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Strategic Game Release Timing in Competitive Markets with Network Effects

Di Wu, Jinting Wang, Jian Li, Rui Peng, *Senior Member, IEEE*, and Shaomin Wu

Abstract—The gaming industry is thriving, propelled by rapid advances in digital technology and a steadily expanding player base. Game publishers adopt a variety of release strategies: Some games are released on schedule, while others experience delays, a phenomenon commonly referred to as “slips.” Moreover, the growing size of the gaming community also generates significant network effects: as more players engage with a game, enthusiasm spreads, enriching the overall player experience. This paper examines the release strategies of game publishers in a competitive market where player engagement is shaped by network effects. Utilizing a game-theoretic model, we find that (1) immediate release is optimal when the initial quality gap is small or the cost of delay is high, (2) a fast slip strategy dominates when the quality gap is moderate and can be substantially reduced in a short time, and (3) a slow slip strategy is preferred when the gap is large, quality can be improved rapidly, and postponement is relatively inexpensive. The paper also considers the possibility of “reverse slip”, releasing earlier than planned. Extending the model to competing publishers, we derive equilibrium conditions for release-timing choices and show that both slip strategies remain viable, depending on quality differences among games. We further substantiate these analytical results with real-world numerical evidence from major game releases, showing that well-timed acceleration or postponement can improve launch outcomes, whereas releasing with unresolved quality problems may lead to severe post-launch penalties. Our findings offer actionable guidance for release planning that jointly considers quality evolution, network effects, and competitive dynamics.

Index Terms—Game publisher, incumbent-entrant, players, release strategy, video games

Managerial Relevance Statement—For engineering managers, the findings of this research provide a structured framework for deciding whether to proceed with, delay or accelerate a planned game release. The real-world numerical evidence indicates that well-timed acceleration or delay can improve launch outcomes when aligned with the underlying quality gap, whereas launching with unresolved quality issues undermines post-launch performance—even under strong initial demand. The framework focuses on three key levels: controlling or overseeing current product quality, the expected pace of quality improvement, and community or network effects. These insights translate into concrete strategies such as freezing feature development to focus on developing a player base, approving a short delay to reach a “satisfactory” quality level or investing in a longer refinement phase to support a premium positioning. For policymakers and platform owners, the research result clarifies when release delays are a rational response to quality and network concerns rather than mere mismanagement. This understanding enables them to set more realistic certification timelines, manage stakeholder expectations more effectively, and design support policies (e.g., targeted incentives or clear guidelines) that promote timely, high-quality releases. This paper also contributes to the following SDG: SDG 9.

I. INTRODUCTION

WITH the rapid advancement of digital technology, the gaming industry is experiencing unprecedented growth. Statistics show that the global gaming market revenue has been rising at an astonishing rate over the past few years and reached \$27.97 billion in 2024 [1], attracting significant investment and generating substantial innovation. Gaming has evolved beyond being a pastime for the young. This rapid growth trend presents the gaming industry with more opportunities and challenges in product releases.

Planning the time when a new game should be released, namely, the release strategy, is critical to the operational success of the game manufacturers. In practice, in addition to an on-time, final release of a new game, two other release strategies are also adopted: delays (also known as “slips”) and early releases (referred to as “reverse slips”), which account for 48~52% and less than 1%, respectively [2]. In other words, failing to meet the scheduled release dates is normal.

(1) From a strategic competition perspective, changing a release plan can be used to reduce head-to-head rivalry and reposition against competitors more effectively. A prominent long-horizon case is Star Citizen, whose originally anticipated launch timeline has been repeatedly pushed back over years [3]. In contrast, reverse slips do occur. For example, the PC (Steam) version of Death end re;Quest 2 was officially moved up by one week relative to its previously planned date,

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illustrating that game publishers sometimes accelerate releases when strategic and operational conditions allow [4].

(2) From a product lifecycle and quality-management perspective, slips may be chosen to improve polish and protect long-term reputation. Nintendo publicly delayed *The Legend of Zelda: Tears of the Kingdom* by roughly one year to refine the product before release [5]. Similarly, Capcom's *Pragmata* experienced multiple postponements (including an indefinite delay) with the publisher explicitly linking the extra time to meeting the quality expectations of players [6].

(3) From a financial and operational perspective, release timing can be shaped by production complexity, platform coordination, and investor-facing expectations. For instance, CD Projekt's final delay of *Cyberpunk 2077* to December 10, 2020, was explained in public communications as driven by the difficulty of shipping many platform versions simultaneously, highlighting how operational constraints can dominate timing decisions [7].

Motivated by these real-world practices, we study how a game publisher selects among four release strategies, immediate release, fast slip (a short postponement), slow slip (a significant postponement), and reverse slip (releasing earlier than scheduled)—and how this choice depends on market and firm conditions. Importantly, timing decisions in the gaming industry are shaped by network effects: a larger player base makes a game more attractive, strengthens community interaction, and increases the game's social value, thereby drawing in additional players. As a result, publishers must consider the development of a broader gaming ecosystem (e.g., community health, cross-title engagement, and long-run player-base growth) rather than focusing solely on the success of a single title. Building on this, we examine (i) when publishers adopt each of the four release strategies, (ii) which factors drive these choices, and (iii) how strategies should adjust when multiple publishers make interdependent timing decisions in the same market. Table I further illustrates the relationship between the real-world practices and our research questions.

Our results show that the optimal release strategy depends on the quality of the game and those of other games on the market, as well as the potential for quality improvement. If the entrant already holds a quality advantage, the reverse slip is an effective strategy. If the quality of a new game can be rapidly improved, fast slip will allow it to capture a larger market share. Otherwise, the game publishers must find a balance between a low price (corresponding to immediate release) and the inability to generate revenue in the short term (corresponding to slow slip). The different strategies proposed in this paper can provide game publishers with recommendations on quality improvement, pricing, and release timing. Meanwhile, savvy players can also judge the potential quality of a game by its release timing.

