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多市場競爭中音訊與影音 podcast 平台之市場進入策略
Market entry strategy of audio and video podcasting platforms
under multi-market competition

黃文新

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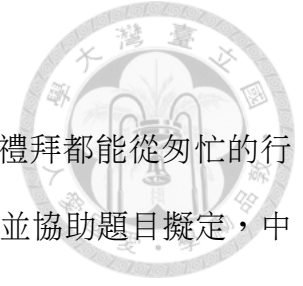
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摘要



播客產業在過去幾年經歷了快速成長。除了廣為人知的音訊形式之外，還有影像的形式，並越來越受歡迎。因此，播客產業可以分為兩個市場。最初，沒有任何平台正式進入這兩個市場：Spotify 和 Apple Podcasts 專注於音訊版本，而 YouTube 則專注於影像版本。當 Spotify 在 2020 年採取行動，允許創作者上傳視訊版本時，情況有了變化。不久之後，Apple Podcasts 也進行了相同措施，YouTube 也從另一邊擴張。直觀上，這些行為可能會造成競爭，導致價格下降，並損害其獲利能力；然而，這些平台都宣佈在 2023 年漲價，促使我們研究這個產業觀察背後的原因。

在這項研究中，我們建構了一個賽局理論模型來研究他們的行為。在我們的模型中，有兩個多邊市場，其中有一群可以市場多棲創作者與兩群不重疊的消費者。我們考慮三種情況：兩個市場都只有一個平台（案例 SS），只有一個市場有兩個平台（案例 SD），以及兩個市場都有兩個平台（案例 DD）。這項研究有三個主要發現。首先，價格在競爭中永遠不會下降。其次，平台在案例 DD 情況下比在案例 SS 情況下更有利可圖。第三，案例 DD 是唯一且雙贏的納許均衡。我們的結果有助於解釋這些平臺的策略與行動。

關鍵字: 播客平臺、多邊平臺、多市場、賽局理論、市場擴張、市場競爭。

Abstract



The podcast industry has experienced rapid growth in the past few years. Besides the well-recognized audio podcasts, there is another version called video podcasts, which has been gaining more popularity recently. Thus, the podcast industry can be divided into two segments. Initially, no podcast platform giants officially entered both markets: Spotify and Apple Podcasts focused on the audio version, while YouTube focused on video podcasts. Things changed when Spotify took action in 2020, allowing creators to upload video podcasts. Before long, Apple Podcasts followed suit, and YouTube expanded from the other side. Intuitively, these actions might create competition, cause a price decrease, and harm their profitability; however, these platforms all announced a price rise in 2023, driving us to study the rationale behind this industry observation.

In this study, we construct a game-theoretic model to study their behaviors. In our model, there are two multi-sided markets with a group of multi-homing creators and two groups of non-overlapping customers. We consider three scenarios: both markets have only one platform (case SS), only one market has two platforms (case SD), and both have two platforms (case DD). There are three main findings in this study. First, prices never decrease under competition. Second, platforms are more profitable in the case DD than in the case SS. Third, case DD is a unique win-win equilibrium. Our results thus help explain the strategic moves of these podcast giants.

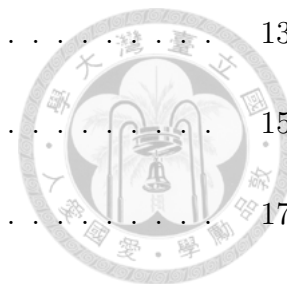
Keywords: podcast platform, multi-sided platform, multiple markets, game theory, market expansion, competition.



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Chapter 1

Introduction

1.1 Background and Motivation

The podcast industry is experiencing significant growth, especially after the outbreak of COVID-19. However, podcasts have been around since as early as 2003, and the first audio podcast platform emerged a year later. This industry gradually gained mainstream recognition after the entry of Apple iTunes (later rebranded as Apple Podcasts) in 2005 (Marshall, 2023; Son, 2023). Recently, Edison Research (2023) indicates that 64% of the U.S. 12+ population have listened to a podcast, with 42% of them being monthly users and 31% being weekly listeners. All of these figures set a record high, revealing the growing importance of podcasts. Furthermore, comparing the data with the period before the pandemic (2018), the percentages were 44%, 26%, and 17%, respectively. Here we can observe a significant percentage increase. From the perspective of advertising, the same report shows that U.S. podcast listeners are more affluent, more educated, and more employed. They spend more time listening than before, and 46% of monthly users

do not find ads on podcasts intrusive at all. All of these factors make podcasting a more appealing media for advertising.



In addition to the commonly recognized audio podcasts, there is another form of podcast known as video podcasts. Video podcasts, as a type of podcast that incorporates visuals, appeared later in the podcast scene. Voices (2022) reveals that since video podcast gained popularity and the launch of the podcast section on YouTube, the significance of podcasting has been increasingly on the rise. Makari (2023) reports that many experts and senior managers in the podcast industry, such as Amazon Music senior podcast manager Megan Bradshaw, agree with the idea.

Cumulus Media and Signal Hill Insights (2023) gives us an outline of the podcast industry in 2023. In October 2023, YouTube was the biggest podcast platform, reported that 28% of weekly podcast customers utilized YouTube the most. Spotify took the second place, holding 15% of them. Meanwhile, Apple Podcasts accounted for 12%. Compared to the data in 2019, at that time, Apple Podcasts led the industry with 29%, Spotify took 16% of weekly users, and YouTube only held 15%. Here we can observe a reversal in rankings. The report also reveals the disloyalty of customers between platforms. 56% of YouTube podcast users admit that they took the same podcast on other platforms, and 73% of them will leave YouTube if the podcast creators they want sign an exclusive agreement with others. Lastly, this report also shows that audio podcasts are no longer the preferred way for customers to consume podcast content. Only 35% of recipients prefer the audio version, an 8% decrease compared to the October 2022 study. Conversely, the percentage of individuals who prefer actively watching a video while listening has increased by 9%, up to 37%, while the remaining choose to play videos in the background

or minimize them on their devices.

Interestingly, we noticed a trend where some podcast platforms are trying to expand their market territory. YouTube, a video-focused platform, offered a podcast-specific page in the U.S. in 2023, YouTube introduced podcasts on the YouTube Music app and offered creators the option to transfer video podcasts to audio versions with a click in the U.S. market, with plans to gradually expand to other countries. When using YouTube Music to consume podcasts, users could switch between video podcasts and audio podcasts (Roth, 2023). Spotify, an audio-focused platform, took actions from another direction. Spotify started allowing video podcasts in 2020 and widely rolled them out in 2021 (Spotify, 2023). We can also find that Apple Podcast, another audio-focused platform did the same thing (Koetsier, 2022).

Intuitively, according to economic theory, a decrease in heterogeneity between platforms would lead to more intense competition, resulting in reduced profitability for them. YouTube, originally focused on video podcasts, differed from Spotify and Apple Podcasts, which were primarily audio podcast platforms. However, YouTube chose to encourage creators to upload audio podcasts. Moreover, both Spotify and Apple Podcasts also allowed the incorporation of video podcasts on their platforms. This deviates from the traditional understanding, and such unconventional moves yields our curiosity.

In this study, we compare platform profits when platforms independently decide whether to enter another type of podcast market or not. We aim to identify the critical reasons behind these platform decisions and understand the impact on creators or customers resulting from such actions.

1.2 Research Objectives



In this research, we develop a game-theoretic model to address the research question. The model involves three primary participant categories: two customer groups, two platforms, and a group of creators. Customers are distributed across two markets, representing audio podcasts and video podcasts, with no overlap between customers in the two markets. Customers independently decide whether to join any platform in their respective markets. We assume that each market initially has one platform, and platform decisions include (1) whether to enter the other market and (2) the subscription fee of a membership. Creators choose whether to collaborate with each platform independently and follow that platform into the corresponding one or both markets. Following the current practice, we assume creators may do multi-homing and participate in both platforms. To analyze the impact of competition, however, we assume customers are single-homing. We anticipate that by obtaining equilibrium solutions for different entry states, we can analyze the reasons for platforms choosing to enter both markets and expanding the scope of competition. This analysis aims to identify the factors that drive platforms to deviate from economic principles.

1.3 Research Plan

In Chapter 2, we conduct literature reviews on the characteristics of podcasts or streaming platforms, focusing on multi-sided platform competition and multi-market competition. Then, in Chapter 3, we develop a model that depicts the competition between two multi-sided platforms under two related but different markets. Subsequently, in Chapter 4, we

propose our expected results. Following this, in Chapter 5, we conduct an extension to test the robustness of our results. Finally, in Chapter 6, we state our conclusions and outline future work.





Chapter 2

Literature Review

In this study, we focus on the pricing decision under multi-sided and multi-market competition of two podcast streaming platforms. In Section 2.1, we are going to refer to some literature on podcasts or streaming platforms to understand more about the factors that influence platform decisions. In Sections 2.2 and 2.3, we concentrate on multi-sided platform and multi-market competition, respectively, as the type of competition plays a vital role in platform decisions.

2.1 Podcast and streaming platform

Podcast platforms represent a typical type of streaming platform, sharing certain characteristics. Numerous studies have focused on online streaming platforms.

Wlömert and Papies (2016) analyze the influence of the pricing strategy of music streaming platforms on the entire music industry. They conduct research on customers and conclude that streaming is beneficial for the industry only in a paid streaming strat-

egy, due to positive revenue contribution. Therefore, platforms need to promote paid streaming rather than free streaming. Barata and Coelho (2021) also study music streaming but focus on purchasing and recommendation intention. Using an extension of the UTAUT2 model to investigate, this research reveals that usage habit plays the most vital role. This highlights the importance of personalization. Thus, in our article, we use horizontal differences to model customer platform preferences in order to illustrate the importance of the platform's personalized system for customer utilities.

