UNIVERSITY OF LJUBLJANA
SCHOOL OF ECONOMICS AND BUSINESS

MASTER'S THESIS

DEVELOPMENT MODE AND PRICING STRATEGY OF CHINA UNIONPAY, UNDER OLIGOPOLISTIC COMPETITION IN CHINA THIRD-PARTY MOBILE PAYMENT MARKET

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INTRODUCTION

With high-speed communication network technology maturing in China, mobile terminals, such as smartphones has spread rapidly. China online retail, started in 2003 from Taobao[1], has already developed into a market with CNY10.6 trillion in annual transaction volume in 2019 (National Bureau of Statistics, 2019). At the same time, the market has been shifting from PC to mobile terminals.

In 2018, the number of mobile payment users has reached 659 million, and this number is estimated to reach 790 million by 2020 (iiMedia Polaris, 2019). The number of transactions via mobile payment could reach 1.22 trillion times in 2019, amounting to CNY199.39 trillion in transaction value. The growth of mobile payment in China was so fast that it had become the most common means of payment, representing more than 61% of total amount in all kinds of transaction (Ipso, 2019). The industry of mobile payment has reached an unprecedented prosperity.

Along with the development of mobile payment, an increasing amount of online applications also emerged. Many of those applications provide new forms of shopping experience, such as online shopping, online food ordering and online reading grow rapidly. Those new applications, in turn complement mobile payment. Additionally, mobile payment platforms also started to develop additional functions which aim to ease people's daily lives in various scenarios. People can now use the platforms for ID certification, taking loans, riding public transportation, paying utility bills and more. Those platforms also keep launching new ways of payment authorization, for example pin-free payment for small amount, finger print and facial recognition. Those new ways of authorization present brand new payment experiences, which helps attract more young generation users, and, at the same time, help make payment more secure. Mobile payment platforms have infiltrated Chinese people's daily life, not just as a convenient way of payment, but as an all-purpose life assistant.

It is notable that the mobile payment market in China is dominated by third-parties, among them are 2 leaders: Alipay and WeChat Pay (iiMedia Polaris, 2019). As the transaction scale of third-party mobile payment keeps growing, it starts to play an increasingly important role in national economy. So it is meaningful for us to study how third-party mobile payment platforms formulate their development strategy and pricing strategy, improve the user viscosity and market share. There have been rich literatures researched on Alipay and WeChat Pay, which have established sophisticated development modes. Therefore, this thesis will focus on another important player in Chinese third-party mobile payment market: China UnionPay.

China UnionPay is currently ranked third in the industry of third-party mobile payment, yet its user penetration rate at 27.2% is far lagging behind the two larger players. WeChat Pay

[1] Taobao is a famous online retail website in China.

has user penetration rate at 92.4%, while Alipay has it at 72.1%. However, the recent development showed substantial growth in the number of users for UnionPay, while the other two suffered slightly both in terms of the scale and number of transactions. Therefore, China UnionPay shows great potential in the market (Ipsos, 2019).

In this thesis, I will take China UnionPay as an example to study third-party mobile payment. First of all, the development path, the growth pattern as well as the market entry strategy of UnionPay will be illustrated, followed by an analysis, based on two-sided market theory, of its competition environment and pricing strategy. Hence, a model will be constructed in order to understand what is the impact of three elements (platform's network externality, degree of differentiation and matching rate) on pricing strategy under different settings of pricing mode and users homing situation.

In section one and section two, I will introduce the third-party mobile payment market and illustrate the past and ongoing development of it. Also I will mention other market participants except China UnionPay for reference. UnionPay is still in its early development stage, many questions, such as how to utilize its unique resources, how to counter the larger competitors and win over larger market, still remain to be answered.

In section three, I will talk about literature review. This part will present some previous academic studies on concepts including mobile payment, third-party payment and two-sided market. It will help better understand the market and lead the study to next step.

In section four, I will construct a pricing model, which will help evaluate the pricing strategy of UnionPay when taking different pricing modes of 'charge registration fee', 'charge transaction fee', or 'charge two-part tariff', under the different circumstances of users' homing situations: 'both sides single-homed', 'both sides partial multi-homed', 'one side single-homed while the other side partial multi-homed'.

In conclusion part, I will provide suggestions for further development of China third-party mobile payment platforms including China UnionPay based on the analysis, and I will also discuss the limits of this study.

1 INDUSTRY OVERVIEW OF THIRD-PARTY MOBILE PAYMENT

This section illustrates the development path and the current situation of third-party mobile payment, followed by a brief introduction to its payment procedure, in which the features of a two-sided market are outlined.

1.1 Development of third-party mobile payment

The very first stage of third-party mobile payment started in 1999 when two third-party payment companies (Beijing Capital and Shanghai Huanxun) were established (wyzhifu, 2017). Suffering from slow development of China e-commerce at that age, those two companies didn't achieve a lot. In the next year, banks in China entered the market of mobile payment and dominated the market for years. Bank of China cooperated with China Mobile and launched a new product called mobile bank, which is the first China mobile payment product. Soon afterwards, many other banks also launched their mobile bank products and promoted the services (Chen, 2000). In December 2004, Alibaba launched Alipay, a third-party payment platform, to serve its e-commerce website Taobao (Yang, 2017). Payments in that age are mainly operated on PC. Affected by fast-growing Taobao, Alipay soon developed and expanded into the biggest third-party payment platform in the world.

From 2005 to 2013, facilitated by developing communication technology, both mobile payment and third-party payment showed their great potential. Banks used to operate their online businesses through sending short messages. Later on, they start using Wireless Application Protocol (WAP). In near field communication market, Agricultural bank of China was the first one to launch NFC SIM card. These cards enable consumers to pay on the spot with their phone, and not necessary physically connecting to the POS machine. Afterwards, many other banks such as China Merchants Bank and Shanghai Pudong Development Bank also seized the mobile payment market by launching similar products (wyzhifu, 2017). At the same time, third-party payment platforms also grew fast and closely relied on e-commerce platforms. Including Taobao, leading e-commerce platforms such as JD.com and Amazon soon created their exclusive payment products to attract more consumers and enhance sales performance. In 2012, Alipay added a new payment method in Alipay: QR code (Yangcheng Evening News, 2012). Consumers can pay with QR code by scanning a merchants' QR code or showing their own QR codes to the special POS machine. The creation of QR code started a new chapter of offline payment, and stabilized the dominating position of Alipay in China third-party mobile payment market.

From 2013 to 2015, third-party mobile payment platforms accelerated promotion from big cities like Beijing, Shanghai, Guangzhou and Shenzhen to other cities. Government also introduced policies to encourage the development of third-party payment. In 2014, China Banking Regulatory Commission issued "Notice of Strengthen Cooperation of Commercial Bank and Third-Party Payment Institutions" (China Banking Regulatory Commission, 2014). Later that year, central bank published the 5th list of third-party payment licenses (People's

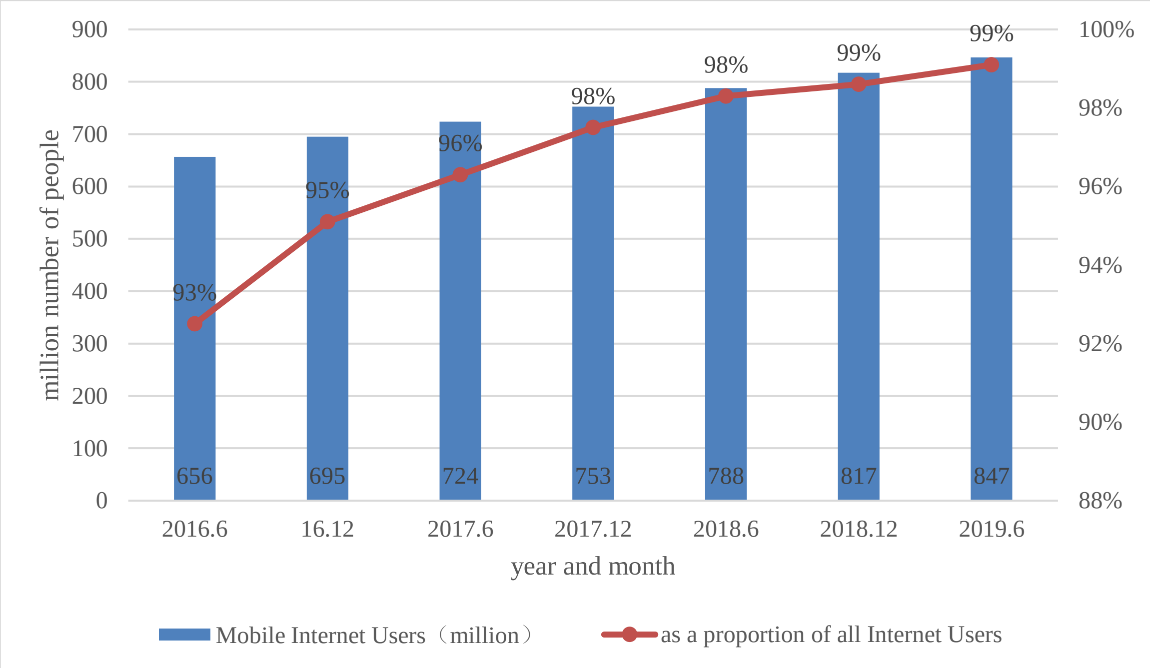
Bank of China, 2014). More companies joined in the market while leading players such as Alipay and WeChat Pay maintained their status by unite with shops and restaurants. They organize several activities to attract new users and increase old users' stickiness.

As to the way of payment, limited by technology and the difficulty of changing sim-card, NFC offline payment didn't become popular in the past years. In contrast, QR code offline payment swept the country, relying on the advantages of convenience and low cost. However, from year of 2016, the market structure started to change. Apple Pay and Samsung Pay entered Chinese market consecutively in February and March, and started seize the market share from Alipay and WeChat Pay in NFC offline payment market (wyzhifu, 2017).

