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Competing with Superstars: Does Exclusive Third-Party Content Discourage Complementary Innovation?

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Abstract

We study how the introduction of exclusive third-party applications affects competing complementors' innovation strategies in platform ecosystems. In this study, we exploit the exclusive entry of Super Mario Run into the complementary app market of Apple's iOS App Store in Autumn 2016 as a quasi-experiment. We collect monthly time-series data throughout the observation period. We find that complementors show heterogeneous innovation behavior after the entry. First, we demonstrate that affected complementors with a similar market position as the entrant follow a competition strategy for update releases in the affected niche market. Complementors who do not hold a similar market position reduce the number of updates for existing products in the affected niche market following a differentiation strategy. Finally, independent of the complementor's market position, affected complementors follow a differentiation strategy for new app releases, increasing the number of new app releases in other categories.

Keywords: Platform ecosystems, complementary innovation, platform governance, exclusive third-party entry

Introduction

In a platform business model, firms open their technology to independent third parties, so called complementors, and allow them to contribute ancillary complementary innovation to the platform (e.g., Boudreau and Hagiu 2009; Parker et al. 2016; Tiwana et al. 2010). Complementary innovation creates value by extending the core functionality of the platform. Apple, for example, opened its iOS mobile operating system to independent "app" developers in 2008, which has since then grown to a platform that encompasses more than 2 million complementary apps. The success of platform ecosystems is highly dependent on innovative and high-quality complements of third-party developers. In inter-platform competition, an attractive portfolio of third-party applications is one of the core value propositions to differentiate from competing platforms (Mantena et al. 2010). Platform owners rely on third-party developers to provide a large variety of high-quality content. One common strategy to outcompete rival

platforms is to enter into exclusivity contracts with popular third-party complementors (e.g., Cennamo and Santalo 2013; Lee 2013; Mantena et al. 2010; Weeds 2016). Exclusivity ensures that popular products are exclusively sold on the focal platform, thus, limiting the supply of these products to rival platforms and increasing the focal platform's competitiveness (e.g., Hagiu 2009; Yoffie and Kwak 2006). Hence, exclusivity agreements are a promising competitive strategy for platform owners (Weeds 2016).

Exclusive content is endorsed by the platform owner and popular among consumers (Rietveld and Eggers 2018). Yet, while providing exclusive content on the platform intuitively implies positive feedback from the consumer side, it is unclear how the supply side of the ecosystem, namely incumbent third-party developers, react to the market entry. Research in the platform context provides initial evidence that exclusivity agreements positively affect the attractiveness of platforms to consumers (e.g., Cennamo and Santalo 2013; Landsman and Stremersch 2011). However, the platform owner's decision to introduce exclusive third-party applications to the market changes the competitive landscape for competing complementors substantially. Literature provides some understanding about how increased competition incentivizes complementary innovation. However, empirical evidence about how firms choose to compete with exclusive third-party entrants has yielded mixed results.

First, complementors might try to compete with the entrant pursuing a competition strategy. Initial findings in the economics and wider management literature suggest that competing complementors might increase innovation activities ex-post in order to maintain a competitive position (e.g., Derfus et al. 2008; Kraatz and Zajac 2001; Wang et al. 2018). Literature argues that an exclusive third-party entry signals an attractive niche market to other market participants and is, hence, likely to be followed by others (e.g., Connelly et al. 2011; Hukal et al. 2020; Ozalp and Kretschmer 2018). Previous research in the domain of platform ecosystems provides initial evidence that an exclusive third-party entry might promote innovation in complementary markets, suggesting an increase in innovation output (updates and new app releases) after an entry (e.g., Cennamo et al. 2016; Ershov 2018; Foerderer et al. 2018). In contrast to these findings, there are studies suggesting that exclusive third-party entry might crowd out innovation and force competitors to follow a differentiation—or even diversification—strategy in order mitigate competitive pressure (e.g., Mazzeo 2002; Seim 2006; Zhou 2006). Thus, exclusive third-party entry might discourage competing complementors from operating in affected niche markets and incentivize affected third-party developers to differentiate their products or abandon the platform.

Given the strategic importance of complementary innovation for platform success, it is crucial to deepen our understanding about whether and how competing complementors' innovation strategies are affected by exclusive third-party entries. Research on whether and why an exclusive third-party entry denotes an effective tool to guide complementary innovation is, however, missing. Empirically, it has been notoriously difficult to observe and isolate the effect of an exclusive third-party entry on complementary innovation because a suitable control group is usually not available.

This study investigates the effect of an exclusive third-party entry on competing complementors' innovation behavior in the context of Apple's complementary app market. Platform owners, such as Apple and Google, regularly introduce exclusive third-party content as a strategic governance instrument (Mantena et al. 2010). Apple, for instance, announced the exclusive launch of the app 'Super Mario Run' in September 2016, the first mobile game with the popular game character 'Super Mario' (Bhopti 2016). The consumer response was very positive. However, the entry of exclusive third-party content also constitutes a shock to the developer community and the complementary app market. Overall, the effect of the introduction of exclusive content on the innovation behavior of competing complementors remains unclear.

Superstar Entry and Innovation Strategies

Exclusive Third-Party Entry

An attractive portfolio of third-party applications is essential for platform success (e.g., Boudreau 2012; Parker et al. 2017; Tiwana 2014). Yet, platform owners have little control about what content is generated by the large number of independent third-party developers on the platform (e.g., Wareham et al. 2014). As individual communication with each complementor is not feasible due to the high number of complements and complementors on the platform, platform owners have to rely on arm's length relationships to communicate strategic interests (e.g., Boudreau 2012; Tiwana 2014). Strategically, platform owners might