Bhargava (2021) model the influence of platform decision on creators behavior under a given platform's scale. It shows that when the revenue-sharing ratio increases, creators have a greater incentive to produce videos, driving total viewership, and subsequently increasing advertising demand and prices. Platform profits also rise. However, this trend continues only until advertising prices become too high, leading to a decline in advertising demand. As a result, both platform profits and the revenue share obtained by creators decrease. Ultimately, this may lead to a situation where creators are unwilling to produce content. Following their direction, we also consider revenue sharing ratio, creator incentive, advertising fee in our model.

There is also some research on podcast platforms. Sullivan (2019) discusses the past and future of podcast platforms. Similar to other media, podcasts have evolved due to platformization. It is noteworthy that unlike other media, the decentralized architecture of podcasts is based on Really Simple Syndication (RSS), making platformization more challenging. However, in recent times, the podcast industry has undergone rapid changes, primarily driven by the interest of major tech giants such as Apple, Spotify, and Google (YouTube). The competition between these giants will spur the expansion of extraction

and platformization.

Chan-Olmsted and Wang (2020) conducts a nationwide survey in the United States, exploring customers from the perspectives of motivation and usage. It points out that podcasts have their own diverse audience, platforms, and creators. It should be considered a new medium rather than an extension of radio. With the entry of non-audio-specific platforms (such as YouTube), the increasing adoption of listening devices (such as home smart speakers), and the involvement of celebrities, this conclusion may be further amplified. Based on this notion, in this article, we discuss the post-entry scenario of non-audio platforms into the market, focusing on competition in both the audio and video markets and the related business decisions.

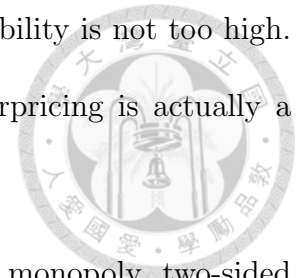
These research highlights some properties of podcast or streaming platforms, but none of them provides the answer to our research question: why these two tech giants choose to move closer to each other, regardless of the possibility of competition intensifying.

2.2 Multi-sided Competition

After understanding some characteristics of podcasting or streaming platforms, here we will review the competition in the “multi-sided market” In this reign, two-sided platforms are the most widely discussed.

Godes et al. (2009) use an analytical model to underscore the importance of the intensity of competition. In a two-sided market, when market competition is not too intense, a new entrant may lead to a higher content price, which is counterintuitive. For example, firms in a duopoly market may set a higher content price than a firm in a

monopoly market setting, especially when the degree of substitutability is not too high. This result is primarily due to the fact that the benefit of underpricing is actually a concave-down curve as the competitive intensity increases.



Armstrong (2006) examine the factor of content pricing in a monopoly, two-sided single homing and only one group join all the platforms in the model. He find that externalities, paying policy and single-or-multi-homing could influence the equilibrium price. In this research, he claim that there is no incentive to discuss multi-homing on both sides since all possible match had already included. However, Bakos and Halaburda (2020) introduce the multi-homing on both sides in a duopoly two-sided platform to bridge the gap. They argue that allowing multi-homing does not guarantee all party in that side will join all the platforms and based on the reality, for instance, ride-sharing or food delivery, are multi-homing on both sides. They demonstrate the existence of multi-homing on both sides, and under that situation, the effectiveness of subsidy strategies on two-sided platforms would be reduced.

Carroni et al. (2023) built a model focusing on how exclusivity influences profit in a two-sided platform competition scenario. They point out that in situations where customers do not exhibit significant platform preferences, it is more advisable for the platform to sign exclusive contracts with superstars. This is because superstars could attract more customers and, thereby, other creators to join the platform. The platform may capitalize on selling the broadcasting rights of exclusive creators to gain greater profits than merely maintaining exclusivity.

Amaldoss et al. (2021) establish a three-sided platform competition model, encompassing customers, advertisers, and content creators, to study the impact of different

provision strategies on platform and content provider profits. They also examine how these results would change with variations in the bargaining power of content suppliers. They find that when the bargaining power of content suppliers is low, an increase in customer demand for content, leading the platform to purchase more content, could erode advertising revenue, potentially harming the overall profits of platforms. However, the content provider's profit would increase. If the demand from advertisers increases, it would boost platform revenue, but the profit of content providers would decrease. On the other hand, when the bargaining power of content providers is higher, such as in the case of a monopoly in the content market, content providers cannot fully extract market profits. This is because the platform can choose to monetize through advertising, causing the demand for content to be significantly affected by content prices.

Although the mentioned papers are related to platform business models and discuss competition on two-sided or multi-sided platforms, they do not provide explanations for competition strategies specifically in the context of two markets. This remains an area of curiosity for us.

2.3 Multi-market Competition

There is also another dimension of competition called “multi-market competition.” Cai and Chen (2011) concentrate on referrals within three distinct markets involving two separate firms. The first two markets are filled with customers only knowing one firm, while the remaining market recognizes both. The study indicates that if the profit-sharing ratio is sufficiently high, even one-way referrals can be profitable for both parties.

Furthermore, two-way direct referrals always contribute to a larger market size.

Yu and Jr. (2012) make a comprehensive review on Multi-market competition research. In multi-market competition, when taking action in one market (such as price reduction), competitors may retaliate by taking action in more than one market, intensifying competition broadly. This concept can be traced back to Edwards (1955). Many scholars have proposed similar hypothesis, known as “mutual forbearance ,” exist under different conditions (Gimeno and Woo, 1994). The main areas of research on Multi-market competition include: antecedents, outcomes, moderating factors of mutual forbearance, and extensions of previous studies. In our research, we consider a two-market competition. The above studies cannot justify the actions between these two podcast platforms.



Chapter 3

Model

We consider a dual-market setting with two streaming platforms, two groups of customers, a group of creators, and an advertiser. These two markets, denoted by A and B , are similar to some extent, facilitating any platform to enter both markets. They share the same advertiser and creators but have their own customer segmentations. In a real-world example, we can divide the podcast industry into audio podcasting and video podcasting. The content may be created by the same creators, may provide impressions for the same advertiser, but their customers have different preferences.

The platforms charge customers for third-party content with appropriate content prices and charge advertisers for each impression, but they share some profit with the creators they cooperate with. Customers and creators can decide whether to join any platform in any market, similar to many previous research studies. We discuss the competition between two platforms (denoted by 1 and 2) and focus on three scenarios based on the competitive conditions in the market: one is where there is only one platform in each of the two markets (SS); another is where there are two platforms in one market and

only one platform in the other market (SD); the third is where there are two platforms in both markets (DD). We use superscripts to denote these scenarios.



3.1 Customers

Assume customers are in a Hotelling Line based on their platform preferences, which is denoted as x . We assume that x is uniformly distributed in $[0, 1]$ in both markets. Platform 1 is located at 0, and platform 2 is located at 1 and with a transportation cost t . When t is large, customers are more concerned with their platform preference. Let P_j is the content price for platform j in his one or two market. Here, we enforce identical pricing across markets to eliminate vertical differences and focus on the impact of competition types.

Assume any subscription will produce a fixed utility $V > 0$. Assume a customer's utility is positive-correlated to S_j , number of creators in the platform, with a constant $\alpha > 0$. Customers need to decide whether to join any platform. Here we use U_{ij} to denote the utility and D_{ij} to represent the total demand of Platform j in market i . Both utilize subscripts to indicate scenarios. For SS case, since there is no competition on customer side (each market has only one platform), utility function for customer located at x are

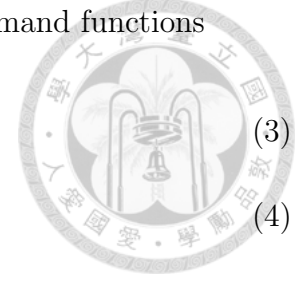
$$U_{A1}^{SS} = V + \alpha S_1^{SS} - P_1^{SS} - tx \tag{1}$$

$$U_{B2}^{SS} = V + \alpha S_2^{SS} - P_2^{SS} - t(1 - x) \tag{2}$$

And by utility equation (1) and (2), we have the corresponding demand functions

$$D_{A1}^{SS} = \frac{V + \alpha S_1^{SS} - P_1^{SS}}{t} \quad (3)$$

$$D_{B2}^{SS} = \frac{V + \alpha S_2^{SS} - P_2^{SS}}{t} \quad (4)$$



Also, in case SS, we need to assume $D_{A1}^{SS} > 0.5$ and $D_{B2}^{SS} > 0.5$ to secure competition exists when any platform decides to deviate.