Although this paper uses video game releases as examples, its principles, including continuous quality improvement, network effects, and strategic release timing in an incumbent-entrant setting, can apply to many other digital markets,

including software and streaming services, smart devices and IoT platforms. Our analysis can therefore be interpreted as a general framework for understanding how game publishers choose the time when a new product should be released.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature. Section 3 sets up the model. Section 4 characterizes the equilibrium when only two games compete on the market. Section 5 extends the competition from two game publishers to three or more game publishers, demonstrating the robustness of our proposed model. Section 6 concludes the paper and suggests future research.

II. LITERATURE REVIEW

The literature relevant to the research in this paper encompasses several key areas: product release strategies, consumer options under network externality, and the video game industry.

[8] introduce two release strategies---immediate-release and late-release---for a new product and construct a theoretical model for analysis. [9] explore a two-period duopoly model, examining varying levels of user upgrade costs and switching costs. [10] investigate the entrant issue with technology investment. When optimizing product release strategies, providers must balance the trade-off between release time and product quality. [11] conduct an empirical study to scrutinize factors potentially influencing the performance of new product introductions.

The work similar to our research is [8], as both propose two different product release strategies: on-time release and delayed release. Meanwhile, [12] quantify how the timing of exclusive game releases on competing platforms generates intertemporal demand spillovers. [2] conduct a large-scale empirical analysis of over 23,000 steam titles and show that release delays are very common in PC games and are associated with slightly lower user ratings than other industries. [13] analyze how user engagement with video game platforms evolves over the platform lifecycle and how software release characteristics shape engagement and market outcomes. The key difference is that while their study focuses on the market that sells software and services, the present paper focuses on the gaming sector, where players' utility is influenced by network effects. Additionally, we observe that in the gaming market, product delays (slips) fall into two categories: short-term delays, which typically last a few weeks, and long-term delays which last several months or even a year. Therefore, we focus on two distinct branches of delayed product release: fast slip and slow slip.

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TABLE I
REAL-WORLD PRACTICES, MECHANISMS, AND LINKS TO OUR RESEARCH QUESTIONS

Real-world practice	Core mechanism	Strategy implication	Links to RQ 1 (when choosing which strategy?)	Links to RQ2 (What factors drive choice?)	Links to RQ3 (How to adjust with multiple publishers?)
Avoiding intense head-to-head competition by shifting timing ()	Competitive positioning and strategic waiting	Often favors fast slip or slow slip when expected competition intensity is high	(fast or slow slip)		
Accelerating a planned release when conditions become favorable ()	Seizing a temporary window	Enables reverse slip (rare but strategically meaningful)	(reverse slip)	(marginal benefit of early launch)	(pre-emption vs retaliation)
Delaying protecting quality and long-run reputation ()	Trade-off: short-run revenue vs. long-run reputation	Supports slow slip when the quality gap is large; fast slip when minor polishing suffices	(fast or slow slip)	(quality gap, cost of delay)	
Timing constrained by multi-platform shipping complexity ()	Operational constraints and coordination costs	Can force fast or slow slip even if competition incentives differ	(fast or slow slip)	(platform mix)	
Observable competitive spillovers: other publishers push dates in response to a major rival's announced timing (e.g., announcement prompting date shifts) (GameDeveloper, 2025)	Strategic interdependence and coordination failure	Endogenizes slips in multi-firm environments	(fast or slow slip)	(rival strength, expected demand diversion)	(multi-firm equilibrium adjustments)

TABLE II
REAL-PRACTICE NUMERICAL EVIDENCE

Model implication	Real-practice case	Release-timing evidence	Numerical outcome	How the case supports the model
Immediate release or reverse slip is preferred when the quality gap is small, or the delay cost is high.		PC version release moved from August 31, 2023, to August 3, 2023; PS5 version delayed to September 6, 2023.	SteamDB reports an all-time peak of 875,343 concurrent players and 96.8% positive Steam user reviews.	The case shows that when the product is already close to market-ready quality, accelerating or maintaining release timing can avoid a costly competitive window.
Fast slip is preferred when the quality gap is moderate and can be reduced in a short period.		Release moved to February 25, 2022, after the publisher stated that additional time was needed for final adjustments.	The game reached 12 million units sold worldwide by March 16, 2022; SteamDB reports an all-time peak of 953,426 concurrent players and 93.0% positive Steam user reviews.	The case illustrates the value of a short delay: a manageable quality gap can be closed without dissipating player enthusiasm or network-driven launch momentum.
Slow slip is preferred when the quality gap is large, quality improvement is valuable, and slip cost is manageable.		Nintendo delayed the game release from a planned 2022 to Spring 2023.	The game sold over 10 million units worldwide in its first three days; review aggregation reported scores around 97 at launch.	The case shows that a longer refinement period can be optimal when the publisher can maintain demand and transform additional development time into a high-quality launch.
Releasing a game with quality problems can generate large negative impacts.		The game launched with very high demand but unresolved quality problems.	SteamDB reports a peak of 1,054,388 concurrent players, but Sony removed the game from the PlayStation Store and offered refunds.	The benchmark shows that network enthusiasm alone is insufficient when the quality gap is large.

The network effect can be comprehended as the additional influence that a user of goods or services exerts on the value of that product for others. Specifically, when the network effect is positive, the value of a product or service increases in proportion to the number of other users who are utilizing the same product. [14] highlight an alternative approach that involves cross-group network, which refers to the surplus per-buyer accessible to a coalition of buyers, and the effect of the within-group network, indicating that the seller's influence grows as the size of the buyer coalition expands. More recently, scholarly publications addressing the network effect within the platform have been growing rapidly. For instance, [15] explore the word-of-mouth effect, [16] address blockchain technology, and [17] consider the behavior-based pricing.