want to direct the quality, scope or diversity of content generated on the platform (Boudreau 2010; Tiwana et al. 2010; Wareham et al. 2014), reduce redundancies (e.g., Boudreau and Jeppesen 2015) or incentivize content generation in distinct areas of the ecosystem (e.g., Foerderer et al. 2018; Rietveld et al. 2019). Therefore, platform owners need to find ways to overcome the information asymmetry regarding desirable innovation activities between platform owner and complementors. One promising approach for platform owners to govern content generation while having no formal authority is to use signals (Connelly et al. 2011; Hukal et al. 2020). Hukal et al. 2020 distinguish between supply-oriented and demand-oriented signals. While supply-oriented signals aim to directly influence complementors to engage in strategically desirable innovation activities (Evans and Schmalensee 2016), demand-oriented signals are designed to attract consumers (Hukal et al. 2020; Rietveld et al. 2019). Platform owners use exclusive contracting of popular third-party applications "to secure content in exclusivity, thus limiting the supply of similar goods to rival platforms while enhancing the competitiveness of the platform's offerings" (Cennamo and Santalo 2013, p. 1332). While the introduction of popular products aims to signal platform attractiveness to consumers, it is unclear how the entry of exclusive third-party content affects competing complementors (e.g., Armstrong and Wright 2007; Hagiu and Spulber 2013). Demand-oriented signals are widely studied in the literature, however, implications for the supply-side of the platform are often overlooked (Hukal et al. 2020). Exclusive third-party entries remain a popular yet not well-understood strategic governance instrument to influence platform evolution (e.g., Armstrong and Wright 2007; Cennamo and Santalo 2013).

Further, it is important to differentiate between *types of market entries*. So far, platform literature has been mainly concerned with various forms of platform owner entry – the case when platform owners deliberately enter into complementors' product spaces with own products (e.g., Cennamo et al. 2016; Foerderer et al. 2018; Gawer and Cusumano 2002; Wen and Zhu 2019; Zhu and Liu 2018). According to the literature, platform owners enter into complementors' product spaces to capture value (e.g., Zhu and Liu 2018), control quality (e.g., Gawer and Cusumano 2002), achieve standardization (e.g., Gawer and Henderson 2007), and influence the direction of innovation by pushing complementors out of certain market segments (e.g., Wen and Zhu 2019). However, we propose that the effect of platform owner entry on competing complementors' innovation strategies deviates considerably from exclusive third-party entries given the nature of the launched product being either a substitute or a complement (Hagiu and Spulber 2013).

Many of the owner entry studies to date focus on product entries that aim to *substitute* complementors' competing products (e.g., Wen and Zhu 2019; Zhu 2019). Gawer and Henderson (2007), for example, show that Intel uses substitutive entries to ensure control over new platform interfaces by pushing competing complementors out of the market. Other studies focus on owner entry in terms of feature integrations (e.g., Wen and Zhu 2019). Google and Apple, for instance, integrated a flashlight and guided access feature into their mobile operating system. Consequently, consumers have little incentives to install a third-party application providing similar services. The platform owner's decision to enter a market by feature integration renders the market for competing complementors applications almost redundant. Thus, "given a large platform owner's market power and product advantages, it is nearly impossible for complementors to deter or to compete with it" (Wen and Zhu 2019, p. 1361). Consequently, complementors affected by substitutive entries shift their innovation output to other market niches following a differentiation strategy in order to create or regain a competitive advantage or abandon the platform entirely (e.g., Cennamo et al. 2016; Wen and Zhu 2019; Zhu and Liu 2018). In contrast, exclusive third-party entries tend to *complement* the market of available complementor products without making competing products in the market segment obsolete, offering complementors a chance to actually compete with the entrant. Since little empirical evidence for complementary entries is available, our study aims to assess the entry of 'Super Mario Run' as an exclusive product into the mobile game category of Apple's mobile app market, changing the competitive landscape for competing game developers substantially. Even though 'Super Mario Run' is an exclusive third-party entrant in the market, all mobile games equally compete for the consumer's attention and time (Park and Kim 2013). In addition, product popularity in the game industry can rapidly decline over time which could incentivize competing complementors to remain and compete in the market segment (Cennamo et al. 2016). Literature discusses possible innovation consequences of exclusive third-party entries controversially. In our study, we aim to understand if complementary entry causes different innovation strategies compared to substitutive entry and whether the choice of the innovation strategy is driven by complementor characteristics.

Innovation Strategies

This study examines the effect of the introduction of exclusive content on competing complementors' innovation behavior. We distinguish between two possible ex-post innovation strategies for competing complementors: competition strategy and differentiation strategy.

Competition Strategy

First, complementors might increase their innovation output in the affected niche market as a reaction to the competitive threat of the new entrant (e.g., Barnett and Hansen 1996; Derfus et al. 2008). Giachetti et al. (2017) argue that competitors engage in innovation activities after an exclusive third-party entry in a continuous and evolutionary race to maintain competitive parity – the so called racing or Red Queen effect. According to research, competition strategies are most likely to be followed between firms with comparable resources and market positions (Hannan and Freeman 1977; Lieberman and Asaba 2006). Foerderer et al. (2018), for instance, find that larger and more diversified complementors are more likely to engage in innovation activities in the affected market segment after an entry compared to smaller complementors with a more focused portfolio. Hence, following the logic of a competition strategy, we argue that complementors with a market position comparable to the exclusive third-party entrant are likely to increase their innovation output in the affected market segment ex-post in order to compete with the popular third-party entrant. According to the literature, popular applications tend to receive a disproportionally high fraction of consumer attention and obtain comparably high user ratings (e.g, Ershov 2018; Kübler et al. 2018; Zhong and Michahelles 2013). As exact app download data is not published by platform owners, this study relies on high user ratings as an indicator to identify popular applications with a similar market position to the exclusive third party entrant (e.g., Ershov 2018; Kübler et al. 2018; Zhong and Michahelles 2013).[1] The exact threshold will be discussed in chapter "Hypothesis Tests".

Hypothesis 1 is as follows:

Hypothesis 1: An exclusive third-party entry increases the likelihood of affected complementors with a similar market position (high user ratings) to increase innovation in the affected category.

Differentiation strategy

Pursuing a competition strategy can intensify competition in the respective niche market leading to decaying prices and profits (e.g., Peteraf 1993). Hence, to avoid competition, firms ex-post may follow a differentiation strategy—horizontal or even vertical—aiming for innovation that distinguishes them from the exclusive third-party entrant to create or restore a competitive advantage (e.g., Mazzeo 2002; Seim 2006; Zhou 2006).