For case SD and case DD, their utility functions are similar to case SS. We have the utility functions for customer located at x

$$U_{A1}^{SD} = V + \alpha S_1^{SD} - P_1^{SD} - tx \quad (5)$$

$$U_{B1}^{SD} = V + \alpha S_1^{SD} - P_1^{SD} - tx \quad (6)$$

$$U_{B2}^{SD} = V + \alpha S_2^{SD} - P_2^{SD} - t(1 - x) \quad (7)$$

$$U_{A1}^{DD} = V + \alpha S_1^{DD} - P_1^{DD} - tx \quad (8)$$

$$U_{A2}^{DD} = V + \alpha S_2^{DD} - P_2^{DD} - t(1 - x) \quad (9)$$

$$U_{B1}^{DD} = V + \alpha S_1^{DD} - P_1^{DD} - tx \quad (10)$$

$$U_{B2}^{DD} = V + \alpha S_2^{DD} - P_2^{DD} - t(1 - x). \quad (11)$$

As for the demand functions in those cases, we need to further assume that the market with competition is fully covered, and there are no multi-homing customers to ensure competition on the customer side, similar to Cai and Chen (2011). Using the same

treatment from equation (5) to (11), we have the corresponding demand functions

$$D_{A1}^{SD} = \frac{V + \alpha S_1^{SD} - P_1^{SD}}{t} \quad (12)$$

$$D_{B1}^{SD} = \frac{t + \alpha(S_1^{SD} - S_2^{SD}) - P_1^{SD} + P_2^{SD}}{2t} \quad (13)$$

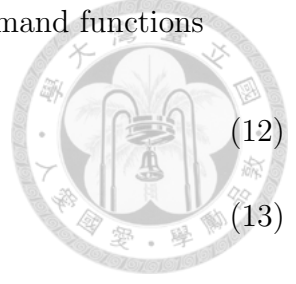
$$D_{B2}^{SD} = 1 - \frac{t + \alpha(S_1^{SD} - S_2^{SD}) - P_1^{SD} + P_2^{SD}}{2t} \quad (14)$$

$$D_{A1}^{DD} = \frac{t + \alpha(S_1^{DD} - S_2^{DD}) - P_1^{DD} + P_1^{DD}}{2t} \quad (15)$$

$$D_{A2}^{DD} = 1 - \frac{t + \alpha(S_1^{DD} - S_2^{DD}) - P_1^{DD} + P_2^{DD}}{2t} \quad (16)$$

$$D_{B1}^{DD} = \frac{t + \alpha(S_1^{DD} - S_2^{DD}) - P_1^{DD} + P_2^{DD}}{2t} \quad (17)$$

$$D_{B2}^{DD} = 1 - \frac{t + \alpha(S_1^{DD} - S_2^{DD}) - P_1^{DD} + P_2^{DD}}{2t}. \quad (18)$$



3.2 Creators

In our model, like Bakos and Halaburda (2020), we allow multi-homing for creators but remain the possibility for any of them to be single-homing. All creators are heterogeneous in their ability to manage fans, denoted as y , which is uniformly distributed between 0 and 1. We use $\beta_j \frac{Demand_j}{S_j} y$ to express the total management cost for a creator in platform j , where $\beta_j > 0$ represents the views per person in platform j . Meanwhile, $\beta_j \frac{Demand_j}{S_j}$ represents the total views for a creator in platform j . The utility function of creators is influenced by the number of customers on the platform, the advertising revenue of the platform, the revenue-sharing ratio on the platform (denoted by $0 < \phi < 1$), and the management cost as defined earlier. Here, we set revenue-sharing ratio as a parameter in our basic model and relax it on the Chapter 5, since adjusting prices is a more common action for platforms.

Furthermore, like Amaldoss et al. (2021), here we assume that platforms have the capability to monopolize the entire surplus generated by advertisers, given that advertising space is limited. Following this practices, advertisers have no decision to make in our model. We let ρ_j denote the valuation of each impression for advertisers on platform j , γ_j denote the viewership ratios on platform j , $R_j = \rho_j \gamma_j \geq 0$ represent the advertising valuation of a customer in platform j , and $Demand_j$ denote the total demand on platform j . The advertising revenue of platform j will be $Demand_j \cdot \rho_j$, and all creators will gain $Demand_j \cdot \rho_j \cdot \phi_j$ in total. Creators will independently choose whether to join either of the two companies, as long as the utility function is non-negative.

We use C to denote the utility function for creator. In all cases, we have

$$C_1^{SS} = \frac{\phi D_{A1}^{SS}(P_1^{SS} + R_1)}{S_1^{SS}} - \beta_1 \frac{D_{A1}^{SS}}{S_1^{SS}} y \quad (19)$$

$$C_2^{SS} = \frac{\phi D_{B2}^{SS}(P_2^{SS} + R_2)}{S_2^{SS}} - \beta_2 \frac{D_{B2}^{SS}}{S_2^{SS}} y \quad (20)$$

$$C_1^{SD} = \frac{\phi(D_{A1}^{SD}(P_1^{SD} + R_1) + D_{B1}^{SD}(P_1^{SD} + R_1))}{S_1^{SD}} - \beta_1 \frac{(D_{A1}^{SD} + D_{B1}^{SD})}{S_1^{SD}} y \quad (21)$$

$$C_2^{SD} = \frac{\phi D_{B2}^{SD}(P_2^{SD} + R_2)}{S_2^{SD}} - \beta_2 \frac{D_{B2}^{SD}}{S_2^{SD}} y \quad (22)$$

$$C_1^{DD} = \frac{\phi(D_{A1}^{DD}(P_1^{DD} + R_1) + D_{B1}^{DD}(P_1^{DD} + R_1))}{S_1^{DD}} - \beta_1 \frac{(D_{A1}^{DD} + D_{B1}^{DD})}{S_1^{DD}} y \quad (23)$$

$$C_2^{DD} = \frac{\phi(D_{A2}^{DD}(P_2^{DD} + R_2) + D_{B2}^{DD}(P_2^{DD} + R_2))}{S_2^{DD}} - \beta_2 \frac{(D_{A2}^{DD} + D_{B2}^{DD})}{S_2^{DD}} y. \quad (24)$$

3.3 Platform

Platforms could decide content price and sharing ratio. In our model, platforms charge content price from customers, receive advertising fee from advertisers and share some profit to creators. Using those notations we have defined, in all cases, profit functions for platform are

$$\pi_1^{SS} = (1 - \phi)D_{A1}^{SS}(P_1^{SS} + R_1) \quad (25)$$

$$\pi_2^{SS} = (1 - \phi)D_{B2}^{SS}(P_2^{SS} + R_2) \quad (26)$$

$$\pi_1^{SD} = (1 - \phi)(D_{A1}^{SD}(P_1^{SD} + R_1) + D_{B1}^{SD}(P_1^{SD} + R_1)) \quad (27)$$

$$\pi_2^{SD} = (1 - \phi)D_{B2}^{SD}(P_2^{SD} + R_2) \quad (28)$$

$$\pi_1^{DD} = (1 - \phi)(D_{A1}^{DD}(P_1^{DD} + R_1) + D_{B1}^{DD}(P_1^{DD} + R_1)) \quad (29)$$

$$\pi_2^{DD} = (1 - \phi)(D_{A2}^{DD}(P_2^{DD} + R_2) + D_{B2}^{DD}(P_2^{DD} + R_2)). \quad (30)$$

3.4 Decision Sequence

The sequence of events is illustrated as Figure 3.1. First, platforms determine whether to enter both markets. Second, platforms set content price P_j . Lastly, customers and creators choose the platform they want simultaneously. Note that customers can only subscribe to one platform, while creators can cooperate with both. In reality, customers and creators do not make their decisions simultaneously; however, they are able to leave or enter freely after seeing others' decisions. In the long run, the equilibrium will be identical to deciding together.

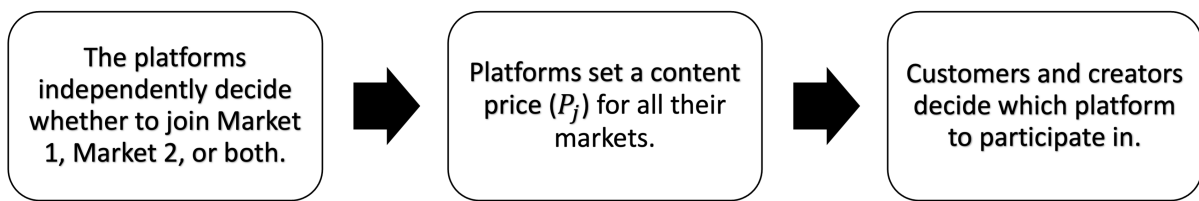


Figure 3.1: Decision Sequence



Chapter 4

Model Analysis

In Chapter 3, we construct a model between two multi-sided platforms under the two-market competition scenario. Based on this model, we find the equilibrium solutions through backward induction. To highlight the impact of entry decisions, we assume there is no difference between the platforms' parameters. In other words, there is no vertical difference between platforms in this section. Thus, we have $\beta_1 = \beta_2 = \beta$ and $R_1 = R_2 = R$. Also, to ensure comparability, we set the sharing ratio as ϕ , regardless of the competition types or platforms.

4.1 Model Equilibrium

In order to reduce overly trivial discussion and provide more useful managerial implications, we use some assumptions to secure interior optimal solution in this section.

Assumption 1. *We additionally assume $t \leq V + R \leq 2t$, $0 \leq \frac{\phi(V+R)}{2\beta(1-\frac{\alpha\phi}{\beta})} \leq 1$, $0 \leq \frac{\phi}{\beta} \frac{2V+7t+2R}{11(1-\frac{\alpha\phi}{\beta})} \leq 1$, $0 \leq \frac{\phi}{\beta} \frac{t}{(1-\frac{\alpha\phi}{\beta})} \leq 1$, $2V - 3t + 2R \geq 0$, to secure the result is interior*

optimal solution.