1.2 Current situation of third-party mobile payment

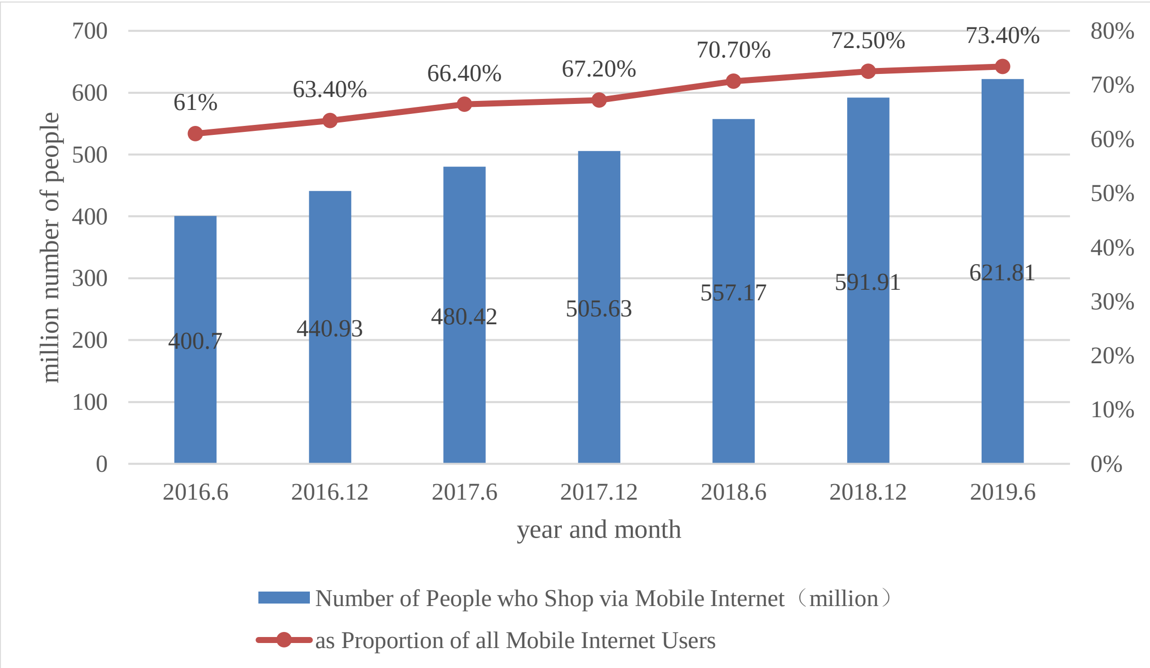
From Figure 1, it can be found that by June 2019, the size of China's mobile internet users has reached 847 million, about 99% of the internet users in China. In the year 2018 and 2019, 396 million and 369 million units of smart phones were sold respectively (Canalys, 2019). The widespread of smart phones and the growing number of mobile internet users laid foundation for the rapid development of third-party mobile payment. Meanwhile, online business (online shopping, online food ordering, internet finance, gaming, live streaming, short-form mobile videos and online education) grew rapidly both in size and variety. These online business booms helped drive up the demand for third-party mobile payment services. Every November 11th is the Chinese version of "Black Friday". On November 11th 2019, the total online sales in China hit the record high of CNY410 billion in a single day (Syntun, 2019). From Figure 1 and Figure 2, it is clear that both the size of mobile internet users and the number of people who shop online have been constantly increasing, and are expected to continue this trend. This brings more potential for growth in the third-party payment service sector.

Figure 1. Number of China's mobile internet users, and as a proportion of all Internet users in 2016-2019



Source: China Internet network information center, 2019.

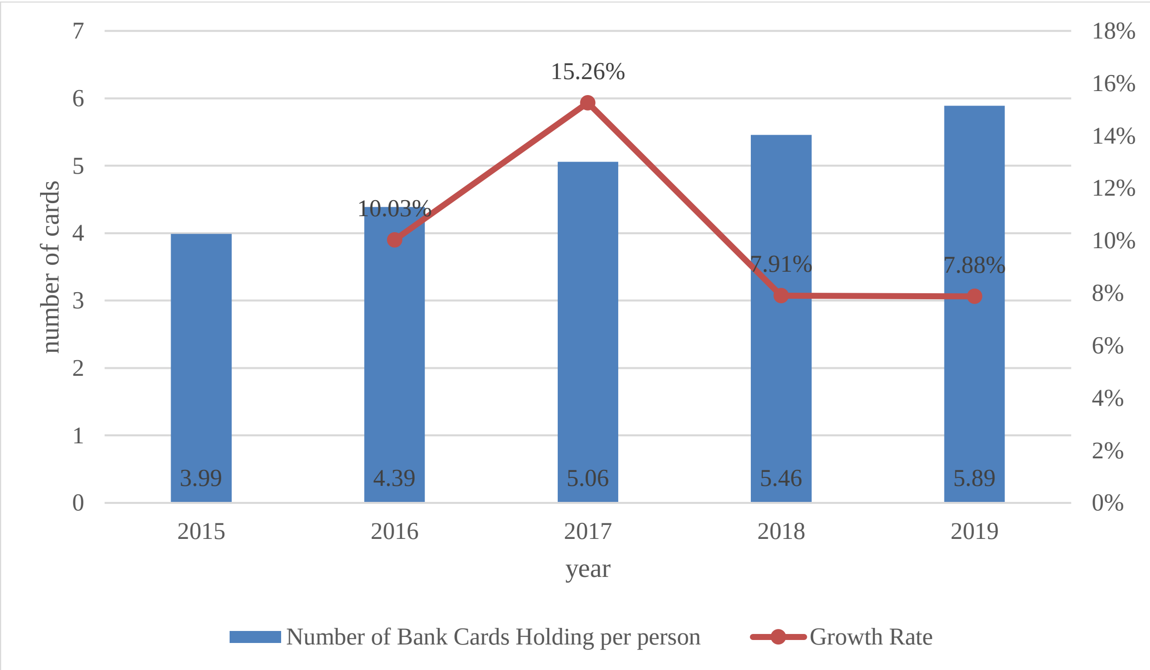
Figure 2. Number of people who shop via mobile network, and as proportion of all mobile Internet users in 2016-2019



Source: The 44th China Statistical Report on Internet Development, 2019.

Figure 3 shows that in 2019, an average Chinese person hold 5.89 bank cards, including credit card and debit card, a much higher number compared to the previous level of 4 cards per person in the year of 2015 (The Bluebook of China Bank Card Industry, 2019). In order to cope with supervision organizations on transaction risk control, users are required to register at least one bank card at third-party mobile payment platform (Kaitao, 2018). Out of convenience, users of third-party mobile payment usually register multiple bank cards at a single payment account, and pay via third-party mobile payment application, instead of using mobile applications provided by individual banks (People Thinkbank, 2018). With this trend, more and more people, who had previously only shopped with cards online or offline, start to connect their bank cards to their third-party mobile payment accounts, adopting the habit of paying everything with mobile phone. Therefore, increase in the number of bank cards per person also brings growth to third-party mobile payment platforms.

Figure 3. The condition of Chinese bank cards holding in 2015-2019



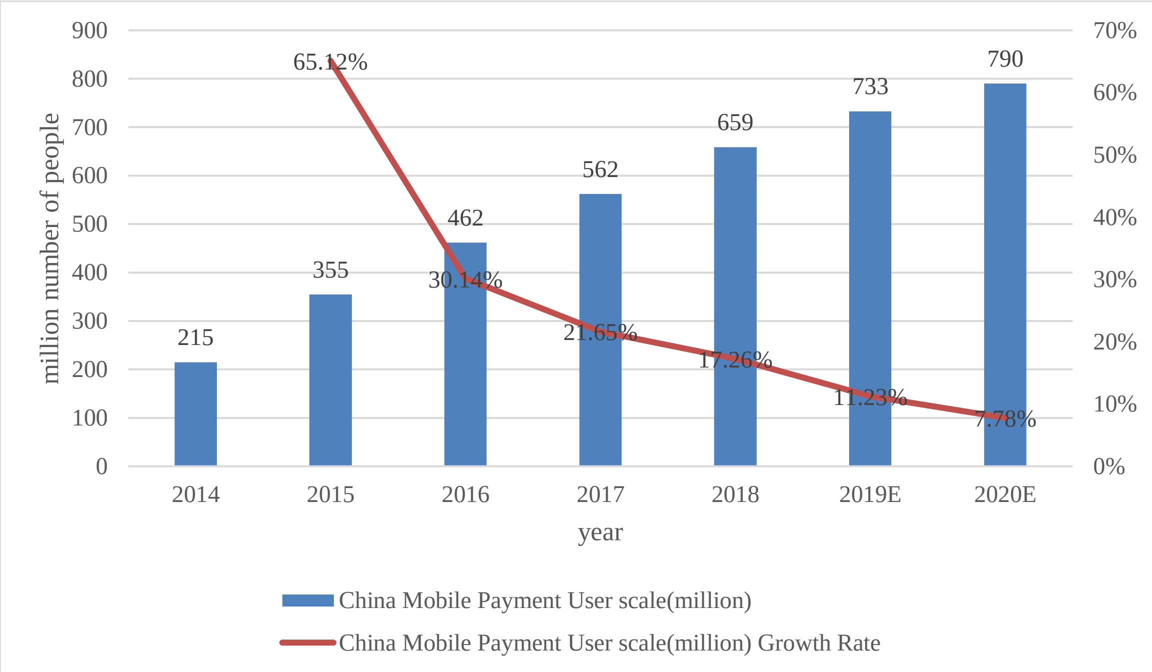
Source: The Bluebook of China Bank Card Industry, 2019.

Increase in the number of mobile network users, widespread of smart phones, increasing online shopping behaviors and growth in the average number of bank cards per person contributed to the growth of mobile payment services. Figure 4 shows that by 2018, 659 million people in China were defined as mobile payment services users, and this number is estimated to reach 790 million by 2020, a 56.4% penetration rate among the entire population (iiMedia Polaris, 2019). Mobile payment will penetrate in all aspects of people's daily lives, from inter-person transactions to shopping payment, from offline shopping to online shopping, from living expenses to financing. More than half of Chinese people rely on mobile payment other than cash or bank cards. From Figure 5, we can find that during the year of 2018, the total transaction via mobile payment amounted to CNY277.4 trillion in China (Payment & Clearing Association of China, 2019).

After a period of rapid development prior to 2015, Chinese market for mobile payment services has entered a new phrase of more steady growth, at an annual rate between 20% to

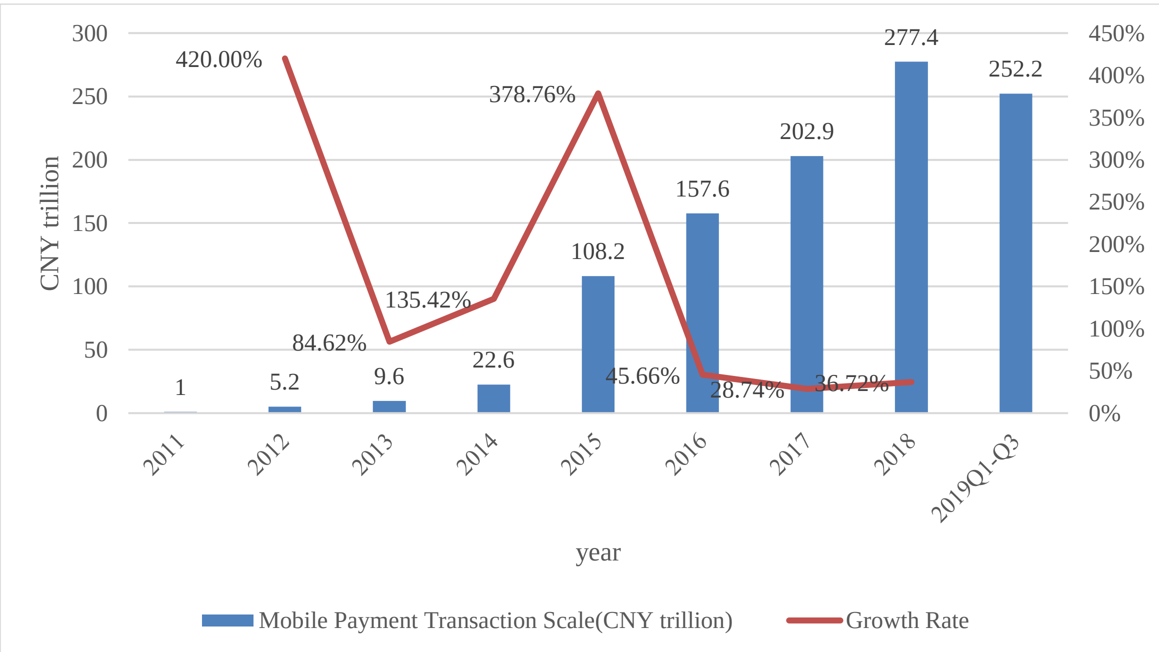
50% (iiMedia Polaris, 2019). With more and more people adapting to using mobile payment, and with an increasing number of functions being added to platforms, mobile payment market will see a sustained trend of growth.