Triggered by a competitive threat, firms may follow a differentiation strategy to survive in the market. Wen and Zhu 2019, for instance, demonstrate that developers ex-post shift their innovation effort to new apps in unaffected categories. From a platform owner's perspective, differentiation is desirable since more product variety increases the value of the entire ecosystem. Zhu and Liu (2018), for example, reveal that Amazon targets successful product spaces to crowd out complementors' substitutes by introducing similar products at lower prices. As a consequence, complementors in the affected product niches are discouraged to further operate in these markets and are incentivized to differentiate or abandon the platform. Some studies suggest heterogeneity among complementors' resources as one factor that influences the innovation outcomes of an entry (e.g., Foerderer et al. 2018; Li and Agarwal 2017; Wen and Zhu 2019). On the one hand, researchers find that smaller incumbents are more likely to rely on differentiation strategies when confronted with a large entrant (e.g., Wang and Shaver 2014). Small firms tend to follow differentiation strategies as they do not possess sufficient resources to compete with the entrant on attributes like quality or price and are hence forced to relocate strategically in order to survive (Wang and Shaver 2014). By

[1] Prior studies have estimated demand drawing on the number of ratings submitted for an app, arguing that the number of ratings is the minimum level of downloads as apps can only be rated after the download (e.g., Foerderer et al. 2021; Yin et al. 2014). As this study can rely on exact app ratings, app ratings appear to be the preferable option. Further, using app rankings to identify complementors with a similar market position is not feasible as the criteria for app rankings are not entirely transparent and prone to bias (e.g., Rietveld et al. 2019).

differentiating, less powerful firms aim to recover a competitive advantage in a market space that is less crowded (Mazzeo 2002; Wang and Shaver 2014). On the other hand, although the relationship between size and differentiation is generally consistent with the predictions, larger incumbents implement a similar strategy in some cases. Ailawadi et al. (2010), for instance, outline that even large competitors may follow a differentiation strategy when confronted with a market entry by a behemoth firm such as Wal-Mart.

Consequently, complementors that do not possess resources or market positions comparable to the exclusive third-party entrant are likely to follow a differentiation – or even diversification – strategy in order to create or regain a competitive advantage.

Hypothesis 2 is as follows:

Hypothesis 2: An exclusive third-party entry increases the likelihood of affected complementors with low user ratings to decrease innovation in the affected category.

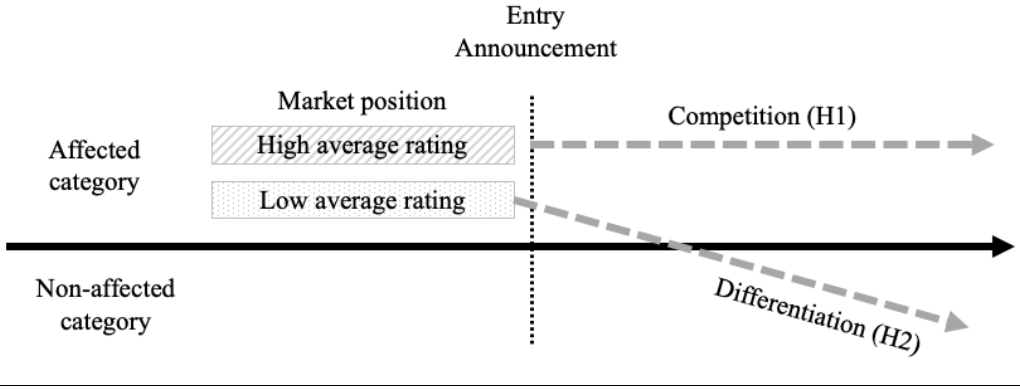

Figure 1. Innovation Strategies

Figure 1 visualizes the two hypothesized ex-post innovation strategies of competing complementors. Despite the debate on potential innovation strategies of competing complementors after the exclusive third-party entry, we know little about the mechanisms between exclusive third-party entries and complementary innovation. This study aims to resolve this question. Further, traditionally, economic models claim homogeneity among complementors (e.g., Caillaud and Jullien 2003; Evans and Schmalensee 2010). However, this neglects varying competitive strength of different complementors (e.g., Taeuscher and Rothe 2021; Wang and Shaver 2014). This study aims to understand if different types of complementors follow different innovation strategies (overview see Table 1). Subsequently, the empirical context of this study will be described outlining our research method and design.

Competition strategy	Complementor type	Description
H1. Competition	Affected complementors with high average portfolio rating	Complementors with comparable market positions choose to compete with the exclusive third-party entrant by increasing their innovation output in the affected niche market.
H2. Differentiation	Affected complementors with low average portfolio rating	Complementors that do not have a comparable market position are likely to avoid competition and follow differentiation strategy in order to create or regain a competitive advantage.

Table 1. Innovation Strategies

Empirical Context and Research Design

Empirical Context and Research Design

This study is conducted in the context of Apple's iOS platform. Apple's mobile operating systems permits independent third-party complementors to provide ancillary mobile apps via the Apple iOS app store. First, this context is particularly fitting for this study because it allows to observe complementor's innovation behavior consistently over time. Second, the context provides a unique opportunity to isolate the effect of exclusive third-party entry on other complementor's innovation behavior in a quasi-experimental research design. Like other platform owners, Apple regularly enters into exclusivity agreements with popular third-party developers to make the platform more attractive to consumers (e.g., Rietveld et al. 2019). Highlighting its exclusivity, the selected app is advertised at Apple's annual developer conference and later prominently featured on the home screen of Apple's iOS app store. By endorsing exclusive apps, Apple actively orchestrates consumer attention towards apps with the aim to boost its sales (Rietveld et al. 2019). It is likely, that an exclusive third-party agreement includes a royalty fee (Rietveld et al. 2019; Weeds 2016). However, details are not publicly available. Table 2 summarizes other potential empirical contexts for this study.