Most of these assumptions primarily aim to ensure that customers' demand and suppliers' demand are within a rational range, with two of them are to satisfy the fully covered setting. For example, the first two are to ensure that, in case SS, customers' demand is between $\frac{1}{2}$ and 1, and suppliers' demand is between 0 and 1. For case SD, we additionally use $0 \leq \frac{\phi}{\beta} \frac{2V+7t+2R}{11(1-\frac{\alpha}{\beta}\phi)} \leq 1$ to secure $0 \leq S_2^{SD} \leq 1$. And the last two equations are to ensure that, in case DD, the suppliers' demand is between 0 and 1, and both markets are fully covered in case SD and case DD.

4.1.1 Case SS

Based on our setting, in case SS, due to the symmetry and lack of competition, it is fair to say that the two platforms share the same optimal solutions. To reduce redundancy, we only use platform 1 for subsequent analysis and calculations here. As for the equilibrium of platform 2, it is technically identical; we just need to change the subscript.

By backward induction, we have Lemma 1.

Lemma 1. *The equilibrium price of platform 1 in case SS is*

$$P_1^{SS*} = \frac{V + (2\frac{\alpha}{\beta}\phi - 1)R}{2(1 - \frac{\alpha}{\beta}\phi)},$$

P_1^{SS*} increases in V , α , and ϕ but decreases in β , and the impact from R depends on $2\frac{\alpha}{\beta}\phi - 1$.

Taking a closer look at Lemma 1, in optimal, the partial derivatives of P_1^{SS*} with respect to V and α are both non-negative. Since V represents the base utility and

α represents the degree of cross effect, this result is very reasonable because the market apparently more comfortable for the platform. Besides, the partial derivative of P_1^{SS*} with respect to ϕ is strictly non-negative. This is because raising the sharing ratio increases creator demand, which boosts customers' utility and provides room for charging more.

We also find that the partial derivative of P_1^{SS*} with respect to β is non-positive. β illustrates the views per person and might be thought to be positively correlated with profit at first glance; however, β has nothing to do with the creator's profit because what really matters is the demand for subscriptions. Instead, β will increase the management cost for creators, pushing creators away, which drives this result.

Moreover, we can notice that t is not in the function. This is because, in a monopoly market, there is no competition; even with a larger t , customers still cannot deviate to other platforms.

As for R , it depends on the sign of $2\frac{\alpha}{\beta}\phi - 1$. When the degree of cross effect α and the sharing ratio ϕ are relatively high, and the views per person β is relatively low, the content market is easier to monetize. If the content market conditions are favorable enough for the platform, higher advertisement revenue per subscription could lead to a price increase. In this way, the platform could benefit from focusing on the content market. On the other hand, if the content market is not that appealing, the platform cuts down the price to attract more customers and generate more revenue from advertising.

By substituting the optimal price into the profit function 25, customer demand function 3, and creator demand function 19, we have Corollary 1.

Corollary 1. *The equilibrium profit of platform 1 in case SS is*

$$\pi_1^{SS*} = \frac{(1 - \phi)(V + R)^2}{4t(1 - \frac{\alpha}{\beta}\phi)},$$

where π_1^{SS*} increases in V , R and α but decreases in β and t . Moreover, profit only increases in ϕ if and only if $\alpha > \beta$. And the equilibrium customer and creator demand of platform 1 in case SS are

$$D_1^{SS*} = \frac{V + R}{2t} \text{ and } S_1^{SS*} = \frac{\phi(V + R)}{2\beta(1 - \frac{\alpha}{\beta}\phi)}, \text{ respectively.}$$

The partial derivatives of π_1^{SS*} basically share the same explanation: when the market is easier to obtain customers, the profit rises, and vice versa. However, the impact of ϕ could be positive or negative, depending on whether α is greater than β . This is intuitive because a larger ϕ increases both creators' demand and cost per subscription for the platform at the same time. If the market is favorable for the content market, a higher sharing ratio could lead to larger profit. On the other hand, t represents the transportation cost, so it is not surprising that the partial derivative is non-positive.

Customer demand is positively correlated with the basic value V and the advertisement valuation of a viewer on the platform R , while it is negatively correlated with t , which meets common sense. Note that, in this study, customer demand should not be less than $\frac{1}{2}$. On the other hand, V , R , α , and β have the same directional impact on creator demand as they do on price or profit. As for ϕ , as we mentioned before, a larger ϕ makes the platform more attractive to creators.

As we mentioned, profit only increases in sharing ratio ϕ when $\alpha - \beta > 0$ and price only increases in the advertisement valuation of a viewer on the platform R when $2\alpha\phi - \beta > 0$. If we set $V = 3$, $t = 2$, $R = 0.2$, and $\phi = 0.2$, and let α and β range between 0 to 3, we



can divide our feasible region into three areas as Figure 4.1 shows.

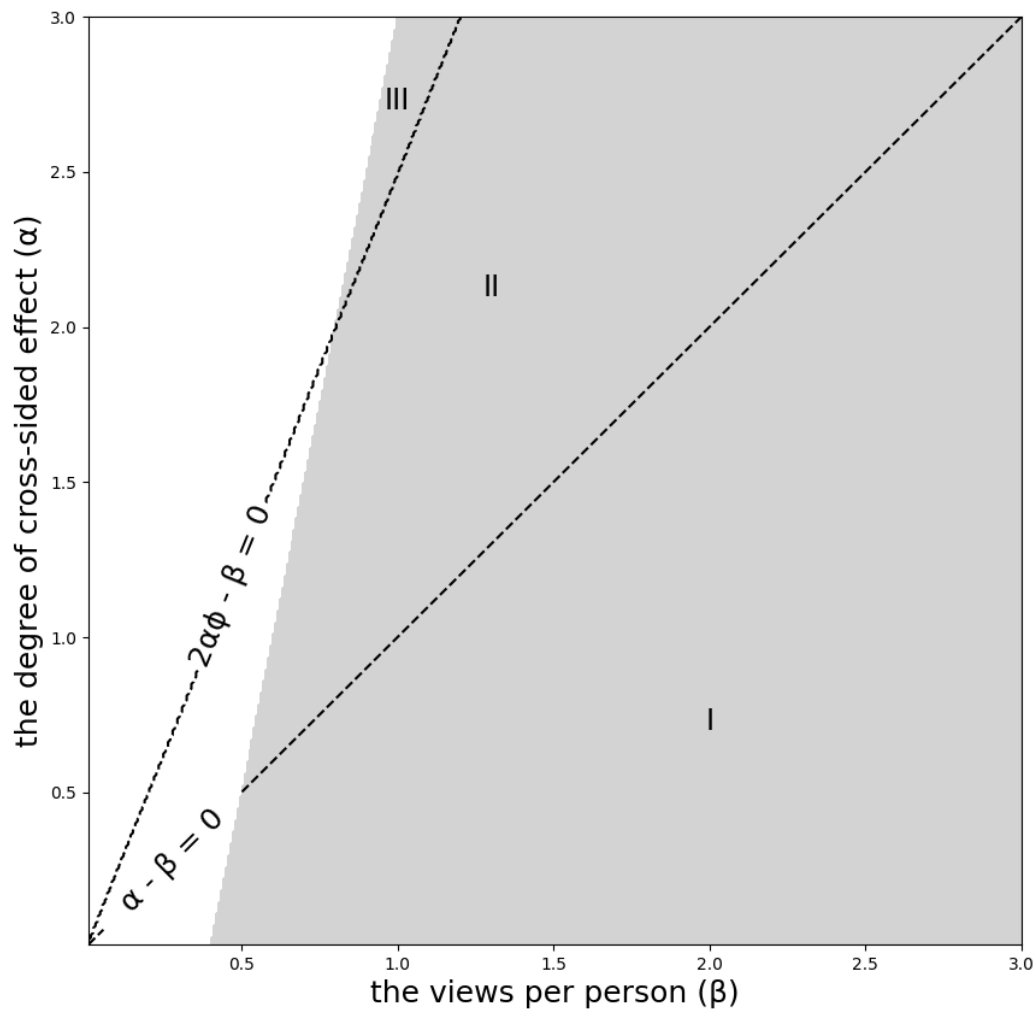


Figure 4.1: Parameter Region in Case SS with a Given Parameter Set

The gray area is our parameter region on with the given parameters. In area I, both conditions fail, which means β overpowers α and ϕ , making the content market difficult to yield. In such an unfavorable content market, an increase in ϕ harms profit, and an increase in R reduces price. The platform's actions are aimed at maintaining demand

in the relatively profitable advertisement market. As for area II, the content market condition is stuck in the middle, where only $\alpha - \beta > 0$ is satisfied. In this area, profit is positively correlated with the sharing ratio while price is negatively correlated with the advertisement valuation of a viewer on the platform.



Last but not least, area III represents a favorable content market for the platform. In this case, the platform focuses more on the content market, raising the price to improve margin profit and increasing the sharing ratio to encourage more creators to get involved, thereby weakening the foreseeable customer demand drop when a price increase happens.

4.1.2 Case SD

In case SD, we let platform1 participates in both market, while platform 2 sticks to market B. By backward induction, we can introduce Lemma 2.

Lemma 2. *The equilibrium prices for both platforms in case SD are*

$$P_1^{SD*} = \frac{4V + 3t + (11\frac{\alpha}{\beta}\phi - 7)R}{11(1 - \frac{\alpha}{\beta}\phi)} \text{ and } P_2^{SD*} = \frac{2V + 7t + (11\frac{\alpha}{\beta}\phi - 9)R}{11(1 - \frac{\alpha}{\beta}\phi)}.$$

Prices increase in V , t , α , and ϕ but decrease in β , and the impact from R depends on other parameters.

