44*	1								
5	*IPC*	0.02	0.76*	-0.37*	0.97*	1							
6	*Exclusivity x IPC*	-0.01	0.74*	-0.41*	0.97*	0.94*	1						
7	*Differentiation*	-0.01	-0.54*	0.01	-0.59*	-0.6*	-0.49*	1					
8	*Differentiation squared*	0	-0.37*	0.12*	-0.38*	-0.41*	-0.31*	0.86*	1				
9	*Platform Price*	0.53*	-0.76*	0.19*	-0.4*	-0.36*	-0.3*	0.38*	0.28*	1			
10	*Platform Age*	-0.45*	0.89*	-0.28*	0.61*	0.54*	0.45*	-0.63*	-0.38*	-0.77*	1		
11	*Platform Age squared*	-0.45*	0.78*	-0.29*	0.46*	0.37*	0.31*	-0.53*	-0.28*	-0.68*	0.95*	1	
12	*Generation Competition*	0.17*	-0.47*	-0.11*	-0.53*	-0.51*	-0.43*	0.71*	0.42*	0.31*	-0.68*	-0.63*	1

* Significant at the 1% level

Empirical Strategy

Table 3
Exclusivity-IPC Trade-off: Informal Evidence

Platform Market Share

	IPC	
	LOW	HIGH
EXCLUSIVITY LOW	0.156	0.189
EXCLUSIVITY HIGH	0.193	0.145

System Average Quality

	IPC	
	LOW	HIGH
EXCLUSIVITY LOW	7.19	7.31
EXCLUSIVITY HIGH	7.01	6.61

LOW and HIGH of each dimension is defined as greater than (HIGH) the median value or lower/equal than (LOW) the median. The table reports for each cell of the belonging sub-sample the median of platform's market share (left-side of the table) and average of titles' quality score (on the right-side).

Table 3 offers some informal evidence of the tradeoff between exclusivity and intra-platform competition. We divide the sample between high and low Exclusivity and high and low IPC by taking as cutting point the respective medians. We then compute the median of platform market share (left quadrant) and system quality (right quadrant) and report in each cell the value of the corresponding sub-sample. As one can notice, platform market share is lower in cases of both low or high Exclusivity-IPC, and is higher when console providers focus their effort either in stimulating a higher variety of new titles (high IPC, low Exclusivity) or when they try to differentiate their console through the provision of exclusive content (high Exclusivity, low IPC). Moreover, the quadrant on system quality clearly shows that the average quality of complementors is lower for the high-high combination of IPC and Exclusivity.

More formally that in Table 3, we test these potential effects by estimating the following panel data model:

$$DV_{it} = \Phi_i + T_t + \beta_0 + \beta_1 \, Exclusivity_{it} + \beta_2 \, IPC_{it} + \beta_3 \, Exclusivity_{it} \, x \, IPC_{it} + \beta_4 \, Differentiation_{it} + \beta_5 \, Differentiation^2_{it} + \beta_6 \, Controls_{it} + \xi_{it} \quad (1)$$

where DV_{it} is the set of our dependent variables, Φ_i represents the coefficient of platform fixed-effects, T_t the set of dummies for time fixed-effects, and ξ_{it} the error term. Even if the presence of platform fixed effects alleviates concerns about omitted variables biases, our equation will not be properly estimated if other endogeneity issues are present. Given the characteristics of our sample, *Price*, *IPC*, and the *Exclusivity* variables may likely be correlated with console's error ξ_{it}. For example, the error term will capture variations of unobserved value and/or quality of console i in month t from its overall mean. Since platform price generally reflects over time these variations in unobserved quality, which will likely be perceived by consumers, price can be correlated with the error term. For similar reasons, IPC, Exclusivity, and as a consequence their interaction will be correlated with the error causing endogeneity biases. As a result, to properly identify equation (1), we need to find instrumental variables (hereafter, IV) that are correlated with our endogenous variables, but uncorrelated with the error term.