	Platform Owner	Platform	Exclusive Entrant	Year	Exclusivity Agreement
1	Sony	PlayStation	Marvel's Spider-Man 2 by Insomniac Games	2023	Third-party exclusive
2	Apple	Apple iOS	Flow by Moleskine	2019	Third-party exklusive
3	Epic Games	Epic Games	Chivalry 2 by Tom Banner Studios	2019	Time-limited third-party exclusive
4	Microsoft	Xbox	Halo Wars by Ensemble Studios	2009	First-party exclusive
5	Nintendo	Wii-U	ZombiU by Ubisoft	2012	Time-limited exclusive

Table 2. Other Potential Empirical Contexts

This study exploits Apple's decision to introduce 'Super Mario Run' as an exclusive third-party product into the 'action' category of Apple's iOS app store on December 15, 2016. Prior to the launch, Apple announced the launch of 'Super Mario Run' during Apple's annual developer conference on September 7, 2016. 'Super Mario Run' was the first mobile game featuring Super Mario, "the most beloved video game hero of all times", developed by Nintendo, a Japanese video game company (Bhopti 2016). The consumer response to the announcement of the exclusive entry was very positive—the game received more that 20 million pre-orders before the launch in December 2016 and 2.85 million downloads on the day of its release[2] (Webster 2016). This study exploits the exclusive entry of 'Super Mario Run' into the Apple iOS app store as a quasi-experiment. Following a conventional difference-in-differences framework, the release allows us to compare the innovation behavior of complementors affected by the entry with the innovation behavior of an unaffected control group, before and after the entry announcement of 'Super Mario Run' (Angrist and Pischke 2009; Bertrand et al. 2004).

Data Collection

The dataset consists of a monthly time series panel of applications published in the game category of Apple's iOS app store. Data was obtained on app-level (e.g., the number of reviews, consumer ratings, updates and new app releases) from AppMonsta, the Internet Archive, and AppAnnie. The dataset begins four months prior to the announcement of the exclusivity agreement in September 2016 and ends nine months after the

[2] In comparison, the popular app Pokémon Go received 900,000 downloads in the same period (Webster 2016).

announcement in May 2017. A random sample of 20.000 complementors active in the game category of the Apple iOS app store was tracked as a basis for constructing the treatment and control groups. The study's identification strategy uses the entry announcement of 'Super Mario Run' as a market shock for competing complementors to assess the consequences of exclusive third-party entries on complementary innovation. Previous studies in the platform context have shown, that complementors adapt their behavior following the disclosure of an imminent entry threat by the platform owner (e.g., Jiang et al. 2011; Wen and Zhu 2019). Complementors do not wait until the actual entry takes place, but adapt their behavior in preparation for the impending entry. This early reaction carries the risk of substantial sunk costs, if the actual market entry, contrary to expectations, does not take place at a later stage (e.g., Goolsbee and Syverson 2008; Wen and Zhu 2019). However, in the context of this study, the imminent exclusive entry of 'Super Mario Run' is very likely as it is announced by the platform owner. Apple and Nintendo have entered into an exclusivity agreement. Apple even announces the exact date of the actual market entry. Hence, complementors gain a competitive advantage by reacting before the actual entry takes place as they are able to adjust their strategic innovation behavior to accommodate for a changing competitive landscape. In the course of this study, the term 'entry' refers to the imminent 'entry threat' by Nintendo caused by Apple's announcement of the exclusivity agreement in September 2016.

With the aim to study heterogeneity among complementors' innovation strategies after an exclusive third-party entry, the analysis is conducted on the complementor level. Therefore, app-level data was aggregated on complementor level as one complementor can hold a portfolio of multiple apps. To identify complementors that were affected by the entry (treatment) and complementors that were not affected by the entry (control group), this study relies on Apple's app categories. Apple has 18 game categories (e.g., Action, Puzzle, Strategy). Prior studies have successfully relied on app categories to identify treatment and control groups (e.g., Foerderer et al. 2018). Categories are particularly suited to study the effects of entry as they ensure a certain level of homogeneity among the apps. First, categories group apps regarding their functionality (e.g., Action, Casino, Family, Puzzle). Customers use the category labels to search for apps regarding their game preferences. Using categories as an identification strategy reduces heterogeneity among the apps as e.g., user preferences, development costs and prices for apps are likely to be correlated in the same category (Foerderer et al. 2018). 'Super Mario Run' was released in the 'action' category of Apple's iOS app store. As the analysis is conducted on complementor-level, complementors with more than 50% of their app portfolio in the 'action' category on the day of the entry announcement are defined as treated (treatment group). For the control group, complementors with more than 50% of their app portfolio in the game category 'puzzles' were selected. 'puzzles' is an appropriate control category as the pre-entry characteristics of the included complementors in the category 'puzzles' were similar based on observational pre-entry announcement characteristics (e.g., updates, new app releases, number of reviews) compared to complementors with the majority of their portfolio in the treatment category 'action' (Angrist and Pischke 2009). Table 3 shows no significant differences in means for observational characteristics between treatment and control group prior to the entry announcement.

		Puzzle - Control			Action - Treatment			Difference
	Variable	Mean	S.D.	Median	Mean	S.D.	Median	T-stats
1	Portfolio Size	2.545	3.73	1	2.461	4.698	1	.914
2	Rating	4.199	.708	4.384	4.221	.701	4.396	-1.439
3	# of Ratings	1338	17627	21	1891	22151	25	-1.274
4	Price	.366	.753	0	.384	.846	0	-1.032
5	# of Updates	.187	.757	0	.197	1.663	0	-.354
6	# of New Apps	.042	.303	0	.042	.493	0	.073

Table 3. Observational Pre-Entry Announcement Characteristics

Further, apps in the 'puzzles' category have a relatively narrow functional purpose and are unlikely to overlap with apps from the 'action' category. The unobserved heterogeneity among the thousands of complementors published in the app store is minimized by limiting the analysis to two categories. All complementors that had apps in both categories ('action' and 'puzzles') in their portfolio were excluded. The first four months (May-August 2016) of the observation period is defined as pre-entry period to estimate pre-entry differences.

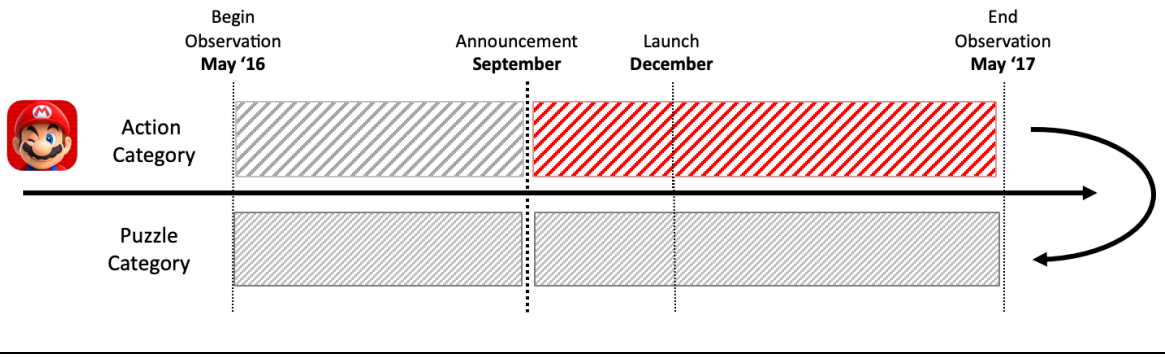

Figure 2. Timeline[3]

Further, the post-entry period ends nine months after the entry announcement (September 2016 – May 2017). Following the approach of Foerderer et al. (2021), the length of the post-entry period is a trade-off between variance in the dependent variables which increases over time and capturing the immediate effects of the entry by limiting the risk of confounding events over time. Figure 2 depicts the timeline.