Figure 4. China mobile payment user scale and its forecast of China mobile payment industry in 2016-2020



Source: iiMedia Polaris, 2019.

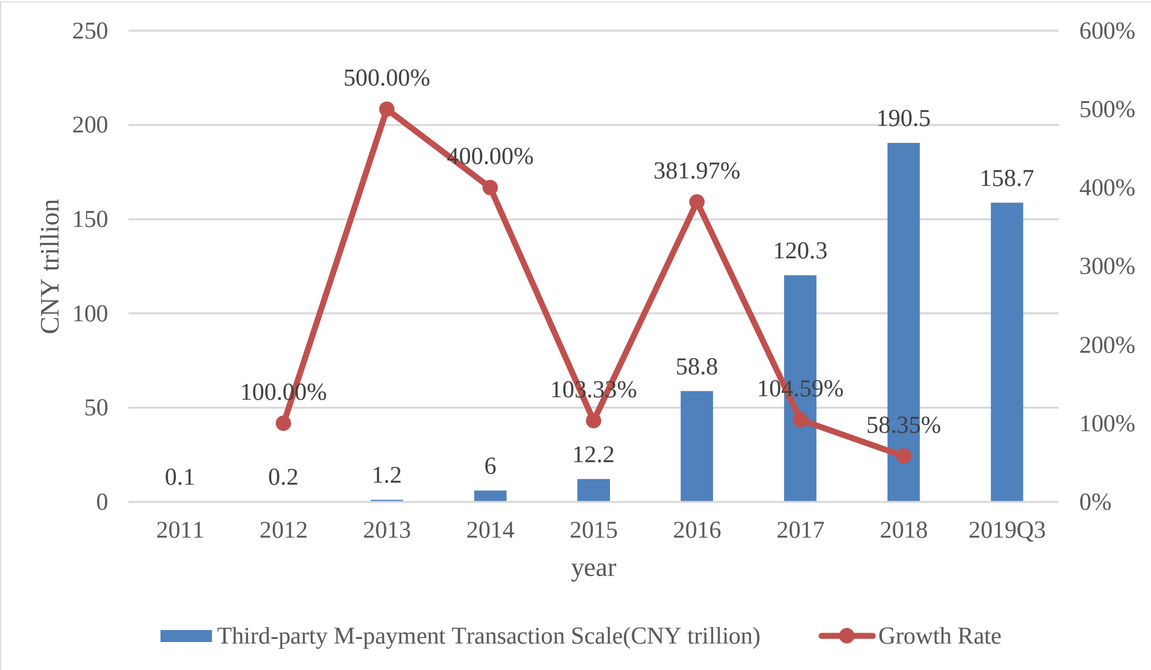
Figure 5. China mobile payment transaction scale from in 2011-2019



Source: iiMedia Polaris, Payment & Clearing Association of China, 2019.

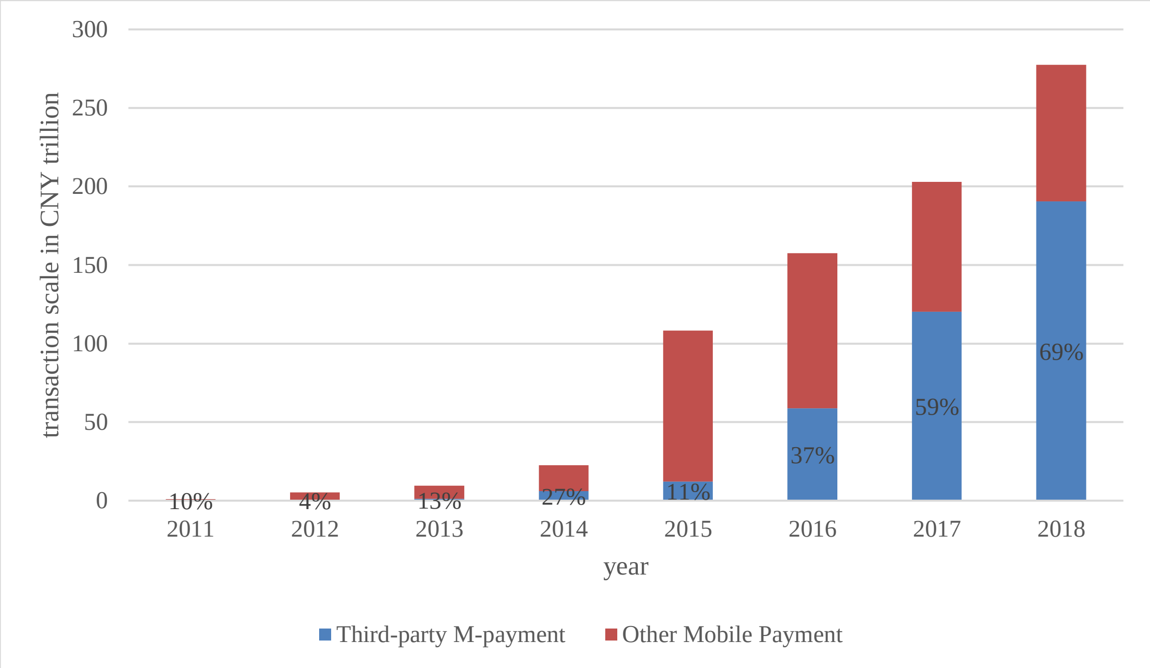
Figure 6 and Figure 7 shows that, as the most active participants in China's mobile payment industry, third-party mobile payment accomplished CNY190.5 trillion worth of transactions in 2018, which accounts for 68.7% of total mobile payment transactions. It was a significant achievement since the proportion was only 11% for third-party mobile payment in 2015 (iResearch & 199it, 2019). In the coming years, with technology continues evolving and transaction security issues better addressed, third-party mobile payment is expected to gain even larger market share in mobile payment industry.

Figure 6. China third-party mobile payment transaction scale in 2011-2019



Source: iResearch & 199it, 2019.

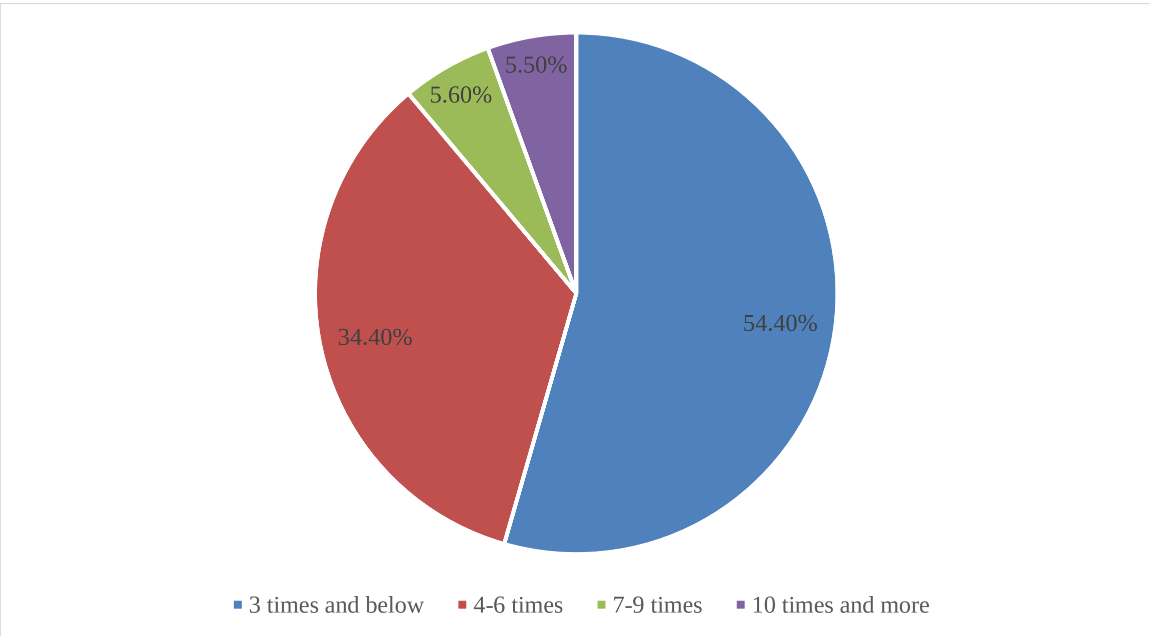
Figure 7. Transaction scale contrast of China third-party mobile payment and mobile payment in 2011-2018



Source: iiMedia Polaris, Payment & Clearing Association of China, iResearch & 199it, 2019.

Figure 8 shows that, according to a study done by iiMedia research, mobile payment users in China have become accustomed to frequent mobile payment usage. More than 45% of users use mobile payment over 3 times per day, and 34.4% of users use from 4 to 6 times a day (iiMedia, 2019). Mobile payment has been the dominating way of payment in users' daily lives, completely replacing other more traditional means of payment in a majority of circumstances.

