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Platform Commission Reduction And Mobile App Performance

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Abstract

Commission is a common platform pricing strategy for charging a portion of transaction revenues. However, digital platform firms face long-standing disputes with app developers and even lawsuits regarding their commission rules. This study investigates how reducing platform commission affects mobile app performance and developers' behaviors. We leverage a natural experiment based on a commission policy change implemented by Apple and conduct a difference-in-differences (DID) analysis. Surprisingly, we find a negative impact of commission reduction on app performance measured by daily active users and downloads. The impact of commission reduction on app performance is heterogeneous across apps with different ranks and across apps in the game and non-game app categories. Further analysis of the mechanism reveals that the apps eligible to enjoy the benefits of commission reduction are updated less frequently, indicating that developers devote less effort to improving and advancing these apps. Our findings provide important theoretical and managerial implications.

Keywords: Mobile app platform, platform pricing, commission, mobile app performance, update frequency

Introduction

Commission fee is a common pricing strategy for platform owners to generate revenues and profits (Birge et al. 2021; Borck et al. 2020). The two leading app platforms, Apple App Store and Google Play, charge app developers a 15% to 30% commission fee for the revenues from in-app transactions of digital content and services. However, recent skirmishes between the app platforms and app developers (e.g., Epic Games, Spotify) surface their long-standing dispute regarding this pricing rule. As a result, the conflict of interests has caused a significant loss for both platforms and developers. For instance, after being removed by Apple and Google for circumventing the commission rule, the popular game Fortnite experienced a decrease in daily active users by 60% (Sandler 2020). The two app stores also suffered a 60% loss in revenue from game apps (Urbi 2020). Moreover, Apple and Google faced scrutinization and even lawsuits due to the alleged anticompetitive issues of their commission rules (Sohn 2021). These recent developments in the mobile domain indicate the importance of a fair and effective platform pricing strategy. The existing literature has developed theoretical models to explore the issue of optimal platform pricing strategies (Hagiu 2006; Reisinger 2014; Chen et al. 2016; Zhang et al. 2019). Yet, we know relatively little about how developers may react to changes in platform commission in practical situations. This study aims to empirically examine the impact of platform commission reduction on app performance through a natural experiment.

From the platform governance perspective, a lower platform fee can increase participants' commitment to the platform. From the economic perspective, subsidizing seller-side participants can incentivize them to improve product and service quality and innovation (e.g., Parker & Van Alstyne 2005, Rysman 2009, Chou et al. 2012, Lin et al. 2020). Since the developers can gain a larger share of revenues, reducing platform commission is expected to increase mobile app performance. However, some studies suggest that platforms can charge more in some contexts, such as when the platforms have a large scale of user-sided participants willing to pay for high-quality products (Lin et al. 2011; Hagiu 2009). Moreover, these conclusions and predictions from existing modeling studies are usually based on how sellers or content providers with specific characteristics and preferences react to different platform pricing strategies in certain competitive contexts. Differing from these theoretical contexts, the behaviors of developers or sellers in practice are more complicated and unknown. For example, while app developers are expected to be incentivized by a lower platform commission, they are also likely not to take any action in response to this change. Then users will not notice any material changes in mobile app quality and user experiences. Therefore, how the platform commission reduction affects mobile app performance remains unclear.

To evaluate the impact of platform commission reduction, we leverage a natural experiment research design based on a policy change implemented by Apple App Store. Specifically, since September 1, 2016, Apple reduced its commission from 30% to 15% for all subscription service renewals after a user's first year of subscription. The apps with the in-app subscription option released one year before the event are thus eligible to enjoy the benefits of platform commission reduction, which we label as the treatment group. The apps with in-app purchase options yet without subscription services can serve as the control group. We then adopt the difference-in-differences (DID) approach to compare the performance change of mobile apps in treatment and control groups within the period of one year before and after the event. One critical challenge in our quasi-experimental analysis is ensuring the treatment and control groups are similar except for the treatment condition. To mitigate the concern that apps offering subscription services may be inherently different from apps offering one-time in-app purchases, we utilize the fact that most popular apps are available on the two leading app stores, Apple App Store and Google Play. During our study period, the commission policy remained unchanged on Google Play. By taking the difference in the performances of the same multihoming app on both platforms, we eliminate both time-invariant and time-variant individual app characteristics and alleviate endogeneity concerns in our DID analysis.

Our analyses yield several novel findings. First, the event of platform commission reduction leads to a decrease in mobile app performance measured by daily active users and downloads. Second, our results show the heterogeneous impact of platform commission reduction across different apps. Specifically, we find that mobile app performance decreases more for apps ranked in the top 500 before the event. Also, platform commission reduction increases the performance of game apps but decreases that of non-game apps. Third, our mechanism analysis reveals that developers update the apps eligible to enjoy the platform commission reduction less frequently. In other words, developers devote less effort to improving the apps after they can receive more revenues due to the platform commission reduction. In addition, a comparison of the number of monthly new mobile apps on the two platforms shows that developers devote relatively more effort to creating new apps with subscription options and less to the development of apps without subscription services on the Apple App Store, which sheds further light on the underlying mechanism that drives our results.

Our study provides several key contributions. First of all, to our best knowledge, this study is among the first to empirically examine the effect of platform commission on developer efforts and user-side demand. Although prior literature has theoretically explored various pricing strategies in different two-sided or multi-side platform contexts, there is no consensus on whether platform owners should charge participants more or less. By empirically documenting the negative impact of platform commission reduction on mobile app performance and investigating the underlying mechanisms, our study contributes to the literature stream on two-sided platform pricing literature. Moreover, given that it is particularly difficult and costly for other digital platforms to experiment with a change of platform commission fees, our work provides valuable insights into the consequence of platform commission change.