The final sample includes 1,184 complementors with an average portfolio of 2.46 apps in the treatment group ('action') and 996 complementors with an average portfolio of 2.55 apps in the control group ('puzzles'). The balanced panel was observed over an observation period of thirteen month, resulting in a total of 28,340 complementor-month observations. The dataset was complemented with eight interviews with complementors directly affected by the entry of 'Super Mario Run' to validate this study's key assumptions of the research design. The semi-structured interviews were conducted with founders or senior executives of competing complementors directly affected by the exclusive entry of 'Super Mario Run'. The findings are discussed in chapter "Interview Evidence".

Variables and Measures

To measure complementors' innovation behavior, this study considers complementors' updates (i.e., product improvements) for existing applications as well as new app releases (e.g., Boudreau 2012; Tiwana 2015). Thus, the two dependent variables are UPDATE and NEWAPP.

To identify innovation strategies, this study distinguishes between updates in the complementors home category ('action' for treated complementors and 'puzzles' for complementors in the control group) and updates for apps in other categories than the complementor's home category, respectively. Update and new app releases in the 'action' category by affected complementors are interpreted as competition behavior. Further, update and new app releases by affected complementors in unaffected categories (not 'action') are used as an indicator for differentiation behavior in order to avoid competition with the entrant. The term UPDATE_HOME is an indicator that holds the total count of updates that complementor *i* released in their respective home category in month *t* ('action' for treated complementors and 'puzzles' for control complementors). Equivalently, UPDATE_OTHER is an indicator that holds the total count of updates that complementor *i* released in other categories than their respective home category in month *t*. The term NEWAPP_HOME is an indicator that holds the total count of new apps that complementor *i* released in their respective home category in month *t*. Further, NEWAPP_OTHER is an indicator that holds the total count of new apps that complementor *i* released in other categories than their respective home category in month *t*. To approximate consumer demand, this study relies on the number of user ratings for a complementor. Prior studies in the platform context have estimated demand drawing on the number of ratings submitted for an app, arguing that the number of ratings is the minimum level of downloads as apps

[3] Note: The figure illustrates the quasi-experimental research design of this study. This study exploits the entry announcement of 'Super Mario Run' (red) in September 2016 as a market shock to apps in the 'action' category. Monthly app-level times series data was collected in Apple's game category (balanced panel with approx. 20,000 complementors with an average portfolio size of 10.3 apps).

can only be rated after being downloaded (e.g., Foerderer et al. 2021; Yin et al. 2014). Hence, RATING_COUNT holds the total count of ratings for all apps in the portfolio of complementor *i* in month *t*. Due to the skewed distribution of variable RATING_COUNT, this study uses the log transformation in the regression analysis. This study relies on two control variables. First, RATING is a continuous variable indicating the average consumer rating of complementor *i*'s app portfolio in month *t*. Second, PRICE captures the average price of complementor *i*'s app portfolio in month *t* in USD. This study refrains from using the number of consumer ratings as a control variable because it is likely to be a "bad control" (Angrist and Pischke 2009). According to Angrist and Pischke (2009, p.64), "bad controls are variables that are themselves outcome variables in the notional experiment", meaning that the number of ratings is likely to be directly affected by the entry due to the phenomenon of attention spillover. Table 4 describes all variables included in the study.

Variable	Measurement	Mean	S.D.	Min.	Median	Max.
UPDATE	Total count of updates that complementor *i* released in month *t*	0.20	1.56	0.00	0.00	150.00
UPDATE_ HOME	Total count of updates that complementor *i* released in their respective home category in month *t*	0.12	0.84	0.00	0.00	65.00
UPDATE_ OTHER	Total count of updates that complementor *i* released in other categories than their home category in month *t*	0.09	1.04	0.00	0.00	143.00
PROTFOLIO_ COUNT	Total count of apps available of complementor *i* in month *t*	2.59	5.06	1.00	1.00	167.00
NEWAPP	Total count of new apps that complementor *i* released in month *t*	0.03	0.42	0.00	0.00	26.00
NEWAPP_ HOME	Total count of new apps that complementor *i* released in their respective home category in month *t*	0.01	0.19	0.00	0.00	12.00
NEWAPP_ OTHER	Total count of new apps that complementor *i* released in other categories than their home category in month *t*	0.02	0.29	0.00	0.00	14.00
PRICE	Average price of complementor *i*'s app portfolio in month *t* in USD	0.36	1.62	0.00	0.00	23.99
RATING	Average consumer rating of complementor *i*'s app portfolio in month *t*	4.21	0.69	1.00	4.38	5.00
RATING_ COUNT	Total count of consumer ratings (log) for complementor *i*'s app portfolio in month *t*	3.80	2.02	1.61	3.22	13.51

Table 4. Descriptive statistics of the primary sample, N=28,340 complementor-month

Empirical Model

Econometric Framework

Hypothesis 1 and 2 are tested following a difference-in-difference-in-differences (DDD) approach, which is an extension of the a difference-in differences framework (Angrist and Pischke 2009). The aim of this study is to compare the relative change over time in innovation outcomes for affected complementors ('action' category) with a similar market position as the entrant (high consumer rating) to high rating complementors in the control category 'puzzles' and to low rating complementors in the 'action' category. The DDD estimation approach creates a triple interaction, exploiting variation over time (comparing pre vs. post entry periods), across categories ('action' (treated by entry) vs. 'puzzles' (control)), and across complementor types (comparing high vs. low rating complementors). The DDD method allows to overcome the limitations of isolated DID approaches. A simple DID comparison between complementors in the 'action' category and complementors in the 'puzzles' category before and after the entry would not be sufficient to show heterogenous innovation behavior between different types of complementors. Similarly, the isolated comparison between high and low rating complementors before and after the entry without considering the category affiliation would not allow to draw conclusion regarding the immediate effect of the exclusive entry. By combining the two isolated comparisons, the DDD approach appears to be most

suitable to assess the ex-post innovation behavior of high-rating complementors in the affected category ('action'). Performing DDD estimations is regularly used in public health, social sciences as well as the wider economics literature (e.g., Benmarhnia et al. 2016; Butler and Cornaggia 2011; Long et al. 2010; Nunnenkamp and Öhler 2011).