The primary contribution of this paper is the investigation of network effects among players and the analysis of how these network effects influence game release strategies for providers. [18] review the main theoretical contributions on network effects in platform markets and show how they shape platform governance and market power. Due to the presence of player communities, more players simultaneously playing a game increases the visibility of the game, which in turn attracts even more players. Taking in account this characteristic, we demonstrate the relationship between the two types of slip strategies and the effect of the player network, providing guidance on which release strategies should be adopted for different types of games. For example, multiplayer games have stronger network effects than single player games and thus should prioritize early release over refining game quality.

In recent years, a growing number of studies have focused on the gaming industry, examining the interplay between game providers' pricing strategies and consumer engagement. [19] consider premium subscriptions in games and investigate social comparisons between players and matchmaking processes of game publishers. [20] use a Markov decision process to model the participation of players. From an empirical perspective, [21] and [22] discuss the concerns about fairness of players and their participation in different games, respectively.

However, to the best of our knowledge, little research has considered game release strategies. In practice, we observe that many games are not released on time. Our study provides potential insight into the factors that influence the timing of game releases, such as the quality of the game itself and the rate at which game developers can improve it.

III. MODEL SETUP

Consider a competitive gaming market with two game publishers: one is incumbent A with a game released at time t_0 , and the other is market entrant C that plans to release a game. The game of A has a quality level q_A , and the game of

C has a quality level q_C .¹ Entrant C can release the game at the earliest time of 0.

It is essential to note that when A released its game, the quality of the game had already been determined. Suppose that once a game is released, its quality remains unchanged until an intended intervention is conducted. This assumption holds under the scenario that incumbents with a significant potential player community are less adaptable than new competitors. Consequently, incumbents cannot swiftly or frequently alter their strategies due to possible technological and structural inertia, as discussed in [23] and [24].

Suppose that C can improve the quality of its game, its quality level can be improved from q_C at time 0 to q_C^R at time t_C . Before C releases its product, A sets its price to enjoy monopoly profits. After C releases its product, both A and C engage in competition setting their respective prices p_A and p_C , respectively, where the superscript 'R' denotes the release of the product. A finite demand window is considered, e.g., from time 0 to t_D . Figure 1 illustrates the two scenarios.

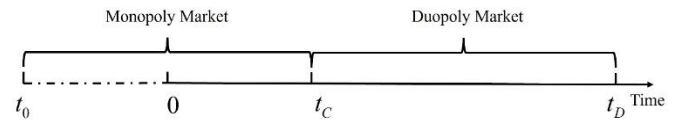


Fig. 1. Time sequence.

The development costs incurred by the entrant prior to time 0 are considered sunk, implying that the entrant only needs to focus on maximizing its profits within a finite demand window following time 0. Additionally, the entrant *decides* the release time, denoted by t_C , strategically allowing it to further improve its game's development before the actual release. Like the assumption made by [25], we assume that the quality of the entrant's game experiences a linear improvement in time t , as shown below

(1)

where α represents the slope, which shows how much (i.e., quality improvement for C) changes for a unit change in t .² Similarly, A has the potential to improve the quality of their game (e.g., by releasing a patch) even if it is initially released at a rate β . In practice, once a game is released, the incumbent's focus usually shifts toward operation and incremental refinements rather than major quality improvement. In contrast, entrants are often willing to undertake more radical or faster innovation before releasing a game. Consequently, their product quality and market

¹ We understand that the quality of a game can be reflected in multiple aspects, such as game mechanics, artistic design, and game genre. Here, we abstract these aspects and consider game quality as a comprehensive measure of its overall excellence, assuming that consumers always prefer higher-quality games, which is in line with the vertical differentiated setting and shown in both [19] and [22]. At the same time, a game developer's efforts to improve game quality can be reflected in its market research aimed at consumers. By gathering feedback, developers can adjust game mechanics, artistic design, and other aspects, ultimately improving consumers' perceived value of the game.

² In particular, quality improvement may exhibit diminishing marginal effect, such as $\alpha = \frac{1}{t}$ or $\alpha = \frac{1}{t^2}$. Even in this case, the product-release strategies proposed remain valid. Diminishing marginal effect makes the entrant more likely to adopt the fast-slip strategy and less likely to adopt the slow-slip strategy.

performance can outperform peers [26-27]. It is therefore natural to assume that the post-release rate of quality improvement of A is lower than that of C . After the game release of the entrant, the quality improvement rate, decreases to β , which is consistent between all game publishers. In other words, we have $\beta_A < \beta_C$ before the entrant releases its game, and $\beta_A = \beta_C$ after its release. As a result, the quality levels of the games released by A and C can be represented as:

$$(2)$$

and

$$(3)$$

respectively, where β_A for $t < t_{EA}$ and β_C for $t > t_{EA}$

The costs borne by a game publisher are directly related to its quality-improving activities and consist of two components: development costs and operational costs. Following [28], both the development cost γ and the operational cost ϕ are assumed to be linear in the time it takes to improve or maintain the quality of the game. The per-unit-time cost of development, which captures the resources devoted to improving product quality prior to release, exceeds the per-unit-time cost of operation, which reflects the resources required to maintain the achieved quality level after release, i.e., $\gamma > \phi$. For simplicity, we define γ as the incremental development cost per unit of time associated with additional quality improvement. Consequently, the total cost encompassing both development and operational quality-related costs for the entrant can be formulated as follows:

$$(4)$$

In Eq. (4), the term γt_{EA} is constant. We can therefore safely omit it and focus solely on the total marginal development cost. At time 0, C has two options: slipping (i.e., delaying release) for quality improvement or releasing the game immediately. Figure 2 illustrates the qualities of both game publishers in these two distinct scenarios. Figure 2.a shows the situation where C improves the quality of their game and releases the game when the quality is lower than that of A 's. In contrast, Figure 2.b depicts the scenario in which C improves the quality of their game until it exceeds that of A 's.

