RELOAD AND RELAUNCH:

STRATEGIC GOVERNANCE OF PLATFORM ECOSYSTEMS

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Abstract

Platform owners have a number of strategic levers for managing the value of their ecosystems. However, they must use them carefully: how and by whom that value is captured is shaped by the competitive dynamics between the producers of complementary goods and the platform itself. We begin by developing a framework of value creation and value capture in platform markets. This framework yields a number of implications for whether and when a platform owner should selectively promote individual complements. We test our arguments on data from seventh generation video game sales, assessing both how games are selected for promotion, and how promotion affects subsequent sales performance. We find that platform owners do not simply promote "best in class" complements; they strategically invest in underappreciated games where there is greater marginal value to be unlocked, and with whom the platform may have greater bargaining power. We also find important temporal effects.

Keywords: Platform-based markets; ecosystems, complementors; value creation; value capture; video games.

1. INTRODUCTION

Many products are only valuable and desirable when used with complementary goods or services (e.g., software for computers, fuel and service for automobiles) (Schilling, 2009). This can lead to strong network externalities: A more valuable (or more widely adopted) platform will stimulate the development and sale of complements, and in turn, high availability and quality of complements will stimulate greater sales of the platform (Katz & Shapiro, 1986). The platform and complements might be sold as a pre-assembled bundle (as when a computer arrives pre-installed with software) or sold in separate components that the user combines themselves. When a product bundle is composed of a platform and complements in this way, there can be a complex interplay in how each element of the bundle contributes to the overall value of the product. A platform owner, for example, must consider not only how its investments influence the standalone value of its platform, but must also manage (and often invest in) the value delivered by complements produced by others. That is, it must manage the value of its overall ecosystem (Adner & Kapoor, 2010). Apple's stringent control policies for applications for the iPhone provides an apt example – unreliable applications would erode the device's reputation for quality and ease-of-use. Similarly, Elon Musk's commitment to provide a network of charging stations for the Tesla electric vehicles is designed to increase customers' perceived value of the car by reducing their fears that they will be unable to charge their batteries.

The preceding suggests that platform owners face important strategic decisions about how to manage the value produced by complements. Platform owners might invest directly in the provision of complements (as in the Tesla example), they may provide incentives and controls to improve the quality of complements provided by others (as illustrated in the iPhone example above), or both. Video game console producers, for example, typically develop a range of games in-house to ensure there are quality games available at the launch of their consoles, however they also work vigorously to attract the participation of third-party game developers, and may enlist a number of strategies to ensure or improve the value provided by third-party games.

Though it is easy to assume a platform owner seeks to simply maximize the size, quality, and visibility of its complements, the choice of whether, how, and when to invest in individual complements is actually considerably more complex. First, a platform owner typically faces resource constraints that preclude making all possible valuable investments. This suggests that platform owners must utilize rationing, and thus must make choices about which investments will have the biggest payoff, and when they should be made. This leads to a second complication: The producers of a firm's complements are likely to be competing against each other, and any investment the platform owner makes in individual complements influences the competitive dynamics between those complements producers, which in turn affects their incentives and their bargaining power. This raises important questions about how platform

owners deploy their resources to greatest advantage: *How do platform owners choose the complements in which to invest? Which complements benefit most by the platform's investment? Do temporal dynamics influence these payoffs?*

Much of the early work on platform-based markets used formal modeling to generate predictions about strategies such as pricing (e.g., Parker & Van Alstyne, 2005; Rochet & Tirole, 2003; Hagiu, 2009), installed base (Economides, 1996; Katz & Shapiro, 1985; Zhu & Iansiti, 2012), timing (Casadesus-Masanell & Yoffie, 2007), openness (Rysman, 2009; Casadesus-Masanell & Halaburda, 2014), offering of first party content (Hagiu & Spulber, 2013), and value capture (Casadesus-Masanell & Yoffie, 2007). Empirical researchers subsequently found support for many of these predictions (Adner & Kapoor, 2010; Boudreau, 2010; Brynjolfssen & Kemerer, 1996, Gandal, 1994; Landsman & Stremersch, 2011; Schilling, 2002; Seamans & Zhu, 2013; West, 2003), yet also often exposed more complex nuances such as learning effects (Schilling, 2002), the effect of distinctly different buying behavior by different market segments (Rietveld & Eggers, 2016), the effects of producing complements for multiple platforms ("multihoming") (e.g., Cennamo & Santalo, 2013; Rysman, 2007; Tanriverdi & Lee, 2008), credible commitments and signaling (Gawer & Henderson, 2007), and more (see a review by Birke, 2009). Furthermore, though early work on network externalities often emphasized the actions of independent industry players and the emergence of dominant platforms through the interplay of market forces, a growing awareness has emerged that most successful platform ecosystems become successful through the deliberate and strategic orchestration of a platform governor – that is, they are carefully managed by a single player that possesses a high degree of architectural control (Boudreau & Hagiu, 2009; Eisenmann, Parker & Van Alstyne, 2009; Schilling, 2009). Research on whether and how platforms owners govern their ecosystems is still relatively scant, but the area is attracting growing interest (Adner & Kapoor, 2010; Tiwana, 2014; Wareham, Fox & Giner, 2014). High profile industry examples of ecosystem governance decisions, such as the Apple and Tesla examples mentioned previously, have highlighted our need to better understand the influence of a platform's strategies with respect to governing its complements ecosystem.

Our contribution in this study is twofold. First, we integrate ideas from work on network externalities and value-based strategy to develop a parsimonious framework of value creation and value capture in platform markets, and outline some of the main objectives and governance strategies of platform owners. Some of the key takeaways from this framework include: a) though platform owners seek both depth and breadth of complements to attract and satisfy customers, quality concerns, competition between complements providers, and resource constraints create strategic trade-offs the owner must manage in determining whether and when to promote individual complements, and b) because the platform owner is not only concerned with value creation but also its own ability to

appropriate as much of this value as possible itself (*value capture*), it also seeks to manage its ecosystem in a way that strengthens its own bargaining power while limiting the bargaining power of individual complements producers. This framework yields several testable predictions about how platform owners manage their ecosystem of complements through selective support and promotion of individual complements. Second, we empirically examine these arguments by using data on how seventh generation video game consoles (Microsoft Xbox 360 and Sony Playstation 3) selectively invested in promoting individual complements (games) to manage the value creation and value capture in their overall ecosystems. We further examine how those investments interacted with the original performance of the complement, and how that interaction is influenced by the temporal dynamics unfolding in the ecosystem.

2. VALUE CREATION AND CAPTURE IN PLATFORM MARKETS

A platform owner wishes to increase the value of the overall ecosystem it governs (*value creation*), and its ability to extract value from that ecosystem itself (*value capture*) (Bowman & Ambrosini, 2000; Brandenburger & Stuart, 1996). Increasing the value of its overall ecosystem increases its direct profitability because the platform owner typically captures profits both from the sale of its platform, and captures a share of the value created by each member of the ecosystem. For example, a successful videogame ecosystem yields profits to the platform owner both through sales of the console, and royalties from games (Schilling, 2003). The degree to which the platform owner can capture the value created, however, will be influenced by its bargaining power vis-à-vis the bargaining power of complements producers. Producers of extremely successful games, for example, will be able to negotiate better royalty terms from console producers, and may resist exclusivity agreements (Johns, 2006). To manage both value creation and value capture simultaneously can be complex. There can be a delicate balancing act between attracting valuable complements and retaining bargaining power so that producers of complementary goods do not appropriate most or all of the value of the ecosystem. Furthermore, there are temporal dynamics that influence how value is created and captured across different stages of the lifecycle of a platform.

The factors that will have the greatest influence on the value of the overall ecosystem are a) the functionality of the platform itself, b) the functionality of individual complementary goods, which is in part due to their interaction with the functionality of the platform, and c) the depth and breadth of the range of complements in the ecosystem. The division of value capture will be most influenced by the relative bargaining power of individual complements, and the marginal value they gain from the support of the platform.

2.1. Platform Functionality

The functional performance (e.g., speed, fidelity, ease-of use, etc.) of the platform itself is typically readily observable, and is important for attracting complementary goods providers as well as customers, and thus directly affects how the value of the overall ecosystem evolves. This is particularly important early in each generation's lifecycle when the value of the overall ecosystem is still evolving. The aesthetic qualities and ease of use of the iOS and iTunes platforms, for example, were major draws for consumers – even people who were not enthusiastic users of mobile phones or fans of the Apple Mac OS could not help but be entranced by the smooth scrolling and vibrant appearance of the Apple iPhone, or the simplicity of the iTunes system for downloading and organizing music. Similarly, in each generation of video game consoles, platform owners introduced consoles that had two or three times the processor speed and major increases in hard drive storage over previous generations (Schilling, 2003). In recent generations, firms have spent as much as $500 million in R&D to develop highly advanced video game consoles that offer major advances in performance.

