# Pricing and Competition in Mobile App Markets

Ning-Yao Pai and Yung-Ming Li
*Institute of Information Management, National Chiao Tung University, Hsinchu, Taiwan*

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Abstract: With the fast growth in smart phones, tablets and apps markets, the competition is increasing between market platform such as Android and iOS. And the growth numbers of apps available and downloaded, the competition between app market platforms are also very intensive. The economic behaviours of participants are determined by market factors, such as the effects of the number of apps available in the market and the number of users purchasing mobile platform devices and download apps. In this research, we analyse the pricing issues (subscription fee and revenue sharing ratio) in apps market under the scenarios of monopolistic and duopolistic apps markets.

## 1 INTRODUCTION

With the fast growth in smart phones, tablets and apps markets, the competition is increasing between Android and iOS. According to comScore Reports (source: comScore), the top smart phone operating system in the United States was Android with 52.2% of all smart phone owners, while Apple's iOS was the second most common smart phone operating system with 40.6% of the market. BlackBerry OS ranked third with 3.6 percent share, followed by Microsoft with 3.2% share and Symbian with 0.2 percent of the market. IDC reports that, in 2013, 1,004.2 million smart phones were sold worldwide and a sale of smart phone in Q4 2013 is 284.4 million (source: IDC). The growth number of apps and the number of downloads of apps are also very impressive. App Store is the official Apple online app distribution system for iPad, iPhone, and iPod touch, and Google Play (Android Market) is a digital application distribution platform for Android operated by Google. Both Google Play and App Store launched in 2008. In July 2013, there were more than 1,000,000 apps available for Android, and the estimated number of apps downloaded from Google Play was 50 billion (source: www.androidanalyse.com). In December 2013, Apple's App Store contained more than 1,006,557 apps, which have collectively been downloaded more than 60 billion times (source: www.macrumors.com). The amount of apps and support are important indicators to rational customers who have the will to purchase smart phone. And mobile device OS determines the costs and difficulty of apps development. With the increasing number of smart phone users each day, meanwhile, there is an equal increase in the number of app developers. Although the developers have a lot of mobile platforms to choose from, they are likely to choose the most popular one or two platforms, iOS and Android.

App market is a two sided market, it provides platform to bring two types of participants (Bakos and Katsamakas, 2008), such as apps users and apps developers. A two-sided market is two sets of participants interact through a platform and the decisions of each set of participants affects the outcomes of the other set of participants (Rysman, 2009). The apps market economy is different from the past economy. There are three elements combined in the economy: mobile device, operating system provider, and apps channel. Such as Apple Inc., its best-known mobile device products are the iPhone and iPad. It is also the iOS operating system provider and the apps platform App Store which is the official Apple online application distribution system. Different apps markets have different management or usage rules. Google Play, for example, inherited from the Android system which is free and open, Google also takes an open management strategy on app publishing. It does not set strict management and process for developers

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when publishing an app on Google Play. App Store is another type of apps platform. In order to maintain a consistent quality assurance, before app publishing, an app must be examined through the review process to ensure that the iOS system device users can get the best experiences. Apps become a highly competitive market, because it not only can create enormous revenue, but also drive hardware sales, advertising and technology innovation. The massive software business opportunity becomes the new Blue Ocean of business competition, and an important driving force of industrial transformation. With the rapid growth of hardware sales, the rapid growth of apps accompanies.

In this paper, from the mobile platform infrastructure aspect, we aim to contribute to the effort of proposing the model to analyse apps market's competing strategy between platforms. Therefore, a natural issue faces us is the analysing business (revenue) model for mobile apps markets. We consider the models of two types of apps markets: one is the monopolistic apps market, and the other is the duopolistic apps market. In the apps market setting, we need to consider two types of participants: apps providers and apps users. Each participant has its profit function and utility function respectively. The economic behavior of participants are determined by market factors, such as the effects of the number of apps available in the market and the number of users purchasing mobile platform devices and downloading apps in the apps market. The apps market platforms are assumed to maximize their profits, and need to consider the factors that critically influence profits such as the apps quality, varieties, provision fee, and download fee etc. Specifically, the profit function of the apps market platform is composed of apps market subscription fee and apps revenue sharing from apps providers. For instance, Google Play has a one-time subscription fee of $25; iOS developer program on App Store is $99 a year. The two app market platforms get 30% of app sales revenue and share 70% of app sales revenue to app developers. In a duopolistic apps market, the market shares of apps providers and users are different in the two platforms. Therefore, we will study the effect of competition on the apps market revenue model development.

