Seeding for Quality of Platform Complements: Evidence from Amazon's Alexa Ecosystem.

Research-in-Progress

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Abstract

An important objective for digital platform governance is to ensure the creation of high-quality complements. For nascent platforms, complements are typically the main force in attracting early adopters and, consequently, further improving platform's attractiveness to potential complementors. In this research-in-progress paper, we study seeding – direct financial support to selected complements by the platform owner – as an indirect governance mechanism in motivating the complement quality improvement in general. The dataset consists of 499 connected home complements on Amazon's Alexa platform that were released during the first three years after the platform launch. The preliminary findings reveal that complements launched after platform owner's seeding actions generally show better quality. Such a quality improvement effect seems to be reinforced if the platform owner can conduct repetitive seeding on the same complement. However, the effectiveness of repetitive seeding may vary depending on the investment and the maturity of the target complement's business.

Keywords: Digital platform, Platform strategy and governance, Connected Home complements

Introduction

Complement quality is an important concern for digital platforms particularly at the nascent stage of their development. Soon after the platform launch, various complements (e.g. Google actions) take a pivotal role in demonstrating the specific features and utilities of platform (e.g. Google Home) to its intended users (Verdegem and De Marez, 2011; Wareham et al. 2014). The usefulness and quality of complements significantly account for consumers' overall evaluation on the platform's popularity. A perceived platform popularity can, in turn, support the platform's sustained growth by attracting more capable developers to contribute (Evans & Schmalensee, 2010). Therefore, to boost platform's growth, promoting high-quality complements is an important task to platform owners.

However, the modularized platform architecture entails that the platform owner can only deploy arm's-length control over complementors and the quality of their products (Baldwin and Clark, 2000). Apart from restricting complementors' behaviour through some formal mechanisms such as participation rules, and platform boundary resources (Tiwana, 2010; Ghazawneh and Henfridsson, 2012), platform owners can also use more indirect techniques that encourage desired high-quality contributions from complementors (Tiwana, 2015). Different from formal controls which often apply at the level of the entire platform ecosystem (Gulati et al. 2012; McIntyre and Srinivasan, 2017), indirect governance mechanisms entail more flexibility regarding the scale at which they target complementor, the ease of duplication and modification of the measures, and the possibility for swift reversion if environment changes.

Seeding, defined as the platform owner's financial sponsorship given to selected complements, is one such indirect governance mechanisms. Suggested by Parker (2016), relying on a small number of capable complementors can be an effective way to introduce a platform and its benefits to potential customers. While, platform owners should bear in mind that both their action and outcomes of seeding would address far reaching impact on performance of later-joined complements. On the one hand, the complements that are seeded by a platform owner will be perceived by other complementors as the source of benchmarking (Parker, 2016). As a result, complementors who wish to catch attention and surpass those seeded complements must face the race and bring about better performance (Foerderer et al, 2018; Barnett and Pontikes, 2008). On the other hand, the platform owner's exclusive sponsorship designated to a few complements may potentially discourage novel contribution, because the cost of succeeding in the competition increases due to initial advantage given to a few seeded players (Gawer and Henderson, 2007; Foerderer et al, 2018). Also, a complementary market where platform owner is involved may signal a threat that most of the profits will flow to a selected few due to their access to insider secrets (Choi and Stefanadis, 2001; Ceccagnoli et al, 2012).

To shed light on how seeding works as a platform governance mechanism, we investigate the following question:

> *How does 'seeding' as an indirect governance mechanism used by nascent platforms' owners influence the quality of complements in general?*

We use a dataset consisting of 499 Connected Home complements on Amazon's Alexa platform from 2015 to 2018. Based on multiple linear regression with a number of controls, the preliminary findings reveal that complements launched after platform seeding generally display higher quality. Moreover, the quality-increasing effect seems to be reinforced if a platform owner conducts repetitive seeding on the same target complement, depending on the intensity of financial sponsorship as well as the maturity of the seeded complement's business. We also discuss plans to further extend and improve the robustness of the findings.

Theoretical background

Complement quality in nascent platforms

Encouraging external developers' creation of novelty whilst ensuring adequate quality is a central task to the owners of most nascent platforms (Tiwana, 2015). The utility and usefulness of complements significantly affect the potential users' evaluation of the platform. To this regard, the platform's attractiveness to consumers is not under the platform owners' sole control but circuitously depends on the performance of the complements (Fukuyama, 2013). For a nascent platform, it is often important to quickly lock in an increasing base of users by offering relevant complementary services, as the platform's popularity accumulated at the early stage can, in turn, determine how lucrative the platform is to the latter complementors. Essentially, consumers and complementors gained at the early stage make far-reaching influence on platform's growth in the long run.