We follow Clements and Ohashi's (2005) identification procedure to control for the endogeneity in console price and IPC variables. We use the 1-year lag monthly exchange rates between the U.S. Dollar and Japanese Yen as instrument for price. Since the manufacturing process of almost every console present in our sample is undertaken in Japan, and given that consoles are usually introduced first in Japan one year before the commercialization in the States, these exchange rates are a good proxy of the production cost of the console and therefore should affect the U.S. console retail price. At the same time, these exchange rates should be independent of the unobserved variations in quality of other platform-level missing variables that compose the error term in our regressions. The monthly average age of titles active in a given month is employed as instrument for IPC. This variable is an indicator of the residual life (or obsolescence) of game titles and can be used as proxy by complementors' producers to guide their game's introduction decision. At the same time, a higher average age may also indicate the presence of "blockbuster" titles, which, because of their market success, have an extended life cycle and contribute to rising the average age of all titles. Accordingly, this variable is likely related to producers' decision of releasing new titles for the platform, hence, to IPC. However, the average age of titles should have no effects on variations of unobserved quality of the platform across time (i.e., the error term): what matters to consumers' adoption decision is not the age of titles but their quality, characteristics and availability in variety. Clements and Ohashi (2005) use in fact this variable to instrument the offer of game titles in their estimations.

We use the number of exclusive titles in the previous generation of the platform as instrument for Exclusivity. Such titles may increase the differentiation capacity of the previous generation console, hence its market penetration. The updated console (i.e., the new generation console of the same provider) can benefit from such differentiation in the form of higher brand reputation and visibility. Platform providers can then leverage on such intangible, path-dependent resources to successfully introduce the new generation and have higher bargaining power with complementors' providers. We expect then exclusivity of previous generation console to affect publishers' expectations and decision about whether to release the titles in exclusivity to the platform. Yet, these titles have no value for buyers of the new generation console since might not be compatible with the console of current generation and will, in any case, be no longer available on the market; henceforth, they should be independent from the unobserved variations of platform value captured by the error term in our regressions. Finally, we instrument the interaction of Exclusivity with IPC by using the interaction of their respective instruments, which is suggested as good instrument if the instrumental variables are independent of each other (Baum et al., 2007)[5]. As Clements and Ohashi (2005), we also use the squared terms of the instruments in our estimation. We implement these instruments and estimate equation (1) via standard IV estimation.

RESULTS

Table 4 presents OLS and IV estimation results for models in which the number of High Value Exclusive Titles is the dependent variable. As expected, platforms with enhanced levels of both IPC and exclusivity will end up with exclusive complementors of limited value as evidenced, in all models of table 4, by the strong negative relation between High-Value Exclusive Titles and the interaction term. It is interesting to note the contrast with the main effects: The number of exclusive titles of superior value is negatively and significantly related to IPC, while are positively related to exclusivity. This is in line with our theory predicting a strategic tradeoff between maximizing the number of complementors that qualify for a minimum quality standard (i.e., IPC) and maximizing the quality of complementors by securing top quality complementors via exclusive agreements, after granting them some intra-platform market power (i.e., exclusivity). Accordingly, we find strong support for hypothesis 1a.

[5] This is a well plausible assumption in our case, as we do not see any clear interdependence between the average titles' age of current generation and the number of exclusive titles released for the console in the old generation.

Table 4

High-Value Exclusive Titles

Variable	Model (5-1) OLS	Model (5-2) OLS	Model (5-3) 2SLS	Model (5-4) 2SLS	Model (5-5) 2SLS (robust)
Exclusivity	296.54**	421.71**	358.01**	549.45**	549.45**
	(17.07)	(19.43)	(45.27)	(45.39)	(63.89)
IPC	-179.58**	-145.31**	-340.16**	-263.78**	-263.78**
	(21.11)	(19.65)	(69.36)	(60.19)	(93.42)
Exclusivity x IPC		-302.41**		-467.40**	-467.40**
		(27.69)		(57.53)	(129.26)
Platform Price	1.31	-0.78	17.98**	9.08*	9.08
	(0.89)	(0.84)	(4.23)	(3.79)	(7.28)
Platform Age	1.26**	0.98**	2.24**	1.54**	1.54**
	(0.06)	(0.06)	(0.28)	(0.26)	(0.46)
Platform Age squared	-0.01**	-0.01**	-0.01**	-0.01**	-0.01**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Generation Competition	-2.23**	-2.79**	-2.21**	-3.23**	-3.23**
	(0.34)	(0.32)	(0.44)	(0.40)	(0.78)
N obs.	648	648	648	648 648	
R-squared	0.97	0.98	0.92	0.94	0.94
F stat.	1270**	1429**	813**	1001**	287**

* Significant at the 5%; ** Significant at the 1%. The table reports OLS and 2-Stages Least Squares panel-data estimations of platform's *number of exclusive titles of high value.* All models include time (in quarters) and platform fixed-effects. In Model 5-5 errors are robust to arbitrary autocorrelation and heteroskedasticity.