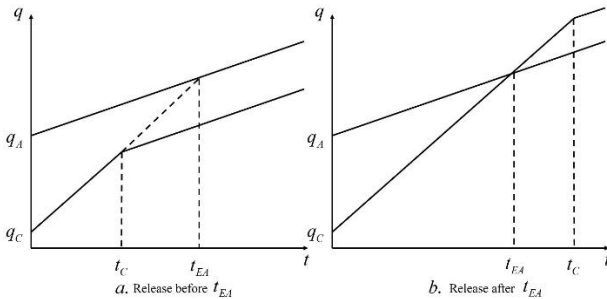


Fig. 2. Two scenarios for the entrant.

C compares profits associated with two options and opts for a more profitable one. Denote t_{EA} as the time required for C to reach the quality level of A 's. We can then obtain

On the demand side, the net utility of a consumer's (i.e., player) from consuming a product (i.e., playing a game) with a specific quality depends on their valuation of the product. In the vertical differentiated setting, let v_A denote the variations in players' valuations of a game with a given quality. Therefore, the net utility per unit of time that a type θ player derives from playing game A is

$$(5)$$

where q_A represents the quality of A 's at time t , and p_A denotes the price set by A .

Like the assumption made by [29], it is assumed that the benefits arising from network effects increase linearly in the size of the network. To clarify, we use n_A to refer to the installed base (the number of players who play the game produced by A) in a monopoly scenario, indicated by the superscript "M". Additionally, we utilize n_A^D and n_C^D to illustrate the installed bases of games A and C ---the numbers of players who play the game produced by A and C , respectively---in a duopoly scenario (indicated by the superscript "D"). Therefore, in the context of a duopoly scenario, the net utility per unit of time that a player of type θ derives from playing game A is as follows

$$(6)$$

where α represents the intensity of the within-network effect and measures the increase in a player's willingness to play when an additional player joins for the same game, and β denotes the intensity of the cross-network effect and measures the increase in a player's willingness to play when an additional player joins for a different game.

It is particularly noteworthy that, in our setting, players always derive positive utility from network externalities, which is a distinctive feature of the video game context compared with other product release settings (e.g., movies, music albums or software updates). Unlike competitive environments where network externalities may reduce consumer utility through congestion or crowding, in the video game market a larger player base typically leads to higher community engagement and thus greater utility from gameplay. Specifically, the within-network effect can be understood as the sense of belonging that arises when more people play the same game, meaning that more like-minded individuals are engaging with the same title, a common theme in the gaming literature [19]. The cross-network effect captures broader community- or genre-level interactions: as overall participation in games increases, there is more discussion, content creation, and social interaction within the player community, which further improves the enjoyment of players [30]. These two types of positive network effects are much stronger and more central in video games than in settings such as films or music, where additional consumers do not directly improve an individual's instantaneous consumption experience to the same extent. Formally, we assume that the within-network effect dominates the cross-network effect, with $\alpha > \beta$ [31-32].

To put it differently, α signifies the utility augmentation

resulting from additional players within the same game, and represents the utility improvement stemming from an additional player in a different product market. We define α , which indicates the degree of incompatibility. Moreover, β quantifies the level of complexity faced by the players of game G when attempting to harness the cross-product network effects arising from game G . A higher value of β corresponds to the players of game G that produces lower utility from the network of game G when G . When the two games are fully compatible (or fully incompatible), we have $\alpha = 0$ (or $\alpha = 1$), leading to $\beta = 0$ (or $\beta = 1$). When the network effect falls between the thresholds of 0 and 1, we characterize this situation as partially compatible. The substitutability of the two games represents the similarity in their game types. For instance, if both games are role-playing games, they exhibit a certain level of substitutability. However, if one game is a role-playing game and the other is an action game, they do not possess substitutability.

The game sequence is depicted as follows. C initially observes the market and selects the optimal release time. Once C releases their game, C and A engage in competition. In other words, similar to the work by [33-34], the entrant first determines the release time and then sets the price. Since the release time does not affect the player's utility, our main results remain unchanged even if the entrant had to first set the price and then determine the release time. Consumers select games that maximize their net utility. Ultimately, all rewards are realized. All notations are summarized in Table A-I in Appendix.

IV. THE OPTIMAL GAME RELEASE STRATEGY OF THE ENTRANT

A. Slip (Release after t_A)

First, we examine the slip strategy, in which C improves its game quality and releases the game once the quality exceeds the quality of the offering of the incumbent. We initially assume that the release time needs pre-planning, allowing us to determine the optimal quality for the entrant and then schedule the optimal release time in a reverse manner. Subsequently, we assume the market share of C following the game release as μ_C . Denote the market share of A by μ_A . The players are indifferent with two games, as shown in Eq. (7).

(7)

By substituting μ_C into Eq. (7), the indifferent point is

(8)

Denote the profit of the incumbent and entrant as π_A and π_C , respectively. Given the market share of the two parties, the problem faced by the two game publishers is to find the solutions with the following optimization problem:

Then the pricing strategy when the game is released after t_A can be optimized according to Lemma 1.

Lemma 1. *The optimal prices for the incumbent and entrant price are p_A^* and p_C^* , respectively. Specifically, $p_A^* = p_C^*$ iff $\alpha = 0$.*

To maximize its total profit, C , over the entire demand window, C must ensure that the quality of its game is similar to or the same as that of A 's. This means releasing before time t_A when the qualities of the two games are equal. Considering the costs presented in Eq. (4), the problem faced by C is

(10)

Lemma 2 characterizes the optimal game release time for C in this scenario. Note that the specific expressions for p_A^* and p_C^* are provided in Table A-II in Appendix.