The complement's quality is reflected in users' overall evaluation of the complement's innovation value (Cennamo 2018). Manifestations of such subjective assessment can be, for instance, customer rating score, customer reviews, and the price set by the complementor (Foerderer et al. 2018). To this regard, to improve complement's quality equally means to improve multiple components that are (un)consciously counted in customers' evaluation procedure. Therefore, these influential components form a group of critical controls that should be included in our analysis. Adapted from Claussen et al

(2015), Tiwana (2018), and Cennamo et al (2018), three main groups of quality's determinants are included:
1) *The complement's features.* The most visible indication of quality to the users is a number of features in terms of different functional dimensions such as languages supported, interface design, the variety of uses achieved, and the number of peripheral extensions enabled. 2) *The External Coupling*. It indicates the extent to which the complement is architecturally coupled to the platform's core technology. The lower the external coupling, the quicker a complement can plug in new features without having to reconfigure its connections with the platform's core. 3) *The Internal Coupling*. It describes the internal interdependence among multiple modules of the complement. The internal coupling implies the variety of services that a complement can offer (Baldwin and Clark, 2000). The higher internal coupling usually means the complement has integrated more types of services.

Seeding as a strategy to increase complement quality

Seeding – the platform owner's financial assistance given to selected complements – has particular importance to newly established digital platforms (Huber et al. 2017). When consumers are the main force behind platform growth, an important way to convince them about the platform's unique value is to enable real user experience through high-quality complementary services. However, the platform's core product may entail huge technological differences from the complementary products, which makes it quite difficult for the platform owners to simultaneously concentrate on developing both platform's core product and complements. Therefore, instead of in-house development from scratch, the platform owners would rather rely on partnerships to create the initial complementary value units (Parker and Van Alstyne 2016; Dellermann & Reck 2017).
As a governance mechanism that directly targets only few of the platform's complements, the impact of seeding must be understood beyond simple financial support (Boudreau, 2010; Wareham et al. 2014). First, as suggested by Parker (2016), supporting selected complements implicitly convey the expected quality that platform owners want to see from the following-joined complements. Benchmarking themselves against the seeded complements, the non-seeded complements tend to show subsequent superior performance to maintain the market position against unequal competition (Derfus et al., 2008). Second, the financial investment manifests platform owners' commitment to the complementary services market. This, in turn, can reduce complementors' perceived uncertainty regarding the new technology and thus induce more autonomous contributions (Goldback et al., 2014; Dellermann and Reck, 2017). Lastly, the platform owners' presence in the complementary market draws attention from the demand-side (Foerderer et al, 2018). The increased amount of user feedback from such attention can result in spillover benefits to all complementors through enhanced innovation efficiency and enlarged consumer base (Sahni, 2016). Therefore, the first hypothesis we have is:

H (1): Complements that launch after the platform's seeding actions tend to show better quality.

Contrary to ecosystem-level governance which uniformly applies to all participants, seeding as an indirect governance mechanism possesses more flexibility (Wareham et al. 2014; Huber 2018). Some major advantages include the possibility of phased implementation, quick reversal in the case of inadvertent side-effects, and easy duplication. One opportunity emerging from such flexibility is reinforced seeding, where platform owner financially sponsors the same complement more than once. Considering the different market competition before and after platform owners' repeated investments, we also propose that:

H (2): Complements that launch after the reinforced seeding only display better quality if the seeded complement has not monopolized the complementary market.

Research Data

We use a dataset consisting of 499 connected home complements for Amazon's Alexa platform. Alexa is an ideal research context for our purpose because all complements are closely centred around platform's core product—Echo. Meanwhile, inside each complement there are sub-systems that may trigger multiple types of smart home services. Therefore, the research context serves our purposes to observe both external and internal complement's coupling. Taking complement's rating (continuous value from 1 to 5) as the dependent variable, the analysis also includes following variables to control the possible confounding effects:

Regarding the features of the complements, we have *Language* which represents the number of languages supported by the complement. *Origin* which describes where the complement is developed, to recognize geographic differences on innovation capacity. *Category* where we manually reviewed and categorized all complements into 16 groups of smart home services (lightings, electronics, home security, air circulation, entertainment, utility monitor, thermostat, network, smart furniture, garage, irrigation, pet feeder, location track, cleaning, personal assistance, home integration). Characteristics of complement developers are also included: *Complementor_Age* measures the age of developer company or the length of activation of a developer individual. *Complementor_Size* define the complement to be Micro (1-10 employees), Small (11-50), Medium (51-200), and Large (over 201). *Complementor_IPO* distinguishes public from the private business to control for different financial strength.