Table 5 displays the estimation results of models in which system quality is the dependent variable. As predicted by hypothesis 1b the coefficient of the interaction between Exclusivity and IPC is negative and strongly significant in model (5-2). However when we instrument the endogenous variables, the same coefficient turns out positive and not significant in model (5-4). In fact, besides price, none of the instrumented variables are significant. This is a surprising finding. Equally surprising is the negative sign of the price variable: This would imply that an increase in platform's price be associated with a lower quality of the system. However, by inspecting the first-stage estimation results of the IV procedure (available upon request from the authors), we realize that our price instrument in fact is not significant. We believe that this problem is not specific to the chosen instrument but can be attributed to the restricted sample used for testing hypothesis 1b, which, for the generation 5, excludes information on three out of the total five platforms (3DO, Jaguar and Saturn); precisely those unsuccessful. By using this restricted sample, our identification procedure would fail to account for these failure cases; which might ultimately limit and influence accordingly our second-stage estimations. We address this issue in the following way. Since in the first stage of the IV procedure we do not need information about system quality, the variable for which we do not have information for failure platforms, we use the whole sample (including 3DO, Jaguar and Saturn) to fit each of our endogenous variables (Price, IPC and Exclusivity). We use then these fitted values and estimate, on the restricted sample, the effect of Exclusivity and IPC on System Quality. We correct the standard errors following Green's (2003) widely accepted procedure. Results are reported in the model (5-5). As H1b predicts, the coefficient of the interaction term is now negative and significant. This is in line with findings of the OLS estimation and might suggest that the lack of significance in model (5-4) could be attributed to the identification issue highlighted before. Also, and consistent with our theory, the main effect of Exclusivity is positive and significant: an exclusivity strategy focused on the promotion, attraction and selection of superior complementors can enhance the differentiating value and overall quality of the system. System Quality is also negatively and significantly related to the IPC variable; a finding that holds in every specification of table 5 and is consistent with our theory. Platforms that stimulate a wider production of complementors via within system competition may well accumulate game titles of high quality as well as titles of inferior quality. However, high levels of IPC reduce incentives of high-quality complementors, especially when exclusive, and constrain platform's capacity to attract superior complementors, supporting H1b.

Table 5
System Quality

Variable	Model (6-1) OLS	Model (6-2) OLS	Model (6-3) 2SLS	Model (6-4) 2SLS	Model (6-5) 2SLS full (robust)
Exclusivity	3.27**	4.66**	4.17**	3.91**	7.11**
	(0.51)	(0.62)	(0.96)	(1.10)	(1.04)
IPC	-1.38*	-0.92	-2.15	-2.49	-5.28**
	(0.63)	(0.64)	(1.39)	(1.56)	(1.02)
Exclusivity x IPC		-3.47**		0.90	-4.73*
		(0.90)		(1.94)	(1.94)
Platform Price	-0.17**	-0.19**	-0.39**	-0.35*	0.01
	(0.03)	(0.03)	(0.11)	(0.14)	(0.19)
Platform Age	-13.42**	-16.9**	-18.52**	-16.22*	-1.80
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Platform Age squared	5.42**	6.69**	6.23*	5.30	0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Generation Competition	-0.03**	-0.03**	-0.05**	-0.05**	-0.03
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
N obs.	578	578	578	578	578
R-squared	0.84	0.84	0.25	0.25	0.79
F stat.	171**	167**	17**	16**	406**

+ Significant at the 10%; * Significant at the 5%; ** Significant at the 1%. The table reports OLS and 2-Stages Least Squares panel-data estimations of platform's *System Quality.* All models include time (in quarters) and platform fixed-effects. In Model (6-6) errors are robust to arbitrary autocorrelation and heteroskedasticity. The whole sample is employed In Model (6-6) to fit endogenous variables in the first-stage and errors have been accordingly adjusted in the second-stage estimation. Coefficients of *platform age* and *platform age squared* have been multiplied by 1k and 100K, respectively, for presentation purpose.

Table 6 displays the estimation results of those models with Platform Performance as dependent variable. For enhanced levels of IPC, exclusivity would be detrimental to platform performance. While Exclusivity and IPC affect positively performance, we find a strong negative effect for their interaction. These results hold true for every specification of table 6, supporting H1c.