2.2. Complementary Goods Functionality

The functional performance of individual complementary goods will also typically be extremely important to the value of the overall ecosystem. Exceptional complementary goods can have disproportionate influence on customer adoption (Binken & Stremersch, 2009; Kim, Prince, & Qui, 2014; Lee, 2013). Many game console customers, for example, will choose their console based on the availability of one or a few highly desired games. Similarly, it is well understood that a "killer app" can make or break a computing or smartphone platform. Platform owners do not, however, have complete control over the complements produced by third-party complementors – they can only incentivize them, screen them, and (as discussed more later) provide some signaling about those complements to the end customer. Furthermore, the functional performance of complements developed by third parties will also be linked to both the quality of the platform (because a low quality platform typically limits the functionality of its complements) and the installed base of the platform (because platforms with larger installed bases attract more complements and provide greater incentive for investment in those complements than platforms with small installed bases). The platform producer thus elicits the attention and cooperation of third-party complementors by signaling them about the quality of its platform and its likelihood of success in the marketplace. The interests of the platform producers and third-party complementors are largely aligned (in that both groups want the platform to have a large installed base and for complements to sell well), but both groups face resource constraints and must make strategic choices about where to make their investments.

2.3. Complementary Goods Depth and Breadth

Finally, the depth (e.g., number and quality) and breadth (e.g., diversity and range) of an overall ecosystem can be important both in an individual customer's purchase decision (i.e., when customers seek a variety of complements), and for reaching different segments of the market that have heterogeneous preferences (Boudreau & Haigu, 2009; Rietveld & Eggers, 2016). Customers only buy platforms for which they believe the range of their complements needs will be met (Dubé, Hitsch, & Chintagunta, 2010). Computing platforms that lack software programs that customers need, for example, will be spurned; gaming consoles that lack games in particular genres the customer enjoys will be avoided. More generally, ample evidence exists in the economics literature showing a relationship between the number of complements available for a platform and the adoption of said platform by end-users (Clements & Ohashi, 2005; Nair, Chintagunta & Dubé, 2004), as well as an additional marginal benefit from the number of complements that are exclusive to a particular platform (Corts & Lederman, 2009; Landsman & Stremersch, 2011; Lee, 2013).

2.4. Bargaining Power and Differences in Marginal Value

The preceding indicates that the platform owner wishes to attract and retain complements of the highest quality, across a diverse range of categories. To some degree, the platform owner's bargaining power is a direct function of the value it creates in the overall ecosystem. Complements producers want to be part of the most successful ecosystem, and therefore are more likely to be loyal and agree to licensing terms that are favorable to the platform owner. The story, however, is not as simple as it appears. First, extremely popular complements also typically have high bargaining power: They can extract better terms from the platform owner, and they are more likely to refuse an exclusivity agreement to the platform owner, thereby reducing the amount of value that the platform owner captures from the complement (see Johns, 2006 for an overview of issues relating to complementors' bargaining power in the context of the console video game industry). Second, the value of the complement is not independent of the actions taken by the platform owner: It can increase (or decrease) both the performance and visibility of the complement through its own strategic actions, such as giving it earlier or deeper access to the platform's specifications (thereby enabling the complement to have greater performance), or by endorsing the complement to give it prominence among the platform's customers. Third, it should be readily apparent that the marginal value of privileged access or an endorsement is a nonlinear function of the complement's standalone performance: Poorly designed complements cannot be made into "stars" by giving them earlier or deeper access to specifications or by giving them endorsements, suggesting that there are some positive interaction effects between the underlying quality of the complement and the boosting strategies of the platform owner. However, it is also likely that at some point diminishing returns set in: The amount of improvement in either performance or visibility available to an already exceptional complement may be

limited (see, for example, Adner & Zemsky, 2006; Rietveld, Lampel, & Bellavitis, 2013). Therefore the marginal gain to a complement of a platform's boosting efforts for it might be highest for great-but-not-best complements.

Consider, for example, the strategy of International Management Group (IMG), the world's first sports management agency. IMG earns its revenues by a) securing endorsement deals for the athletes from which IMG will draw a share, b) helping to place the athletes in major tournaments where they can win prizes from which IMG will receive a cut, and c) helping the athletes manage their overall careers to maximize their lifetime value. Having top performers helps ensure that IMG's athletes win more and larger purses; having those top performers in a wide range of sports helps IMG to craft lucrative endorsement deals from clients such as Rolex, Nike, Mercedes, etc. who often wish to contract for a bundle of sporting events simultaneously. The very top performers, however, such as Tiger Woods in golf or Roger Federer in tennis, have considerable bargaining power to craft contracts that favor them. They do not need a management agency's help to get invitations to prestigious tournaments or endorsement offers. It is instead the up-and-coming athletes who reap the greatest potential gain from working with an excellent talent management agency (this is, of course, only valuable if the athlete can deliver the expected performance). Up-and-coming athletes know that IMG can help make them into a highly-paid, highly visible star. They also know that if they alienate IMG, IMG might find ways to exclude them from events, camera shots, and broadcast mentions. The up-and-coming athlete, then, is likely to be loyal and willing to give IMG very good terms in their management contract.

IMG thus strategically manages its stable of talent in a delicate balancing act: It must attract and retain stars to increase the value of the overall ecosystem, but it gets the most leverage from the investments it makes in boosting the value of up-and-coming athletes. Platform owners in many industries face a similar balancing act. They want to attract and develop exceptional complements that boost the value of their overall ecosystem, but exceptional complements will also be able to capture more of the value in the overall ecosystem (see Figure 1). The platform owner thus seeks to manage the ecosystem in a way that creates value in in the ecosystem while also retaining its ability to capture much of that value through strategies as described below.

---INSERT FIGURE 1 HERE---

3. PLATFORM OWNER STRATEGIES TO CREATE AND CAPTURE VALUE

Platform owners have a number of strategies they can employ to increase the availability and quality of complements available for their platforms, and thus the value created by their platform for the end-user. First, platform owners can invest in developing complements themselves. Consistent with this, Schilling (2003) finds that every successful game console producer has also made a significant number of in-house

games (sometimes up to 30% of total titles) to ensure that quality games were available at launch. Consoles that relied heavily on third-party developers (e.g., 3DO's Interactive Multiplayer, NEC's Turbografx 16, Atari's Jaguar) failed.

Second, platform owners can subsidize complements production (Corts & Lederman, 2009). Though video game console producers do not typically pay directly for games to be developed for their consoles, they do invest heavily in tools to make it easier to develop games for their consoles. For instance, one of Microsoft's advantages in entering the videogame console industry was that it could leverage its DirectX software development kit which provided runtime libraries, documentation, and headers for use in coding. DirectX was already familiar to many PC software and game developers and made it much simpler for them to develop Xbox games.

Third, as long as compatibility is selective and controlled (through, for example, licensing agreements), platform owners can screen and control the quality of complements. In the videogame industry, for example, game developers have to submit their games to the console producers for approval (a procedure referred to as "lot check") before those games are authorized for production. This is as important to other complements developers as it is to distributors and end customers; a platform that allows complements unrestricted access to the platform, particularly if they are of variable quality, dilutes the incentives of its complements providers (Boudreau, Lacetera, & Lakhani, 2011). Though a complementor benefits from a valuable ecosystem that attracts customers to the platform, and part of that value is driven by the breadth and depth of complements availability, beyond some threshold of breadth and depth, additional complements impose more costs in the form of competition to any given complements provider than benefits created by making the ecosystem more attractive to customers (Boudreau & Jeppesen, 2014). Furthermore, if complements are of variable quality, poor quality complements create signals to customers that can have negative externalities for high quality complements (a negative "halo effect") (Huber & McCann, 1982; Janakiraman, Sismeiro, & Dutta, 2009). In absence of the ability to directly discriminate about the quality of a product, customers will use other observable attributes to make inferences about the unknown attributes (Boatwright, Kalra, & Zhang, 2008; Sine, Shane, & Gregorio, 2003). If customers observe (or hear about) poor quality complements in a platform's ecosystem, customers may rationally infer that the platform does not have strict quality standards, and thus they may adjust their perception of the expected quality of the overall ecosystem, and its constituent complements, downwards.[1] It is thus important to all complements providers (and customers, and distributors) that complements quality is controlled.

[1] Many industry spectators have attributed the 1983 crash of the video game industry to the release of a single high-profile, poor-quality, video game. In 1982, platform market leader Atari had obtained the exclusive licensing rights to Steven Spielberg's movie E.T., but was given an extremely tight deadline for the production of the game in order to have its release coincide with the launch of the movie in December. The high profile release of a rushed-to-

Finally, platform owners can provide direct promotion of particular complements to enhance their value. This selective promotion of particular complements has been relatively understudied, and is the focus of our empirical study.