All parameters retain the same properties as in case SS; however, the transportation cost t starts to appear in the price function since competition exists. A larger t indicates that customers are more reluctant to move, which provides some protection for the platforms from too intensive competition. Thus, providing a motivation not to cut the price.

Moreover, we can observe that P_1^{SD*} is more likely to increase when R increases than P_2^{SD*} . When the advertisement market is more profitable (larger R), platform 1 gets more opportunities to raise prices since it can benefit from market expansion, accepting the risk of losing some customers. Platform 2, on the other hand, needs more prudent consideration, only increasing R when the content market is very easy to monetize.

By substituting the optimal price into the profit functions 27 and 28, customer demand functions 12, 13, and 14, and creator demand functions 21 and 22, we have Corollary 2.

Corollary 2. *The equilibrium profits, customer demands and creator demands for both platforms in case SD are*

$$\pi_1^{SD*} = \frac{3(1-\phi)(4V+3t+4R)^2}{242t(1-\frac{\alpha}{\beta}\phi)}, \quad \pi_2^{SD*} = \frac{(1-\phi)(2V+7t+2R)^2}{242t(1-\frac{\alpha}{\beta}\phi)},$$

$$D_{A1}^{SD*} = \frac{7V-3t+7R}{11t}, \quad D_{B1}^{SD*} = \frac{-2V+4t-2R}{2t}, \quad D_{B2}^{SD*} = \frac{2V-2t+2R}{2t},$$

$$S_1^{SD*} = \frac{\phi(4V+3t+4R)}{11\beta(1-\frac{\alpha}{\beta}\phi)}, \quad \text{and} \quad S_2^{SD*} = \frac{\phi(2V+7t+2R)}{11\beta(1-\frac{\alpha}{\beta}\phi)}.$$

Profits increase in V , R , and α but decrease in β . Moreover, profits only increase in ϕ if and only if $\alpha > \beta$. Finally, when t increases, π_1^{SD} decreases, but π_2^{SD*} increases.*

The parameters' effects on optimal profits are basically aligned with case SS; however, here we notice that the transportation cost t now has different directional impacts on both profits. This is because, in case SD, platform 1 is trying to enter market B, where platform 2 already exists. A larger transportation cost means platform 1 finds it more difficult to invade, and platform 2 can defend more easily, which drives this consequence.

For customer demand in market A, which remains a monopoly, all the properties hold. Nevertheless, in a dual market, the impacts of basic utility V , advertising revenue per person R , and transportation cost t are opposite to each other. This is natural, as they compete within a fixed-size market, and customers have no interest in multi-homing. As for creator demand, all properties remain the same as in case SS. Additionally, with higher t increasing prices, we also see creator demand increase consequently.

In case SD, if we using the same parameter set as we utilized in case SS, the result is similar to the previous. Thus, there is no need to discuss it again.

4.1.3 Case DD

In this subsection, we consider the scenario when both platforms enter both markets. Utilizing the same treatments, here is Lemma 3.

Lemma 3. *The equilibrium price for platform 1 in case DD is*

$$P_1^{DD*} = \frac{t - (1 - \frac{\alpha}{\beta}\phi)R}{1 - \frac{\alpha}{\beta}\phi} \text{ and } P_2^{DD*} = \frac{t - (1 - \frac{\alpha}{\beta}\phi)R}{1 - \frac{\alpha}{\beta}\phi}.$$

Price increases in t , α , and ϕ but decreases in β and R .

It is clear that both platforms set the same price; this is not a coincidence. Since these two platforms have no vertical difference, both markets are fully covered, and all customers never consider multi-homing, the result in this part will be symmetric. Most of the parameters share the same explanation as we have mentioned; however, R , advertising revenue per subscription, now becomes always negatively correlated with price. This is because both markets now suffer from competition, and relying on the content market is not a smart decision. By substituting the optimal price, we have Corollary 3.

Corollary 3. *The equilibrium profit, customer demand and creator demand for both platforms in case DD are*

$$\pi_1^{DD*} = \frac{(1-\phi)t}{1-\frac{\alpha}{\beta}\phi}, \quad \pi_2^{DD*} = \frac{(1-\phi)t}{1-\frac{\alpha}{\beta}\phi},$$

$$D_{A1}^{DD*} = \frac{1}{2}, \quad D_{B1}^{DD*} = \frac{1}{2}, \quad D_{A2}^{DD*} = \frac{1}{2}, \quad D_{B2}^{DD*} = \frac{1}{2},$$

$$S_1^{DD*} = \frac{\phi t}{\beta(1-\frac{\alpha}{\beta}\phi)} \quad \text{and} \quad S_2^{DD*} = \frac{\phi t}{\beta(1-\frac{\alpha}{\beta}\phi)}.$$

Profit increases in t and α but decreases in β . As for ϕ , profits only increase in ϕ if and only if $\alpha > \beta$.

Most of the parameters share the same explanation as in case SD. Also, customer demand for a platform in a market will be exactly $\frac{1}{2}$, which is an inevitable result given the symmetrical platform conditions. Moreover, using that same parameter set, the result is still similar to case SS.

4.2 Comparison

After calculating the optimal solutions in all cases, in this section, we try to compare these solutions to see the impact of entry strategy and whether it will always lead platforms to enter another market. Noted that all the assumptions in Section 4.1 still hold here. Thus, we have Proposition 1 and Proposition 2. Firstly, we compare within prices. Given that in case SS and case DD, platforms have identical results, we use P^{SS*} and P^{DD*} to denote the prices.

Proposition 1. *In equilibrium, we have $P^{DD*} \geq P_2^{SD*} \geq P_1^{SD*} \geq P^{SS*}$. Prices never*



decrease after competition. Also, in case SD, platform 2, whose market is being invaded, will raise its price higher than platform 1.

In case SD, for platform 1, it definitely gains more total demand due to the new market entry, which provides room for raising prices. However, we find that platform 2 also increases its price. To explain this, we have to realize that when competition happens, platforms can only adjust prices to cope. In all cases, creator demand equals to $\frac{\phi}{\beta}(P + R)$. Thus, creator demand never decreases after either or both platforms launch a market expansion. Though raising prices might hurt customer demand in every single market, it truly increases creators' incentives, which indirectly increases customer demand and directly increases margin profit. On the other hand, cutting down the price could lead to an increase in customer demand but would directly reduce margin profit. These two effects confront each other, and the former could offset or even overpower the latter under competition. For platform 1, it still has one market (market A) that remains a monopoly, which means the degree of price increase for platform 1 is less than for platform 2 in order to gain more in market A.

The same thing happens when the competition type shifts from SD to DD. Yet, in case DD, both markets are under competition, giving platforms less resistance to increasing prices. This gives us an implication that, in multi-sided and multi-market, reducing price is not always the best solution to defend the entry from competitors. Straightforward economic intuition might not apply in this scenario.

Proposition 2. *As for profit, we have $\pi_1^{SD} \geq \pi^{DD} \geq \pi^{SS} \geq \pi_2^{SD}$. The most favorable condition for a platform is to enter both markets while the opponent sticks to their base, and vice versa. However, when both platforms choose to expand their market, meaning*

both markets encounter competition, the total profit for both platforms increases.

Platform 1 gains the most profit in case SD, while platform 2 gains less at the same time, as a matter of course. What's important is the comparison between case SS and DD. We find that profits in case DD are no less than those in case SS. The reasons behind this are the total demands for both platforms never decrease and neither do the prices.

In our previous discussion, we have not considered case DS. However, this case is just a symmetrical version of case SD. Thus, we have Table 4.1 to illustrate what happens in all the market structures.

Table 4.1: Profit Table of All Market Structures

Platform 1's strategy	Platform 2's strategy	
	S	D
S	$\frac{(1-\phi)(V+R)^2}{4t(1-\frac{\alpha}{\beta}\phi)}$, $\frac{(1-\phi)(V+R)^2}{4t(1-\frac{\alpha}{\beta}\phi)}$	$\frac{(1-\phi)(2V+7t+2R)^2}{242t(1-\frac{\alpha}{\beta}\phi)}$, $\frac{3(1-\phi)(4V+3t+4R)^2}{242t(1-\frac{\alpha}{\beta}\phi)}$
D	$\frac{3(1-\phi)(4V+3t+4R)^2}{242t(1-\frac{\alpha}{\beta}\phi)}$, $\frac{(1-\phi)(2V+7t+2R)^2}{242t(1-\frac{\alpha}{\beta}\phi)}$	$\frac{(1-\phi)t}{(1-\frac{\alpha}{\beta}\phi)}$, $\frac{(1-\phi)t}{(1-\frac{\alpha}{\beta}\phi)}$

In Table 4.1, it shows both platforms' profits in different market structures. The horizontal direction represents the strategy of platform 1 (the condition of Market B), while the vertical direction represents platform 2 (the condition of Market A). As before, S represents single platform in the corresponding market and D represents dual platforms. Within the matrix, the former corresponds to the profit of platform 1, and the latter to platform 2. Based on the table, we introduce Proposition 3.

Proposition 3. *For platforms without vertical differences, case DD is an inevitable and win-win result.*

Market expansion might cause a more serious competition. However, this action does

not harm their profitability at all in this case. In fact, market expansion provides an incentive to raise price to attract more creators for customers, eventually enlarge both platforms total demand without cutting down their prices.



In our model, to highlight the importance of entry decisions, we assume all platforms' parameters become identical between platforms. Though this is not always the case in practice, our study does not indicate that our conclusions only hold when these platforms' parameters are exactly the same. Instead, our conclusions remain valid when the differences are not too significant.