Lemma 2. *If both the rate of quality improvement γ and the summation of incompatibility $\alpha + \beta$ are small, the optimal option for the entrant is to release the product immediately, employing an immediate-release strategy. Otherwise, the new entrant should adopt a slip (i.e., delay release strategy) and release the product at either t_A or t_C , depending on the initial quality difference, the level of incompatibility difference, quality improvement rates for both suppliers, and the total length of the demand window.*

Lemma 2 holds because when there is no difference in the quality of two games and consumers are indifferent between them, the best option for the entrant is to immediately release the game and compete with the incumbent for market share. In other words, in this scenario, capturing market share takes precedence over pricing considerations. In contrast, when there is a quality difference, and consumers value quality, focusing on quality improvement is likely to result in higher expected long-term profits for the entrant. As such, the entrant should prioritize long-term profitability over engaging in disadvantageous competition with the incumbent at time 0.

B. Release before t_A

Now, we consider the scenario in which C releases their game before the quality of the game exceeds that of A 's. The calculation methods remain the same as those outlined in subsection 4.1. Consequently, adjustments should be made to the market segment and C 's optimization problem. Lemma 3 demonstrates the optimal prices in this scenario.

Lemma 3. *The optimal prices for the games by A and C are p_A^* and p_C^* .*

(11)

_____ and _____, respectively. Specifically, _____ iff _____.

Lemma 3 offers guidance to the entrant when deciding the price for the game. It involves assessing the quality difference and evaluating incompatibility. In the long run, C 's optimization problem can be represented as the following (12)

Lemma 4 characterizes the optimal game release time for the entrant.

Lemma 4. *If the quality improvement rate _____, the sum of incompatibility _____, and the quality difference _____ are small, the optimal option for the new entrant is an immediate release strategy. Otherwise, the new entrant should adopt a slip (i.e., delay release strategy), selecting either _____ or _____ based on the initial quality difference, the level of incompatibility difference, the quality improvement rates for both suppliers, and the total length of the demand window.*

Lemma 4 is similar to Lemma 2, with the key difference being the inclusion of the quality improvement rate in the decision-making process. Even if the quality difference is substantial, the entrant can still benefit from entering the market and releasing the game when the quality improvement rate is high. In contrast, when the quality of the game of C is only slightly inferior to that of A 's and a significant quality improvement is challenging, the optimal option for C is: not to release the game.

C. W

In this subsection, we delve into the scenario when

at time 0. Our objective is to assess whether C can take advantage of a continuous increase in its game quality. Intuitively, the entrant's market share will grow as the quality gap between the two game publishers widens. Lemma 1 demonstrated that the game's price would rise with increasing quality disparity. Both a high price and a significant market share can be advantageous for the entrant's profitability. However, it is important to note that adopting a delayed release strategy will result in increased costs and profit loss during the quality improvement process. It is crucial to remember that when the entrant possesses a quality advantage, the total profit earned through the utilization of an immediate-release strategy (denoted as " P ") is as follows:

$$(13)$$

and the profit earned by releasing at L (superscript ' L ') is

$$(14)$$

The total profit difference can be calculated as follows:

For a new entrant, opting for a late-release strategy when they already possess a quality advantage is never optimal. Furthermore, the longer the delay, the greater the potential loss in profit.

D. The optimal release strategy for the entrant

We now analyze the profitability across three scenarios outlined in subsections 4.1 to 4.3, subsequently presenting the optimal release strategy for the entrant. Figure 3 illustrates the specific quality improvements over time within different release strategies. Two distinct late-release approaches are considered:

Late-release strategy 1: releasing the product prior to the entrant exceeding the incumbent's quality and

Late-release strategy 2: releasing the product after the entrant exceeds the incumbent's quality.

For entrants with relatively low quality, three options are available: **immediate release** at time 0, late release before (late-release strategy 1, i.e., fast slip), and late release after (late-release strategy 2, i.e., slow slip). If the rate of the quality improvement is low or the quality gap between the two products is too substantial to bridge or when the two products exhibit a high degree of similarity (high compatibility), the immediate-release option will be selected. Otherwise, the entrant will initially focus on improving product quality. Proposition 1 provides the core theoretical result that explains the entrant's observed release-timing practices.

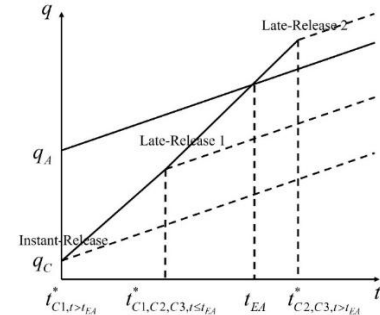


Fig. 3. Game release strategy for the entrant.

Proposition 1.

at time 0 or when _____, C should immediately release the game. If _____, C should delay the release. Specifically, if the difference between the quality of _____ is not substantial or the rate of quality improvement is high, then fast slip is optimal. Otherwise, slow slip is optimal.

We elucidate the optimal strategy for C as follows: if the quality of C 's game exceeds that of A 's, the optimal strategy is immediate release, as demonstrated in subsection 4.1. In contrast, two scenarios arise:

- If _____, C finds no profitability in improving its quality, rendering immediate release the sole viable option.
- If _____, quality improvement becomes profitable. If the quality difference between the game of A and the game of C is not substantial or the rate of quality improvement is high, then fast slip emerges as a strictly dominant strategy. The entrant's decision to release its product at _____, and _____, as depicted in Lemmas 2 and 4, hinges on the specific parameters. However, if the quality gap between the two products is substantial or the rate of quality

improvement is low, then slow slip transforms into the strictly dominant option. The entrant's release timing, whether at or , depends on whether is significant or is substantial.