The DDD estimator for the baseline specification at the complementor-month level is as follows:

$$Y_{i,t} = \beta_0 + \beta_1 \text{AFTER}_t \text{ x ENTRY}_i \text{ (x RATING}_i) + \kappa_i + \phi_t + \text{Control}_{i,t} + \epsilon_{i,t} \quad (1)$$

The depended variable of interest is $Y_{i,t}$ for complementor i in month t, capuring the relative change in complementors' innovation behavior. AFTER_t is an indicator variable that is 1 if month t is after the entry announcement. ENTRY_i indicates whether complementor i is in the treatment category ('action'). RATING_i is 1 if complementor i has a portfolio rating above the categories average rating to compare high versus low average rating complementors. We use κ_i to control for any complementor fixed effects, capturing any complementor attributes that could be correlated with the depended variables. ϕ_t are month fixed effects. The regressor AFTER_t is collinear to time fixed effects and, hence, not included in the model. The main term ENTRY_i is omitted from the model because it is collinear to the complementor fixed effects. The DDD coefficient of interest is $\beta 1$, which is the relative change in $Y_{i,t}$ of the treatment group compared to the control group caused by the exclusive third-party entry. The vector $\text{Control}_{i,t}$ contains time-variant controls. We use heteroscedasticity-robust standard errors in our main specification. We estimate our count data (number of updates and new app releases) using a Poisson estimator. This study follows Bertrand et al. (2004) and demonstrate that the estimates remain consistent when block bootstrapping the standard errors to encounter issues of autocorrelation.

Results

Hypothesis Tests

Table 5 reports the regression estimates of hypothesis 1 and 2.

	Update in home category (UPDATE_HOME)			New app in other category (NEWAPP_OTHER)
	(1) Baseline	(2) Bootstrapped	(3) Interaction	(4) Baseline
After x Entry	-.541*** (.074)	-.541** (.181)	-1.266*** (.155)	.635** (.183)
After x Entry x High Rating			1.008*** (.192)	
Specification	Poisson	Poisson	Poisson	Poisson
Observations	28,340	28,340	28,340	28,340
Controls	Yes	Yes	Yes	Yes
Compl. FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Table 5. Effect of Entry on UPDATE_HOME and NEWAPP_OTHER [4]

First, we find support for hypothesis 1. Table 5, columns (1) and (2) report the estimates for equation (1). The dependent variable of interest is UPDATE_HOME. The coefficient in column (1) suggests that for affected complementors in the 'action' category the odds of publishing an update in their home category after the exclusive third-party entry are $e^{-0.541} = 0.58$ times (-42%) that of unaffected complementors in the control category 'puzzles'. Column 2 indicates that the results are robust when block bootstrapping the standard errors. Column 3 shows the triple interaction and reports the estimates for equation (1), adding

[4] Note: Standard errors given in parentheses. *, **, *** indicate significance at the 5%, 1%, and 0.1% levels, respectively.

the regressor $RATING_i$ which is 1 if complementor *i* has a portfolio rating above the categories average rating to compare high versus low average rating complementors. As discussed in chapter "Competition Strategy", this study relies on high user ratings as an indicator to identify complementors with a comparable market position as the exclusive entrant. In particular, in this study a complementor is classified as high-quality complementor if the complementor's holds a disproportionally high average portfolio rating above 4.5 of a 5-star rating scale (> 4.51 average rating). Correspondingly, we define complementors as low quality if their average portfolio rating is below the first quartile of average ratings (< 3.86 average rating) in comparison to other complementors in the sample. When comparing affected complementors in the 'action' category with a high average rating to unaffected complementors in the 'puzzles' category with a high average rating, we find that 'action' complementors with a high average rating still suffer a reduction in home updates in the 'action' category if to a smaller extend than low average rating 'action' complementors ($e^{(-1.266+1.008)}$=0.77). Interestingly, while an overall decrease in home update releases is observed in the affected category (0.58), the odds of high-quality complementors publishing an update in the home category are $e^{1.008}$=2.74 times higher for high rating complementors compared to low rating complementors in the 'action' category and compared to complementors in the control category 'puzzles', respectively. Hence, affected complementors that do not have a similar market position as the entrant are discouraged to release product improvements for their existing products likely shifting their innovation effort to other products (H2), while high quality incumbents follow a competition strategy (H1) publishing product improvements in the affected niche market to compete with the entrant. Taken together, our data provides support for hypothesis 1 and 2 for update releases.

Column 4 reports the estimates for equation (1) with NEWAPP_OTHER as the dependent variable. Column 4 indicates a significant positive effect. The odds to publish new apps in other categories then the 'action' category after the exclusive third-party entry are 1.88 times ($e^{0.635}$ =1.88) higher for complementors in the 'action' category compared to complementors in the control category 'puzzles'. The interaction effect is not significant. An analysis of NEWAPP_HOME as dependent variable is not significant. Hence, both low and high-rating complementors in the affected category follow a differentiation strategy for new app releases and increase their innovation efforts in unaffected categories to avoid competition with the new entrant in the future. Against our proposition, high-rating complementors do not follow a competition strategy for new app releases (H1) but follow a differentiation strategy instead. Hypothesis 1 does not hold for new app releases. However, our results support hypothesis 2. Low-rating complementors follow a differentiation strategy for new app releases.