4.3 Industry Observation

Back in the real world, YouTube Music raised their price in July 2023, right after their launch of a podcast-specific page. At the same time, Apple and Amazon Music also decided to follow suit. Meanwhile, Spotify stated that their service was ready to raise prices (Porter, 2023). Spotify announced a price increase later in the same month (Tencer, 2024). Both YouTube and Spotify increased their prices from 9.99 to 10.99. Though we cannot state that these platforms raised prices solely to cope with more intense competition, at least, it is fair to say our result does not violate current trends and it is a possible reason for the rise.



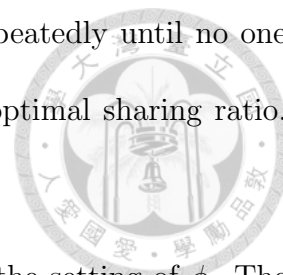
Chapter 5

Extensions

Previously, we solved our model to explain why platforms deviate from traditional economic intuitions. However, some might argue that platforms can also adjust the sharing ratio ϕ to cope with competition. Indeed, platforms have this option at hand. So in this part, we conduct a numerical study where platforms can adjust both the subscription price P and the sharing ratio ϕ at the same time, following all the assumptions mentioned in Section 4.1, to test the robustness of the result that platforms are not going to decrease the price when the competition type shifts from case SS to case DD after market expansion.

We set the subscription price range from 0 to 10 with a 0.2 spacing and the sharing ratio range from 0.02 to 1 with a 0.02 spacing. Our numerical study calculates all profits and finds the equilibrium optimal in case SS for a given parameter at first. Then, we use the corresponding optimal price and optimal sharing ratio as the starting point under case DD. Next, we let one platform take an action (noting that the platform can change both price and sharing ratio simultaneously) to pursue its own maximum with the other

platform's price and sharing ratio fixed, and change their roles repeatedly until no one wants to deviate. Therefore, we have another optimal price and optimal sharing ratio. Then, we compare this with the original one.



We use the same parameter set as in Section 4.1.1 but ignore the setting of ϕ . The intervals for α and β are from 0.1 to 3 with units cut every 0.1. Figure 5.1 shows the result of the optimal price (P) in case SS, and Figure 5.2 shows the share ratio (ϕ).

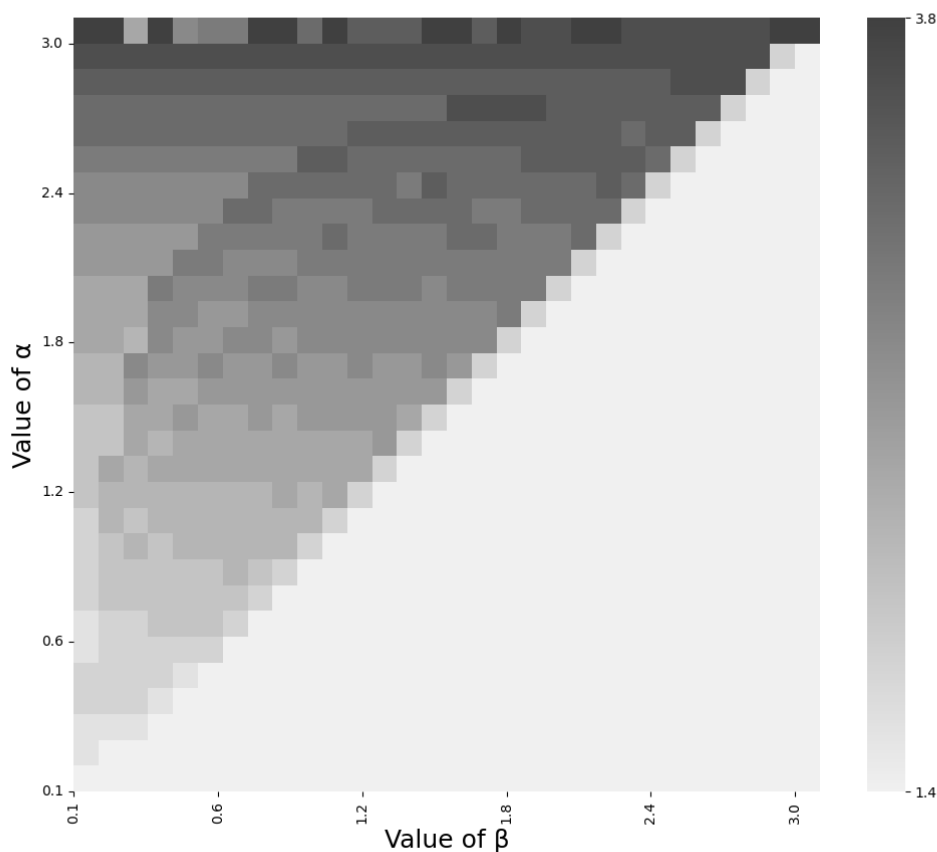


Figure 5.1: Optimal Price in Case SS of the Numerical Study

In Figures 5.1 and Figures 5.2, we can observe that when the views per person β overpower the degree of cross effect α , which means the content market is relatively

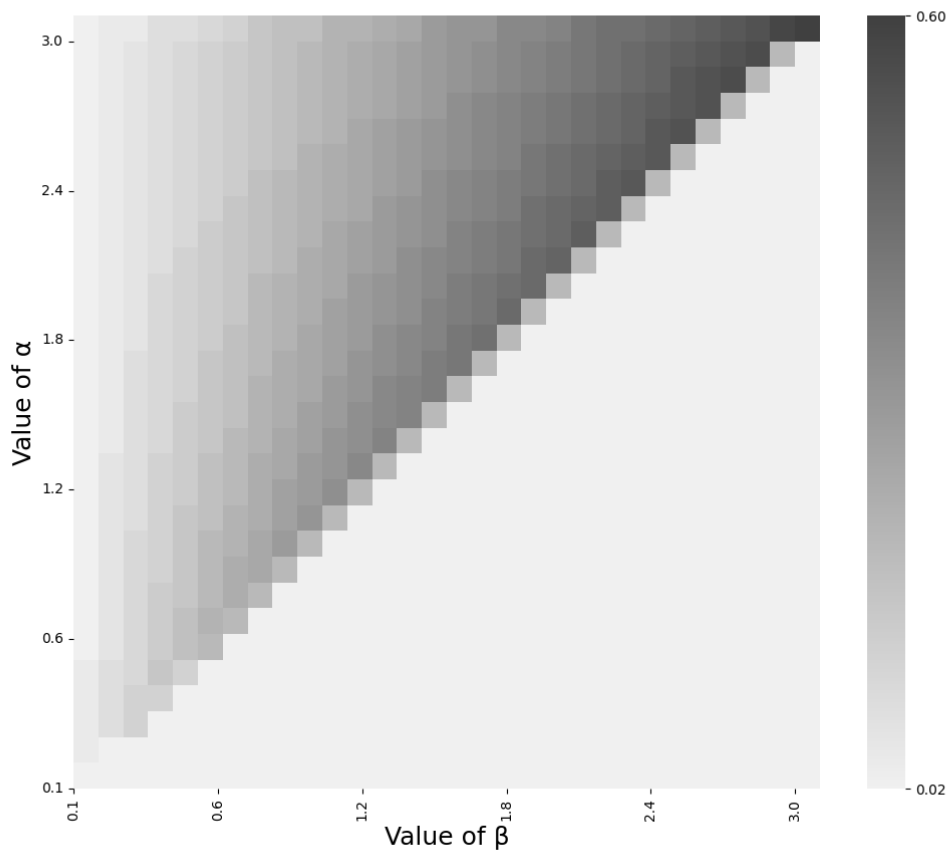


Figure 5.2: Optimal Ratio in Case SS of the Numerical Study

harsh for platforms, platforms keep prices and sharing ratios as low as possible. This is consistent with the previous analysis when we discussed Figure 4.1. In such an area, any increase in ϕ harms profit. Moreover, when α becomes greater, which means the content market condition is getting more favorable for platforms, the optimal price increases. As for the sharing ratio, we first look at the top-left corner. When the content market is extremely good for platforms, they do not need to set an appealing sharing ratio for creators; however, as α becomes smaller or β becomes greater, the sharing ratio increases to attract creators until the content market condition becomes unfavorable.

Compared to case DD, in these 900 instances, as Table 5.1 shows, even if platforms could change the sharing ratio, none of them led to a price decrease. This proves the robustness of our Proposition 1: platforms never choose to cut their prices when competition happens. In Proposition 2, we claim that profit never decreases after competition type transformation from case SS to case DD. In our numerical study, all of instances show the same thing.

Table 5.1: Number of Cases in Each Outcome Category in the Numerical Study

Equilibrium Decision	From SS to DD		
	Increase	Decrease	Remain Identical
Price (P)	900	0	0
Sharing Ratio (ϕ)	17	10	873



Chapter 6

Conclusions and Future Works

Our study creates a game theory model to illustrate why podcast platforms choose to deviate from traditional economic intuition. The model is a two-market, multi-sided model with two platforms, a group of creators, and two groups of customers without overlap. Each market has its own group of customers and initially has only one platform, while both share the same group of creators who are allowed to multi-homing. We focus on the entry strategy and prove that platforms do have an incentive to invade other market.