On the apps platform, there are many factors influencing the obtainable profit, such as mobile device price, the apps subscription fee, the number of apps available in the market, the number of app developers, the quality of apps, and the apps publishing rules. We want to develop the optimal pricing strategy (subscription fee) of the apps market platform. How does a platform company set the apps market subscription fee? How does competition affect the pricing scheme? The game theoretical models, which are mainly used to extend the decision context to the competitive environment, will be developed in the whole research structure. It is important to do a deep analysis and modelling for all different kinds of participant behavior in various market structures which reflect the real world situations.

The remainder of the paper is organized as follows. In section 2, we review the related literatures. Section 3 we describe the models of two types of apps market and discuss the implications of our analytical results. Finally, Section 4 provides concluding remarks and discusses future research directions.



## 2 RELATED LITERATURE

A two-sided market is two sets of participants interact through a platform in which the decisions of each set of participants affect the outcomes of the other set of participants (Economides and Katsamakas, 2006). There are many Internet intermediaries providing two-sided marketplace; they operate platforms to bring together two types of participants, such as buyers and sellers (Bakos and Katsamakas, 2008). Two-sided market can be found in many Internet intermediaries, such as operating systems composed of users and developers; recruitment sites composed of job seekers and recruiters; search engines composed of advertisers and consumers. The well-known companies that operating platform including Match.com, eBay, Google, Facebook and others. There exist same-side and cross-side network effects in two-sided markets, and each network effect can be either positive or negative. In this paper, we use the two-sided market structural characteristics to analyse apps market.

Shy (2001) proposed software are the supporting service for the hardware, and the variety of software that supports a hardware influences the value of this hardware device. Users can get more utilities when joining a platform that provides higher variety compatible products. Through the indirect network effect, user's purchase behaviour will be altered (Mantena et al., 2010) in the information goods (software application / video games). With the network effects, the two types of participants attract to each other and the platform's value is dependent on the number of both sides of the groups (Eisenmann et al., 2006). Platforms attend to do more efforts to their business model, and they give overall considerations to attract two-sided users while making money (Rochet and Tirole, 2003). The competition occurs between platforms that have to attract two-sided participants to transact on them. The platform can charge the fees (commission/access fees) to the buyers or to the sellers, in terms of overall market conditions, the consumers on the one side of the platform are permitted free entry (S. Li et al., 2010). Rysman (2009) show that openness means two strategic points on two-sided markets; one is the amount of sides to pursue, the other is how to compete with rival platforms. In this research, we will model and examine the pricing strategies for the mobile app markets, which are an emerging popular type of two-sided market.

## 3 THE MODEL

We consider the apps market platform with two types of participants: apps providers and apps users. A typical apps user has heterogeneous value creation rate on the apps market platform, where value creation rate is uniformly distributed within an interval. The higher personal value creation rate or the higher total number of apps download, the higher apps user's utility. Besides, because of Google Play and App Store have different apps publishing policy, the expected quality of apps also influence the user's utility. The user utility function of using mobile devices that is determined by individual value creation rate, the total number of apps download, the expected quality of apps, and the mobile platform device price. The apps users will purchase the mobile device and apps when they have non-negative utility.

Assume there are totally potential $\rho_0$ apps providers and potential $\lambda_0$ apps users in the apps markets. A typical apps user $i$ has heterogeneous value creation rate $v_i$ on the apps market platform, where $v_i$ is uniformly distributed within an interval [0, 1]. We represent the created value creation for apps user as $v_i q\rho$ , where $q$ is the expected quality of apps and $\rho$ is the total number of apps available in the market. The apps market platform earns revenues from users when they purchased apps. Apps users will evaluate the quality and the number of apps to download to decide whether to download free apps or do nothing. Notice that apps users may download some paid apps and get some free apps. The value creation rate $v_i$ can be interpreted as a net value which has deducted the charge of purchasing apps. In order to be able to use apps, the apps users must pay a price $p$ to purchase a mobile device. The utility of each apps user with $v_i$ is defined as follows:

$$U_i = \begin{cases} v_i q\rho - p & \text{, Purchase the mobile device and apps} \\ 0 & \text{, Purchase none} \end{cases} \quad (1)$$

According to the apps user utility function, we observe that the apps users will purchase the mobile device and apps in non-negative utility, $U_i \geq 0$ . Hence, we have the set of purchased users $D = \{i \mid v_i \geq \frac{p}{q\rho}\}$ and the demand of users is $\lambda = \mid D \mid = \left(1 - \frac{p}{q\rho}\right)\lambda_0$ .