Second, this study provides important references for future theoretical research on optimal platform pricing strategies. Specifically, our empirical evidence on developer behaviors can help these studies formulate more realistic assumptions about platform participant behaviors in their theoretical models. In turn, our findings can be used to reassess the applicability of the theoretical models to real-world situations. For example, our surprising finding that platform commission reduction negatively impacts mobile app performance implies that subsiding the seller side of a platform may not lead to expected outcomes.

Third, our study also contributes to the literature on platform governance. Past research has investigated how platform governance strategies in technology investment (e.g., Song et al. 2018, Ye & Kankanhalli 2018, Jung et al. 2019, Tan et al. 2020, Tiwana 2018) or platform openness and competition (e.g., Zhu & Iansiti 2012, Parker & Van Alstyne 2018, Gal-Or et al. 2018) affect participants' entry and contribution. Our study delineates how platform owners' pricing strategy can interfere with developers' development efforts and influence their business outcomes.

The remainder of the paper is organized as follows. We first survey the literature related to our study. We then describe the empirical context, dataset, and identification strategy. Next, we present the model specification and report the findings, followed by robustness checks and additional analyses. Finally, we conclude our study.

Theoretical Framework

In a two-sided or multi-sided platform context, the platform owner and one side of platform participants complement each other in the way that the former provides technological architectures and distribution channels, while the latter supplies complement in the forms of products or services (Huber et al. 2017; Song et al. 2018; Jung et al. 2019; Weyl 2010). In the past two decades, platform-based businesses have received significant attention from researchers in information systems (e.g., Parker & Van Alstyne 2005, Parker et al. 2017, Song et al. 2018, Bakos & Halaburda 2020), economics (e.g., Rochet & Tirole 2003, Rysman 2009, Valverde et al. 2016), and strategy (e.g., Eisenmann et al. 2011, Zhu & Iansiti 2012, Boudreau & Jeppesen 2015). Various platform issues such as technical architecture (e.g., Brunswicker et al. 2019, Tiwana 2018), governance (e.g., Boudreau 2010, Wareham et al. 2014), multihoming (e.g., Cennamo et al. 2018, Bakos & Halaburda 2020), and competition (e.g., Lin et al. 2011, Gal-Or et al. 2018, Bakos & Halaburda 2020) have been examined. Since our study sets to empirically examine the impact of platform commission reduction on mobile app performance and developers' strategic behaviors, we first review the theoretical studies on the designs and impacts of different platform pricing strategies. We then review the empirical studies on the consequences of commission changes and discuss how platform commission reduction may affect mobile app performance and developer behaviors.

Theoretical Studies on Platform Pricing Strategy

As the demand coordinator between buyers and sellers in two-sided marketplaces (Evans 2003), platform owners usually get compensated by charging the side that sells products or services in various ways, such as fixed entrance fee (Lin et al. 2011), transaction fee (Zhang et al. 2019), and marketing fee (Chen et al. 2016). Besides investigating and comparing several different platform business models and pricing structures in various platform contexts (e.g., Reisinger 2014, Roger & Vasconcelos 2014, Chen et al. 2016, Zhang et al. 2019), the literature further explores how to charge the platform participants. In this section, we briefly summarize the literature on platform pricing issues.

First, the two-sided platform literature suggests that subsidizing one side of participants (e.g., sellers, developers) or charging them less is a common pricing strategy to attract another side of participants (e.g., Parker & Van Alstyne 2005, Rysman 2009, Lin et al. 2011, Chou et al. 2012, among many others). From the perspective of the platform owner, this strategy helps gain more profits from the other side and thus optimize platform revenues. The key condition for benefiting from the subsidy is the existence of a cross-network effect within the platform ecosystem, which is the research focus of some studies. For example, subsidizing the side with large price elasticity can induce the cross-network effect (Rysman, 2009).

Along the lines of prior work in this platform subsidy research stream, some studies formulate specific strategies of charging either higher or lower fees under certain conditions (e.g., Chou et al. 2012, Wen & Lin 2016, Lin et al. 2020, Bakos & Halaburda 2020). For example, Bakos and Halaburda (2020) show that the platform owner's benefits of subsidizing sellers are limited and can even disappear when both sides are multihoming. Chou et al. (2012) suggest that if the sales of the content side can positively affect the sales of the console markets, platform owners can charge both sides more than the base selling prices. Wen and Lin (2016) document that platform owners design a non-linear fee rate for high-price contests in a crowdsourcing platform context.

In contrast to the literature highlighting the benefits of subsidies or charging less, some studies indicate that charging more can induce participants' positive behaviors and outcomes in certain platform scenarios (Lin et al. 2011; Hagiu 2009). For example, Lin et al. (2011) find that a higher seller-side access fee can stimulate innovation in equilibrium when sellers engage in innovation in the infinite horizon. Hagiu (2009) suggests that when users prefer a great variety of products and have high payment intentions, platform owners can charge more from sellers to increase the platform revenues.

Extant theoretical and modeling papers have also attempted to examine how platform commission rules can shape the behaviors of seller-side participants. They have made different assumptions about platform and participant characteristics and tried to derive optimal platform commission strategies to maximize platform profits or participant welfare. For example, several studies assume that a higher commission reduces the utility of sellers and thus influences their entry and participation within the platform ecosystem (Cachon et al. 2021; Armstrong 2006). Other studies assume that, in a decentralized pricing context where sellers set the price of their products, the commission rate affects how developers or sellers set their product prices (Birge et al. 2021; Benjaafar et al. 2019). In addition, Roger and Vasconcelos (2014) conjecture that reducing commission fees can incentivize sellers to choose good actions, despite that their theoretical research does not explicitly define good actions.