E. The Possibility of Reverse Slip

In Proposition 1, we assume that the earliest possible release time of the entrant's product is 0. Thus, even if its quality at time 0 is higher than that of A's, one will still only choose the immediate release strategy, as discussed in Subsection 4.3. However, in addition to the slip strategy, there are products in the video game market that adopt a reverse slip strategy, i.e., they bring forward their release date. We therefore adjust the earliest release time of the product to . In this case, the entrant can either release the product earlier to capture the market or continue refining it at rate to further improve its quality. Corollary 1 demonstrates the change in the optimal release strategy in this case.

Corollary 1. When

at time 0, C should release the game at , i.e., reverse slip. Otherwise, the optimal release strategy follows Proposition 1.

Corollary 1 presents another feasible release strategy, namely reverse slip. When the entrant's game has a competitive advantage in product quality compared with the incumbent's released game, any delay in release becomes unacceptable. This is because once the incumbent's product is released, further improvements in its quality can no longer expand its market share. In contrast, the entrant should release its product earlier to enter competition with the incumbent as soon as possible and capture duopoly profits. Instances of reverse slip have become increasingly common in recent years, such as *Death end re;Quest 2* mentioned in the Introduction and *Borderlands 4* [35].

F. Real-practice numerical evidence

To connect the analytical results with observable industry practice, we provide real-practice numerical evidence from recent game releases. Since the variables in the proposed model are not directly observable in open data, we use practical proxies: release-date movement as a proxy for release-timing strategy, review and user-review outcomes as proxies for realized product quality, early sales and concurrent-player counts as proxies for market response and network effects, and negative launch outcomes as a benchmark for the status quo of releasing despite unresolved quality issues. Table II summarizes the evidence. The sources for include [36] and [37]; the sources for *Elden Ring* include [38-40]; the sources for *The Legend of Zelda: Tears of the Kingdom* include [41] and [42]; the sources for *Cyberpunk 2077* include [43-45].

These cases provide practice-based support for the four release-timing regimes derived in our model. is consistent with the immediate-release or reverse-slip logic: when quality is sufficiently high and the opportunity cost of waiting is large, moving earlier can capture player attention before a congested release window. *Elden Ring* illustrates the

fast-slip logic: a short postponement can be valuable when the remaining quality gap is moderate, and additional time can quickly improve the launch version. *The Legend of Zelda: Tears of the Kingdom* illustrates the slow-slip logic: when a publisher can preserve community anticipation and use additional development time to substantially improve their game, a longer delay can lead to exceptional launch outcomes. In contrast, *Cyberpunk 2077* provides a benchmark case showing the risk of launching with unresolved quality problems. Although the game attracted more than one million concurrent Steam players on the day it was launched, its console-quality issues resulted in refunds and temporary removal from the PlayStation Store. These cases show that the prescriptions of the proposed model not only are analytically meaningful but also have business implications: release timing should be chosen by jointly evaluating current quality, expected quality-improvement speed, delay cost, and the strength of player-community network effects.

V. EXTENSIONS: GAME RELEASE STRATEGY WITH MORE PARTICIPANTS, TIME, AND COST

Consider three game publishers on the market: A, B, and C, each offering games with differentiated quality³. To maintain generality, we designate providers A and B as the incumbents and provider C as the entrant. Suppose that incumbent A offers a higher-quality product than incumbent B, denoted as . Both incumbents have already released their games at a time earlier than , i.e. both incumbents have entered the market and have successfully secured certain market shares. In addition, they have made optimal strategies regarding pricing and game quality.

At time , the entrant releases its game with a quality level . At this point, all game publishers begin competition by selecting their prices, namely, , and . The sequence of this game is illustrated in Figure 4.

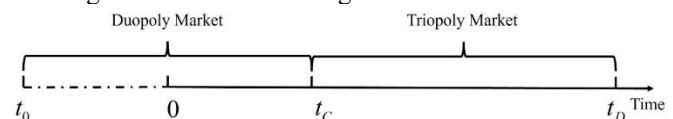


Fig. 4. Time sequence when two incumbents coexist.

Similarly, we posit that the rate of the quality improvement of the entrant before its game release exceeds that of both incumbents. Meanwhile, we assume that the quality improvement rates for both incumbents are equal: . Consequently, before the entrant releases its game, and after the release. As a result, we can express the market share of the three providers after the entrant releases the game as follows:

$$(15)$$

³ Note that, although there may be multiple potential entrants, under our sequential-release framework any such scenario can be decomposed into a sequence of single-entrant problems. The first entrant faces only the existing incumbents, and once it releases its game it becomes an incumbent; subsequent entrants then face a market with multiple incumbents and a single entrant, which is exactly the setting captured by our extension with multiple incumbents.

There are three scenarios for the entrant. First, the entrant's game is of the highest quality among all providers. Under these circumstances, the entrant will immediately release the game and compete with both incumbents. The rationale behind this decision aligns precisely with our earlier discussion in subsection 4.3. When the entrant possesses a quality advantage, the optimal strategy will invariably be an immediate-release strategy. In other words, there is no need for the entrant to further improve the quality of its game, as an increase in quality cannot guarantee an increase in market share. The second case corresponds to Section 4.2, where the quality of the entrant's game is lower than that of incumbent A and higher than that of incumbent B . In this scenario, the entrant has two options: it can either slip (i.e., delay the release of the game) and continuously improve its quality until it exceeds the quality of incumbent A 's game or it can release the product immediately. The entrant will compare the potential profit under these two options and select the one that yields highest profit. We denote t_{EA} as the time required for entrant C to meet the quality requirement of incumbent A , which can be expressed as