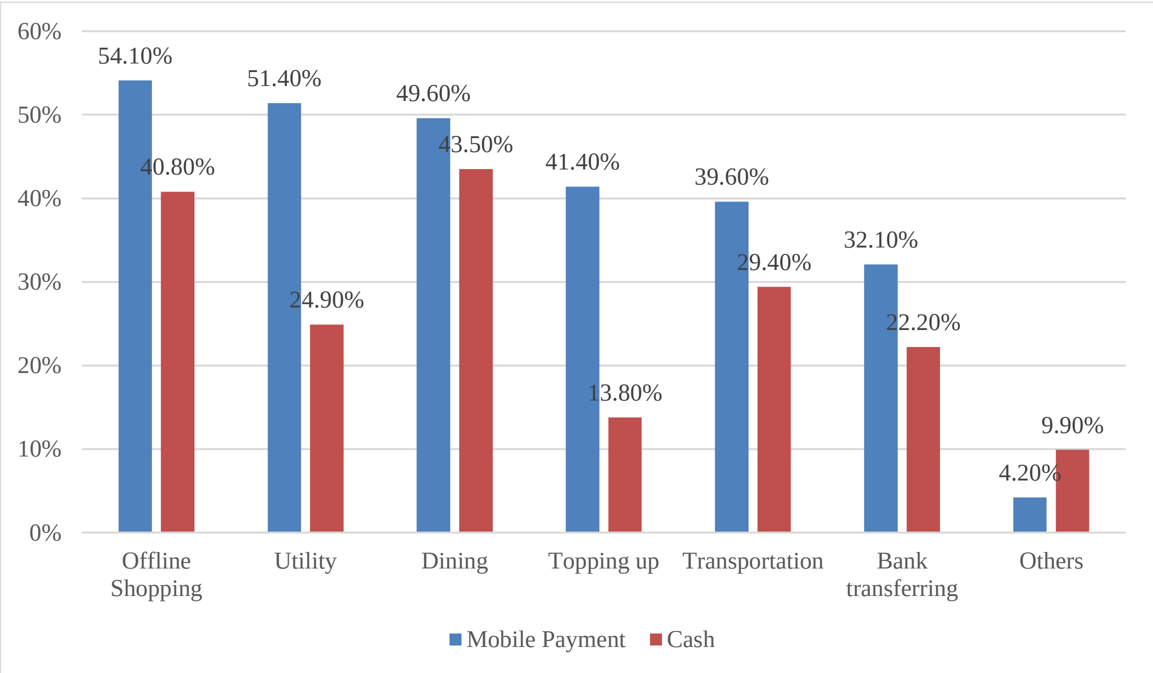
Figure 8. Survey on daily usage-frequency of China mobile payment users in 2019



Source: iiMedia, 2019.

Mobile payment is becoming more popular in offline scenarios. Cash payment used to be the first choice in offline transactions, but recent data show a quite different answer. Figure 9 shows that in scenarios of offline shopping and utility payment, more than half of the users chose mobile payment rather than cash. And in dining scenarios, the percentage is also close to the previous two scenarios (iiMedia, 2018). Mobile payment has therefore permeated Chinese daily life, and gradually replaced cash in many scenarios.

Figure 9. Preferences to mobile payment and cash payment in offline scenarios in first quarter of 2018

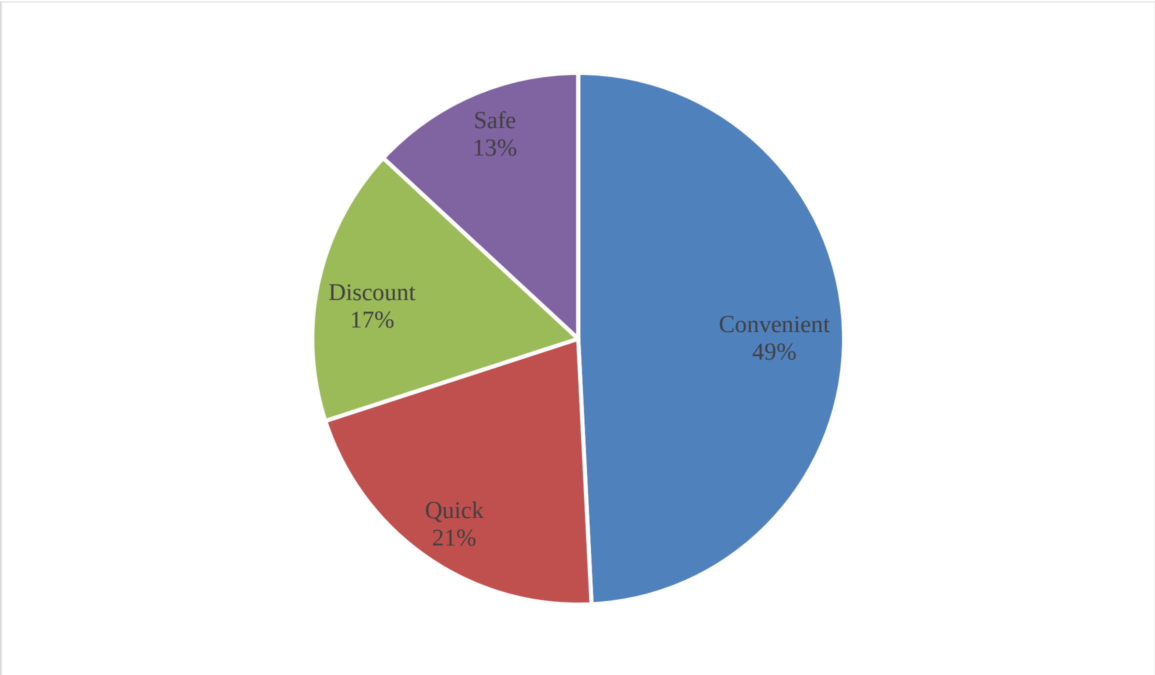


Source: iiMedia.cn, 2018.

In China mobile payment market, Alipay and WeChat Pay are two oligopolists. In the first quarter of 2018, those two players took up 90.6% of the whole market share, Alipay had 49.9% share and WeChat Pay had 40.7% share (Ipsos,2019; iiMedia, 2019). Interestingly, it is observed that users have different preferences between the two platforms in different payment scenarios. When paying online, 59.2% of the users chose Alipay and 34.4% of them chose WeChat Pay. Situations is reversed when paying offline. 59.5% of the users chose WeChat Pay while only 36.3% of them chose Alipay (Ipsos, 2019; iiMedia, 2019). This can be explained by different product features. Relying on the biggest e-commercial website Taobao, Alipay has strong user stickiness when shopping and paying online. To many users, the very first payment choice that comes to their minds is Alipay. Different from the e-commercial feature, WeChat has advantage on social network and was used frequently in daily life. So more users tend to rely on WeChat when paying offline. Similar findings were shown in survey of QR code scanning. 54.3% of the users prefer Alipay when scan online code, while 52.7% of the users prefer WeChat Pay when scan offline code (Ipsos, 2019).

Figure 10 shows that the main reason for Chinese users to use third-party mobile payment is convenience. Almost half of the respondents indicated that convenience is the first reason. Quickness, discount and safety are the second, third and fourth most important factors, respectively (iiMedia, 2019). As to online-paying, third-party mobile payment has dominant advantage of convenience, compared to payment via PC terminals. PC terminal users need to first fill in blanks of personal information and verification code received on the phone, sometimes also need to plug in a safety USB to finish the whole paying procedure (Baidu Experience, 2015). This process usually takes more than one minute to complete. Meanwhile, the same transaction could be done on mobile within seconds (Alipay, 2020). As to offline-paying, third-party mobile payment shows merits of discount and safety. In order to promote their payment products, platforms give high discount for new users (Eastmoney, 2019). They also provide old users with favored price. Compared to cash-paying, third-party mobile payment is safer. It becomes unnecessary to carry cash with yourself, thus avoiding accidents of losing money. Since every transaction of payment is recorded on the platform, buyers are able to check on their phone if the payment amount is correct after leaving the paying scenarios. Meanwhile, sellers can easily track if any payment was lost. These advantages cannot be realized in cash-paying.

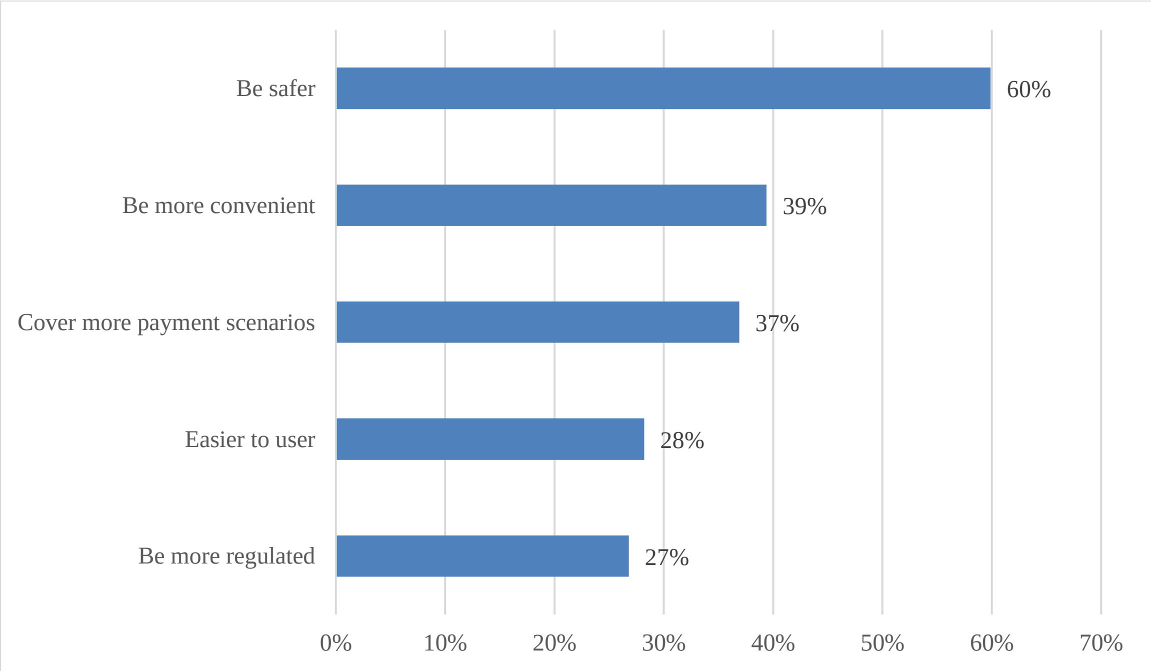
Figure 10. Main reasons of using third-party mobile payment in first quarter of 2018



Source: survey.iiMedia.cn, 2019.

According to Figure 11, a 2019 mobile payment user expectation study found out that transaction security has become the top concerns since 60% of users want mobile payment to be more secure. 40% of users want more convenience, while 37% of users want mobile payment to cover more payment scenarios and to develop more functions besides payment. Also noticeable is that 27% of users want to have better regulation and supervision measure, especially in the areas dealing with credit loan, insurance and wealth management (iiMedia, 2019). As a new and fast evolving industry, third party payment has created many challenges for regulation because existing legislation and regulations are lagging behind in adapting to new business models. In the future, relevant legislative and regulating bodies need to come up with more sophisticated rules in order to effectively supervise the industry.