Our scrutiny of the literature suggests that existing theoretical and modeling studies focus on platform revenue maximization, with mixed conclusions regarding whether the platform should charge more or less. One plausible reason can be that these studies are built on different assumptions of the characteristics and motivations of the platform participants or are situated in different business contexts. This implies that current investigations of optimal platform pricing strategies through theoretical modeling might generate limited insights and managerial implications. In other words, empirical evidence is rare yet necessary to evaluate the impact of platform pricing adjustment. Our study contributes to bridging this research gap by conducting an empirical analysis based on a natural experiment and quantifying the economic impact of the platform commission reduction. Moreover, we explore a plausible underlying mechanism by which platform commission reduction leads to a decrease in mobile app performance. Next, we review the empirical literature on platform commission changes and then hypothesize on how platform commission reduction affects mobile app developers' behaviors and performances.

Empirical Studies on Platform Commission Changes

While platform owners often have dominant market power in their digital platform ecosystem, they face the challenges of setting a rational and effective platform commission strategy. Platforms may charge a commission fee for revenue reasons (Birge et al. 2021) or technical and management cost concerns (Tan et al. 2020; Evans 2003). According to the research report by Borck et al. (2020), digital platforms typically charge 5% to 80% of transaction revenues as commissions. Table 1 presents several examples of platform commission rates from Borck et al. (2020).

Market	Platform(s)	Commission Side	Commission Rate
Mobile App	Apple App Store, Google Play	App Developers	15-30%
Video Game	Xbox, PlayStation, Wii	Game Developers	15-30%
Video Sharing	YouTube	Advertisers	45%
Ridesharing	Uber, Lyft	Drivers	20-25%
Food Delivery	Uber Eats, Grubhub	Restaurants	15-33%
Online Retail	Amazon, eBay, Etsy	Sellers	5-17%

Table 1. Examples of Platform Commission Rates

To our best knowledge, only a few studies have empirically examined the consequences of a platform commission change and reported mixed findings in other business contexts. Valverde et al. (2016) explore how the reductions of interchange fees affect payment card services with a bank-level data set. They find that reductions in interchange fees can lead to positive outcomes such as increased merchant acceptance, consumer adoption, and transaction volumes. Lin et al. (2012) survey sellers' switching intention on online auction platforms. Their study shows that a higher perceived transaction fee leads to a higher switching intention. Reducing platform commission fees may also cause negative outcomes in some contexts. For example, an empirical investigation of food delivery platforms by Li and Wang (2021) shows that platform commission reduction makes independent restaurants experience a decline in orders and revenues. Such unexpected outcomes are driven by a concomitant change in the recommendation preference of delivery platforms. In other words, their study focuses on how platform owners respond to the regulations on the platform commission policy.

According to the Incentive Theory, the forces that drive agents' actions can come from the external environment and managerial interventions (Laffont & Maskin 1982). This theory has been wildly used in the economic field to explain or predict the effects of organizational incentives on individual behavior. The information systems literature has also applied the logic rooted in the Incentive Theory to explain how favorable platform incentive policies can entice positive behaviors of participants. Platform governance refers to the policies and mechanisms through which platform owners manage the activities of participants within the platform ecosystem (Song et al. 2018). In particular, the platform can adopt different incentive mechanisms and managerial promotion strategies to maximize profits (Li et al. 2022), such as encouraging artists to distribute their music to streaming platforms (Bender et al. 2021), attracting participants to join crowdsourcing platforms (Wen & Lin 2016), and incentivizing developers to increase app quality by rewarding the apps with higher user engagement (Claussen et al., 2013).

The platform commission reduction embodies distributing more profits or surplus to platform participants, which can be regarded as a platform incentive mechanism. Drawing on the literature on platform commission changes mentioned above and the Incentive Theory, we hypothesize that reducing platform commission can increase the attractiveness of the platform and in turn the loyalty and engagement of participants. In our research context, Apple's commission reduction policy in 2016 aims to benefit app developers who can keep app subscribers for more than one year. Since the benefits from the changed platform commission rule are conditional on how well an app attracts and retains users, it can be regarded as a rewarding policy that can incentivize developers to devote more effort to improving their content and service. For example, developers are motivated to optimize software functionality, develop more attractive app features, learn user preferences, and improve user experience. In addition, the reduction in platform commission can increase the likelihood of making more revenues in the future, which may incentivize developers to set a lower download price (Zhang et al. 2020; Cheng et al. 2015). It can also increase the flexibility of developers to set a competitive price and conduct promotion activities for the in-app subscription services. All these efforts can increase the attractiveness of mobile apps and hence lead to higher mobile app performance. Therefore, based on prior studies in the platform governance and incentive mechanism literature, it seems reasonable to expect that platform commission reduction may increase app performance.

Research Context and Data

Research Context

Our empirical setting focuses on the two leading mobile app platforms, Apple App Store and Google Play. The two platforms are similar in business model and technical management. First and most related to our study, the two platforms charge developers a fixed registration fee and a 15 to 30% commission fee for in-app transactions. Note that the commission fee does not apply to purchases of physical goods (e.g., shopping in the Amazon app) and offline services (e.g., Uber rides). Second, both platforms provide technical support for mobile app development, such as software development kits, operating systems, libraries, and so on (Ye & Kankanhalli 2018; Karhu et al. 2018; Eaton et al. 2015). Third, both platforms provide and manage mobile app distribution channels, based on which developers sell their content and services to users who purchase and consume them.

Starting from September 1, 2016, Apple reduced its commission from 30% to 15% for all subscription service renewals made by mobile app users after their first year of subscription. A key motivation of this change for Apple is to encourage app developers to focus on customer retention. Apple kept the commission for paid app downloads and other one-time in-app purchases unchanged at 30%. In addition, Google did not make any commission fee change in 2016 and maintained the commission rate for both one-time in-app purchases and subscriptions at 30% until January 1, 2018. From the perspective of mobile app developers and users, this event can be considered as an exogenous shock. Therefore, it helps infer a causal relationship in evaluating the effects of platform commission reduction on their behaviors and app outcomes.