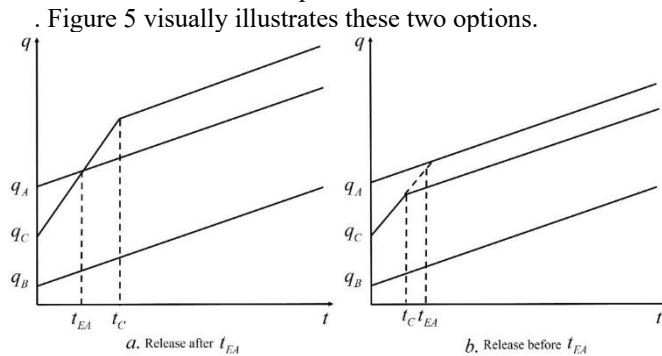


Fig. 5. Entrant's quality lies between two incumbents'.

The third scenario corresponds to subsection 4.1, where the entrant's game has the lowest quality among all games. In this scenario, the entrant has three strategies to adopt: (i) release its product immediately (known as immediate release, corresponding to Figure 6.a); (ii) delay the release and improve the quality until it matches or exceeds the quality of incumbent B (known as fast-slip, corresponds to Figure 6.b); and (iii) delay the release and improve the quality until it matches or exceeds the quality of incumbent A game (known as slow-slip, corresponds to Figure 6.c). In this case, the entrant evaluates these three strategies and selects the one that offers the greatest advantage. We denote t_{EB} and t_{EA} by the time for the entrant to meet the quality requirements of incumbent B 's game and incumbent A 's game, respectively. Then

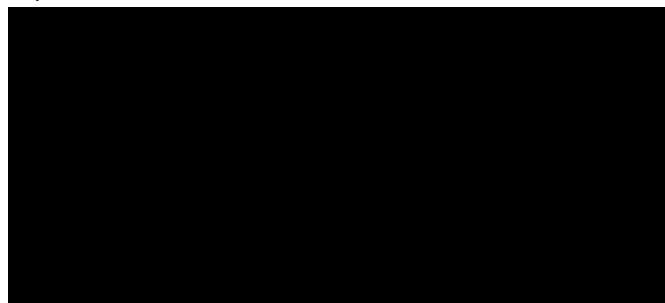


Fig. 6. Entrant's game with the lowest quality.

We further denote the installed base, representing the number of players, for A 's game and B 's game in the duopoly case as n_A and n_B , respectively. In the triopoly case, we employ n_A and n_B to denote the installed bases for games A , B , and C , respectively, again reflecting the number of players. We now proceed to evaluate a player's utility per unit of time in the triopoly case as

$$(16)$$

where α represents the intensity of cross-network effects from another game, and p represents the price set by the game publisher, with all other parameters being consistent with those presented in Eq. (6). Similarly, we have

and U_B . To simplify our analysis, we assume that the cross-network effects of one game are the same for all other games. In other words, the cross-network effect of game C on game B is equivalent to the cross-network effect of game C on game A . We denote the level of incompatibility between games A and B with β_{AB} , where $\beta_{AB} = \beta_{BA}$, which captures the level of difficulty for players of game A to harness the cross-product network effects arising from games A and B . Note that we do not consider compatibility between games A and B , as they already exist on the market. When two providers have already released their games, the market is already shared. Therefore, the compatibility between games A and B is an exogenous parameter that does not influence the outcome. Without loss of generality, we further assume that $\beta_{AB} = \beta_{BA}$, which is reasonable since two compatibilities usually are not equal. Otherwise, the incumbent with a relatively lower market share may intentionally make its game compatible with the game with a higher market share, thus taking advantage of the larger network effect.

We can also extend our model to a more generalized case in a competitive market where an arbitrary number of incumbents coexist, denoted as n incumbents. The decision of the entrant remains to choose the optimal release time considering its long-term profit. Two classical cases worth discussing are oligarchs and perfectly competitive markets. In the former case, the time sequence will be altered, as shown in Figure 7.

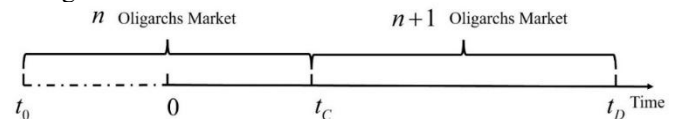


Fig. 7. Time sequence with n incumbents.

For new entrants, there are three distinct cases:

Case 1: the quality of the entrant's game exceeds that of all other participants' games;

Case 2: the quality of the entrant's game is the lowest among all games of the participants; and

Case 3: the quality of the entrant's game falls within an arbitrary range located between the quality intervals of the games of the two participants. In this context, incumbents with game's quality level higher than q_C and incumbents with game's quality level lower than q_C define the entrant's position. It is assumed that all incumbents are arranged in ascending order based on their quality, and the quality of the

entrant, denoted as C , falls within the range $q_C \in [q_A, q_B]$. More precisely, the quality indices of games larger than q_C are collectively denoted as $q_{>C}$, while those quality indices below q_C are collectively denoted as $q_{<C}$. In this case, the incumbent scenario can be degenerated to the two-incumbent scenario, which we will examine in the following subsection.

Proposition 2 extends the analysis to competing publishers and provides the key conditions that rationalize the observed strategic adjustments in practice; the detailed threshold expressions and analysis for three cases are reported in the online Appendix.