A typical apps provider $j$ has heterogeneous revenue creation rate $r_j$ on the apps market platform, where $r_j$ is uniformly distributed within an interval [0, 1]. Not every apps user will buy the apps; some users pay for apps and some users download free apps. $r_j$ is a random variable, it means the average revenue and benefits gained from per apps user. App providers which provide a free app can still have revenues, such as through advertising, in-app purchase, provided a paid subscription advanced version, ad-free version with an additional fee. Some free app providers want to increase goodwill, or provide extra service to customers. For instance, some restaurants provide a free app that allows their customers to book in the app prior to going to the restaurant. Moreover, some stores provide a free app to get services or obtain goods in the stores that realize the business model of online to offline. We represent the generated revenue for apps provider as $r_j\lambda$ , where $\lambda$ is the total number of apps users purchasing the mobile device and apps. The expected benefits from providing apps is $r_j u_j \lambda$ . Assume $\beta$ ( $0<\beta<1$ ) proportion of the app providers provide a paid app. They can gain revenue sharing from apps market platform. The expected revenue sharing ratio of apps is denoted as $u_j = \varepsilon$ , where $0<\varepsilon<1$ . Furthermore, $1-\beta$ proportion of the app providers provide a free app and they will retain all the benefit ($u_j = 1$). Assume parameter $f$ represents the apps market subscription fee for an app provider. The profit function of apps provider $j$ is defined as follows:

$$\pi_j = \begin{cases} r_j u_j \lambda - f & \text{, Subscribes to the apps market and develops apps} \\ 0 & \text{, Subscribes none and develops none} \end{cases} \quad (2)$$

According to the apps provider profit function, we observe that the apps providers will subscribe to the apps market and develop apps in non-negative profit, $\pi_j \geq 0$. Hence, we have the set of subscribed apps supplier $S = \{j \mid r_j \geq \frac{f}{u_j \lambda}\}$. The total number of apps available in the market is $\rho = |S| = \rho_\varepsilon + \rho_f$, which includes the number of paid apps $\rho_\varepsilon = \beta\left(1 - \frac{f}{\varepsilon\lambda}\right)\rho_0$ and the number of free apps $\rho_f = (1-\beta)\left(1 - \frac{f}{\lambda}\right)\rho_0$.

The notations used in the model are summarized in Table 1.

## 3.1 Monopolistic Apps Market

While monopolistic apps market does not currently exist in the real world, we treat the scenario as a model for an early stage of the market and use this baseline model as a benchmark for comparison. When there is only one apps market platform in the market, we represent the profit function of the apps market platform as:

$$\Theta_m = f\rho + (1-\varepsilon)E\left(r_j \mid j \in S\right)\rho_\varepsilon \lambda \quad (3)$$

The first part of the profit function is the revenue from apps market subscription fee; the second part is the revenue from selling apps to users that deducted some revenue shared to apps providers. For expression simplification, we denote $\kappa = p/q$.

Since the platform will choose the best pricing strategies (apps market subscription fee) to maximize its profit, we can derive the optimal subscription fee for the apps market platform as:

Table 1: Notations used in the model.

| Notation | Description |
|---|---|
| $\lambda_0$ | Potential apps users in the apps markets |
| $\rho_0$ | Potential apps providers in the apps markets |
| $v_i$ | A typical apps user $i$ has heterogeneous value creation rate on the apps market platform |
| $\rho$ | The total number of apps available in the market |
| $q$ | The expected quality of apps |
| $p$ | The mobile platform device price |
| $U_i$ | The utility function of the apps user |
| $r_j$ | A typical apps provider $j$ has heterogeneous revenue creation rate $r_j$ on the apps market platform |
| $u_j$ | The expected benefits from providing apps |
| $\lambda$ | The total number of apps users purchasing the mobile device and apps |
| $\varepsilon$ | The expected revenue sharing ratio of apps |
| $f$ | The apps market subscription fee |
| $\pi_j$ | The profit function of the apps provider |
| $\Theta_m$ | The profit function of the apps market platform |

Examining (4) , we have the following results.

*PROPOSITION 1. The apps market platform subscriptionb fee decrease with the number of apps providers.*

When the number of apps providers is increasing; the platform would like to earn profit from sales apps, and therefore the subscription fee is decreasing.