Identification Strategy

We adopt the difference-in-differences (DID) approach to quantify the causal effects of platform commission reduction on mobile app performance. We consider the change of commission rule implemented by the Apple App Store a natural experiment. The immediate outcome of this policy change is that the revenue share from each subscription transaction for developers increases to 85% of the subscription price. Still, this benefit only applies to subscribers who have been with an app for at least one year. In other words, the platform commission reduction only affects some mobile apps but not all in the short term. We identify two groups of mobile apps for comparison. The treatment group includes all the mobile apps released on the Apple App Store for at least one year before the event and provides subscription services with in-app payment options. These requirements ensure that the apps in the treatment group are eligible for the reduced 15% commission rate set by the app store.

To construct a control group, we first select all the mobile apps without subscription options on the Apple App Store released at least one year before the event date. We then ensure that all the apps in the control group have one-time in-app purchase options, which we think can make the control group resemble the treatment group. In other words, both the apps in treatment and control groups have in-app purchase options. Figure 1 illustrates our empirical research design. Since the apps in both treatment and control groups are iOS apps, any platform policies implemented by Apple in our study period would simultaneously affect the mobile apps in both groups. Thus, their effect would cancel out in the DID model.

One key concern of the DID model in any quasi-experimental research design is whether the treatment and control groups are similar to each other (except for the treatment condition) and can be compared. To address this concern, we focus on the same apps released on both Apple App Store and Google Play (i.e., multi-homing apps) to control unobservable app characteristics such as growth trends and qualities. Following prior cross-platform literature (Feng et al. 2019; Chen et al. 2018), we take the performance difference between the same apps on the two platforms. By doing this, we mitigate the bias caused by any difference between treated and controlled apps. Although multi-homing apps may not account for a large portion of all mobile apps, the mobile application ecosystems are multi-homing markets if we focus on the most downloaded apps (Hyrynsalmi et al. 2016). In other words, multi-homing apps carry the most economic significance in the mobile market regarding their installation base.

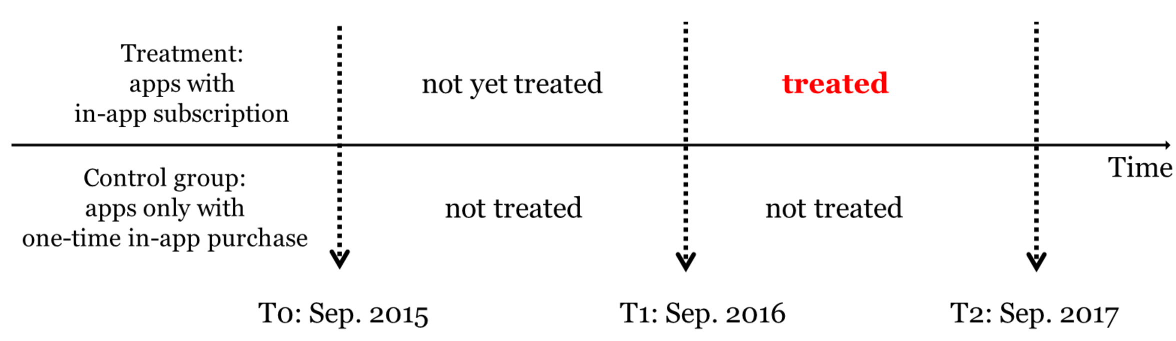


Figure 1. The Change of Platform Commission Rule

Due to the difference in platform architecture and openness (Cennamo et al. 2018), the same apps may have different characteristics and designs across the two platforms. This concern will not bias our research result for three reasons. First, a prior study on 1,295,320 applications from the three ecosystems, Google Play, Apple App Store, and Windows Phone Store, shows that the business model and core features of the same mobile applications on different platforms are relatively similar (Hyrynsalmi et al. 2016). Second, due to cost-saving and development efficiency reasons, the developers of multi-homing apps prefer to use the same software development kits and tools, which makes the apps look, feel, and perform similarly across platforms (Chen et al. 2022). Third, any platform-specific confounding factors are likely to apply to apps in both treatment and control groups, and they can be accounted for in a DID model specification. In addition, to our best knowledge, Apple did not implement any other policy change specific to the subscription apps during our study period. Also, Google started a similar policy on January 1, 2018, which implies that it had kept its commission policy unchanged during our study period.

Sample and Variables

Our data is purchased from the leading mobile app analytics firm Apptopia. We first extract the population of all apps that were available on Apple App Store and Google Play Store on September 1, 2015. Then we apply the sample selection criteria described in the prior section to select the sample of apps for our analysis. The final research sample includes 59,445 mobile apps, with 14 percent belonging to the treatment group. According to prior literature (Kummer & Schulte 2018), the most relevant measure of an app's demand or usage in the mobile industry is daily active users. We thus measure app performance with the variable DAU_{it}, which is the average number of daily active users for app i in month t. Following prior mobile app literature (Song et al. 2018; Ye & Kankanhalli 2018), we also measure app performance with monthly app downloads. Later in the mechanism analysis, we measure the app update frequency to indicate developers' efforts of improving and innovating their apps.

Table 2 presents the summary statistics of the mobile apps in our sample. Our study period is 24 months long, including 12 months before and after the event. In total, there are 1,426,680 observations in our sample. The variables $aDAU_{it}$ and $aDownload_{it}$ capture the average numbers of daily active users and downloads for app i in month t on Apple App Store, respectively. Similarly, the variables $gDAU_{it}$ and $gDownload_{it}$ represent the app performance on Google Play. In addition, the variables $aUpdate_{it}$ and $gUpdate_{it}$ capture update frequencies of the apps on Apple App Store and Google Play, respectively. We observe that, on average, the apps on Apple App Store have more daily active users and downloads than those on Google Play.