There are three main findings based on our model analysis. First, platforms increase their prices after any market invasion. A rise in price might decrease customer demand but simultaneously increase margin profit and creators' incentives, which indirectly increase customer demand slightly. In a two-market, multi-sided market with competition, after weighing the trade-offs, platforms favor price increases. Moreover, the platform whose market is being invaded could raise its price more than the invader. This is mainly because the invader still has one market in monopoly, which somewhat restrains its price

increase. Second, profit also increases from case SS to case DD, and the most favorable situation is being the only invader. The reason behind this is that total demand and prices never decrease after launching market expansion. Lastly, double invasion is an inevitable but win-win result. Based on game theory, case DD is a Nash equilibrium and the profits are greater than those in case SS. Additionally, we conducted a numerical study allowing platforms to adjust their sharing ratio to creators to test the robustness of our main results, and the main findings still hold.

Our research can go further in several directions. First, back into to the real world, creators are not homogeneous on popularity, some creators definitely gain more view than others. In our study, we ignore the differences. The second direction is slightly relevant to the previous one. In reality, some platforms utilize exclusive contract to secure the loyalty of some powerful creators. It could be a higher sharing ratio or even a fixed amount of buyout to prevent them from multi-homing. In our study, we only focus on the impact of a basic case with a uniform revenue sharing ratio. Also, we observe that some advertisers trying to contact with creators directly, using placement marketing instead of advertising on the platform. These are all possible future directions.



Bibliography

- Amaldoss, W., J. Du, W. Shin. 2021. Media platforms' content provision strategies and sources of profits. *Marketing Science* **40(3)** 527–547.
- Armstrong, M. 2006. Competition in two-sided markets. *The RAND Journal of Economics* **37(3)** 668–691.
- Bakos, Y., H. Halaburda. 2020. Platform competition with multihoming on both sides: Subsidize or not? *Management Science* **66(12)**(5599-5607).
- Barata, M. L., P. S. Coelho. 2021. Music streaming services: understanding the drivers of customer purchase and intention to recommend. *Heliyon* **7(8)** e07783.
- Bhargava, H. K. 2021. The creator economy: Managing ecosystem supply, revenue-sharing, and platform design. *Management Science* **4**.
- Cai, G.-G., Y.-J. Chen. 2011. In-store referrals on the internet. *Journal of Retailing* **87(4)** 563–578.
- Carroni, E., L. Madio, S. Shekhar. 2023. Superstar exclusivity in two-sided markets. *Management Science* **0(0)**.

Chan-Olmsted, S., R. Wang. 2020. Understanding podcast users: Consumption motives and behaviors. *New Media & Society* **24**(3) 684–704.



Cumulus Media and Signal Hill Insights. 2023. Cumulus media podcast download fall 2023 report. Tech. rep., Cumulus Media and Signal Hill Insights. URL <https://www.westwoodone.com/blog/2023/12/04/youtubes-growth-as-a-podcast-power-player-revealed-in-cumulus-media-and-signal-hill>

Edison Research. 2023. The podcast consumer 2023: An infinite dial report. Tech. rep., Edison Research.

Edwards, Corwin D. 1955. *Business Concentration and Price Policy*, chap. Conglomerate Bigness as a Source of Power. Princeton University Press, 331 – 359.

Gimeno, J., C. Y. Woo. 1994. Multipoint competition, market rivalry and firm performance: A test of the complete mediation model. *Academy of Management Proceedings* **1994**(1) 32–36.

Godes, D., E. Ofek, M. Sarvary. 2009. Content vs. advertising: The impact of competition on media firm strategy. *Marketing Science* **28**(1) 20–35.

Koetsier, J. 2022. Spotify vs apple: Video podcasts for free (and for all). URL <https://www.forbes.com/sites/johnkoetsier/2022/04/21/spotify-vs-apple-video-podcasts-for-free-and-for-all/?sh=6987e9d34bae>.

Last checked: 2023-12-11.

Makari, R. 2023. Ai, video, and subscriptions: the hottest topics at this year's podcast show. URL <https://www.podpod.com/article/1824404/>

ai-video-subscriptions-hottest-topics-years-podcast-show. Last checked: 2023-12-11.



Marshall, N. 2023. Podcasting is growing for a reason—don't miss out on that growth. URL <https://www.forbes.com/sites/forbesagencycouncil/2023/01/17/podcasting-is-growing-for-a-reason-dont-miss-out-on-that-growth/?sh=56b6741342a7>. Last checked: 2023-12-11.

Porter, J. 2023. Youtube premium now costs an extra \$2 each month. URL <https://www.theverge.com/2023/7/20/23801390/youtube-premium-music-price-increase>. Last checked: 2024-06-18.

Roth, E. 2023. Youtube music is officially rolling out podcasts. URL <https://www.theverge.com/2023/4/27/23701093/youtube-music-podcasts-rollout>. Last checked: 2023-12-11.

Son, M. 2023. The complete history of podcasts. URL <https://descript.com/blog/article/history-of-podcasts>. Last checked: 2023-12-11.

Spotify. 2023. Spotify tops 100,000 video podcasts. URL <https://newsroom.spotify.com/2023-06-29/spotify-tops-100000-video-podcasts/>. Last checked: 2023-12-11.

Sullivan, J. L. 2019. The platforms of podcasting: Past and present. *Social Media + Society* 5(4) 2056305119880002. Last checked: 2023-12-11.

Tencer, D. 2024. Spotify to hike prices again, introduce new subscription tier (report). URL <https://www.musicbusinessworldwide.com/>

spotify-to-hike-prices-again-introduce-new-subscription-tier-report/.

Last checked: 2024-06-18.



Voices. 2022. The power of podcasts - listening trends report. Tech. rep., Voices.

Wlömert, N., D. Papiés. 2016. On-demand streaming services and music industry revenues — insights from spotify’s market entry. *International Journal of Research in Marketing* **33**(2) 314–327. The Entertainment Industry.

Yu, T., A. A. Cannella Jr. 2012. A comprehensive review of multimarket competition research. *Journal of Management* **39**(1) 76–109.

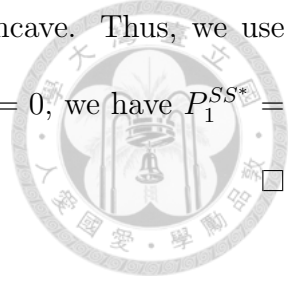
Appendix

Proof of Lemma 1.

Proof. First, we calculate the creator’s demand. In a Hotelling line, we can determine it by calculating the value of y when setting the creator utility function (19) to 0. Therefore, we have creators’ demand $S_1^{SS} = \frac{\phi(P_1^{SS}+R)}{\beta}$. Combining this with customer demand function (3) and going a step further with platform profit function (25), we get platforms’ profit functions $\pi_1^{SS} = \frac{(1-\phi)(P_1^{SS}+R)(V+\frac{\alpha}{\beta}\phi(P_1^{SS}+R)-P_1^{SS})}{t}$. By differentiating platform 1 profit function π_1^{SS} with our decision variable P_1^{SS} and differentiating twice, we have

$$\frac{\partial \pi_1^{SS}}{\partial P_1^{SS}} = \frac{1-\phi}{t} (V + (2\frac{\alpha}{\beta}\phi - 1)(P_1^{SS} + R) - P_1^{SS}) \text{ and}$$

$$\frac{\partial^2 \pi_1^{SS}}{\partial (P_1^{SS})^2} = 2\left(\frac{1-\phi}{t}\right)\left(\frac{\alpha}{\beta}\phi - 1\right).$$

Due to our assumption, $\frac{\partial^2 \pi_1^{SS}}{\partial (P_1^{SS})^2}$ is negative, so the function is concave. Thus, we use first-order condition to determine the optimal price. Solving $\frac{\partial \pi_1^{SS}}{\partial P_1^{SS}} = 0$, we have $P_1^{SS*} = \frac{V + (2\frac{\alpha}{\beta}\phi - 1)R}{2(1 - \frac{\alpha}{\beta}\phi)}$. 

Proof of Corollary 1.

Proof. By simply substituting, the proof is completed. □

Proof of Lemma 2.

Proof. Again we calculating creators demand first, by letting creator utility function (21) and (22) to 0, we have creator demand $S_1^{SD} = \frac{\phi(P_1^{SD} + R)}{\beta}$ and $S_2^{SD} = \frac{\phi(P_2^{SD} + R)}{\beta}$. Substituting S_1^{SD} and S_2^{SD} into customer demand function (12), (13) and (14) and combined the solutions with platform profit function (27) and (28), we have platforms profit functions $\pi_1^{SD} = \frac{(1-\phi)(P_1^{SD} + R)(2V + 3\frac{\alpha}{\beta}\phi(P_1^{SD} + R) - P_1^{SD} - \frac{\alpha}{\beta}\phi(P_2^{SD} + R) + P_2^{SD} + t)}{2t}$ and $\pi_2^{SD} = \frac{(1-\phi)(P_2^{SD} + R)(-\frac{\alpha}{\beta}\phi(P_1^{SD} + R) + P_1^{SD} + \frac{\alpha}{\beta}\phi(P_2^{SD} + R) - P_2^{SD} + t)}{2t}$. One platform only has one decision variable P^{SD} . After differentiating profit function with it and differentiating twice, we have

$$\frac{\partial \pi_1^{SD}}{\partial P_1^{SD}} = \frac{1 - \phi}{2t} (2V + 3(2\frac{\alpha}{\beta}\phi - 1)(P_1^{SD} + R) - 3P_1^{SD} - (\frac{\alpha}{\beta}\phi)(P_2^{SD} + R) + P_2^{SD} + t) \text{ and}$$

$$\frac{\partial \pi_2^{SD}}{\partial P_2^{SD}} = \frac{1 - \phi}{2t} (-\frac{\alpha}{\beta}\phi)(P_1^{SD} + R) + P_1^{SD} + (2\frac{\alpha}{\beta}\phi - 1)(P_2^{SD} + R) - P_2^{SD} + t) \text{ and}$$

$$\frac{\partial^2 \pi_1^{SD}}{\partial (P_1^{SD})^2} = 6(\frac{1 - \phi}{2t})(\frac{\alpha}{\beta}\phi - 1) \text{ and } \frac{\partial^2 \pi_2^{SD}}{\partial (P_2^{SD})^2} = 2(\frac{1 - \phi}{2t})(\frac{\alpha}{\beta}\phi - 1).$$