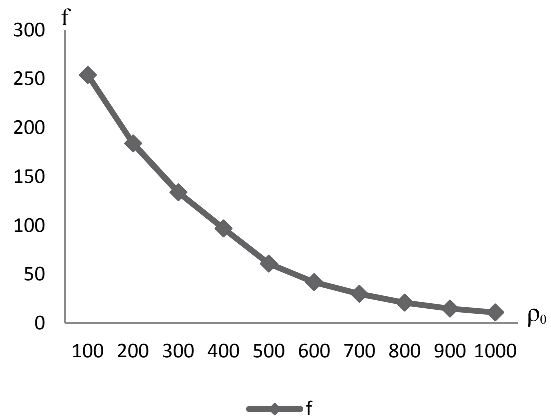


Figure 1: The impact of the number of apps providers on subscription fee level.

$$f = \frac{\varepsilon\lambda_0\left(2\varepsilon\rho_0 + \beta\rho_0 - 2\beta\varepsilon\rho_0 - 2\varepsilon\kappa - \beta\kappa + \beta\varepsilon\kappa - \beta^2\rho_0 + 2\beta^2\varepsilon\rho_0 + \beta\varepsilon^2\rho_0 - \beta^2\varepsilon^2\rho_0\right)\left(2\varepsilon\rho_0 - 2\varepsilon\kappa - \beta\kappa + \beta\varepsilon\kappa + \beta\rho_0 + \beta^2\rho_0 - 2\beta^2\varepsilon\rho_0 - \beta\varepsilon^2\rho_0 + \beta^2\varepsilon^2\rho_0\right)}{2\rho_0\left(\beta + \varepsilon - \varepsilon\beta\right)\left(2\varepsilon + \beta - \varepsilon\beta\right)\left(2\varepsilon\rho_0 + 2\varepsilon\kappa + \beta\kappa - \beta\varepsilon\kappa + \beta\rho_0 + \beta^2\rho_0 - 2\beta^2\varepsilon\rho_0 - \beta\varepsilon^2\rho_0 + \beta^2\varepsilon^2\rho_0\right)} \quad (4)$$

If there are more free apps in the market, the platform would not make profit from sales apps. In order to keep the profit level, the apps market platform subscriptionb fee increases with the number of free apps.

## 3.2 Duopolistic Apps Market

In this subsection, we consider a market with two apps market platforms in the market. Assume there are two competing apps market platform *A* and *B*. $\theta$ portion of apps users having higher preference to market platform brand *A* ( $i \in D_A$ ) and $1-\theta$ portion apps users having higher preference to apps market platform brand *B* ( $i \in D_B$ ), the disutility for a user to use a less preferred mobile platform is denoted as $\delta$ .and $\phi$ portion of apps providers having higher development skill in apps market platform brand *A* ( $j \in S_A$ ) and $1-\phi$ portion apps users having higher development skill in apps market platform brand *B* ( $j \in S_B$ ). $\omega$ is the extra cost for an app provider to develop apps in a less preferred market platform. The utility of each apps user with $v_i$ is defined as follows:

$$U_i = \begin{cases} v_i q_k \rho_k - p_k & \text{, Buy mobile device and apps, for } i \in D_k \\ v_i q_k \rho_k - p_k - \delta & \text{, Buy mobile device and apps, for } i \notin D_k \\ 0 & \text{, Buy none} \end{cases}$$

, where $k \in \{A, B\}$ (5)

The profit function of apps provider *j* is defined as follows:

$$\pi_j = \begin{cases} r_j u_j \lambda_k - f_k & \text{, Subscribes to the apps market and develops apps, for } j \in S_k \\ r_j u_j \lambda_k - f_k - \omega & \text{, Subscribes to the apps market and develops apps, for } j \notin S_k \\ 0 & \text{, Subscribes none and develops none} \end{cases} \text{, where } k \in \{A, B\} \quad (6)$$

When there are two apps market platforms in the market, we represent the profit function of each apps market platform as

$$\Theta_k = f_k \rho_k + (1-\varepsilon_k) E(r_{kj}) \rho_{\varepsilon k} \lambda_k,\ k \in \{A, B\}, \quad (7)$$

Denote $f_A^*$ and $f_B^*$ are undercut-proof equilibrium subscription fees (Shy, 2001; Li and Lin, 2009). In this conditions that both competing apps market platforms have no incentive to undercut its subscription fee are

$$\Theta_A = f_A^* \phi \rho + (1-\varepsilon_A) E(r_{Aj}) \phi \rho_{\varepsilon A} \theta \lambda \geq (f_B - \omega) \rho + (1-\varepsilon_A) E(r_{Aj}^D) \rho_{\varepsilon A} \bar{\lambda}_A$$

and

$$\Theta_B = f_B^* (1-\phi) \rho + (1-\varepsilon_B) E(r_{Bj}) (1-\phi) \rho_{\varepsilon B} (1-\theta) \lambda \geq (f_A - \omega) \rho + (1-\varepsilon_B) E(r_{Bj}^D) \rho_{\varepsilon B} \bar{\lambda}_B, \quad (8)$$