	Observation	Mean	Std. Dev.	Min	Median	Max
$aDAU_{it}$	1,426,680	173,848	9,172,959	0	0	2.05E+09
$gDAU_{it}$	1,426,680	150,890	1.14E+07	0	0	2.89E+09
$aDownload_{it}$	1,426,680	3,220	41,220	0	0	4,599,081
$gDownload_{it}$	1,426,680	2,931	40,577	0	0	4,592,138
$aUpdate_{it}$	1,426,680	0.111	0.434	0	0	17
$gUpdate_{it}$	1,426,680	0.119	0.526	0	0	21

Table 2. Summary Statistics of Key Variables

Analyses and Results

Model Specification

The difference-in-differences (DID) regression framework allows us to control for time-specific, app-specific, and platform-specific characteristics in our panel data. Our model specification is as follows:

$$\Delta DV_{it} = Treatment_i \times After_t + f_i + f_t + \varepsilon_{it} \qquad (1)$$

where ΔDV_{it} is the difference in app performance across Apple App Store and Google Play for app i in month t. To reduce data skewness and improve model fit, we take the logarithmic transformation for performance variables before calculating the differences. Specifically, $\Delta DAU_{it} = Log(aDAU_{it} + 1) - Log(gDAU_{it} + 1)$ and $\Delta Dowload_{it} = Log(aDowload_{it} + 1) - Log(gDowloads_{it} + 1)$. In the additional analysis section, we also use the differences in update frequencies as the dependent variable to estimate the impact of commission reduction on the efforts of improving and innovating current apps. Although we do not observe the specific characteristics of mobile apps, such as their design, business model, development expertise, and so on, our pairing of the same apps on the two app platforms helps mitigate any bias caused by this data limitation issue. The variable $Treatment_i$ denotes whether app i belongs to the treatment group (with in-app subscription option) or the control group (without subscription option). The variable $After_t$ captures whether the event of platform commission reduction has occurred or not by month t. Since we take the difference between the apps in the two stores, the effects of all app-specific and platform-specific factors can be removed. In our model, f_i is the app-fixed effect attributed to the differences in unobserved app-platform time-invariant effects between Apple App Store and Google Play. By incorporating this fixed effect in our model, we control the app-platform time-invariant effects, such as platform-level special offers for certain types of apps. is the time-fixed effect to account for any seasonality or time trend that impacts apps in both groups.

Main Results

The estimation results for the impact of platform commission reduction on daily active users and app downloads are shown in Tables 3 and 4, respectively. In Table 3, Column 1 shows the impact of platform commission reduction on daily active users for the full sample. Surprisingly, we find a strong and significant drop in daily active users after the platform owner (Apple) reduced its platform commission rate from 30% to 15%. The coefficient estimate of $Treatment_i \times After_t$ in Column (1) is -0.200. This result indicates that platform commission reduction leads to a 20% drop in daily active users of subscription apps on Apple App Store relative to Google Play compared to those apps in the control group. In the section on plausible mechanisms, we show that the disparity can be attributed to developers' shift of efforts from improving treated existing apps to creating new apps that are eligible to enjoy the benefits of a lower platform commission, which thus causes the reduced performance of current apps.

To get more insights into the impact of platform commission reduction, we also consider the heterogeneous effects of platform commission reduction across different types of mobile apps. Drawing on prior literature on mobile app markets, we first divide the apps into two groups according to their best rank before the event, i.e., whether an app had been within the top-500 list or not. Columns (2) and (3) present the results of regressions for these two groups of apps, respectively. We find that if the apps had been in the top 500 lists before the event, they would have a 26.8% decrease in daily active users on Apple App Store relative to Google Play. If the subscription apps had not been in the top-500 list before the event, their daily active users on Apple App Store would only have a 4.5% decrease relative to Google Play, which is significantly lower than the apps in the top-500 list. When we choose a different threshold (e.g., top 1000) to categorize the apps into two groups, the results are qualitatively similar and available upon request. The heterogeneous effects of platform commission reduction across different mobile apps show that this platform rule change does not incentivize developers of the mobile apps that are arguably more economically important in the market as intended.

We also divide the apps into two groups according to their categories: game and non-game apps. Columns (4) and (5) present the results of regressions for these two groups of apps, respectively. The results show that game apps with subscription options on Apple App Store achieve a 63.0% relative increase in daily active users, but non-game apps with subscription options on Apple App Store have a 24.1% relative decrease in the number of daily active users.

	(1) Full sample	(2) Rank<=500	(3) Rank>500	(4) Game	(5) Non-game
$Treatment_i \times After_t$	-0.200*** (0.008)	-0.268*** (0.011)	-0.045*** (0.011)	0.630*** (0.051)	-0.241*** (0.008)
App fixed effect	Yes	Yes	Yes	Yes	Yes
Month Fixed effect	Yes	Yes	Yes	Yes	Yes
App number	59,445	21,717	37,728	27,658	31,787
Observation	1,426,680	521,208	905,472	663,792	762,888
Adj. R-square	0.7775	0.7654	0.6874	0.7494	0.8054

Table 3. The Impact of Platform Commission Deduction on App DAUs

Table 4 shows the results of regressions for app downloads. From an economic perspective, compared to the apps in the control group, mobile apps in the treatment group have a 10.9% decrease in monthly downloads. Column (2) shows that if the subscription apps on Apple App Store had been in the top-500 lists before the event, they would have a 15.1% relative decrease in monthly downloads . If the apps had not been in the top-500 lists before the event, the difference of their downloads between the two stores will not change significantly. The results in Columns (4) and (5) in Table 4 for comparing game apps and non-game apps follow a similar pattern as those in Table 3.