Table 6
Platform Performance

Variable	Model (7-1) OLS	Model (7-2) OLS	Model (7-3) OLS	Model (7-4) OLS	Model (7-5) OLS	Model (7-6) 2SLS	Model (7-7) 2SLS (robust)	Model (7-8) 2SLS	Model (7-9) 2SLS (robust)
Exclusivity	0.39**		-1.04**	1.37**	1.48**	1.93**	1.93+	1.85*	1.85
	(0.07)		(0.22)	(0.25)	(0.25)	(0.58)	(1.11)	(0.76)	(1.33)
IPC		0.65**	1.83**	2.58**	2.35**	4.07**	4.07**	4.98**	4.98**
		(0.09)	(0.26)	(0.24)	(0.23)	(0.60)	(1.09)	(0.68)	(1.25)
Exclusivity x IPC				-6.06**	-5.91**	-10.09**	-10.09**	-12.72**	-12.72**
				(0.39)	(0.40)	(0.96)	(2.07)	(1.31)	(2.37)
Differentiation					-0.67**			-0.50**	-0.50*
					(0.09)			(0.14)	(0.21)
Differentiation squared					0.58**			0.49**	0.49*
					(0.09)			(0.15)	(0.20)
Platform Price	-0.06**	-0.08**	-0.08**	-0.12**	-0.12**	-0.18**	-0.18*	-0.10	-0.10
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.05)	(0.08)	(0.06)	(0.11)
Platform Age	-0.01**	-0.01**	-0.01**	-0.01**	-0.01**	-0.02**	-0.02**	-0.02**	-0.02**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Platform Age squared	0.01	0.12**	0.24**	0.45**	0.40**	0.67**	0.67**	0.60**	0.60+
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Generation Competition	-1.96	0.86	1.08	-4.13	11.33*	-15.82**	-15.82+	-5.84	-5.84
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
N obs.	944	944	944	944	895	944	944 895 895		
R-squared	0.76	0.76	0.77	0.81	0.83	0.78	0.78	0.71	0.71
F stat.	130**	135**	133** 169**		172**	140**	52**	102**	44**

+ Significant at the 10%; * Significant at the 5%; ** Significant at the 1%. The dependent variable is *Platform Market Share*. Models (7-6) through (7-9) show instrumental variables estimations; all specificiations include time (in quarters) and platform fixed-effects. Models (7-7) and (7-9) report results with errors robust to arbitrary autocorrelation and heteroskedasticity. In Models (7-8) and (7-9) observations regarding the NES platform are excluded from the analysis, due to missing values on the genre variable. Coefficients of *platform age squared* and *generation competition* have been multiplied by 10k and 1K, respectively, for presentation purpose.

Hypothesis 2 about the quadratic effect of system differentiation on performance is also supported. As the full model of table 6 shows, the coefficient of the differentiation variable is significant and negative, as expected: departing from the mainstream composition of the system's portfolio has negative effects on platform's appeal and performance. Yet, the squared term is positive and significant: As system differentiation grows large, rival platforms have no longer *capability equivalence;* the differentiated platform offers complementor bundles with superior ability to satisfy niche's customer needs.

Regarding control variables in Table 6 note that platform price has a negative effect on platform market share, as expected. However, this effect is not significant for the IV models when including also the differentiation variables in the analysis. Corts and Lederman (2009) also find platform price be insignificant in some of their specifications. The result on the effect of the number of rivals competing in the same generation is also of interest. After controlling for endogeneity, we find this variable influences negatively performance of the focal platform. However, this effect is significant only in models (6-6) and (6-7). When we include differentiation in the model, this variable is no longer significant. This may be consistent with what shown in Corts and Lederman (2009); namely that, the number of rivals competing in the same generation can have a negative but also a positive effect on performance, depending on the presence (or lack thereof) of cross-generation externalities, which, in turn, is function of the amount of multi-homing versus exclusive complementors.

CONCLUSIONS AND LIMITATIONS OF THE STUDY

In this study we have taken the perspective of treating complementors as resources of the platform's system and analyzed the reasons that explain a tradeoff between two different strategies for managing complementors. We find that platforms that pursue a strategy of tying in exclusive complementors and at the same time maximize the number of complementors get stuck in the middle (using Porter´s terminology) and lack strategic focus. This eventually translates in lower performance, as evidenced by our findings. We also report arguments and evidence that show how differentiation strategies in terms of the content type provided by complementors pays off only for relatively high levels of system differentiation, while, for relatively low levels, it is detrimental to performance. This finding further confirms the importance of building distinctive capabilities in terms of diverse functional resources when aiming at serving different customer needs. We believe that our findings contribute to the integration of the nascent literature about platform market strategy with mainstream Resource-Based Theory.