3.1 Selecting Complements for Promotion

One of the key ways that platform owners influence the value of their ecosystem is through selectively promoting individual complements that a) offer the most opportunity for marginal value creation, and b) enhance the platform's bargaining power, and therefore its ability to capture value in the ecosystem. In many ecosystem industries, one of the primary ways that the platform owner promotes individual complements is through endorsements. By endorsing a particular complement, the platform owner helps to direct customer attention to it (increasing its visibility and saliency), and provides information that serves as strong signal of the complement's quality. When there are a large number of complements competing for users' attention, even high quality complements may go undiscovered. An award or endorsement can significantly increase awareness for such complements. For example, Apple's staff picks applications and games to feature in categories such as "Best New Apps," "Best New Games," "Hollywood Hits," etc. on the opening page of its App Store. Applications that are featured by Apple in this way may get up to six times as many downloads as other applications during the period they are featured (Broekhuizen*et al.*, 2013; Koetsier, 2014). In industries such as films, books, and video games, producers often relaunch their products after receiving an award, adding the award to the packaging or advertising of the product. An endorsement of a complement by a platform owner (e.g., having a complement identified as "Best of" its category) is, as we will discuss at greater length below, a powerful way to signal customers about the quality of the complement, and to help customers sort between multiple competing complements. For example, Sony PlayStation awards the best games of each console generation with the title, "Platinum: The Best of PlayStation." It describes this award with the following (Sony, 2006): "Games that warrant a Platinum release are the cream of the crop, the very best games that have been published for PS2. They're often titles that are innovative in their design and feel, offer immersive gameplay, wowed game critics and received their fair share of accolades and awards." Nintendo similarly has a "Nintendo Selects" endorsement title, and Microsoft has a "Microsoft Xbox 360 Classics" endorsement title.

The console video game industry is an exceptional context in which to examine the interactions between performance, endorsements, and timing, because though games may have some signals about

market product left many disappointed consumers wary of buying additional games, triggering the sudden demise of the industry at large. After the collapse of the game industry in 1983, Nintendo regained consumer confidence by introducing its emblematic "Seal of Quality". The platform enforced strict publishing guidelines for third-party game developers, exerted tight control over platform entry, and set minimum order thresholds for game cartridges to ensure a certain level of quality for the games entering its platforms (Rietveld & Lampel, 2014).

their quality at release (e.g., it may be developed by a dominant publisher, be a sequel to a previously successful game, or feature big stars), the "feel" and infectiousness of a game is difficult to know in advance (Rietveld *et al.*, 2013). A user's experience of a game is a highly complex combination of visual, auditory, motion, and timing elements. Some games spark the imagination and/or induce an adrenaline response that enables nearly complete suspension of disbelief. A game can be so compelling that it is addictive (Kuss, Louws, & Wiers, 2012; Tejeiro Salguero & Moran, 2002). Other games, despite careful thought into plotlines or heavy investment in graphics, remain dull, confusing, or otherwise non-captivating. For these reasons, a game's success, or its selection by the platform owner as a "Best of" game, provide high payload signals to a potential customer.

Though a platform owner can provide an endorsement at little direct cost, the endorsement is still a highly constrained resource because if the platform awards too many, it dilutes the meaning of the endorsement and the value of endorsement is eroded. Platform owners want complements to be successful in part because the success of the complements drives the success of the platform, and in part because the sales of complements provide direct cash flow to the platform owner in the form of royalties. The platform owner therefore desires to maximize the impact of the endorsement.

As argued previously, a platform's strategy of investing in the success of individual complements will be shaped by its desire to both create and capture value in its overall ecosystem. Complements enhance the value of the overall ecosystem both when they have high functional performance on a standalone basis, and when they collectively offer depth and breadth of selection to the customers (see figure 1). We treat each of these in turn below.

First, with respect to standalone functionality of the complement, it should be clear that the platform owner is more likely to endorse complements that have exceptional quality and demonstrable superior performance. The reasons for this are twofold: a) The endorsement is a signal of quality and if the platform owner provided that signal about a complement that was actually of low quality, it would violate the trust between the platform owner and the customer, and would erode the customer's faith in the endorsement, thereby eroding its value in future deployment and the platform owner's overall reputation; and b) if a complement already has high quality and mass market appeal, using an endorsement to help customers identify that complement can result in a much greater sales increase (in absolute terms) than applying that endorsement to a weaker complement. However, while it is easy to assume a platform will simply endorse the best performing games, this is often not its best strategy for maximizing its value creation and value capture: The platform owner needs to take into account the range and quality of complements, their opportunity for sales increase, their competitive interactions, and their bargaining power. First, as argued previously and illustrated by the IMG example, the platform owner's ability to increase the standalone value of a complement may be greater for complements whose full value

has not yet been recognized – the "up and coming" complements. This suggests that platform owners are likely to endorse complements that have high quality, and high initial sales performance but are not yet the market leaders in their categories:

Hypothesis 1: Platform owners will be more likely to endorse complements that experts have assessed as being of exceptional quality.

Hypothesis 2: Platform owners will be more likely to endorse complements that have demonstrated superior initial sales performance but are not yet market leaders.

Next, because platform owners need to manage the collective value creation of the overall ecosystem, they will be influenced by the contribution individual complements make to the overall ecosystem depth and breadth. This suggests that platform owners will be inclined to spread their endorsements out over important categories rather than choosing complements to endorse purely on their standalone performance. For example, if a platform does not have a high selling complement (e.g., a hit game) in an important category, the platform owner is likely to directly target complements in that category for endorsement in order to raise customers' perception of the quality of the platform's complements in that category, and thus the breadth of the ecosystem as depicted in Figure 1.

Hypothesis 3: Platform owners will be more likely to endorse complements in high-value categories in which the platform owner does not already have a top-selling complement.

The platform owner's desire to create value in its overall ecosystem also suggests there are implications for the timing of when a platform owner will endorse a complement. First, because the platform owner wishes to maximize the impact of its endorsements, it prefers to wait until the relative performance of the complements has become clear for reasons that have been discussed previously. Second, because complements are competing against each other (and the platform owner does not wish to lose the support of any of them), it is politic for the platform owner to not choose winners and losers too early in the generation's lifecycle. Third, the platform owner may wish to use endorsements to generate new "buzz" about the platform, thereby reinvigorating platform sales and helping to smooth cash flows. Notably, the signal of the endorsement is likely to stand out more clearly in a market that is not currently awash with promotional media about new complements and platforms. Finally, waiting to endorse a complement provides an opportunity to promote the product to a new market segment of end-users that has come to the platform later in the lifecycle. This enables the complement to generate a new wave of sales that extends the lifecycle of both platform and complement.

Both cash flow smoothing and tapping a later audience are evident in the following quotes we obtained during an interview with a senior marketing manager at one of the platform owners, "When the platform is coming to the end of its life there is a new audience, a younger audience, for which price is more of an issue. Rereleasing during this period might help capture this audience with quality games for a

low price. We do take into account the lifecycle of the platform" and "Also, if the calendar is looking empty we will rerelease to fill the catalogue. Contrarily, during Christmas we won't rerelease."

The preceding suggests that platform owners will prefer to endorse during a period in which their sales have begun to decline, and will prefer to endorse games that have had a chance to prove their performance by this time, and be "fresh" to late adopters. Collectively, this implies that platform owners are more likely to select complements for endorsement that were launched early in the platform lifecycle as these games are more likely to have proven their performance by the time platform sales have begun to decline. We thus hypothesize:

Hypothesis 4: Platform owners will be more likely to endorse complements that were launched early in the platform lifecycle.

As argued previously and illustrated in Figure 1, profit-seeking platform owners will be concerned with both value *creation* and value *capture* in their ecosystem. Very successful complements providers may be able to capture most or all of the standalone performance of their product by refusing exclusivity arrangements with a platform and negotiating deal terms that are highly skewed in their favor. Consider the case of the immensely popular video game series Grand Theft Auto (GTA). From 1997 until 2004 when *GTA: San Andreas* was released, the franchise was licensed exclusively to Sony PlayStation platforms. *San Andreas* accumulated nearly 21 million unit sales on the PlayStation 2, turning it into the highest selling GTA game to date. This success, however, led to publisher Take 2 Interactive raising the price for exclusivity. Because Sony was also facing rising development costs for its seventh generation game consoles, it opted not to pay the high price and when the next game in the GTA series came out, the series was no longer exclusive to Sony. Furthermore, when Take 2 set out to release two additional content packages for the hugely popular *GTA IV* game, Microsoft allegedly paid $50 million to have these *Episodes from Liberty City* exclusive on the Xbox 360 platform for a limited amount of time. Sony lost further bargaining power with Take 2 Interactive in the seventh generation video game consoles due to a deteriorated market share vis-à-vis rivals Microsoft and Nintendo.

When complements are not exclusive, investments the platform provider makes in enhancing the reputation of a complement are likely to spillover to versions of the complement designed for other platforms, thereby benefiting other platforms. These arguments reinforce our earlier hypothesis that the platform owner may prefer to not endorse complements that are the market leader in their category. Further, these arguments suggest that platform owners may prefer to endorse complements that are exclusive to their platform; to do otherwise would partially subsidize the success of competing platforms.

Hypothesis 5: Platform owners will be more likely to endorse complements that are exclusive to their platform.