Interview Evidence

To validate our key assumptions and further support our hypothesis tests with anecdotal evidence, eight interviews with founders or senior executives of competing complementors directly affected by the exclusive entry of the app 'Super Mario Run' were conducted. First, the interviews confirmed that complementors closely monitor the app market for potential rivals. For example, one interviewee reported that they "look at which games are being launched … [by] all the major mobile gaming companies." Similarly, another interviewee stated that they even „have an entire business unit … to monitor … what competitors are doing." Additionally, the interviews confirmed that the planned exclusive entry of 'Super Mario Run' was not communicated to the developer community prior to the official announcement of the exclusivity agreement at Apple's developer conference. An interviewee stated that Apple sharing information prior to the official announcement is something "not that I know of". Another interviewee added that for information regarding entries "we read the news around, and that is the main source" while a third interviewee added "you find out on conferences".

The interviews further corroborated to our hypothesis tests. First, they provide support for hypothesis 1 regarding competition behavior of complementors with a similar market position. For example, one interviewee of a company with a similar market position claimed that "games and game genres constantly evolve. And if you don't stay on top of it, you risk becoming irrelevant …" Another interviewee added that "it is a very competitive environment" and another added that they get "best practices from [the entrants] new game, which might be applied to our games." Second, interviewed competitors who do not hold a similar market position (H2) stated that "it is very hard to go against the market leaders" and that the "most likely reaction is to kind of pull back … and not to try to compete with them, because there is really no point."

Robustness Tests

Sensitivity Analysis

We conducted two additional analyses for sensitivity. First, the main model was estimated without any control variables. The results remain consistent. In a second sensitivity analysis, the model is estimated with two alternative control variables for app prices. Instead of the average portfolio price, we include IN_APP_PCT which is the share of apps in the complementor's portfolio for which complementor *i* offered in-app purchases in month *t* as well as FREE_PCT which the share of apps in the complementor's portfolio which complementor *i* offered for free in month *t*. The results are consistent.

Assumption of Parallel Trends

The control category was selected based on similarity in observational pre-entry characteristics. To further support this choice and the claim of pre-entry homogeneity among the groups, a test for 'parallel trends' is conducted. The difference-in-differences estimator is based on the idea "that in absence of the treatment, the average outcomes for treated and controls would have followed parallel paths over time" (Abadie 2005, pp.1). In other words, as long as the treatment event has not occurred, there should be no significant difference in average outcome changes between treatment and control group. To test for 'parallel' trends prior to the entry announcement, we follow Strumpf et al. (2017) and estimate a regression in which we interact a continuous time trend variable (TREND) with the treatment indicator ENTRY. Data is restricted to the pre-entry periods. Insignificant interaction terms for the pre-entry periods support the assumption of 'parallel trends'. We estimated the regression for demand ((log)RATING_ COUNT), update releases (UPDATE) and new app releases (NEW_APP). The results report no significant interaction terms, which further corroborates the choice of the control group.

Discussion

Main Findings

The aim of this study was to investigate how the platform owner's decision to introduce popular exclusive third-party content in complementary markets affects competing complementors' innovation behavior. We conducted a quasi-experiment in the context of the exclusive entry of the popular application 'Super Mario Run' in the game category of Apple's iOS app store in Autumn 2016. The study finds that complementors show heterogeneous innovation behavior after the entry. We yield two main findings.

First, the odds of affected complementors in the 'action' category of releasing an update in the affected niche market ex-post are 0.58 ($e^{-0.541}$) times that of complementors in the control category 'puzzles'. However, when differentiating between high and low average rating complementors in the 'action category, we find that although affected complementors with a similar market position as the entrant reduce the number of update releases in the affected category (0.77), they are 2.74 times more likely to release an update in the affected niche market ex-post compared to affected low average rating complementors in the 'action category. High average rating complementors in the affected category update their products in the 'action' category in order to compete with the entrant, following a competition strategy. However, this does not hold for new app releases. Independent of a complementors' rating and market position, incumbents are 1.88 times more likely to release a new app in other categories than the 'action' category compared to complementors in the 'puzzles' category ex-post. Even though high rating complementors choose to compete with the exclusive third-party entrant with existing products, they opt to follow a differentiation strategy for new app releases avoiding direct competition in the future (H1). Second, complementors in the affected category with a low average portfolio rating decrease the number of updates in the affected niche market after the entry ($e^{-0.541}$ =0.58) and show an increase of new app releases in unaffected categories ($e^{0.635}$ =1.88). Complementors that do not hold a similar market position as the entrant defer from updating their products in the affected category – at least temporarily and shift their innovation effort to unaffected categories. Affected complementors that do not have a similar market position as the entrant follow a differentiation strategy for new app and update releases (H2).

Theoretical Contribution

The study makes three contributions to the wider body of literature. First, we advance the research discourse on platform governance (Parker et al. 2017; Tiwana 2014). In particular, we investigate how the strategic decision of platform owners to introduce exclusive third-party content affects complementary innovation in the context of Apple's game category. While platform owner entry has repeatedly been studied in academic literature (Foerderer et al. 2018; Gawer and Henderson 2007; Wen and Zhu 2019; Zhu and Liu 2018), we answer the call of Wen and Zhu (2019, p. 1361) to study entry "in settings in which small firms face an entry threat from a behemoth firm (instead of a platform provider)". We find that deliberate exclusive third-party entry, while designed as demand-oriented signal to attract consumers, indirectly affects complementors' innovation strategies. In the context of gaming applications, we untangle the underlying mechanisms that shape complementary innovation and shed light on the implications of demand-oriented governance signals for the supply side of the platform (e.g., Hukal et al. 2020). By identifying heterogeneous and possibly unintended innovation consequences of endorsing exclusive third-party applications, we add to our understanding of indirect governance mechanisms.

Second, we add to our understanding of the consequences of entry that have been discussed controversially in the economics and wider management literature (e.g., Bresnahan and Reiss 1991; Ershov 2018; Farrell and Katz 2000; Kraatz and Zajac 2001; Li and Agarwal 2017). In particular, we contribute to literature on entry in the platform context (e.g., Cennamo et al. 2016; Ershov 2018; Foerderer et al. 2018; Wen and Zhu 2019; Zhu 2019). We show that different types of complementors follow heterogenous innovation strategies after an exclusive third-party entry in Apple's game category. Further, rather than investigating a product entry that aims to substitute complementors' competing products, we study an entry that complements the market niche. Our results show that while successful incumbent complementors try to remain and compete in the affected market segment with existing products (release of product improvements), new app releases are discouraged in the affected niche market.