Figure 11. Survey on user expectation of development of China mobile payment industry in 2019



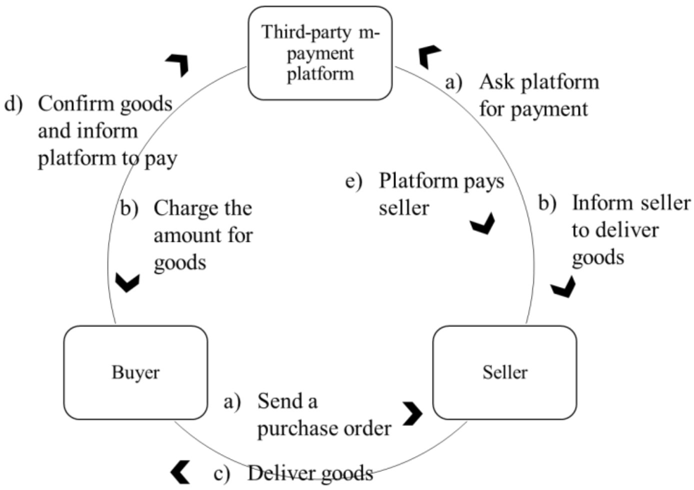
Source: iiMedia, 2019.

1.3 Operation procedure of third-party mobile payment platform

Figure 12 shows that in most circumstances, the payment procedure of third-party mobile payment can be broken down into the following steps (CSDN, 2018):

1. A buyer sends a purchase request to a seller; the seller accepts the request, and ask the platform for payment
2. The platform charges the buyer the agreed amount for the goods, and informs the seller to deliver goods or services,
3. The seller delivers the goods or services as requested
4. The buyer confirms the goods or services, and informs the platform to pay the seller.
5. The seller receives the agreed amount

Figure 12. Payment procedure of third-party mobile payment



Source: CSDN, 2018.

1.4 Industrial features of third-party mobile payment

Third-party mobile payment is a typical two-sided market. Merchants and users on the two sides of payment platforms rely on each other. Platforms play the role of a bridge between the two sides, and seek to match them. The market possesses features of direct network externality and indirect network externality. Platforms that are used more by users are more attractive to merchants, and vice versa. Value of platforms also increases with the number of users or merchants. The feature of indirect network externality indicates that, in early stage of market development, platforms usually take strategy of low price to attract as many merchants and users as possible. Only in this way they can reach critical mass and survive in fierce competition. In this market, relevance between transactional scale and price structure is evident, and the price structure is non-neutrality. Pricing strategy on users and merchants can greatly affect the transaction scale on platforms (Ren, Zhang & Zhao, 2013).

Meanwhile, third-party mobile payment platforms can be mutually exclusive. Since the core function of a third-party mobile payment is transaction service, which is highly identical across different platforms, users are unlikely to use more than one platform. Considering a two-sided market, if every seller joins multiple platforms, a buyer can reach all the sellers by simply joining one platform. However, due to the fact that third-party mobile payment platforms in China are usually associated to unique resources, and provide different value-added services, multi-homing situation for both sellers and buyers is rather common, and any one single platform cannot easily prevent users from using others (Alipay & WeChat Pay & QuickPass, 2020).

2 DEVELOPING MODE OF CHINA UNIONPAY

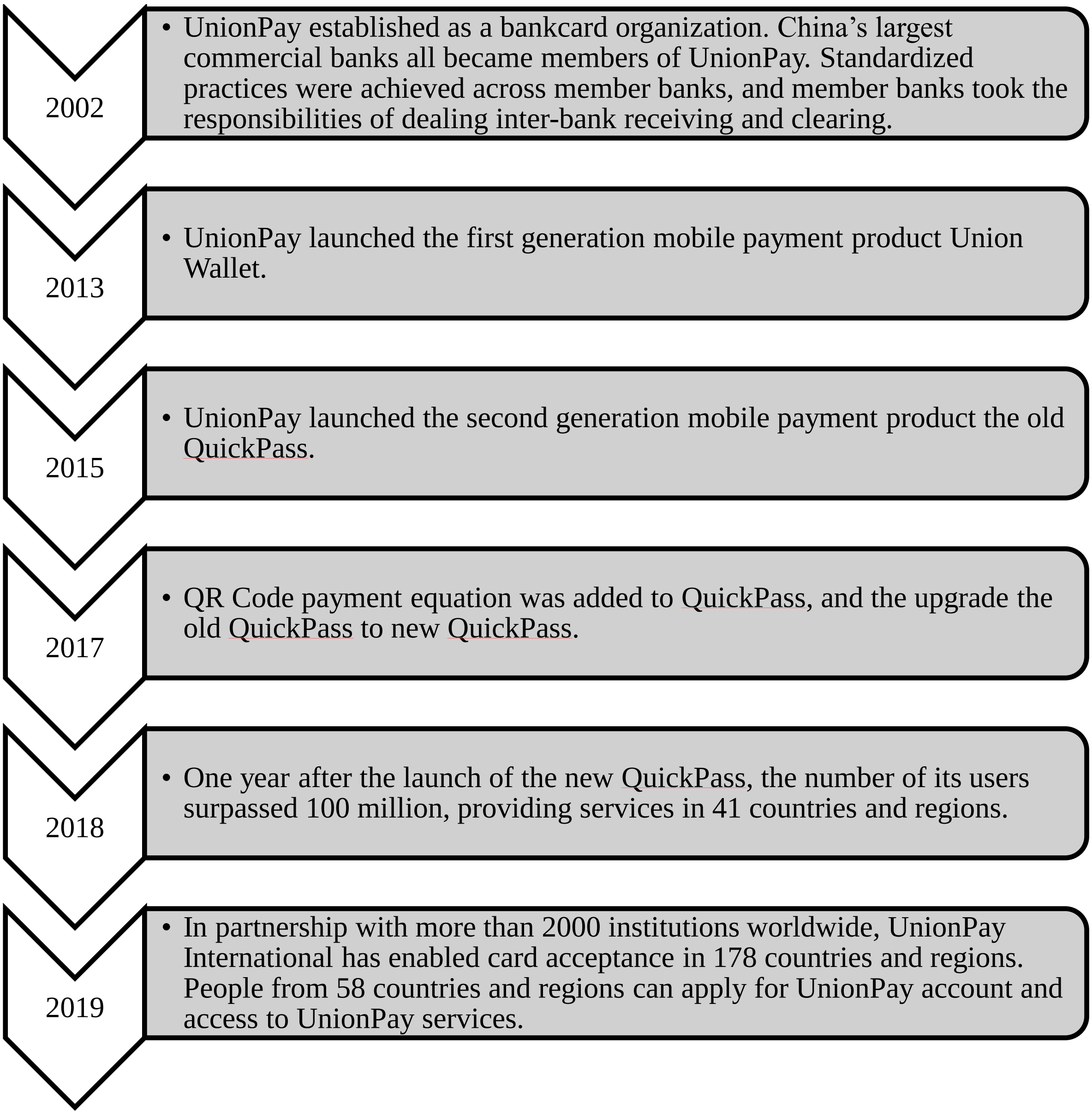
In this section, I will analyze developing mode of China UnionPay from introducing its history to dissecting its growth strategy. Then, I will give preliminary development suggestions based on those analysis.

2.1 Development history of China UnionPay

China UnionPay is the first bankcard organization in China. It was established in 2002 in Shanghai. In the same year, 71 card issuers and 2078 institutes joined China UnionPay, bringing in 630 million times of inter-bank transactions, which amount to CNY179 billion (China UnionPay, 2015). By the end of the year 2019, the number of card issuers connected to the UnionPay net has exceeded 200. A UnionPay user could enjoy the services of UnionPay in more than 178 countries and regions all over the world, covering more than 51 million businesses and 2.57 million ATMs (China UnionPay, 2020).

In 2013, China UnionPay released a brand new payment application called Union Wallet (Baidubaike, 2019). In December 2015, under the instruction of the People's Bank of China, China UnionPay formed a service union with various commercial banks and phone makers, and upgraded Union Wallet into QuickPass (mpaypass, 2016). However, due to the lack of useful functions and the poorly-designed marketing strategy, the performance of QuickPass did not meet the expectations of China UnionPay both in terms of the number of users and the user experiences. In 2017, UnionPay upgraded the old QuickPass again and renamed it to the new QuickPass (Baidubaike, 2019). The new QuickPass started to support QR Code payment method, and integrated mobile payment functions and benefits of all UnionPay member banks. Also, the new QuickPass is the first third-party mobile payment platform that provides services including checking account balances of multiple banks and instant opening of virtual sub-account. Transaction volumes through UnionPay NFC and UnionPay QR Code increased rapidly. One year from its launch, the new QuickPass has had more than 100 million users, and became the third largest mobile payment platform in China, only after Alipay and WeChat Pay, and forth largest worldwide (China UnionPay, 2018). Figure 13 shows the development process of China UnionPay.

Figure 13. Development history of China UnionPay



Source: Baidubaike, 2019; *China UnionPay*, 2018 & 2020; *mpaypass*, 2016.

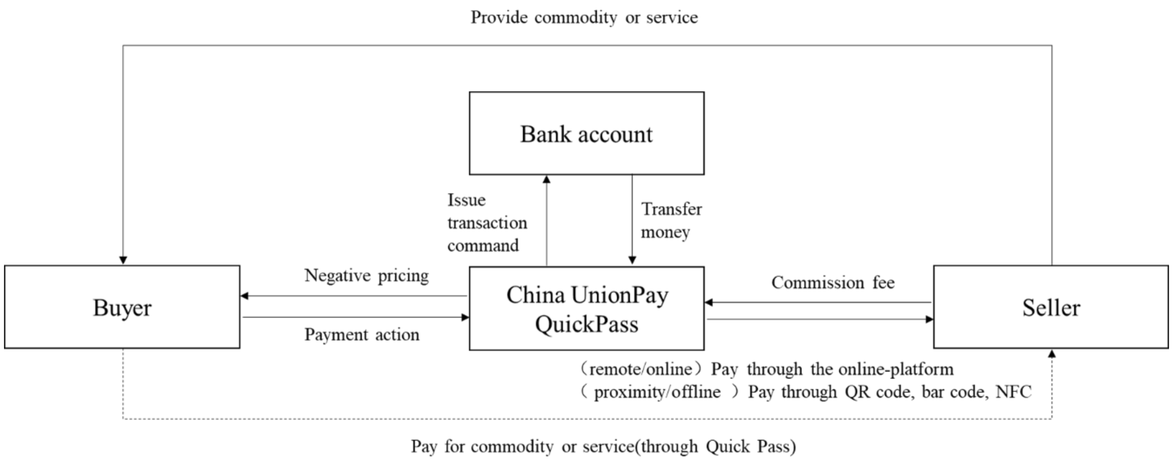
2.2 Growth strategy of China UnionPay QuickPass

From the beginning, QuickPass faced intense market competition. Alipay and WeChat Pay owe their successes largely to Taobao and WeChat, a successful e-commerce and a top networking platform. Lacking this advantage, UnionPay had to choose following strategies different from the two competitors.

a) **No remaining balance.** Similar to other third-party mobile payment platforms, QuickPass plays the role of an intermediary in transactions. Different from Alipay and WeChat Pay, QuickPass doesn't have the function of remaining balance. Users of Alipay and WeChat Pay can deposit money in these two institutes just like in banks. Those money will be saved in a function called 'wallet' (Alipay & WeChat Pay, 2020).