3.2. The Effect of Endorsements on Complement Sales

An endorsement enables the platform owner to directly increase the value of a complement by a) providing a positive signal of its value to end consumers, and b) creating an opportunity for new promotion. Collectively, this can enable a publisher to re-kindle enthusiasm for a game and tap portions of the market that have not yet been reached. Take for example, *Uncharted: Drake's Fortune*, a third-person shooter game for the PlayStation 3 platform. The game was launched in time for the 2007 Christmas season, and sold 205,902 copies before being endorsed and re-released on August 5th, 2008. As shown in Figure 2, sales of the game had flattened prior to the endorsement, but the endorsement and re-release was accompanied by a significant acceleration in sales. The game went on to sell 139,274 units after the endorsement, bringing total unit sales of the game to 345,176. We thus start with the following baseline hypothesis:

Hypothesis 6: An endorsement by the platform owner will positively influence the sales performance of a complement.

--- INSERT FIGURE 2 HERE ---

Furthermore, in product categories in which there are self-reinforcing "tipping" effects, an endorsement may cause a product to gain a boost in adoption that fuels increasing returns. There are strong tipping dynamics in video games for at least two reasons: First awareness of games spreads largely through a social diffusion process and unfettered social diffusion tends to result in highly self-reinforcing feedback effects that can lead to exponential growth until saturation or some other limiting factor kicks in (Salganik, Dodds, & Watts, 2006).[2] Second, gaming enthusiasts will tend to buy many game titles and do so early in the lifecycle of the console. Later in the lifecycle of the console, casual gamers enter the market who may purchase only a few game titles (Juul, 2010; Rietveld & Eggers, 2016). These individuals will tend to select carefully, choosing only those games that are already well-known to be high-quality and/or popular, increasing the selection pressure that favors already popular games. Both of these dynamics should lead game sales to have a skewed distribution with a long right tail: Most games will perform poorly and some games become blockbuster hits. Consistent with this, evidence suggests that a small number of games tend to share the vast majority of video game revenues (Clements & Ohashi, 2005; Cox, 2014; Shankar & Bayus, 2003).

But which complements gain the most from the boost in recognition offered by the endorsement? As argued earlier in the paper, a platform owner may be able to create the most value for complements whose full value has not yet been recognized by the market -- "up and coming" complements. For these

[2] Consider a social network where ten individuals each recommend a product to ten of their friends, and those friends each recommend the product to ten of their friends and so on. Ignoring redundant connections, the individuals receiving recommendations for the product will increase at 10^n where n represents the number of periods in which recommending takes place.

complements there may be strong synergies between their inherent quality and endorsement benefits. An endorsement that unlocks the "star" potential of a game by revealing its quality to the market could thus lead to a very large increase in its sales.

By contrast, complements that are market leaders in their categories may already be so recognized by the market that the investment of additional promotion by the platform owner has little marginal effect. They have already "tipped." This is consistent with arguments by Adner and Levinthal (2001) and Adner and Zemsky (2006) that when there are already robust quality signals about a good, there may be diminishing marginal utility in providing yet another signal of the quality of the good. If a complement has many positive signals of its value, the buyer's needs may be largely sated, lessening the additional value an endorsement yields. In this case, we might expect the endorsement to have a sub-additive interaction with its previous performance.

Furthermore, poor quality complements typically cannot be made into "stars" by simply endorsing them (and platform owners face strong incentives to not endorse poor complements, as discussed previously). We therefore predict that the strongest benefits of endorsements will be reaped by complements that have high quality, but not market-leading sales performance:

> *Hypothesis 7: Complements that have exceptional quality but not superior sales performance will experience greater sales increases subsequent to endorsement than those with superior performance or low quality.*

3.3. Temporal Dynamics and Value Contribution

In general, in industries characterized by rapid technological change, time tends to erode the value of the original offering. To maintain a product's value, firms can add endorsements, features and services to counter, or even reverse, this erosion effect (Sirmon & Hitt, 2003). This raises the question, then, of whether the timing of endorsement influences the value it creates. If the value of the endorsement interacts positively with the value of the complement to which it is added, the endorsement should be conferred early, before the value of the complement has had a chance to erode. On the other hand, if adding the endorsement enables the firm to tap a different population of buyers that enters the platform at a different time, then the endorsement should be timed to maximally impact that audience.

Both of these dynamics are at work in the video game industry. First, there is ample evidence that the value of games erodes rapidly. In general, the enthusiasm for and sales of a game are highest in its first few weeks after launch (as illustrated previously in the example of Uncharted: Drake's Fortune in figure 2). An early endorsement might be able to amplify the enthusiasm for the game, particularly if the game is launched into a market where customers are trying to select between several competing alternatives. Games also tend to get most of their press attention (including expert review scores) very

early in their lifecycles, suggesting that the visibility of an endorsement would be heightened if it is given early.

On the other hand, customers in the platform lifecycle are heterogeneous in a way that suggests that later endorsements could be more valuable by tapping into a new customer segment previously under-represented on the platform. According to Rogers (2010), innovators and early adopters (the first 16% of the market to adopt a new product) tend to be well-informed; they are avid and sophisticated consumers of information. In the gaming industry, such customers would be termed "gaming enthusiasts" or "hardcore gamers". Enthusiasts buy both consoles and games soon after launch, will tend to buy many games, and have a great appetite for information about the games as obtainable from friends, websites, magazines, etc. (Juul, 2010). By the time an exceptional game is endorsed by the platform, enthusiasts already know (and likely own) the game. The endorsement thus has little opportunity to influence their purchase behavior. Early majority or late majority adopters, on the other hand (i.e., "casual gamers"), tend to be more risk averse, tend to not be as interested in technical information about a product, and are more likely to buy a product only after a significant portion of their social network has already purchased it (Rogers, 2010). For these adopters, an easily obtainable signal that a game is one of the best games on a platform is very important information that can have a strong influence on their purchase decision. Furthermore, because late adopters buy fewer games overall, the sorting process becomes that much more influential in driving the selection of "winning" games from average or losing games, leading to a bigger sales differential for blockbuster games when endorsements occur later in the platform's life.

It is difficult to know how these effects should aggregate: Is the excitement-amplification advantage of early endorsement greater than the new-market-tapping advantage of late endorsement? We will address this strictly as an empirical question by posing the following competing hypotheses:

Hypothesis 8a: Complements that receive an endorsement earlier in their lifecycle will reap greater sales increases.

Hypothesis 8b: Complements that receive endorsements later in their lifecycle will reap greater sales increases.

4. DATA AND METHODS

4.1. Data

We test our framework in the context of console video game platforms. Game consoles are a fitting setting given their "canonical" features as a multi-sided platform (Cennamo & Santalo, 2013; Clements & Ohashi, 2005; Dubé *et al.*, 2010). Platform owners such as Sony PlayStation and Microsoft Xbox invest heavily in designing technologically superior platforms that are released to the market approximately every seven years. In order to quickly ramp up demand from end-users at early stages in the platform

lifecycle they often price their consoles at or below cost. Console makers capture value both from their own video games, and from licensed video game publishers such as Electronic Arts, Activision, and Ubisoft. As described previously, console owners also carefully govern their platforms to assure both depth and breadth as well as sufficient quality in the pool of games available for purchase on the platform. A key governance mechanism that console manufacturers deploy to curate their platforms is the use of endorsements to promote individual video game titles. 13% of seventh generation video games (i.e. PlayStation 3 and Xbox 360), and just under 11% of sixth generation video games (i.e., PlayStation 2, GameCube, Xbox) were chosen for endorsement and re-released into the market.

We collected longitudinal data on seventh generation video game consoles and video games launched in the United Kingdom between 2007 and 2011. The data include weekly observations for all video games released on Sony's PlayStation 3 and Microsoft's Xbox 360.[3] Sales data and additional measures at the game level (e.g., publisher, genre, price, and release date), were provided by one of the platform owners, and are comprehensive in that they include 90% of all retail transactions in the UK (both online and brick-and-mortar). Data on platform sales were also provided by the platform owner and are measured at the platform-month level. We complemented these data with hand-collected data on expert review scores from review aggregation website Metacritic.com. At the time of data collection, Metacritic tracked 146 online and offline trade publications from which it aggregated and weighted into an average expert review score (or, 'Meta-score') at the game-platform level. Meta scores range from 0 to 100. Because producers will only endorse games after they have met a certain sales threshold in the European market (Sony, 2006), we collected additional sales data for the wider European market. These data were collected from online sales-tracking database VGChartz.com and are expressed in millions of unit sales.

We excluded games from our analysis that were released in 2011 to allow for a minimum lifecycle of one year; games generate the vast majority of their sales within their first six months of being on the market (Binken & Stremersch, 2009). We further excluded five (non-endorsed) observations with extreme values and 27 (non-endorsed) games that were missing values in the European sales measure. Our final sample comprises 475 PlayStation 3 and 536 Xbox 360 games of which, respectively, 65 and 68 games received an endorsement.

[3] We exclude Nintendo's Wii platform from our analyses for two reasons. First, games released on Nintendo Wii deviate in terms of content due to the console's technical specifications and motion-controlled player input. Comparing games for Wii with games for PlayStation 3 and Xbox 360 could thus raise issues of unobserved heterogeneity. Second, Wii was the first Nintendo console to adopt the "Nintendo Selects" label for its endorsements rather than the iconic "Player's Choice" label that had been in place since 1996. Hence, the value of the new label to consumers and publishers is unclear and could obscure our findings.