Proposition 2. *If an entrant offers the lowest quality among all suppliers, the following four potential strategies are available.*

- 1) *immediate-release strategy, i.e., release the game immediately,*
- 2) *late-release strategy 1 before t_{C1} (focused on quality improvement up to but not exceeding that of incumbent B, also known as LR 1 in the following figure),*
- 3) *late-release strategy 1 before t_{C2} (aiming to improve quality until exceeding incumbent B but still below incumbent A's quality, also known as LR 2), and*
- 4) *late-release strategy after t_{C3} (intended to improve quality until it becomes the highest, also known as LR 3).*

Specifically, the immediate-release strategy will be adapted when $q_C < q_A$, the late-release strategy 1 before t_{C1} will be adapted when $q_C < q_A$, the late-release strategy 1 before t_{C2} will be adapted when $q_C < q_A$, and the late-release strategy after t_{C3} will be adapted when $q_C < q_A$.

The sequence is depicted in Figure 8, which illustrates four highlighted quality deficiencies (indicated in red) and four-time deficiencies for each late-release strategy. The same effects can also serve to illustrate as follows: for each incumbent, the entrant must strike a balance between the competitive advantage effect and the cannibalization effect. When the entrant possesses the lowest quality among all participants, the cannibalization effect will be overshadowed by the competitive advantage effect. Therefore, for a new entrant, the optimal option is to improve its quality until it exceeds the quality of at least one incumbent. Subsequently, influenced by both effects simultaneously, the entrant should adopt late-release strategy 2 if its quality catches up with the highest level, and late-release strategy 1 if it falls short.

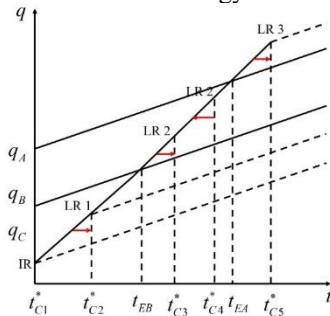


Fig. 8. Game release strategy in the monopolistic market (lowest case).

VI. CONCLUSION

The release timing in the game industry is not only a scheduling problem but also a strategic choice shaped by (i) a game's quality trajectory, (ii) network effects from building and sustaining a player community, and (iii) competitive interaction with rival publishers. This paper developed a unified framework for four release strategies: immediate release, fast slip, slow slip, and reverse slip strategies. It shows that the optimal choice is primarily governed by the initial quality gap across titles and the relative speed of quality improvement. Below, we review our research questions and the motivating real-world examples, and summarize the findings.

When do publishers choose each of the four release strategies? Our model explains when publishers optimally choose among immediate release, fast slip, slow slip, and the rarer reverse slip, consistent with observed practices such as quality-driven long delays (e.g., Tears of the Kingdom; Pragmata) and occasional accelerated launches (e.g., Death end re; Quest 2).

What factors drive the release-strategy choice? The choice is primarily driven by the initial quality gap, the relative speed of quality improvement, and the strength of network effects (i.e., the value of building a community of players).

How should strategies adjust when multiple publishers compete? In markets with multiple publishers, timing becomes strategic: slip strategies can remain optimal, but their effectiveness depends on quality differences between competing titles and the rivals' responses.

The rigor of our findings is supported by closed-form equilibrium characterization and a set of robustness and extension analyses showing that the core conclusions remain stable across alternative assumptions and parameter ranges.

Our findings also challenge a common one-size-fits-all managerial rule ("delay is always bad" or "ship as early as possible"). We show that not all delays are equal: a fast slip can be optimal when minor polishing is needed, and early entry helps seed the player base, whereas a slow slip is justified when deeper quality improvements substantially raise long-run adoption and community value, especially under strong network effects where early adoption and social value can amplify demand over time. When multiple publishers compete, both slip strategies can remain viable in equilibrium, but their effectiveness depends on quality differences across competing games and the strategic responses they induce. Relative to previous work that typically studies release timing in isolation or without distinguishing delay types, our contribution is to provide a single game-theoretic framework that (1) separates fast vs. slow slips, (2) incorporates reverse slip, and (3) characterizes strategic timing adjustments among competing publishers under evolving quality and network effects, yielding clear, testable predictions on when each strategy should be used and how market participants may interpret delays as informative signals about readiness.

While this paper focuses on the decision-making process for game release timing, many avenues for future research remain. For example, an interesting avenue for future research would be to endogenize the quality improvement

process by allowing firms to invest in R&D to influence the rate of their quality improvement, and to study how investment decisions interact with release timing, pricing, and network effects. Another possible extension is to let the release time of product directly affect the utility of players. For example, a delayed release may impose a utility cost on players, while an earlier release could generate a utility gain. In this case, when making decisions, the provider must consider not only quality improvement but also changes in the expected utility of players and should adjust the associated release strategy. Finally, data-driven studies on game release timing present a promising avenue for future research.

APPENDIX

TABLE A-I NOTATION LIST

Notation	Definition
	Quality of the incumbent and the entrant at time 0, respectively
	The release time of the incumbent and the entrant, respectively
	The upper bound of the finite time window
	The entrant's quality at time
	Rate of quality improvement for the incumbent and the entrant, respectively
	Rate of quality improvement after release
	Development cost and the operational cost per unit of time, respectively
	Marginal development cost per unit of time
	The time required for the entrant to reach the quality level of the incumbent
	Players' heterogeneous preference for a game with different quality
	The price charged by the incumbent and the entrant, respectively
	Installed base of the incumbent in the monopoly scenario
	Installed bases of the incumbent and the entrant in the duopoly scenario, respectively
	The intensity of the within-network and cross-network effect, respectively
	The difficulty for players in game i to use cross-product network effects
	The optimal release time for the entrant
	Total profit for the entrant
	Quality, price, and the installed base of the incumbent B
	Numbers of the incumbent
	Profit for the incumbent, the incumbent B , and the entrant, respectively

TABLE A-II DETAILED EXPRESSIONS

Notation	Expressions

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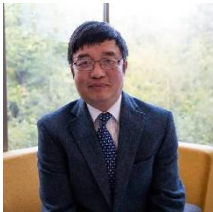
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