Finally, this study contributes to our understanding of complementors' innovation strategies (e.g., Ershov 2018; Foerderer et al. 2018; Wang et al. 2018; Wang and Shaver 2014; Wen and Zhu 2019). In the context of the game category, we identify different types of complementors who follow heterogenous innovation strategies ex-post based on complementor characteristics (e.g., market position). While complementors with a similar market position to the market entrant follow a competition strategy with update releases for existing applications in the affected niche market ex-post, complementors who do not hold a similar market position follow a differentiation strategy for update releases. However, independent of the complementor's market position, affected complementors follow a differentiation strategy for new app releases. By adding the lens of differentiation behavior, this study can disclose that incumbent complementors in the affected game category shift their innovation activities for new product releases to unaffected categories which may positively impact desirable product variety on the platform market (Boudreau 2010; Tiwana et al. 2010; Wareham et al. 2014). The effect of the exclusive third-party entry is thus not limited to the affected niche market but prevalent in the wider ecosystem.

Research Implications and Future Work

Our study provides various implications for research as well as practice. First, our study has implications for our understanding of the effects of exclusive third-party entry as a governance mechanism. While designed to attract consumers, our research in the gaming context raises questions whether exclusive entries create value for the platform owner, given the potentially unintended consequences on complementors' innovation strategies in the wider ecosystem. The platform owner may profit from an increase in possible transaction fees, royalty fees or in-app purchases generated by the exclusive entrant and other complementors benefitting from attention spillover. High-quality complementors in the affected market are release product updates for existing products in the affected category without additional stimuli from the platform owner. Exclusive third-party entry, thus, may be a valuable governance mechanism to direct product improvements in the ecosystem, making the platform portfolio more attractive to consumers.

At the same time, however, incumbent complementors in the game category shift their innovation efforts to other, unaffected categories. This behavior may increase desirable content diversity on the platform (Boudreau 2010; Tiwana et al. 2010; Wareham et al. 2014). Hence, platform owners may not only pursue exclusive third-party entries to attract consumers to the platform but also to increase product variety by pushing new product releases to unaffected categories. On the downside, complementors may fear further

exclusive entries in the future, which could incentivize complementors to consider multihoming reducing the focal platform's competitiveness in intra-platform competition. Future research may examine how exclusive entry affects multihoming. Further, the question remains if the direct value of exclusive entry exceeds the potential negative impact by possible multihoming.

Furthermore, our research raises important questions regarding the persistency of the effect of exclusive third-party entries on innovation behavior. We study an exclusive entry in the context of Apple's mobile game market. Product popularity in the game industry can rapidly decline over time, incentivizing competing complementors to shift their innovation efforts only temporarily and reconsider new app releases in the affected market segment at a later stage (Cennamo et al. 2016).

Managerial Implications

Further, our results have managerial implications for platform owners as well as complementors. First, our study may provide valuable insights for platform owners that use exclusive content to make their platform more attractive to consumers. However, our results demonstrate that the deliberate introduction of exclusive content has heterogeneous and possibly unintended innovation consequences. Thus, platform owners should carefully evaluate whether the benefits (e.g., increase in product improvements, increase in content diversity through differentiation) outweigh the potentially negative consequences of the entry (e.g., incentive for multihoming). The magnitude of the effects likely depends on respective platform characteristics. Therefore, innovation consequences for the affected category, the wider ecosystem as well as possible multihoming incentives should be taken into consideration before making a complex decision to introduce exclusive content.

Second, our results may inform complementors that face popular exclusive entries. Our findings suggest that complementors are encouraged to adapt their innovation strategies to react to the third-party entrant. Complementors that remain and compete in the affected category may benefit from attention spillover. However, differentiation might be a promising strategy for complementors who do not hold a powerful market position to escape tense niche competition and withdraw to less crowded market spaces. The question regarding the persistency of the entry effect remains. Temporal reactions may be a viable option.

Limitations

As with any study, our research has limitations that should be addressed. First, we study the innovation consequences of exclusive entry in the context of Apple's mobile game market. As the dynamics in the game category might not necessarily be representative for the entire ecosystem, future research could consider studying exclusive entries in other context and categories within and across platforms to further investigate the effect of exclusive entries on complementors' innovation strategies. Also, our data is limited to nine months after the exclusive third-party entry. Hence, we cannot account if the effect on innovation strategies is persistent beyond our observation period. Similarly, extending the observation period could deepen our understanding of whether adapting the innovation strategy is beneficial to complementors in the long term, e.g., in terms of survival rates. Further, the observed consequences on innovation strategies may be influenced by contextual factors of the respective platform (e.g., size, industry, prior governance history) which may limit the generalizability of our findings. Further, we cannot conclusively attest that there are no other confounding effects or omitted variables that may influence our results. Even though, we chose the control category carefully based on similar pre-entry characteristics, treated and control complementors may differ on characteristics that we were unable to observe. We conducted eight interviews with complementors directly affected by the exclusive entry of Super Mario Run to validate our key assumptions.

Conclusion

We study how platform owners' decision to introduce popular exclusive third-party content in complementary markets affects competing complementors' innovation behavior. Exclusive content is a popular yet not well understood demand-oriented governance signal that has serious implications for complementors' innovation strategies. In the context of Apple's iOS app store, our results suggest that complementors follow heterogeneous innovation strategies after the entry. First, we find that while the likelihood for an update in the home category is reduced for all affected complementors in the 'action' category, affected complementors with a comparable market position as the entrant are 2.74 times more likely to release an update in the affected niche market ex-post compared to affected low average rating

complementors in the 'action category. Affected complementors with a similar market position follow a competition strategy in order to compete with the entrant. Complementors who do not hold a similar market position reduce the number of updates for existing products in the affected niche market following a differentiation strategy. Second, independent of the complementor's market position, affected complementors follow a differentiation strategy for new app releases. Our findings shed light on our understanding of exclusive entry as an indirect governance mechanism. Platform owners face the complex challenge of using exclusive entries in a way that it attracts consumers while considering possible negative effects on the innovation behavior of complementors in the wider ecosystem. We demonstrate how complementors heterogeneously choose to compete with powerful entrants. We untangle the mechanisms that lead to competition or differentiation strategies of competing complementors. Our insights are relevant for future research and may inform platform owners as well as competing complementors.

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