4.2. Measures

Dependent variables. Our first five hypotheses pertain to platform owners' strategic selection of video games for endorsement. *Endorsed* is a dummy variable that takes the value of 1 if a game is relaunched to the market with a platform endorsement. The unit of analysis for this measure is the game-platform level.

To measure the effect of receiving a platform endorsement on sales (H6), we analyze games' *unit sales* at the game-platform-week level. We identify the effect by narrowing our focus to a subsample of 25 matched pairs wherein the same game was released on both PlayStation 3 and Xbox 360 but only endorsed on one of the platforms. A game that multi-homes is nearly identical in its aesthetic design, structural characteristics, game play, released date, marketing budget, and performance. Because the game is nearly identical on both platforms but only endorsed on one, we have a unique opportunity to separate the effect of endorsement from the effects of other characteristics of the game using a game-pair fixed effects difference-in-difference specification akin to a natural experiment (discussed in more detail below). We log-transform games' unit sales to fit a normal distribution.

To test H7 and H8 we focus on the *sales increase* in unit sales from the endorsement. The measure is operationalized as below:

$$Sales\ increase_{ij} = \frac{Total\ unit\ sales_{ij}}{Pre-endorsement\ unit\ sales_{ij}} - 1$$

Where $_i$ denotes the game and $_j$ denotes the platform a game is released on. We compare this measure for all 133 video games that receive a platform endorsement to assess which games benefit the most from endorsement and how time moderates the sales increase. It is imperative to use a relative measure rather than an absolute measure since more successful games will enjoy thicker tails at the end of their lifecycles compared to less successful games irrespective of receiving a platform endorsement (Binken & Stremersch, 2009).

Independent variables. H1 and H7 study the effect of quality as assessed by expert reviewers. We use Metacritic's reported Meta-score as a measure of quality. To distinguish the quality of games we create three categories in adherence to Metacritic's colored grading schema: We label games with scores ranging from 75 to 100 as being of *high quality*, we label games with scores ranging from 50 to 74 as being of *medium quality*, and we label games with scores up to and including 49 as having *low quality* (Metacritic, 2015). Games with low quality expert scores are excluded from analyses and used as base category in our regression models. The reported coefficients should thus be interpreted as effect sizes relative to games with low review scores. Our reported results are robust to alternative categorizations for the review score.

H2 and H7 pose relationships involving games' initial sales performance. To test these relationships we look at games' first week unit sales and rank these at the platform-year level. We use

first week sales for two reasons. First, in markets for entertainment goods, including video games and motion pictures, first week sales are often indicative of total sales and still tend to be relatively uninfluenced by external factors such as review scores and bandwagon effects (Basuroy, Chatterjee, & Ravid, 2003). Secondly, we take a relatively narrow approach to avoid including any sales that occur after the decision to leverage a platform endorsement has been made to avoid concerns of reversed causality. We do not have to be concerned about variation caused by differences in the weekday of a game's release as all games in a given geographic market are typically launched on the same day of the week (Levy, 2014). Our reported results are robust to using first month sales as basis for sales rank instead of first week sales. In order to distinguish between market leading games, games with superior (but not market leading) first week sales, and games with sales below these thresholds, we break up the sales rank measure into four dummy variables: *Top 1% sales rank* (i.e. market leaders), *top 2%-5% sales rank* (i.e. superior games), *top 6%–20% sales rank*, and *low sales rank (21%-100%)* In the models testing H2 we exclude games with low sales rank as base case. For H2 to hold, games with top 2%-5% sales rank should have a positive impact on the probability of endorsement, more so than games with market leading sales (top 1% sales rank). For H7 to be supported, there needs to be a positive interaction between games with low sales rank and high expert review scores.

To test if platform owners are more likely to endorse games in a high-value genre in which the platform owner does not already have a top-selling game (H3), we construct two variables that are then interacted. The first is a variable that captures whether there has been no prior hit at the platform-genre-year level. *No prior hit in genre* is a dummy variable that takes the value of 1 if there is no top 20% ranked game (in first week unit sales) in the same genre and platform of the focal game in the year preceding its release. We then create a measure of *value of genre* by ranking the genres by total sales for each year. If H3 is correct, we would expect a positive coefficient on the interaction between these two variables.

To test H4, we measure *platform age* as the age of the platform at the time of a game's launch in quarter years (i.e., each unit of age is three months).[4] Since games launched earlier in the platform's lifecycle will be more likely to have proven their performance, we expect a negative coefficient for this variable. To test the effect of a game being exclusive to a particular platform (H5), we look at the broader population of game releases (i.e. PlayStation 3, Xbox 360, and Wii) and count the number of platforms a game is launched on. *Platform exclusive* is a dummy variable that takes the value of 1 if a game is released only on the focal platform.

[4] We use units of three months rather than more granular measures to facilitate interpretation of the coefficients.

To test competing hypotheses H8a and H8b that posit relationships between the moment of endorsement in games' lifecycles and the sales increases that they reap, we measure the time from games' initial launch dates to the date of their endorsed re-launches. *Age at endorsement* registers the age of the game (in days) at the time of games' endorsed re-launches. Since this variable is non-normally distributed we log-transform this measure to better fit our models.

Control variables. Throughout all our models we control for the platform on which a game is launched. *Xbox 360* is a dummy variable that takes the value of 1 if a game is launched on Microsoft's Xbox 360 platform (the obtained coefficient is relative to games launched on PlayStation 3). In our cross-sectional models testing H1-5 and H7-8 we control for a game's genre by including seven genre dummies and omit the "Action" genre as base case.[5] In these models we further control for seasonality by including 11 calendar month dummies and omit January as base case. As noted above, because games producers will only endorse games that exceed a certain threshold of sales in the wider European market, we further include a game's *European unit sales*. We log-transform this measure to improve its approximation to the normal distribution. Notably, including this measure could dampen our ability to pick up the UK sales rank effects, making our test more conservative. Using indicators of certain sales thresholds (e.g. 400,000 units), or omitting the variable altogether, produces similar results as those reported. In the models predicting the sales increase (H7-8), we also include a measure that registers the amount of time an endorsed game is in the dataset to control for any variance caused by differences in the length of the endorsement period. *Length of endorsement period* measures the time (in quarter years) between the launch of the endorsement and the end of the dataset.

In the video games industry indirect network externalities (i.e., the effect of sales of the platform on the sales of games) tend to be strongly positive (Katz & Shapiro, 1985; Parker & Van Alstyne, 2005), while direct or same-side network externalities (the effect on sales of any one game of having more games on the same platform) can trigger a competitive crowding effect (Boudreau, 2012; Boudreau & Jeppesen, 2014; Venkatraman & Lee, 2004). We thus include measures of direct and indirect network externalities in the panel models estimating weekly unit sales (H6). We control for indirect network effects by counting the number of new platform adopters at the platform-month level. We lag our measure of *platform sales* by one month to circumvent concerns of simultaneity or reversed causality. Additionally, we log-transform this variable to fit a normal distribution. We expect the lagged platform sales measure to positively affect a game's weekly unit sales. We control for same-side externalities with a count of the number of games entering the platform at the platform-month level, *competition*. We also

[5] The following genres are included in the models as controls: Fighting, racing, role playing game (RPG), shooting, simulation, sports, and war.

lag this variable by one month to prevent simultaneity or reversed causality. We expect the lagged number of games entering a platform to negatively affect a game's weekly unit sales.

5. RESULTS

Table 1 shows descriptive statistics and pairwise correlations. Panel A lists descriptive statistics for all variables used in the models estimating the probability of endorsement (H1-5), Panel B lists all variables used in models estimating weekly unit sales (H6), and Panel C lists all variables used in models estimating sales increase following endorsement (H7-8). In Panel A we note a positive correlation between games with high review scores and games that are selected for endorsement. Note also that there exists a negative correlation between games with review scores below the 75% threshold and those that get endorsed by the platform. Furthermore, while we obtain positive correlations between all games that rank in the top 20% for first week sales performance and endorsement, this correlation is markedly lower for market leading games that place in the top 1% sales rank.

In Panel B we note that games have lower weekly unit sales later in their lifecycles as captured by the post-endorsement variable. On average endorsed games have higher weekly unit sales than non-endorsed games lending some descriptive support to H6. Games with higher unit sales charge higher average selling prices, but there is no relationship between average selling price and endorsed video games. Expectedly, weeks characterized by high competition negatively correlate with unit sales for the focal game. Perhaps unexpectedly, we also see that weeks in which the log of platform sales is high negatively correlate with unit sales. The direction of this correlation may change when controlling for confounding effects in our models.

In Panel C we see that endorsed games reap an average 17% sales increase relative to their pre-endorsement sales. We note a positive correlation between sales increase and games with high review scores. The correlation between sales increase and medium review scores is negative. On average, games get re-launched at 65 weeks of age, or just over one year and three months. Lending some credence to H8a, we document a large negative correlation between age at endorsement and sales increase. The high correlation between length of the endorsement period and sales increase is a result of how the data are structured. Games that get endorsed early in the dataset have more time to accumulate a sales increase vis-a-vis games that get endorsed later in the dataset. The strong negative correlations among review score variables in our panels are caused by the variables' categorical and mutually exclusive nature.