In transactions, banks are not necessarily involved since users are able to transfer money directly from their wallets if they have deposited sufficient money in it. However, QuickPass doesn't have such a wallet, which means transactions on this platform must involve banks. Figure 14 below shows China UnionPay's operation process, which shows the difference from normal third-party mobile payment. Money kept in Alipay and WeChat Pay's remaining balance is prevented from being used by the platform for any purpose. Users can chose to let wealth manager, provided by Alipay and WeChat Pay, help manage the cash and receive interest on the balance amount, while reserving the right to take cash from remaining balance without formal notice (Alipay & WeChat Pay, 2020). This kind of operation caused major loss to commercial banks' checking accounts (Souhu, 2018). In contrast, QuickPass drops the idea of remaining balance, and acts solely as an intermediary (QuickPass, 2020). In this model, no cash leaves banks' checking accounts unnecessarily, hence allows commercial banks to keep the maximum amount of cash while being connected to a third-party payment platform. This way of approach increased the willingness of commercial banks to work with QuickPass, and to spend more on marketing it (Baidu, 2019).

Figure 14. Operation process of China UnionPay



Source: China UnionPay, 2019.

b) **Focus on proximity payment market.** December 12th, 2018 was the one-year anniversary of launching new QuickPass. On that day, China UnionPay, together with 16 commercial banks and over 400 thousand business, announced the "Half-Price-Day" activity. Users can enjoy 50% off for goods in the participating stores if they pay with the new QuickPass application. The participating offline stores included large supermarket chains for example RT-MART, Wal-Mart, Carrefour, chain restaurants such as Starbucks, Pizza Hut and Burger King, and fast fashion stores like Uniqlo, GAP (China UnionPay, 2018). The promotion on December 12th brought in over a million new users from the offline channels.

c) **Price discrimination and lower service rate.** From Table 1, we can find that similar to strategy taken by WeChat Pay and Alipay, China UnionPay QuickPass charges buyers a zero service rate in payment (China UnionPay & WeChat Pay & Alipay, 2020). However, since QuickPass gives more discount and launches more promotion events which enable buyers pay less, the real rate for QuickPass's buyers should be negative (Baidutieba, 2019). From paragraphs above, we know that the money received by WeChat Pay and Alipay will be saved in wallet. But the two platforms will charge a commission for withdrawal if buyers want to 'move' the money. QuickPass avoid this problem by cutting off wallet ((China UnionPay & WeChat Pay & Alipay, 2020). So in general, QuickPass charges buyers a lower rate than the two competitors. For sellers, QuickPass only charges them a 0.38% service rate while WeChat Pay charges 0.6% and Alipay charges 1.0% ((China UnionPay & WeChat Pay & Alipay, 2020).The strategy of lower service rate has encouraged users to use more often the QuickPass Application for mobile payment, hugely increasing the dependency of existing users and attracting more new users to the platform. At the same time, the strategy of price discrimination guarantees platform's profit while also maximizes platform's efficiency.

Table 1. Service rates on different platforms

<table>
<tr><th></th><th></th><th>QuickPass</th><th>WeChat Pay</th><th>Alipay</th></tr>
<tr><td rowspan="3">Buyer</td><td>Payment</td><td>0%</td><td>0%</td><td>0%</td></tr>
<tr><td rowspan="2">Withdrawal</td><td>0%</td><td>0%(a total exemption amount of ¥1,000)</td><td>0%(a total exemption amount of ¥20,000)</td></tr>
<tr><td>0%</td><td>0.1%(exceed ¥1,000)</td><td>0.1%(exceed ¥20,000)</td></tr>
<tr><td rowspan="2">Seller</td><td>Payment</td><td>0.38%</td><td>0.6%</td><td>1.0%</td></tr>
<tr><td>Withdrawal</td><td>0%</td><td>0%</td><td>0%</td></tr>
</table>

Source: China UnionPay & WeChat Pay & Alipay, 2020.

d) **Provide value-added services.** The new QuickPass integrated amount of extra services. For example, free inter-bank transfer, account balance inquiry, credit card payback, telephone billing, utility fees payment, wealth management, smart health care, campus services, NFC payment, etc (China UnionPay, 2019). Compare to other third-party payment platform, China UnionPay bridges the gap between different banks, and provide checking account inquiry service for more than 330 banks, and credit card bill inquiry and payback service for more than 110 banks. It is also worth mentioning that there is no charge for inter-bank transfer and credit card payback using the new QuickPass (UnionPay Anhui, 2019).

e) **Provide subsidies.** As the competition between third-party mobile payment platforms becomes more and more heated, UnionPay takes advantage of situation that both Alipay and WeChat Pay offer lower subsidies, using effective marketing and price subsidies to bring in an increasing number of new users from offline channels. Meanwhile, UnionPay also attracted a large number of business users by the zero service fee policy (China UnionPay, 2019). The success of QuickPass relies heavily on the support of major commercial banks, the price discrimination for consumer users, and the value-added services its competitors do not have.

2.3 Suggestions for the further development of China UnionPay QuickPass

With promotions and subsidies, QuickPass was able to accumulate over 250 million users (China UnionPay, 2019). However, this number is still small comparing to the user size of 1 billion for Alipay (Alipay, 2019). In addition, user's loyalty is still low especially compared to Alipay and WeChat Pay. In a foreseeable future, QuickPass Cloud still has to rely on subsidies both to business and consumer users in order to expand market and increase user's loyalty.

In terms of user expansion, Alipay and WeChat Pay are working hard on expanding into offline market. To give some examples, Alipay has adopted fingerprint payment method at vending machine, face-scanning payment method at KFC and many supermarkets. In these payment settings, mobile phone is only required for the first time of payment, and users can finish payment with merely their finger or face from then on (Alipay, 2019). These payment methods bring users brand new technology experiences, and attracts many users from younger age groups, giving Alipay and WeChat Pay some edges in offline payment market. QuickPass need to do more work on attracting new users and expanding its offline market share.

As to the value-added services, QuickPass has done more than its competitors. Free inter-bank transfer and account balance inquiry are the most significant advantages compared to Alipay and WeChat Pay (China UnionPay, 2019). However, it lacks application scenarios. While Alipay can be used in all life settings from dinning to entertainment to daily transportation, QuickPass is not as widely accepted. In the future, QuickPass has to make better use of consumer data, in addition to improving payment functions, create more application scenarios for QuickPass, and increase the using frequency.

3 RESEARCH CONTENT AND LITERATURE REVIEW

This section shows research content and briefly reviews relative literatures. Studies to the third-party mobile payment industry mainly took forms of market research and analysis of its financial functions and features. There is noticeably a lack of economic literature on its growth patterns as well as pricing strategies. Since I am going to analyze the industry and build the model on the basis of two-sided market, this part is divided into two sections, one on two sided-market and the other on third-party mobile payment.

3.1 Research content and literature review of third-party mobile payment

Although we have talked about third-party mobile payment in practical concerns, it is still important to further define and elaborate it in theoretical concerns. To better understand the concept, it is necessary to define 'mobile payment' and 'third-party payment' respectively.

3.1.1 Introduction of mobile payment

In academics, many experts and institutions have given their understandings towards mobile payment. Pousttchi (2009, p.363) thought mobile payment as "a type of transaction processing in which the buyer uses mobile communication techniques in conjunction with mobile devices for initiation, authorization, or completion of payment." According to a recent research by Yonghong Cai, Qiling Yin & Aolei Zhang (2017, p.281-282), mobile payment means through wireless Internet, a new payment method transferring money from buyers to sellers by mobile devices.

In this article, mobile payment refers to a type of service allowing users to pay for merchandise or services with their mobile terminals, usually mobiles. To carry out mobile payment, users send payment orders of paying bills or transferring money by mobile terminals to financial institutions such as banks. Owing to development of Internet, finance and communication technology, mobile payment grew quickly. Usually users realize the behavior of mobile payment through mobile applications. Those applications are installed or pre built-in on smartphones or other mobile devices. After registration, users are able to register their bank cards, rewards or coupons to the account, and also to add more personal information like ID card, driving license, insurance information and so on. To certain level of extent, mobile payment is a mobile digital wallet which carries users' identity and payment information and helps realize electronic payment.

Based on mobile payment scenarios in daily life, mobile payment can be classified with four different kinds of standard (Li, Xu & Chen, 2016):

a) Based on amount payed, mobile payment can be divided into micro-payment and macro-payment. Usually a transaction under 10 dollars is called micro-payment while transaction with higher amount is called macro-payment or normal payment. Micropayments mostly occur in situations like video downloading and parking fee paying. Macro-payments often involve bigger trades like commodities purchasing and bank transferring.

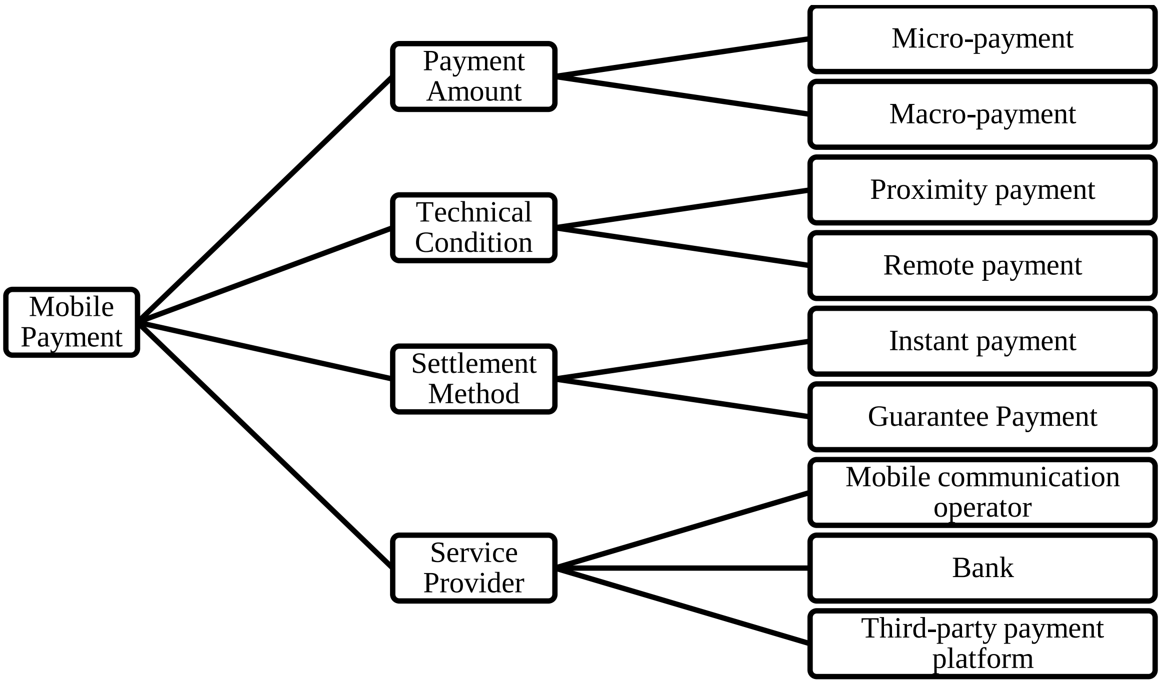
b) Based on the payment distance, mobile payment can be divided into proximity payment and remote payment. Usually, a face-to face transaction completed by mobile payment is called proximity payment while an online transaction completed by mobile payment is called remote payment (Mobile Payment Web, 2018). By scanning QR codes or connecting NFC, users can realize proximity payment with their mobile devices. It is mainly applied in offline consuming scenarios like supermarket shopping, restaurant bills paying and any other offline sellers who accept mobile payment. Remote payment started much earlier and was applied more widely. Bank transferring, rent paying and online shopping are daily occurring nowadays. Generally, transaction scale of remote payments is bigger than proximity payment.