	(1) Full sample	(2) Rank<=500	(3) Rank>500	(4) Game	(5) Non-game
$Treatment_i \times After_t$	-0.109*** (0.007)	-0.151*** (0.009)	-0.012 (0.009)	0.538*** (0.044)	-0.141*** (0.007)
App fixed effect	Yes	Yes	Yes	Yes	Yes
Month Fixed effect	Yes	Yes	Yes	Yes	Yes
App number	59,445	21,717	37,728	27,658	31,787
Observation	1,426,680	521,208	905,472	663,792	762,888
Adj. R-square	0.7307	0.7182	0.6075	0.7026	0.7605

Table 4. The Impact of Platform Commission Deduction on App Downloads

According to the results above, platform commission reduction leads to decreased mobile app performance. One possible explanation for the change in performance is that developers may devote less effort to improving and innovating these apps, resulting in lower app quality and user experience. We explore this possible explanation in the additional analysis section. Next, we check the robustness of the main findings by evaluating whether there exists a pretreatment trend in the mobile app performance and exploring how the treatment effect may vary over time.

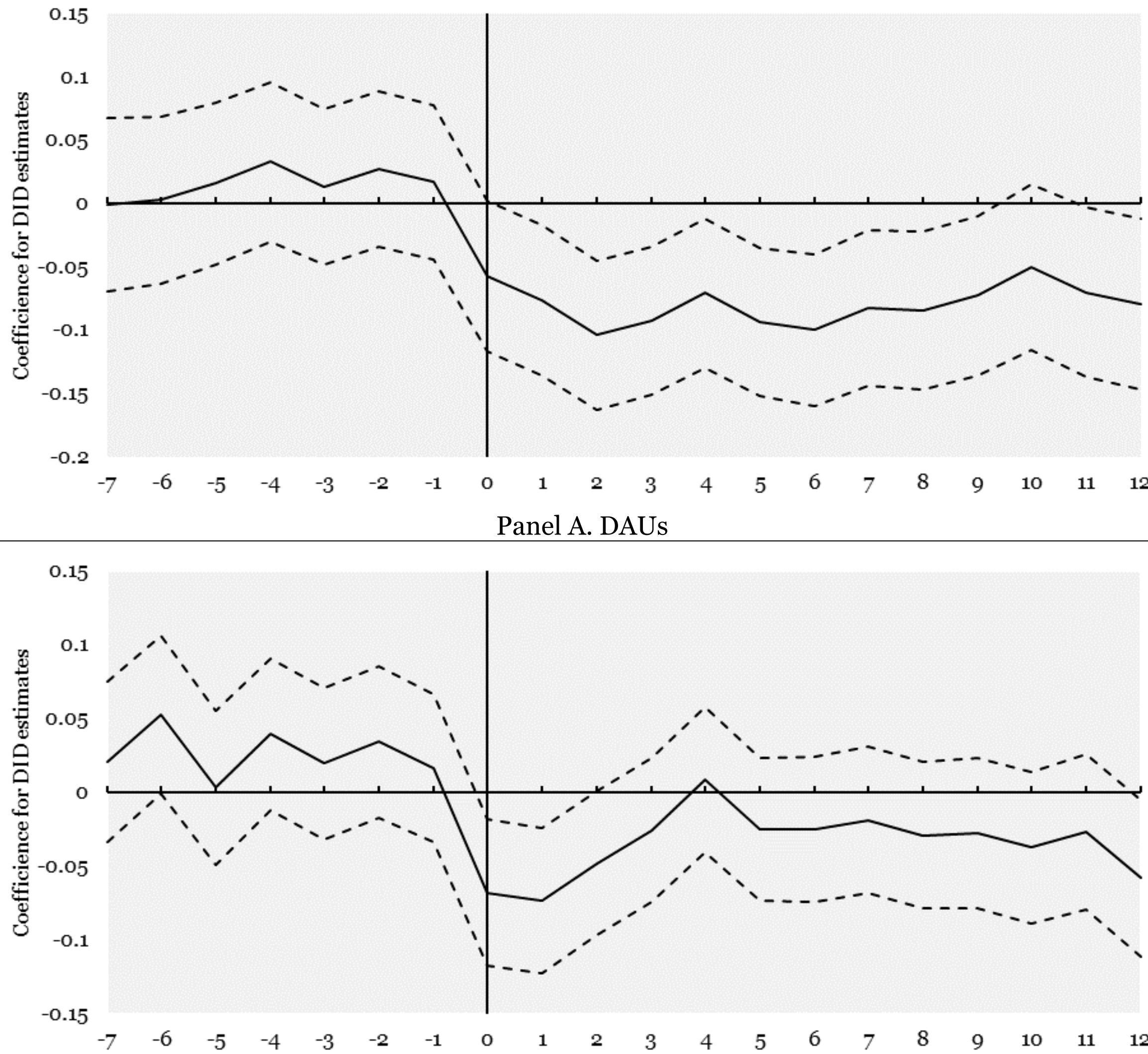
One important condition for the validity of the DID model is that the parallel trend assumption must hold. The dependent variables for the two groups should follow a similar or parallel trend before the event. There are different ways to validate the parallel trend requirement. The relative time model is widely utilized to validate the parallel trend requirement (Foerderer et al., 2021; Zhang et al., 2022). Specifically, researchers conduct the regression analysis in which the treatment variable interacts with continuous time trend variables and then check the significance of the interaction terms before and after the event. In this paper, we adopt the relative time model shown in Equation (2) to examine the monthly treatment effects. $CommissionChange_{it}$ is the interaction term between $Treatment_i$ and the monthly dummy variable for month t.

$$DV_{it} = \sum_{t=-m}^{-1} CommissionChange_{it} + \sum_{t=1}^{n} CommissionChange_{it} + Controls_{it} + f_i + f_t + \varepsilon_{it} \quad (2)$$

This revised model compares the average across months in the pre-event period (excluding the months from -m to -1) with each of the individual months from -m to -1 and from 1 to n. m is the number of months selected to check the anticipatory response if the dependent variable has already started to change before the event. We set the index m as 7. The index n is the number of months in the post-event period.