--- INSERT TABLE 1 HERE ---

5.1. Selecting Games for Endorsement

In Table 2 we test hypotheses 1 through 5. Models 1-6 report odds ratios estimated via logistic regression (STATA 14). Odds ratios can be interpreted as the effect of a variable on the likelihood of an outcome

(i.e., endorsed) where a value of one means no effect. A value of 1.20 would be read as "a one-unit change in the independent variable is associated with a twenty percent higher probability of endorsement" and a value of 0.80 would be read as "a one-unit change in the independent variable is associated with a 20% lower chance of endorsement. Our results are robust to alternative specifications such as the endogenous treatment regression reported in Model 7, as well as to probit models. Throughout all our models we report clustered robust standard errors (clustered by game publisher) in parentheses.

--- INSERT TABLE 2 HERE ---

In Model 1 we enter control variables. In Models 2-6 we enter independent variables step by step. Model 2 adds variables that indicate a game's review score by expert critics, Model 3 adds indicators for a game's initial sales performance rank, Model 4 adds *no prior hit in genre*, *value of genre*, and their interaction to test H3, and Model 5 and 6 add variables for the age of the platform at a game's launch and whether a game is launched exclusively on one platform, testing H4 and H5 respectively. Our full model (Model 6) fits the data well, and the pseudo *R*-squared suggests that it explains 46% of the variance in the dependent variable. In Model 7 we assess the robustness of our findings by treating *platform exclusive* as endogenous (explained in more detail later in this section).

We begin by interpreting the logistic regression results (Models 1-6). Consistent with H1 we find across all of the models that games with high review scores are significantly more likely to receive an endorsement than games with medium or low review scores ($p < 0.05$). Video games with high expert review scores on Metacritic are sixteen times more likely to receive an endorsement than games with low expert scores. The difference between games with high and medium expert scores is significant at $p < 0.01$. H2 is also supported: Top 20% sales rank games have significantly higher chances of getting endorsed compared to bottom 80% sales rank games ($p < 0.01$). Furthermore, the greatest chances for endorsement appear to occur at the 2% to 5% sales rank, consistent with our arguments about "up and comers." Games with sales performance in the 2%-20% sales rank are significantly more likely to be endorsed than games with market leading (top 1%) sales ($p < 0.01$). Platform owners, however, do not discriminate between games with 2%-5% and games with 6%-20% sales ranks; the difference between the coefficients is not statistically significant. We also find support for H3: Controlling for quality and sales performance, a platform is much more likely to endorse a game that is in a high value genre in which the platform does not already have a hit game. The models also indicate support for H4: Every three month increment in platform age reduces the probability for endorsement by nine per cent ($p < 0.05$). We find no support for H5 (that platform exclusive games are more likely to be endorsed) in Model 6. In Model 7 we explore the possibility that this non-result is driven by unobserved differences between platform-exclusive games and multi-platform games.

Prior literature on platforms and two-sided markets studied the positive impact of exclusive, or single-homing, video games' on platform adoption (Cennamo & Santalo, 2013; Corts & Lederman, 2009; Landsman & Stremersch, 2011). This body of work raises concerns about comparing multi- versus single-homing video games as a publishers' decision to support one or multiple platforms may be strategic. As illustrated by the earlier example of *Grand Theft Auto IV*, a game developer with a strong bargaining position may refuse a platform's terms for exclusivity, while if a platform has a strong (weak) market position, publishers may proactively choose to single- (multi-) home their games. To deal with this potential source of endogeneity we adopt an instrumental variable approach. We estimate an endogenous treatment model via Maximum Likelihood Estimation (MLE) where we include two instruments (plus genre and platform control dummies) in the treatment equation: The *platform-publisher fit*, defined as the average penetration rate, among adopters of the platform, across all games released by the publisher of the focal game at the time of release, and the *publisher's single-homing share*, defined as the extent to which the games of the publisher of the focal game are single-homed at the time of release. In choosing our instruments we model our treatment regression after Landsman and Stremersch (2011). The treatment regression adheres to good econometric practice as our instruments are correlated with the endogenous regressor but uncorrelated with the error term (Semadeni, Withers & Certo, 2014).[6] Model 7 reports the results from the treatment regression. The coefficient for platform exclusive is positive but not significant, indicating that H5 is still not supported. We have conducted additional robustness tests such as isolating third-party exclusive games from first party-exclusive games, but found no support for H5 in any of the alternative model specifications.

5.2. The Effect of Endorsement on Game Sales

Table 3 shows results for H6. To test if endorsements have a positive effect on sales we utilize the longitudinal structure of our data and the fact that 25 games are launched on both platforms but receive an endorsement on only one platform.[7] Put differently, apart from the endorsement, the paired games are nearly identical. This provides a natural experiment-like setting that allows us to test the effect of the endorsement on game sales while controlling for all other factors. Our research design is a difference-in-difference test contrasting sales in periods before and after the endorsement (treatment), for games that received the endorsement (treatment group) and those that did not receive the endorsement (control group) (Card & Krueger, 1993; Imbens & Wooldridge, 2007). We obtain estimates from 8,520 game-week observations of 50 games using a random effects panel regression estimated by Generalized Least Squares (GLS) with firm robust standard errors. We include controls for competition and indirect network effects in addition to game pair, game age, and weeks since endorsement fixed effects. In models 3 and 4

[6] The first stage regression table is available from the authors upon request.
[7] A table that documents the pairs of games considered for analysis is available upon request.

we include pricing data for 5,944 game-week observations as a robustness test to control for any volatility in games' prices throughout their lifecycles.[8]

--- INSERT TABLE 3 ---

Model 1 in Table 3 includes control variables while Model 2 adds the interaction between a dummy indicating whether an observation is post-endorsement for one of the games in the pair, and a dummy indicating the game received the endorsement. We find that games that are endorsed have significantly higher sales in the post-endorsement period (Model 2, *post-endorsement * endorsed*). Exponentiating the coefficients reveals that being endorsed increases a game's sales in the post endorsement period by 105% ($p < 0.01$). This finding supports H6. We also find that our control variables respond as expected: Competition from one added game to the platform reduces weekly sales by 3% ($p < 0.01$), a 10% increase in platform sales boosts weekly sales by 3.6% ($p < 0.01$), and games on Xbox 360, on average, have 79% higher sales ($p < 0.05$) than games on PlayStation 3. In models 3 and 4 we repeat the difference-in-difference estimation to assess the findings' robustness to the inclusion of games' average weekly selling prices. We find that a one pound price increase leads to a 3% reduction in weekly unit sales. That said, the inclusion of this variable does not alter the findings reported in models 1 and 2. Our results are also robust to alternative specifications that include, for example, calendar month fixed effects and the age of the platform as additional controls.

5.3. Moderating Factors on Sales Increase for Endorsed Games

The last set of regressions is reported in Table 4. In these models we estimate games' sales increase subsequent to endorsement as a function of their initial sales interacted with their quality (H7), and the time in between their initial launch and the endorsed re-launch (H8). We estimate games' sales increase via OLS and report coefficient sizes and clustered robust standard errors (clustered by game publisher) in parentheses. Since our dependent variable ranges from zero to one, we can interpret the reported coefficients as percentage changes in the dependent variable in response to a single unit change in the independent variable.

--- INSERT TABLE 4 HERE ---

Model 1 starts by adding control variables. Model 2 adds first order effects, and in Model 3 we add the interaction term to test H7. Model 4 adds the log of games' age at endorsement to test H8a and H8b. Lastly, in Model 5 we assess if and how our findings change when we correct for platforms'

[8] Note that platform owners set recommended retail prices for first-time releases as well as for endorsed re-releases. Though publishers and retailers cannot deviate from these recommended prices, they do have some leeway to change prices as games age and consumers lose interest. We thus do not expect too much variation in prices and use the models including prices as robustness tests.

strategic selection of games for endorsement. We use Model 4 for interpretation of our findings. This model fits the data well and explains 53% of the variance in the dependent variable.

Consistent with our expectation and H7, we find a significant positive interaction effect between low sales rank and high review scores ($p < 0.05$). That is, games with exceptional quality but not market leading sales experience twelve percent higher sales increases subsequent to endorsement than market leaders and games with low quality. Lastly, the results provide support for H8a: The age at which a game is endorsed is negatively associated with its amount of sales increase ($p < 0.01$). Launching endorsed re-releases one standard deviation from the mean, or 272 days later than average, reduces sales increase by two per cent.

In Model 5 we control for platform owners' strategic selection of games for endorsement by following a Heckman selection-correction procedure where the selection equation is based off Model 6 of Table 2 (Heckman, 1979). The combination of a high Pseudo *R*-squared in Model 6 of Table 2, a moderate correlation between the Inverse Mills Ratio (IMR) and *endorsement*, and the insignificant effect of the IMR on *sales increase* lead us to believe that it is unlikely that our results suffer from sample selection bias (Certo *et al.*, 2016). Our results are also robust to the inclusion of additional controls such as the age of the platform.