c) Based on settlement method, mobile payment can be divided into instant payment and guarantee payment. Instant payment means at the time of purchasing, money is transferred instantly from account of buyer to seller. Guarantee payment means the mobile payment platform plays role of a guarantee to keep the money. And the money will only be transferred to sellers if buyers confirm completion of the deal. Guarantee payment is mostly applied in scenarios of online shopping to guarantee the right of both sellers and buyers. Mobile payment platform thus provides not only transferring service but also credit guarantee service.

d) Based on services providers, mobile payment can be divided into three modes: led by mobile communication operators, banks or third-party payment platforms. In the early stage, mobile communication operators of China Mobile, China Unicom and China Telecom dominated the market. In that era, mobile phone users usually ordered or purchased good and services through sending short messages. Communication operators in China all provide prepaid service, which means mobile phone users need to make deposit in the phone account. Thus it enables operators to debit users and make the transaction. As to banks led mode, buyers provide sellers with the transaction proof after purchasing and paying. Holding the proof, sellers can clear accounts with banks. In the circumstance of third-party payment platform-led mode, usually platforms are qualified institutions with sufficient credit and fund to act as guarantors. Cooperating with sellers, buyers and banks, third-party payment platforms provide convenient and prompt mobile payment services. Compared with payment methods provided by operators and banks, Chinese third-party payment platforms possess dominant advantages of simplicity and convenience in operation. Firstly, most third-party payment platforms build mobile applications with clearer instructions and more customer-caring services than banks'. Secondly, third-party payment platforms signed contracts with dozens of banks. Users holding different banks cards are able to transact on a single platform rather than operate on multiple bank applications, which saves a great amount of time and energy.

Figure 15 gives clear view of mobile payment industry nowadays.

Figure 15. Four classifications of mobile payment



Source: Own work.

3.1.2 Introduction of the third-party payment

The word third-party can mean different things in different scenarios. In the payment market, third-party means the third actor between buyers and sellers in non-cash transactions (CSDN, 2018). Third party payment platform doesn't involve in the ownership of the money it handle. Instead, it acts purely as a middle man who manages the transfer of money. Third party payment was originally designed to be a solution to bridging the gap between various online banks, as well as dealing with credibility issues in trade. By offering online and offline payment channel, third party payment platforms help finish the whole process of payment, settlement and statistics review for transactions between consumers and merchants, and between financial institutions. Therefore, it is required that only independent and reputable institutions can hold the post of third-party. Those institutions need to sign contracts with banks, because only by accessing banks' payment and settlement systems can they facilitate those transactions.

To most people around the world, the most known third-party payment platform is Paypal. Paypal was created in 1998 by Peter Thiel and Max Levchin to facilitate online transactions between consumers and merchants (Baidubaike, 2020). During a transaction, especially an online one, there arises a problem of money belonging while sellers already send out traded assets but buyers cannot confirm them. The potential risk of credit bothers each side in transactions. Third-party payment platforms such as Paypal were created to solve these problems. Soon later, these platforms changed the procedure of transaction into a relatively complex but much safer way.

In China, third party payment is under the supervision of the People's Bank of China (PBOC). According to PBOC, third party payment institutions are defined as non-bank institutions who handle online payment businesses including payment via internet, mobile phone, fixed-line telephone, digital TV, etc. In China, the most famous third-party payment platforms are Alipay, WeChat Pay, China UnionPay and JDPay.

3.1.3 Business models of third-party mobile payment

According to Xia Wu (2015), third-party payment can be categorized into three types: pure transaction services, transaction services with credit and transaction services limited to selected business.

a) With the first type, third-party payment platforms mainly focused on providing convenient and fast cash transfer services, and most of their income is from transaction service fees. Most known examples for this type are WeChat Pay and UnionPay.

b) With the second type, third-party payment platforms can act as credit guarantors for users of their transaction services. This enables the platforms, in addition to transaction service fees, to earn interest from huge deposits of its users, which practice, however, has been prohibited by China’s central bank (PBC, 2018). This kind of platforms is typically associated with online shopping platforms, for instances Paypal with Ebay, and Alipay with Taobao. The influence of these third-party platforms have on shopping is unprecedented.

c) With the third type, the services of the third-party platforms are only available with selected business. Typically, the business partners would also offer some discounts to the platform users. Metro cards fall into this type. The platforms can gain from providing transaction services, selling cards and collecting remaining deposits.

Pengju Guo (2019) classifies mobile payment business models into four different categories based on the business scenarios they are associated with:

a) Finance and technology scenarios: including wealth management, insurance, credit guarantee, asset management, technology services. Platforms charge transaction service fees, credit guarantee services fees, wealth management fees, technology service fees, and fintech leasing fees.

b) E-commerce: closely associated with e-commerce, providing various services tailored to the needs of e-commerce business. Platforms charge transaction service fees, registration fees, online sore management fees, advertising fees and promotion fees.

c) Networking and content consumption: focusing on online networking, content consumption, entertainment scenarios. The majority of the users are young people. The platforms charge transaction service fees, in-game item sale fees, service fees and commission.

d) Mobile payment solutions: providing communication services. Platforms charge communication service fees, industry chain profit sharing, as well as channel construction fee.

3.1.4 Risks and regulations of third-party mobile payment

Haifeng Gu and Lixiang Yang (2017, p1-21) explicitly researched risk of China third-party mobile payment. Based on document analysis method and scenarios assumption method, they divided the risks into five categories: Mobile network security risk, Credit risk, Operational risk, Business risk and Legal risk. Mobile network risk is similar to traditional online-finance security risk. Security problems emerged in any segment of data transmission could lead to serious result and great sum of loss. Credit risk arises when both buyers and sellers act dishonestly or disagree with each other, and are unsatisfied with third-party's intervention. Operational risk correlates with user's behavior. Inappropriate paying operation may incur compromised account and lost money. If money, which is kept temporarily by third-party is misused, third-party itself may face business risk. Third-party mobile payment is a new and far-reaching subject, relative legislation is still on the way, which leads to potential legal risk.

Zhongbo Yang (2019, p127-134), explores sources of risk for third-party payment platforms, and gives a few suggestions on the risk management. According to Yang, the major risks for third-party payment platforms are attributed to the following factors:

a) unidentified users,
b) unidentified regulating body,
c) unclear rules for responsibilities and compensations,
d) lack of regulating laws,
e) lack of effective internal control system,
f) the nature of platform's business.

As for suggestions on how to manage the risks, Yang believes platforms should:

a) strictly implement compensation rules,
b) enhance credibility,
c) enhance transaction technology and internal control.

Moreover, Yang proposes that industry associations should introduce online dispute solving mechanism; different departments of government should work more cohesively, and establish a regulating system that is led by the central bank; legal system should improve regulations on management of sedimentary money, as well as on information safety issues.

3.2 Research content and literature review of the two-sided market

3.2.1 Definition of the two-sided market

Armstrong M (2005, p.669-691) stated that if in the same market, two groups of users interact through a platform and the number of users from one group on platform exert an influence on users from the other group to join the platform, then the market can be called a two-sided market.

Rochet and Tirole (2003, p.990-1029) gave a definition based on pricing structure. In their theory, a platform is assumed to charge its users service fee on per trade and the total amount charged from two sides is fixed. Then if the volume of transaction is related to pricing structure, the market should be a two-sided one. If transaction volume doesn’t vary along with pricing structure, then it should be a single-sided market. The definition means that platforms can affect transaction volume, profit and welfare through changing pricing structure in a two-sided market. However, the definition only holds in situation of charging service fee on per transaction.

Evans (2003, p193-209) classified two-sided markets into three types:

a) Market-makers who facilitate transactions between users from different sides by increasing possibility and efficiency of searching and matching. E-commerce plarform, real estate agency, marriage intermediary and supermarket are typical examples.

b) Audience-makers who attract advertisers to publish information on their platforms by attracting more audiences, readers and net users. For instance, television channels, magazines, newspapers and websites are those kind of makers.

c) Demand-coordinators who help match users’ demand. Examples like Windows operating system, bank card system connect users from two sides and facilitate their transactions.

3.2.2 Features of the two-sided market

Evans (2003, p193-209) showed, that cross-group network externality distinguishes two-sided market from traditional single-sided market.

Rochet and Tirole (2003, p.990-1029) thought that the greatest feature of two-sided market is asymmetrical pricing, which means platform can choose different pricing strategy for users from different sides.

Armstrong M (2005, p.669-691) pointed out three features of two-sided market. Firstly, the price platform charges will depend on cross-group network externality the user possesses. Secondly, platform can adopt asymmetrical pricing strategy. There is circumstance that consumers are being charged on fixed registration fee while merchant are being charged per transaction. Thirdly, platforms show features of single-homing and multi-homing.

3.2.3 Pricing of the two-sided market

Consistent with single-sided market, two-sided market pursues profit maximization or social welfare maximization. In this thesis, only the situation of maximizing profit will be discussed, since all of the players are private entities. The first question that third party mobile payment platform needs to choose with respect to pricing is, what kind of pricing strategy will choose. There are three main pricing methods in two-sided market: charge registration fee, charge on per transaction, and charge two-part tariff which means charge both registration fee and per trade fee. Faced with users from two sides who possess different price elasticities and cross-group network externalities, platforms in two-sided market usually attract users with low price on one side and get profit by charging a high price on the other side.