Our findings are robust to addressing a wide variety of common econometric problems since the richness of our dataset allows for the use of sophisticated econometric procedures. In particular, we find the same results using standard OLS techniques, alternative measures, econometric specifications that take care of potential endogeneity and platform fixed-effects specifications that prevent potential biases arising from unobservable platform characteristics constant across time. However, as other studies, our work is not free from limitations. The empirical evidence we provide in favor of our hypotheses may be constrained to the specifics of the videogame industry. This industry is characterized by the existence and importance of strong heterogeneity of complementors. A few hits achieve the bulk of total sales – in our sample, top 10% of the titles generate about 53% of total sales, while the lowest 10% represent only 0,2% of total sales. This means that the issue of attracting top quality complementors is critical for the success of videogame platforms and therefore, in this set-up, the trade-off between complementors' quality versus the limits to intra-platform competition may be more important and severe than in other industries in which the ex-ante quality of complementors may be more homogeneous. Although multi-sided platforms operating in other sectors face similar issues, it rests on future research to show whether and to which extent our findings, and the consequent implications for platform strategists, are applicable to these sectors.

Another critical characteristic of the videogame industry that may drive our results is the strong competition present in all generations. For platforms operating in less competitive environments (e.g., Windows in the PC operating system; Google), the trade-offs in complementors strategies might be less apparent or non-existent. In the case of Windows or Google, these dynamics are complicated by the concomitant presence of direct and indirect network externalities, so that, for these platforms, amassing a larger installed base of customers faster than rivals through a wide offer of complementors may be more important than focusing on complementors' quality. Eventually, once a platform becomes the dominant standard, IPC and exclusivity may also provide complementary value. Quasi-monopoly platforms, by leveraging on its high bargaining power, may push for a high number of complementors in an exclusive regime without detrimental effects on platform performance. Future research might expand our work to these cases and enrich our knowledge by teasing out the effects of direct versus indirect network externalities. Future research should also inspect deeper the size versus quality network effect. Our study shows that this is a relevant issue; however, we do not directly inspect which of the two effects is dominant. It might be that quality of the system has an impact on performance only after the system has gained popularity; that is, size-variety of platform's complementor portfolio might matter more in the early-stage of the technological generation, whereas in the mature phase of the market, the quality of the system would be the real differentiation factor for performance progressions.

Finally, in this work we have abstracted from governance-related strategies that platforms may undertake to alleviate the strategic trade-offs. Multi-sided platforms may resort to complex organizational arrangements that may overcome the lack of strategic focus and the hold-up problem that high-quality complementors experience under an exclusivity agreement. In other set-ups, different intra-organizational arrangements have been suggested to alleviate strategic trade-offs present when companies pursue conflicting strategic goals. Markides (2008) for instance, argues in favor of distinct organizational designs when companies compete with dual business models. The designs he proposes are contingent on both the nature of the conflict between business models and its strategic similarity. Future research should address which organizational designs can be used to alleviate the strategic trade-offs we have identified in this paper. Along these lines platform governance can be a particular and powerful leverage to attract high quality complementors. While platforms in diverse sectors engage in different strategic alliances and agreements with providers of complementors, other platforms such as, for instance, Sun Microsystems, Linux, or Google are following the diverse approach of opening their system, or part of it, so that complementors' providers can freely contribute to the integration and evolution of the system. Some studies have started analyzing, for instance, when to open a platform (Economides & Katsamakas, 2005; Eisenmann, 2008) or where the competitive advantage comes from for open platforms (Garud & Kumaraswamy, 1993). Yet, we still know very little about how these different platform governance arrangements affect the strategies employed to manage complementors and their potential trade-offs.

Managing the complementors' side of the market is an important lever for platforms to influence the external environment and the final market outcome. Although complex, this process is direct function of strategic maneuvering by platform providers; platform success is ultimately the result of these strategic interactions. Despite the increasing attention and effort toward the studying of competitive dynamics in platform-mediated markets in the emerging related literature, we still lack a comprehensive knowledge about the interdependence among the different strategies platforms use to shape the competitive landscape in their favor and the contingencies upon which such strategies assume complementary or unpaired value-creation capacity. This study provides a theoretical and detailed empirical analysis that unravels these dynamics in the U.S. videogame industry. However, it represents only a first step for a broader understanding of the phenomena at issue, which calls on future studies to advance our knowledge of platform-mediated markets by exploring other contingencies and industries, and help developing a more complete contingency approach to the strategic trade-offs we present in the current paper.

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