In addition, in Figure 1, the research proposes two more variables that describe the external and internal degree of coupling of each complement. *External Coupling* has two levels where 'high' means the complement is closely bounded with the platform's core product (i.e. Echo). By contrast, 'low' means the complement is connected to Echo with another physical device (e.g. smart hub) in the middle as the integrator. The latter type of complements can easily adjust their internal coupling without reconfiguring the connection to Echo. In terms of the internal coupling, we categorize all complements into four groups based on the number and the variety of services they provide. 1) *Pure Service Control* where Echo is used for only dialogical services but not for operating any devices. 2) *Device Control* where Echo works as the terminal for controlling only or one type of devices. 3) *Suite Control* in which the complement is operating multiple devices from the same manufacturer. 4) *Platform Control* in which the complement is operating multiple devices from the different manufacturers.

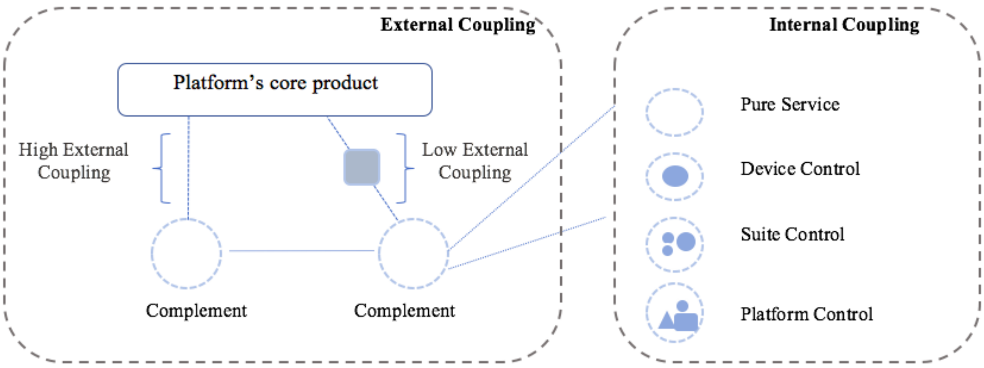

Figure 1. Illustration for complement's external and internal coupling

Preliminary findings

The effect of seeding on complement quality

We test H(1) which proposes that seeding can boost nascent platform's complement quality by fitting Equation 1 using OLS regression:

$$\text{Quality}_i = \alpha + \beta_1 \text{After}_i + \beta_2 \text{Feature}_i + \beta_3 \text{Coupling}_i + \epsilon_i \qquad (1)$$

where $\mathrm{Quality_i}$ is the users' rating score of complement i. $\mathrm{After_i}$ is the treatment variable. It equals to 1 if the complement i was launched after the seeding and equals to 0 if the complement existed before the seeding. β_2 stands for several controls on the complement's features such as language, region, and complementor's age. β_3 contains information regarding both the external and internal coupling of complement i. This equation is reflective to arguments on complement's quality in Claussen et al. (2015), Tiwana (2018), and Cennamo et al. (2018).

The results for Model (1) and (2) are presented in Table 1. In both models, we use platform's financial investment on Ring Video Doorbell, and on Luma Wifi as the treatment event, respectively. The coefficients of *After_seeding* is the β_1 in Equation 1. In the fitted model, 0.516 of β_1 indicates that the complements launched after seeding generally receive point five higher customer rating score. The Model (2) also reveals the similar positive effect (0.525) at 5% significance level. By controlling complement's features such as language and category, both models discovered that complements developed in North America and Europe perform better than complements from other regions. This could be attributed to the strong innovation capability enabled by IT and IP in the regions. Compared to micro businesses with less than 11 employees, large businesses show significantly lower advantages in contributing to high-quality complements. Lastly, Model (1) also indicates that the complements with complex internal coupling generally has better performance than pure service which has few internal couplings.

These preliminary findings confirm the first assumption that seeding will incentivize complements that are launched later to show higher quality. The mechanisms through which seeding take effects could be racing activities among complementors, decreased market uncertainty of participation, and the enlarged consumer attention from the demand side.

Reinforcement effect through repetitive seeding

In this section, we examine whether repetitive seeding can further enhance the positive impact on improving complement quality. To study such a derivative of seeding strategy, we fitting Equation 2 using OLS regression:

$$Quality_i = \alpha + \beta_1 AfterSeeding1_i * AfterSeeding2_i + \beta_2 Feature_i + \beta_3 Coupling_i + \epsilon_i \qquad (2)$$

The $AfterSeeding1_i * AfterSeeding2_i$ is the interaction term which generated by multiplying two binary variables. As the result, it equals to YY if the complement launched after both seeding actions by the platforms; equals to YN if the complement launched only after the first seeding; and equals to NN if the complement is launched before the first seeding action. The interaction term β_1 is our interest variable which examines whether the second seeding enhanced or diminished the strength of seeding's quality improvement effect.