6. DISCUSSION AND CONCLUSIONS

Value creation and capture is more complex in platform-based markets. The value of the overall system is influenced not only by the quality of individual products, but also by the interactions between them (Adner & Kapoor, 2010). Furthermore, the ability of either platform or complements owners to capture that value will be determined by their relative value contribution and bargaining power. We thus began the paper by developing a framework of how a platform owner governs its ecosystem through its management of platform functionality, complements functionality, and the depth and range of the complements portfolio. We also explain how the value the platform owner captures from its ecosystem is a function of its bargaining power with the producers of its complements, and the degree to which it increases the marginal value of those complements. This suggests, for example, that while platform owners might want best-in-class complements for their system, investment in the "up and coming" complements might enable it to unlock and capture the most value. While previous research has primarily focused on value creation in platform-based ecosystem, our framework is the first we know of to parsimoniously capture both value creation and value capture in platform-based markets.

We then examine the implications of this theory for one of the key ways that platform owners govern their ecosystems: Selective promotion of individual complements through endorsement. Though selective endorsement at first appears to be a relatively simple lever employed by the platform owner, its

strategic use and performance effects are actually quite complex. Platform owners do not just endorse best-selling games; instead they are using endorsements to achieve myriad objectives in the management of their ecosystems. We thus are able to use platform endorsements as a lens to examine several different dimensions of value creation and capture in the video game market, significantly contributing to our understanding of governance in platform-based ecosystems. Using a large dataset on the platform endorsements and sales of seventh generation video games, we find that platform owners select games to endorse not only based on their quality and sales performance, but also on the degree to which they can unlock unrecognized value in the game, and the game's potential to enhance the balance of the overall portfolio. Specifically, platform owners were much more likely to endorse games had high quality but were not market leaders. Furthermore, they were much more likely to endorse games that were in a high-value genre in which the platform had no prior top-selling game. Surprisingly, however, we did not find that platform owners were more likely to endorse games that were exclusive to the platform. We expected that a platform would prefer to endorse exclusive games both because it is likely to have greater bargaining power over that game (and thus can capture a larger portion of the value created through endorsement) and because endorsing a non-exclusive game might have spillover benefits to other consoles. This is a counterintuitive result that deserves further study.

We also examined the effect of endorsement on a game's sales, and whether the game's quality and initial sales performance, or the timing of endorsement, influenced that effect. Using a matched-pair analysis, we found that endorsement has a strong positive effect on its sales – a 105% increase on average after controlling for competitive crowding and the installed base of the platform. We further found that games reaped greater benefits from endorsement when they had high review scores but poor initial sales performance. Both of these findings are consistent with the argument that an endorsement can unlock the value of an underappreciated game and that as a result, the greatest value of endorsement may be to "up and comers" rather than market leaders.

There are also interesting timing effects on both the selection of games for endorsement and the benefit games reap from endorsement. Games were more likely to be selected for endorsement if they were launched early in the platform's lifecycle. This is consistent with our arguments that a platform owner wishes to endorse games only after their performance has been proven, and other things being equal, a game launched early in the generation has more time to prove its worth. On the other hand, we also find that the benefit a game receives from endorsement decreases with the age at which the game is endorsed, even when controlling for the length of the period the endorsed game has to earn revenues. This suggests that platform owners should not wait too long to see if a game proves its worth; they should attempt to identify games with star potential as early as possible.

One of the most interesting aspects of platform-based markets is their network externalities: As the platform's installed base grows it is able to attract more complements, and as the range and quality of complement grows, the platform will attract more customers, thereby increasing its installed base. It is a self-reinforcing effect that suggests that everyone – customers, platform owners, and complements providers – is better off with a big ecosystem, i.e., large installed base of consoles and a large portfolio of high quality games. We find, however, that though the installed base of platforms has the expected positive effect on game sales, games also bear a negative competitive crowding effect of having more games available on the platform (Boudreau & Jeppesen, 2014; Wareham *et al.*, 2014). This highlights one of the tensions between the platform's ability to capture value versus the game producers' ability to capture value: Though all platform ecosystems need a critical mass of games to be worth anything to any of the stakeholders, beyond some point, having additional games on the platform can erode the value of the ecosystem to individual games producers. It is also very likely that, other things being equal, games on a "crowded" platform have less bargaining power with the platform owner and thus are less able to negotiate favorable terms. Interestingly, both the timing effects and competitive crowding effects suggest that game producers are better off if their games are launched early in the generation (Rietveld & Eggers, 2016). Those games will be more proven when the console is selecting games to endorse, and will negotiate their terms before the effects of competitive crowding have reached their full effect.

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Table 1. Descriptive Statistics and Correlations

Panel A: Endorsement Estimation (H1-5)

Variable	Mean	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) *Endorsed*	0.13	0.33										
(2) *High quality*	0.37	0.48	0.37									
(3) *Medium quality*	0.42	0.49	-0.22	-0.66								
(4) *Top 1% sales rank*	0.02	0.12	0.20	0.16	-0.10							
(5) *Top 2%-5% sales rank*	0.04	0.19	0.38	0.23	-0.14	-0.02						
(6) *Top 6%-20% sales rank*	0.15	0.36	0.33	0.30	-0.15	-0.05	-0.09					
(7) *No prior hit in genre*	0.18	0.38	-0.09	0.01	0.00	-0.04	-0.07	-0.05				
(8) *Platform age (quarters)*	11.26	5.05	-0.08	-0.07	-0.06	0.01	0.01	-0.02	-0.11			
(9) *Platform exclusive*	0.19	0.40	0.05	0.01	-0.02	0.00	0.06	0.00	0.11	-0.01		
(10) *ln(European unit sales)*	0.22	0.27	0.55	0.53	-0.30	0.49	0.47	0.34	-0.05	-0.02	0.06	
(11) *Xbox 360*	0.47	0.50	0.02	0.07	-0.02	0.00	0.00	0.00	0.09	-0.46	-0.08	0.11

Panel B: Matched Pairs Estimation (H6)

Variable	Mean	SD	(1)	(2)	(3)	(4)	(5)	(6)
(1) *ln(Unit sales)*	4.80	2.29						
(2) *Post-endorsement*	0.28	0.45	-0.17					
(3) *Endorsed*	0.50	0.50	0.12	0.59				
(4) *Competition*	3.31	2.91	-0.15	0.06	0.00			
(5) *ln(Platform sales)*	12.63	0.65	-0.12	0.06	-0.13	0.09		
(6) *Average selling price*	15.38	7.04	0.38	-0.21	-0.01	-0.05	0.01	
(7) *Xbox 360*	0.50	0.50	0.13	0.18	0.47	0.02	-0.25	-0.08

Panel C: Sales Increase Estimation (H7-8)

Variable	Mean	SD	(1)	(2)	(3)	(4)	(5)	(6)
(1) Sales increase	0.17	0.17						
(2) High review scores (75%-100%)	0.84	0.37	0.30					
(3) Medium review scores (50%-74%)	0.14	0.35	-0.29	-0.94				
(4) Bottom (21%-100%) sales rank	0.23	0.42	-0.05	-0.40	0.38			
(5) ln(Age at endorsement)	5.98	0.49	-0.44	-0.24	0.25	0.26		
(6) Length of endorsement period (quarters)	6.98	4.27	0.50	0.31	-0.26	-0.18	-0.26	
(7) Xbox 360	0.49	0.50	0.14	0.18	-0.14	-0.15	-0.24	0.08

Table 2. Regressions (MLE) of the Probability of Platform Endorsement (H1-5)

	Endorsed						
Variable	1	2	3	4	5	6	7
High quality		19.60**	15.60*	17.75*	15.62*	16.03*	0.06**
		[21.57]	[17.71]	[20.83]	[18.64]	[19.36]	[0.02]
Medium quality		6.15†	5.29	5.90	5.05	5.20	-0.01
		[6.60]	[5.83]	[6.96]	[5.98]	[6.23]	[0.02]
Top 1% sales rank			1.48	1.04	1.06	1.11	0.21
			[2.00]	[1.44]	[1.46]	[1.53]	[0.14]
Top 2%-5% sales rank			9.04**	7.19**	7.48**	7.52**	0.42**
			[6.75]	[5.07]	[5.26]	[5.36]	[0.09]
Top 6%-20% sales rank			4.44**	4.25**	4.45**	4.49**	0.20**
			[2.30]	[2.01]	[2.04]	[2.06]	[0.06]
No prior hit in genre				0.07**	0.06**	0.06**	-0.12**
				[0.06]	[0.05]	[0.05]	[0.04]
Value of genre				0.77	1.00	1.03	-0.04
				[0.65]	[0.81]	[0.83]	[0.06]
*No prior hit in genre * value of genre*				1730.58**	719.24**	685.40**	0.32**
				[2615.73]	[1227.05]	[1149.37]	[0.08]
Platform age (quarters)					0.91*	0.91*	-0.01*
					[0.04]	[0.04]	[0.003]
Platform exclusive						1.26	0.01
						[0.65]	[0.07]
ln(Euro. unit sales)	288.91**	87.07**	20.29*	25.92*	28.17**	27.27**	0.33*
	[236.11]	[59.45]	[26.17]	[32.68]	[33.76]	[32.83]	[0.02]
Xbox 360	1.37	1.45	1.28	1.33	1.51	2.10**	0.04†
	[0.30]	[0.33]	[0.38]	[0.43]	[0.39]	[0.59]	[0.02]
Month dummies	YES	YES	YES	YES	YES	YES	YES
Genre dummies	YES	YES	YES	YES	YES	YES	YES
Constant	0.02**	0.002**	0.001**	0.001**	0.002**	0.003**	0.002
	[0.01]	[0.002]	[0.001]	[0.001]	[0.002]	[0.003]	[0.07]
Observations	1011	1011	1011	1011	1011	1011	1011
Pseudo *R*-squared	0.36	0.39	0.43	0.45	0.46	0.46	
Log pseudolikelihood	-251.24	-237.74	-221.70	-214.66	-210.01	-209.79	-404.28

† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$. Publisher-clustered robust standard errors in parentheses (45 clusters).
Models 1-6: Logistic regression, odds ratios reported. Model 7: Endogenous treatment model estimated by Maximum Likelihood (MLE). Analysis of excluded variables indicates that the instruments are not weak (χ^2 =26.99; $p < 0.01$) and meet requirements of exogeneity in outcome regression. First stage regression table available from authors upon request.

Table 3. Matched Pairs GLS Regressions of Endorsed on Weekly Unit Sales (H6)

	ln(Unit sales)			
Variable	1	2	3	4
Post-endorsement	0.47	-2.01	0.03	-0.54
	[0.34]	[0.34]	[0.38]	[0.37]
Endorsed	0.24	0.21	0.02	-0.02
	[0.18]	[0.19]	[0.19]	[0.18]
*Post-endorsement * Endorsed*		0.72**		0.61**
		[0.22]		[0.22]
Competition	-0.03**	-0.03**	-0.03**	-0.03**
	[0.004]	[0.004]	[0.004]	[0.004]
ln(Platform sales)	0.37**	0.37**	0.43**	0.43**
	[0.05]	[0.05]	[0.07]	[0.07]
Average Selling Price			-0.03*	-0.03*
			[0.01]	[0.01]
Xbox 360	0.58*	0.58*	0.51**	0.51**
	[0.25]	[0.25]	[0.18]	[0.17]
Game-pair fixed effects	YES	YES	YES	YES
Game age fixed effects	YES	YES	YES	YES
Weeks since end. fixed effects	YES	YES	YES	YES
Constant	4.22**	4.22**	5.40**	5.36**
	[0.75]	[0.76]	[1.06]	[1.09]
Game-week observations	8520	8520	5944	5944
Games	50	50	50	50
Overall *R*-squared	0.76	0.76	0.71	0.72

† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$. Publisher-clustered robust standard errors in parentheses (10 clusters). Random-effects GLS regression with game-pair, game-age, and weeks-since-endorsement fixed effects. Models estimate the effect of endorsement on games' weekly unit sales for 25 pairs of multi-homing games where the endorsement was received on one platform but not on the other.

Table 4. OLS Regressions of Sales Increase (H7-H8)

	Sales increase				
Variable	1	2	3	4	5
High quality		-0.07	-0.14**	-0.08	-0.01
		[0.06]	[0.03]	[0.05]	[0.08]
Medium quality		-0.20**	-0.25**	-0.17**	-0.13*
		[0.06]	[0.05]	[0.05]	[0.05]
Bottom 21-100% sales rank		0.04	-0.09*	-0.04	-0.10
		[0.05]	[0.03]	[0.05]	[0.08]
*High quality * Bottom 21-100% sales rank*			0.14*	0.12*	0.12*
			[0.05]	[0.05]	[0.05]
*Medium quality * Bottom 21-100% sales rank*			0.11	0.11	0.09
			[0.09]	[0.08]	[0.07]
ln(Age at endorsement)				-0.12**	-0.12**
				[0.04]	[0.04]
Length of endorsement period (quarters)	0.02*	0.02**	0.02**	0.02**	0.02**
	[0.004]	[0.004]	[0.004]	[0.004]	[0.003]
Xbox 360	-0.03	-0.02	-0.02	-0.01	-0.004
	[0.03]	[0.03]	[0.03]	[0.02]	[0.03]
Calendar month dummies	YES	YES	YES	YES	YES
Genre dummies	YES	YES	YES	YES	YES
Constant	-0.05	-0.02	0.08	0.77**	0.58*
	[0.07]	[0.07]	[0.05]	[0.22]	[0.25]
Games	133	133	133	133	133
R-squared	0.41	0.46	0.46	0.53	0.53
Inverse Mills Ratio (λ)[a]					0.06
					[0.06]

† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$. Publisher-clustered robust standard errors in parentheses (18 clusters). OLS regression of sales increase, includes calendar month and genre fixed effects.

[a] Inverse Mills Ratio obtained by following Heckman selection procedure. Probit selection regression based on Model 7 of Table 2.

Figure 1. Value Creation and Value Capture in Platform Markets

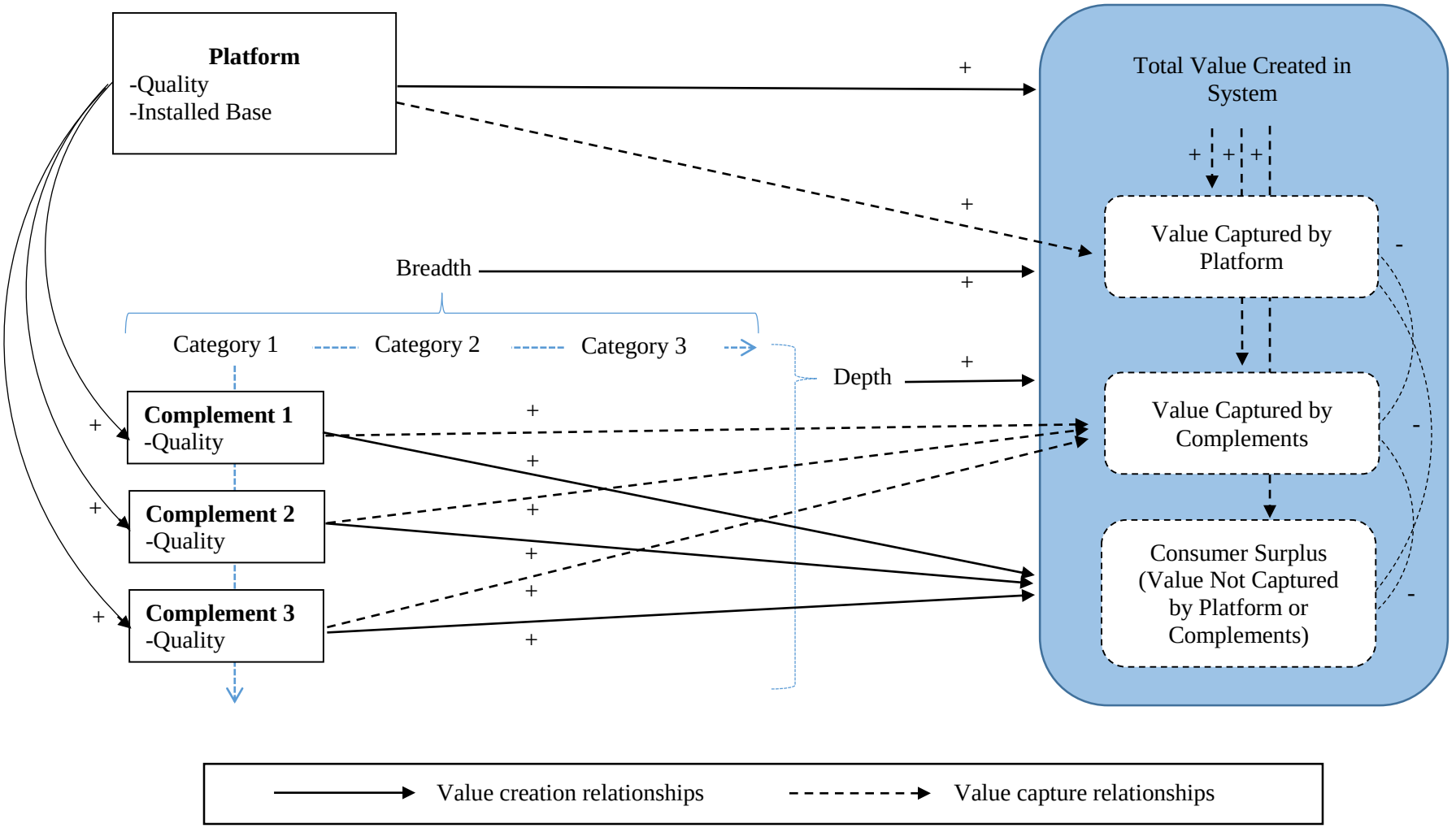

Figure 2. Cumulative Sales Over Time for "Uncharted: Drake's Fortune" (PS3)