where $\bar{\lambda}_A = \theta\lambda + (1-\theta)\lambda_S$ , $\bar{\lambda}_B = (1-\theta)\lambda + \theta\lambda_S$, and $\lambda_S = \left(1 - \frac{p+\delta}{q\rho}\right)\lambda_0$ . The expected revenue value of $\phi\rho_{\varepsilon A}$ paid apps providers develop apps (subscribed apps supplier) in platform *A* is denoted $E(r_{Aj})$, and $E(r_{Bj})$ is the expected value of $(1-\phi)\rho_{\varepsilon B}$ paid apps providers develop apps (subscribed apps supplier) in platform *B*. $E(r_{Aj}^D)$ is the expected value of $\rho_{\varepsilon A}$ subscribed apps supplier in platform *A* and $E(r_{Bj}^D)$ is the expected value of $\rho_{\varepsilon B}$ subscribed apps supplier in platform *B*. Assume the expected revenue sharing ratio of apps in two apps market platforms are the same, $\varepsilon_A = \varepsilon_B = \varepsilon$ and *d* is equal to $1-\varepsilon$ .

The symmetric subscription fees can be obtained:

$$f_A^* = \frac{d\beta\varepsilon\rho^2\lambda(2\varepsilon + d\beta)(1-\phi)(1-\theta+\phi\theta) + 2d\beta\varepsilon^2\rho^2(\phi\bar{\lambda}_B - \bar{\lambda}_B - \bar{\lambda}_A) + d^2\beta^2\varepsilon\rho^2(\phi\bar{\lambda}_B - \bar{\lambda}_B + \bar{\lambda}_A) + (4\varepsilon^2\rho^2\varpi + 2d\beta\varepsilon\rho^2\varpi)(2-\phi)}{\rho^2(4\varepsilon^2 + 4d\beta\varepsilon + d^2\beta^2)(1-\phi+\phi^2)}, \quad (9)$$

$$f_B^* = \frac{d\beta\varepsilon\rho^2\phi\lambda(2\varepsilon + d\beta)(1-\phi+\phi\theta) - 2d\beta\varepsilon^2\rho^2(\bar{\lambda}_B + \phi\bar{\lambda}_A) - d^2\beta^2\varepsilon\rho^2(\bar{\lambda}_B + \phi\bar{\lambda}_A) + (4\varepsilon^2\rho^2\varpi + 2d\beta\varepsilon\rho^2\varpi)(1+\phi)}{\rho^2(4\varepsilon^2 + 4d\beta\varepsilon + d^2\beta^2)(1-\phi+\phi^2)} \quad (10)$$

Examining (9) and (10), we have the following results.

*PROPOSITION 2. Under competition, the apps market platform subscription fee increases with the market share of apps users.*

Figure 2 shows the subscription fee increases with the market share of apps users.

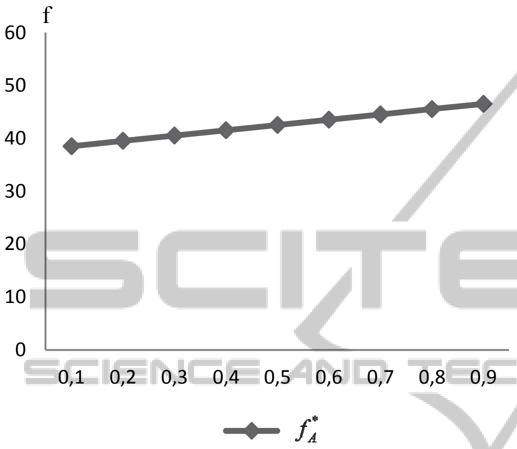


Figure 2: The impact of θ on subscription fee.

## 4 CONCLUSION AND FUTURE WORKS

In this paper, utilizing the methodologies of game theoretic and economic modelling, we analyze the platform subscription fee under the structures of the monopolistic and duopolistic apps market platforms. In monopolistic apps market, we find that the apps market platform subscription fee decrease with the number of apps providers. In duopolistic apps market, the apps market platform subscription fee increases with the market share of apps users.

There are several issues which can be further studied. First, we assume that the expected quality of apps is the same. It would be interesting to develop a model that apps have different quality which would affect apps user's utility. Second, the role of difficulty of developing apps can be incorporated into the model. The difficulty of developing apps will affect the incentive of the apps providers to choose which apps market platform to subscribe and develop apps. Third, the role of apps review policy and quality assurance can be incorporated into the model. The decision of review policy can be further analyzed in our model.

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