The model (3) in Table 1 shows the results of analysing Amazon's second seeding of Ring Video Doorbell. The significant positive coefficient of After_seeding 1 (0.528*) is consistent with our analysis on Equation 1. For the interaction term β_1, the positive coefficient (0.686*) significant at 5% level confirms our assumption that the positive impact on complement quality will be enhanced if platform conducts repetitive seeding. Similarly, in model (4), we investigate Amazon's second seeding on Ecobee Plus. The result does not reveal the significant impact of reinforced seeding. However, the complement's region, complementor size, and the degree of internal and external coupling stay significantly influential to complement's quality.

To explain such inconsistency between two reinforcing seeding actions, we found two potential reasons. Firstly, founded in year 2012, the Ring Video Doorbell was in quite immature status when it received seeding from Amazon. By contrast, the Ecobee has been dominant in the thermostat market since 2008. Given the connected home as a nascent platform, the Ring Video Doorbell thus holds higher relevance to most of the participants. Secondly, the force of second seeding on Ring Video Doorbell is much stronger with Amazon's full ownership on that complement. Rather than curbing innovation, it releases signal to other early stage businesses on the benefits of having a stronger presence on platform.

Table 1. OLS regression results on complement's quality

	(1)	(2)	(3)	(4)
	Ring	Luma	Ring	Ecobee Plus
Specification	OLS	OLS	OLS	OLS
After_seeding	.516*	.525*		
	(0.256)	(.244)		
After_seeding1 Only			.528*	.321
			(.258)	(.213)
After_seeding1 * After_seeding2			.686*	.330
			(.337)	(.370)
Region				
North America	.663*	.665*	.672*	.668*
	(.276)	(.277)	(.276)	(.275)
Europe	.725*	.724*	.722*	.713*
	(.294)	(.294)	(.294)	(.293)
China	-.272	-.272	-.277	-.270
	(.318)	(.318)	(.319)	(.317)
Complementor_Size				
Small	.009	.009	.003	.023
	(.181)	(.181)	(.181)	(.181)
Medium	-.275	-.275	-.277	-.246
	(.189)	(.188)	(.188)	(.188)
Large	-.481**	-.475*	-.485*	-.455*
	(.187)	(.186)	(.187)	(.187)
Internal Coupling				
Platform control	.446*	.431	.435	.442*
	(.224)	(.225)	(.225)	(.225)
Suite control	-.008	-.019	-.014	-.020
	(.162)	(.162)	(.163)	(.163)
Service	-.154	-.157	-.137	-.139
	(.304)	(.304)	(.303)	(.305)
External Coupling (High)	.288	.286	.284	.298*
	(.148)	(1.49)	(.150)	(.148)
Complement's feature control	Yes	Yes	Yes	Yes
_cons	-34.342	-34.79	-30.14	-35.43
	(42.210)	(42.21)	(43.04)	(43.26)
Obs	499	499	499	499
Adj. R-squared	0.213	0.2131	0.2139	0.212
F-test	10.80***	10.91***	9.6***	10.34***

Notes. Robust standard errors are given in parentheses. *,**,*** indicate significance at the 5%, 1%, 0.1% levels, respectively.

Contribution and follow up research

In this study, we quantitatively investigate how nascent platforms could incentive better quality complements using a seeding mechanism. This research in progress aims to contribute to our understanding of platform strategy and platform governance from several perspectives. Firstly, the research context highlights an emerging type of digital platform. Different from established digital platforms (e.g. iOS) which only has complements at the service layer, Alexa connected home enables more complexity regarding the internal coupling within the complement. Given the increasing popularity of IoT and robot technologies, and the resulting physical device complexity, the Alexa platform offers a promising setting to study forward-looking issues in platform economy. Secondly, responding to Stummer et al (2018), this research adopts quantitative methods which can offer robust empirical insights that contribute to the extant studies on platform strategy and governance.

As a next step, we plan to improve both the rigor and scope of the findings. First, we plan to implement robustness checks on the preliminary findings by replacing customer rating score with other quality proxies. Such resources could include complements' download or ratings in other app stores. Second, more data are needed to further exclude possible endogeneity issues in the analysis. For instance, updates on the development kits that Amazon provides to facilitate development of complements can influence complement performance. Lastly, the in-depth comparison could be done by using more statistical techniques. Specifically, we plan to investigate the effects of seeding by using the differences-in-differences model in two different sub-categories of complements.

To conclude, this research-in-progress paper reports preliminary findings on our study of platform seeding. The data tentatively confirms our hypothesis on the positive impact of seeding by incentivising better quality complements. By focusing on an emerging form of digital platform, the anticipated contribution will be relevant to platform strategy and platform governance. New insights on how a nascent platform can improve its complement quality are also likely to result in significant implications to practice.

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