If any of the coefficient estimates for $CommissionChange_{it}$ is statistically significant when t is -m to -1, there is an anticipatory response before the event. In that case, the parallel trend assumption does not hold for such months. Under the condition that the parallel trend assumption hold for the month from -m to -1, the coefficient estimates for $CommissionChange_{it}$ represent the monthly treatment effects after the event when t is from 1 to n. In addition, we can infer how the treatment effect may vary in both the short and long term.

Figure 2 shows the coefficient estimates of $CommissionChange_{it}$(m = 7, and n=12). Panel A and B show the results of regressions for daily active users and downloads, respectively. Note that t is equal to zero when the event happens in that month. As we can see in Panel A, most coefficient estimates on the $CommissionChange_{it}$ are negatively significant when t is greater than or equal to zero. When t is smaller than zero, the coefficient estimates on the $CommissionChange_{it}$ are insignificant. In Panel B, the coefficient estimates on the $CommissionChange_{it}$ are negatively significant when t is equal to zero, one, and twelve. When t is smaller than 0, the coefficient estimates on the $CommissionChange_{it}$ are all insignificant. These results show that the event of platform commission reduction hurts the performance of the treated apps, which is consistent with our main findings.



Panel B. Downloads

Figure 2. The 95% Confidence Internal for Estimates with Different Treatment Windows

Note: the solid line is the coefficient; the dotted lines are the upper and lower 95% confidence interval of coefficients.

Additional Analyses for Plausible Mechanisms

In this section, we present additional analyses to understand further the underlying mechanisms for the change in mobile app performance caused by the platform commission reduction. Our main results show that the reduction of platform commission fees has a significant negative impact on mobile app performance measured by app downloads and daily active users. The purpose of our mechanism analysis is to supplement our main analyses and investigate why mobile app performance decreases. Recall one of the theoretical arguments for the impact of platform commission strategy on mobile app performance is that it can affect developers' decisions and behaviors regarding app quality and innovations. In particular, prior works have shown that the platform pricing rule affects the entries and contributions of seller-sided participants (Cachon et al. 2021; Armstrong 2006).

Update Frequencies

We use our main regression model but replace the dependent variable with app update frequency. The results are shown in Table 5. Column (1) shows that the update frequency of subscription apps on Apple App Store decreases by 1.2% relative to Google Play after the platform commission reduction. Columns (2) and (3) show that only the update frequency of subscription apps within the top-500 list are negatively affected. This result is consistent with our main findings that the top-500 treatment apps experienced a larger reduction in performance after the event. Columns (4) and (5) show that only the update frequency of non-game apps is negatively affected. This result is also consistent with our main findings that only non-game apps experienced a reduction in performance after the event. The results suggest that developers reduce their efforts to improve their current apps, leading to lower app performance and market demand.

Overall, our findings are surprising since the platform reduced its commission fee to incentivize developers to commit more efforts and resources to improve their products and services. In this regard, we conjecture that while they reduce their efforts to current apps, they may have larger incentives to create new apps that can enjoy the benefits of the platform commission reduction. Next, we test this possibility.

	(1) Full sample	(2) Rank<=500	(3) Rank>500	(5) Game	(6) Non-game
$Treatment_i \times After_t$	-0.012*** (0.002)	-0.015*** (0.002)	-0.004 (0.002)	-0.010 (0.007)	-0.012*** (0.002)
App fixed effect	Yes	Yes	Yes	Yes	Yes
Month Fixed effect	Yes	Yes	Yes	Yes	Yes
App number	59,445	21,717	37,728	27,658	31,787
Observation	1,426,680	521,208	905,472	663,792	762,888
Adj.R-square	0.1618	0.1342	0.1961	0.1858	0.1499

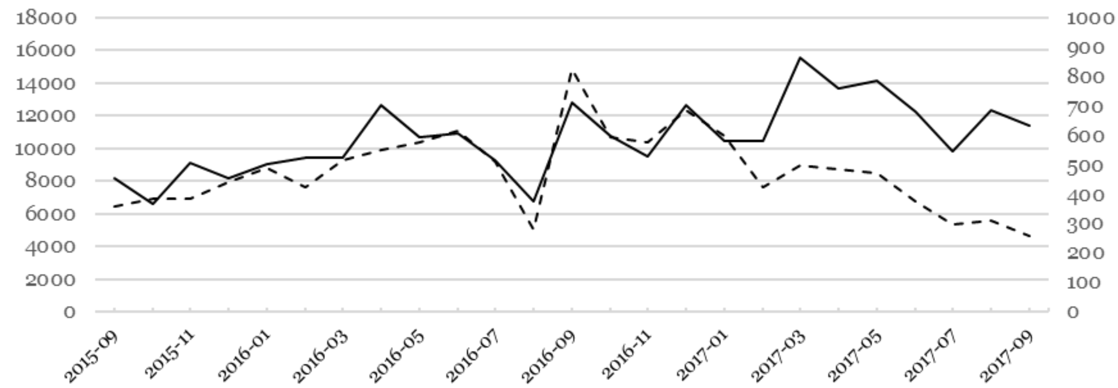
Table 5. The Impact of Platform Commission Deduction on App Updates