Based on our assumption, the second derivatives are all strictly negative, ensuring concavity. Utilizing the first-order condition, we solve the simultaneous equations to get

the optimal prices.

$$\begin{cases} \frac{1-\phi}{2t}(2V + 3(2\frac{\alpha}{\beta}\phi - 1)(P_1^{SD} + R) - 3P_1^{SD} - (\frac{\alpha}{\beta}\phi)(P_2^{SD} + R) + P_2^{SD} + t) = 0 \\ \frac{1-\phi_2^{SD}}{2t}(-(\frac{\alpha}{\beta}\phi)(P_1^{SD} + R) + P_1^{SD} + (2\frac{\alpha}{\beta}\phi - 1)(P_2^{SD} + R) - P_2^{SD} + t) = 0 \end{cases}$$

By some calculations, we have $P_1^{SD*} = \frac{4V+3t+(11\frac{\alpha}{\beta}\phi-7)R}{11(1-\frac{\alpha}{\beta}\phi)}$ and $P_2^{SD*} = \frac{2V+7t+(11\frac{\alpha}{\beta}\phi-9)R}{11(1-\frac{\alpha}{\beta}\phi)}$.

□

Proof of Corollary 2.

Proof. By simply substituting, the proof is completed.

□

Proof of Lemma 3.

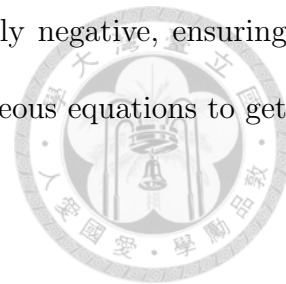
Proof. Again we calculating creators demand first, by letting creator utility function (23) and (24) to 0, we have creator demand S_1^{DD} and S_2^{DD} . Substituting S_1^{DD} and S_2^{DD} into customer demand function (15) to (18) and combined the solutions with platform profit function (29) and (30), we have platforms profit functions $\pi_1^{DD} = (1 - \phi)(P_1^{DD} + R)(1 + \frac{(\frac{\alpha}{\beta}\phi-1)P_1^{DD} - (\frac{\alpha}{\beta}\phi-1)P_2^{DD}}{t})$ and $\pi_2^{SD} = (1 - \phi)(P_2^{DD} + R)(1 - \frac{(\frac{\alpha}{\beta}\phi-1)P_1^{DD} - (\frac{\alpha}{\beta}\phi-1)P_2^{DD}}{t})$. After differentiating profit function with subscription price and differentiating twice, we have

$$\frac{\partial \pi_1^{DD}}{\partial P_1^{DD}} = (1 - \phi)(1 + \frac{2}{t}(\frac{\alpha}{\beta}\phi - 1)P_1^{DD} - \frac{1}{t}(\frac{\alpha}{\beta}\phi - 1)P_2^{DD} + \frac{1}{t}(\frac{\alpha}{\beta}\phi - 1)R) \text{ and}$$

$$\frac{\partial \pi_2^{DD}}{\partial P_2^{DD}} = (1 - \phi)(1 + \frac{2}{t}(\frac{\alpha}{\beta}\phi - 1)P_2^{DD} - \frac{1}{t}(\frac{\alpha}{\beta}\phi - 1)P_1^{DD} + \frac{1}{t}(\frac{\alpha}{\beta}\phi - 1)R) \text{ and}$$

$$\frac{\partial^2 \pi_1^{DD}}{\partial (P_1^{DD})^2} = \frac{2(1 - \phi)(\frac{\alpha}{\beta}\phi - 1)}{t} \text{ and } \frac{\partial^2 \pi_2^{SD}}{\partial (P_2^{SD})^2} = \frac{2(1 - \phi)(\frac{\alpha}{\beta}\phi - 1)}{t}.$$

Based on our assumption, the second derivatives are all strictly negative, ensuring concavity. Utilizing the first-order condition, we solve the simultaneous equations to get the optimal prices.



$$\begin{cases} (1 - \phi)(1 + \frac{2}{t}(\frac{\alpha}{\beta}\phi - 1)P_1^{DD} - \frac{1}{t}(\frac{\alpha}{\beta}\phi - 1)P_2^{DD} + \frac{1}{t}(\frac{\alpha}{\beta}\phi - 1)R) = 0 \\ (1 - \phi)(1 + \frac{2}{t}(\frac{\alpha}{\beta}\phi - 1)P_2^{DD} - \frac{1}{t}(\frac{\alpha}{\beta}\phi - 1)P_1^{DD} + \frac{1}{t}(\frac{\alpha}{\beta}\phi - 1)R) = 0 \end{cases}$$

By some calculations, we have $P_1^{DD*} = P_2^{DD*} = \frac{t - (1 - \frac{\alpha}{\beta}\phi)R}{(1 - \frac{\alpha}{\beta}\phi)}$.

□

Proof of Corollary 3.

Proof. By simply substituting, the proof is completed.

□

Proof of Proposition 1.

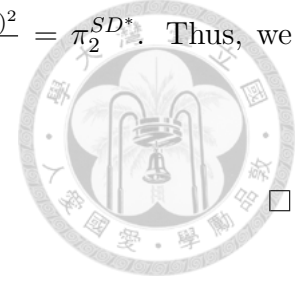
Proof. We have four optimal prices in Chapter 4, $P^{SS*} = \frac{V + (2\frac{\alpha}{\beta}\phi - 1)R}{2(1 - \frac{\alpha}{\beta}\phi)}$, $P_1^{SD*} = \frac{4V + 3t + (11\frac{\alpha}{\beta}\phi - 7)R}{11(1 - \frac{\alpha}{\beta}\phi)}$, $P_2^{SD*} = \frac{2V + 7t + (11\frac{\alpha}{\beta}\phi - 9)R}{11(1 - \frac{\alpha}{\beta}\phi)}$, and $P^{DD*} = \frac{t - (1 - \frac{\alpha}{\beta}\phi)R}{(1 - \frac{\alpha}{\beta}\phi)}$. Based on the assumption $t \leq V + R \leq 2t$, we have $P^{DD*} \geq P_2^{SD*} \geq P_1^{SD*} \geq P^{SS*}$.

□

Proof of Proposition 2.

Proof. We have four optimal profits in Chapter 4, $\pi^{SS*} = \frac{(1 - \phi)(V + R)^2}{4t(1 - \frac{\alpha}{\beta}\phi)}$, $\pi_1^{SD*} = \frac{3(1 - \phi)(4V + 3t + 4R)^2}{242t(1 - \frac{\alpha}{\beta}\phi)}$, $\pi_2^{SD*} = \frac{(1 - \phi)(2V + 7t + 2R)^2}{242t(1 - \frac{\alpha}{\beta}\phi)}$, and $\pi^{DD*} = \frac{(1 - \phi)t}{(1 - \frac{\alpha}{\beta}\phi)}$. By $t \leq V + R \leq 2t$, $1 - \phi > 0$, and $1 - \frac{\alpha}{\beta}\phi > 0$ we have $\pi^{DD*} = \frac{(1 - \phi)4t^2}{4t(1 - \frac{\alpha}{\beta}\phi)} \geq \pi^{SS*}$. Adding $2V - 3t + 3R \geq 0$ into consideration, we have and $\pi_1^{SD*} \geq \frac{3(1 - \phi)(9t)^2}{242t(1 - \frac{\alpha}{\beta}\phi)} = \frac{(1 - \phi)243t^2}{242t(1 - \frac{\alpha}{\beta}\phi)} > \frac{(1 - \phi)242t^2}{242t(1 - \frac{\alpha}{\beta}\phi)} = \frac{(1 - \phi)t}{(1 - \frac{\alpha}{\beta}\phi)} = \pi^{DD*}$ and

$$\pi^{SS^*} = \frac{\frac{121}{2}(1-\phi)(V+R)^2}{242t(1-\frac{\alpha}{\beta}\phi)} > \frac{(1-\phi)(\frac{33\sqrt{2}}{4}t)^2}{242t(1-\frac{\alpha}{\beta}\phi)} > \frac{(1-\phi)(11t)^2}{242t(1-\frac{\alpha}{\beta}\phi)} \geq \frac{(1-\phi)(2V+7t+2R)^2}{242t(1-\frac{\alpha}{\beta}\phi)} = \pi_2^{SD^*}.$$
 Thus, we have $\pi_1^{SD} \geq \pi^{DD} \geq \pi^{SS} \geq \pi_2^{SD}$ and the proof is completed. □



Proof of Proposition 3.

Proof. Since $\pi_1^{SD} \geq \pi^{SS}$, platforms have an incentive to join another market. When one platform deviates, its competitor will follow because $\pi^{DD} \geq \pi_2^{SD}$. For the same reason, after both platforms start a dual-market strategy, neither would want to revert. Thus, case DD is an inevitable result. Given that $\pi^{DD} \geq \pi^{SS}$, this is a win-win situation. □