Development of New Apps

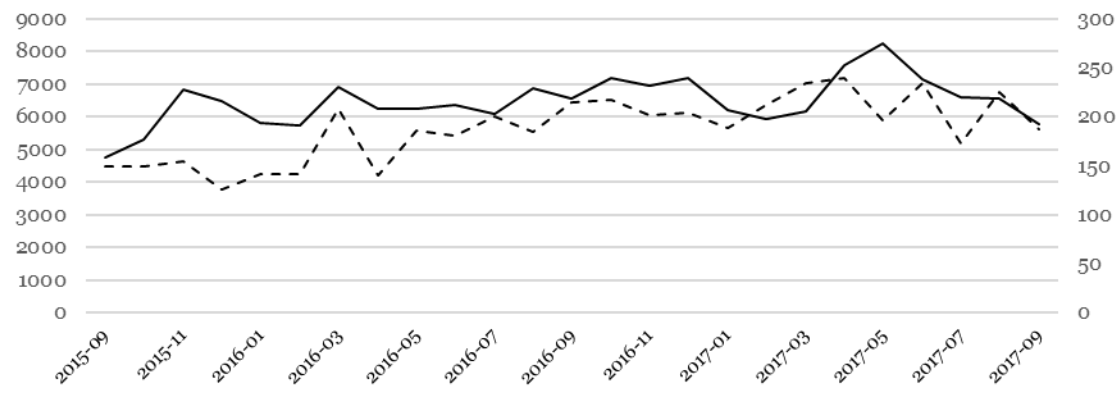
Our analysis result shows that developers devote less effort to current apps in the treatment group. However, whether developers maintain their efforts into innovation in the current platform by developing new apps or shift to a rival platform remains unclear. This question is crucial for platform owners in the increasingly competitive mobile markets.

As an initial attempt to answer this question, we provide some model-free evidence on how developers may reallocate their efforts after the platform commission reduction. Since the platform commission reduction is a subsidy strategy intended to benefit the developers, we expect that it will incentivize developers to increase the number of their new apps that are eligible to gain the benefits.

Figure 3 presents the results. Specifically, we show the trend of new apps with and without subscription services. Panel A is for the new app numbers in Apple App Store, and Panel B is for Google Play. As we can observe, after the Apple commission fee reduction, the number of new apps with subscription options increased gradually on Apple App Store. By contrast, the number of new apps without subscription options drops extensively in Panel A. It shows the developers shift their efforts into creating new apps with subscription services, which has the potential to enjoy the subsidies of the platforms. However, the numbers of two types of apps on Google Play maintain a roughly consistent parallel trend. Although our descriptive analysis regarding the trend of new apps at the platform level cannot provide causal explanations, it sheds further light on how developers' behavior may change in response to the platform commission reduction.



Panel A. New Apps on the Apple App Store



Panel B. New Apps on the Google Play

Figure 3. Distribution of New App Numbers on the Two Platforms

Note: the solid line is for the number of apps with subscription options; the dotted line is for the number of apps with one-time in-app purchase options.

Discussion and Conclusion

Setting an effective platform pricing strategy has aroused wide attention in academic and multiple industries. Since existing platform commission rules lead to conflicts between the platform owners and developers, how platforms should adjust the commission rate remains unclear. By analyzing a natural experiment with the methods of DID regression model, this study provides empirical evidence that platform commission reduction can reduce app performance in terms of daily active users and downloads. We also find that platform commission reduction reduces developer-side efforts to update mobile apps. Moreover, our additional analysis shows that developers increase their new apps with the subscription option, implying an incentive effect of platform commission reduction on innovations.

To our best knowledge, this study is among the first to empirically examine the effect of platform commission change on app performance and developer efforts. Most existing studies on platform commission strategy are based on modeling or analytical methods. Their results are based on the assumptions that the user or developer sides have specific characteristics and preferences. Our study provides empirical evidence on how users and developers react to the change in platform pricing strategy. Our findings thus provide important references for future research, especially for optimal platform pricing strategy studies. Specifically, these studies can apply more realistic assumptions about the behaviors of different sides in their theoretical models. They can also use our empirical results to verify the generalizability of their models.

This study also contributes to the two-sided platform literature on the incentive mechanism and governance. Although there are plenty of studies on the platform pricing strategy and two-sided markets, there are no consistent conclusions on what the platform owners should do. For example, some papers suggest that platform owners can charge less for encouraging developers or sellers to contribute and innovate more and various products (Hagiu 2009), while other papers suggest that platforms can charge more for pushing developers or sellers to produce high-quality products (Lin et al. 2011) or covering platform operation costs (Chou et al. 2012). This study contributes to the literature by empirically documenting the impact of platform commission reduction. Moreover, we contribute to the literature on platform governance and incentives by demonstrating how developers react to the change of platform commission rules.

Our study provides important managerial implications. First, our findings show that reducing platform commission can have a negative impact on mobile app performance. This implies that although reducing platform commission fees can help developers gain a larger portion of the profits from in-app transactions, it may be insufficient to incentivize developers to improve and advance their app quality and user experience. Second, our findings show the heterogeneous impacts of commission reduction on different apps. It suggests that platform owners can also consider setting different platform commission levels and monitoring the reactions of different sides since the platform owner usually has significant market power in setting prices and collecting data. Moreover, differentiated commission structures for different apps may also be a good choice. Third, the empirical evidence on the performance change of current apps and the increasing trend of new subscription apps reveals developers' value creation and capture strategies in response to the change of platform commission. In light of this, platform owners can reevaluate their platform strategies from multiple perspectives and adjust the pricing design according to their comprehensive value proposition and competitive strategies.

Being one of the first works to investigate the impact of platform commission reduction on mobile app performance, this study is subject to several limitations, and there are plenty of opportunities for future research. First, our data is about the two leading mobile app platforms. Future research may consider generalizing the insights on platform commission reduction by examining other software and non-software platforms. Second, this study only considers the impact of reducing commission fees. Future research could explore the consequences of different pricing strategy changes. For example, Apple charged a 15% commission on all small businesses whose annual revenues are less than one million dollars, starting January 1, 2021. It would be interesting to empirically assess the impact of this policy change and compare the differences in the impact of different policy changes. By doing this, we can further the understanding of platform pricing strategies. Third, our study focuses primarily on the performance of the existing apps and developers' efforts to improve them. Future research may explore other key behaviors and strategies of developers, such as whether and how they adjust app download prices.

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