According to Ji (2006, p3), there are several factors that will affect pricing strategy in two sided market. Firstly, price elasticity of demand of users from two sides. Platforms usually charge a high markup on the side possessing relatively small elasticity while charge a low markup on the side possessing relatively high elasticity. Sometimes platforms can charge a price lower than marginal cost or even subsidize users on one side. Secondly, cross-group network externality is significant. It has a positive relationship with price asymmetry on two sides and may also leads to a negative price. Thirdly, some platforms may face the problem of charging users. For example, it is very difficult to charge TV audience for TV advertisements, so platforms can only charge advertisers. Fourthly, situations of single-homing and multi-homing. Most smart phones are only installed with one kind of operation systems, so most phone users are single-homing. While most tenants will seek for apartments on several real estate agency platforms at the same time, so they are multi-homing users. Usually platforms charge a high price on users who are multi-homing, and charge a low price on those who are single-homing. Fifthly, platforms can take exclusive practices, like some preferential measures, to stop multi-homing. Sixthly, product differentiation is a strategy that platforms often conduct.

4 ANALYSIS OF PRICING STRATEGY MODEL

In the Chinese third-party payment market, Alipay and WeChat Pay are the leaders, followed by China UnionPay and other platforms. For model construction convenience and China market conformance, this section will only consider the circumstance in competitive market with a duopoly competition.

4.1 Basic assumptions of the model

Nowadays in Chinese third-party mobile payment market, we can see three conditions of homing. Buyers and sellers are both single-homed or they are both partialy multi-homed, or one side is single-homed while the other side is partialy multi-homed. Single-homing means users on the side only register and transact through one platform. Because third-party mobile payment platforms provide similar payment services to users, it is reasonable to assume that some people are loyal to a single platform. Partial multi-homing means that users on the same side can show different conditions of homing. Some of them are single-homed while the others are multi-homed. Since some platforms provide different value-added services, some users choose to pay on different platforms in different shopping scenarios. Among all third-party mobile payment users, only 1.4% of them are single-homed to Alipay while 21.7% are single-homed to WeChat Pay. And users who are multi-homed to both platforms account for 70.6% (Ipsos, 2019). From the data we can find that the case of pure multi-homing is uncommon in real market. So the condition of pure multi-homing is not considered in the thesis.

In this thesis, I analyze China UnionPay's pricing strategy from the three different conditions of homing and three charging models (charging registration fee or transaction fee or both) to see if it matches the real market behavior. Furthermore, some suggestions for UnionPay's further development will be derived. In this section, a pricing and utility model based on Hotelling model (Hotelling, 1929) and Armstrong model (Armstrong, 2006) will be constructed. Then, discussions will be made about the model's limits and the directions for future study.

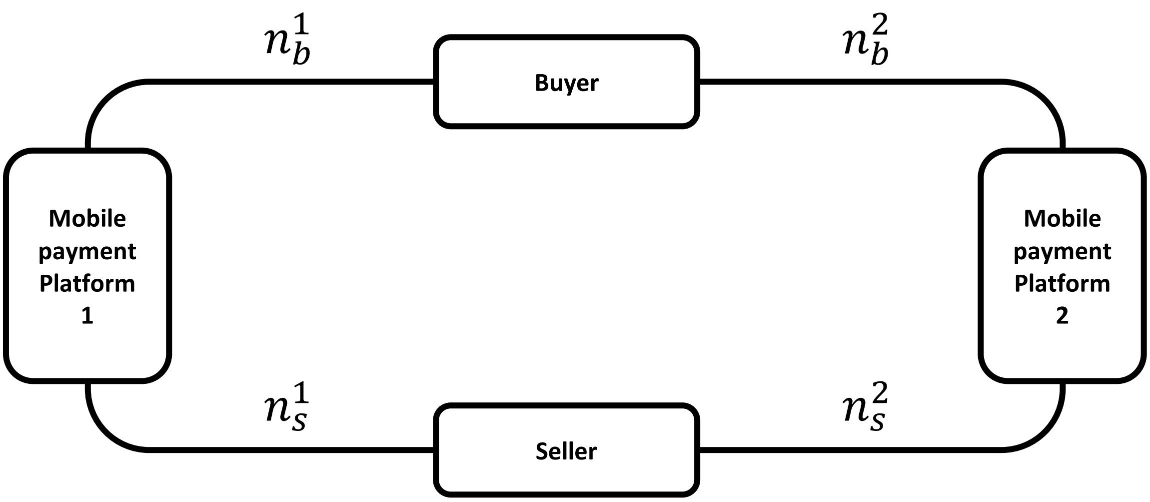
In accordance with Hotelling model, I assume that there are two third-party mobile payment platforms located at both ends of a [0,1] line, and denote the two platforms as 1 and 2. Users from the two sides, denoted as b and s, are distributed uniformly on the line. And there is a measure 1 of users of b and s ($n_b^1 + n_b^2 = 1$ and $n_s^1 + n_s^2 = 1$). The utility that a user b gets from transacting on platform 1 and 2 are denoted as U_b^1 and U_b^2 respectively. The registration price that the two platforms charge on user b are R_b^1 and R_b^2 while the transaction fee are p_b^1 and p_b^2 respectively. The per unit transportation cost of travelling to platforms, which means the differentiation between two platforms, is denoted as t. Users from the two sides can choose their subscription behavior as they wish, they may be single-homed or multi-homed. The network externality parameter here is β for both users. A platform with more sellers registered can attract more users, and vice versa. Just like in other two-sided markets, for example recruitment websites and shopping malls. Job hunters visit websites providing more job information and companies also publish their want advertisements on websites visited by more hunters. Customers usually go to shopping malls that contains more shops while shops choose to locate in malls that bring in more customers. So the number of users on each side can positively affect the other side. The more users on one side, the more users will be on the other side. Network externality β signifies how big the influence can be. Next I assume that users can get identical base utility U_0 from platform 1 and platform 2. U_0 is assumed to be great enough to attract all users to transact at least on one platform. n_b^1 and n_b^2 signify how many buyers are single-homed to platform 1 and 2 respectively, while N_b^1 signifies how many buyers are homed to platform 1, and N_b^2 signifies how many buyers are homed to platform 2, including single-homing and multi-homing. Similarly, n_s^1 and n_s^2 signify how many sellers single-homed to platform 1 and 2 respectively, while N_s^1 signifies how many sellers home to platform 1, and N_s^2 signifies how many sellers home to platform 2, including single-homing and multi-homing. Since third-party mobile payment platforms only play the role of bridge, I assume that all sellers of the same goods provide same price no matter on which platform.

4.2 Pricing models

4.2.1 Charge of the registration fee

4.2.1.1 Users are single-homed on both sides

Figure 16. Platforms on two-sided market when both sides are single-homed



Source: Own work.

The Figure 16 shows how the market looks like when both sides choose single-homing. Users compare the different utilities they get from transacting on two platforms and choose the higher one to register and transact.

Assume that the distance of a buyer from platform 1 is given by x. So his utility of single-homed to platform 1 is:

$$U_b^1 = U_0 - R_b^1 - tx + \beta n_s^1 \tag{1}$$

This equation means that a buyer's utility of single-homed to platform 1 equals base utility (U_0) minus registration fee (R_b^1) and transportation cost (tx), then add the externality the buyer get if join in the platform. The externality equals to externality parameter (β) times number of sellers on the platform.

At the same time, the distance of a buyer away from platform 2 is given by $1 - x$. His utility of single-homed to platform 2 is:

$$U_b^2 = U_0 - R_b^2 - t(1 - x) + \beta n_s^2 \tag{2}$$

Based on Figure 16, at some distance, users will get same utility from the two platforms, which means $U_b^1 = U_b^2$. By combining equation (1) and (2), x can be solved as:

$$x = \frac{1}{2} - \frac{1}{2t}(R_b^1 - R_b^2) + \frac{\beta}{2t}(n_s^1 - n_s^2) \tag{3}$$

In our case, x and $1 - x$ also represent numbers of buyers who are single-homed to the two platforms. So the equation of n can be rewritten as:

$$\begin{cases} n_b^1 = \dfrac{1}{2} - \dfrac{1}{2t}(R_b^1 - R_b^2) + \dfrac{\beta}{2t}(2n_s^1 - 1) \\ n_s^1 = \dfrac{1}{2} - \dfrac{1}{2t}(R_s^1 - R_s^2) + \dfrac{\beta}{2t}(2n_b^1 - 1) \end{cases} \tag{4}$$

By solving simultaneous equations listed above, the relationship between number of users and registration fee is shown:

$$\begin{cases} n_b^1 = \dfrac{1}{2} - \dfrac{t(R_b^1 - R_b^2)}{2(t^2 - \beta^2)} - \dfrac{\beta(R_s^1 - R_s^2)}{2(t^2 - \beta^2)} \\ n_s^1 = \dfrac{1}{2} - \dfrac{\beta(R_b^1 - R_b^2)}{2(t^2 - \beta^2)} - \dfrac{t(R_s^1 - R_s^2)}{2(t^2 - \beta^2)} \end{cases} \tag{5}$$

Since $n_b^1 + n_b^2 = 1$ and $n_s^1 + n_s^2 = 1$, one can easily calculate also n_b^2 and n_s^2.

The way that platforms get profit is to provide services to users on the two sides. For calculation convenience, the model ignores operation cost and fixed cost of platforms. Under this circumstances, the profit equation is assumed as below:

$$\begin{cases} \pi_1 = R_b^1 n_b^1 + R_s^1 n_s^1 \\ \pi_2 = R_b^2 n_b^2 + R_s^2 n_s^2 \end{cases} \tag{6}$$

Substitute equation (5) into equation (6), the profit π_1 can be written as:

$$\pi_1 = \frac{1}{2}R_b^1 - \frac{t(R_b^1)^2 - tR_b^1 R_b^2}{2(t^2-\beta^2)} - \frac{\beta R_b^1 R_s^1 - \beta R_b^1 R_s^2}{2(t^2-\beta^2)} + \frac{1}{2}R_s^1 - \frac{\beta R_b^1 R_s^1 - \beta R_b^2 R_s^1}{2(t^2-\beta^2)} - \frac{t(R_s^1)^2 - tR_s^1 R_s^2}{2(t^2-\beta^2)} \tag{7}$$

To get profit maximization, following calculation is needed:

$$\begin{aligned} \frac{\partial \pi_1}{\partial R_b^1} &= \frac{1}{2} - \frac{2tR_b^1 - tR_b^2}{2(t^2-\beta^2)} - \frac{\beta R_s^1 - \beta R_s^2}{2(t^2-\beta^2)} - \frac{\beta R_s^1}{2(t^2-\beta^2)} \\ &= \frac{t^2 - \beta^2 - 2tR_b^1 + tR_b^2 + \beta R_s^2 - 2\beta R_s^1}{2(t^2-\beta^2)} \end{aligned} \tag{8}$$

$$\begin{aligned} \frac{\partial \pi_1}{\partial R_s^1} &= \frac{1}{2} - \frac{2tR_s^1 - tR_s^2}{2(t^2-\beta^2)} - \frac{\beta R_b^1 - \beta R_b^2}{2(t^2-\beta^2)} - \frac{\beta R_b^1}{2(t^2-\beta^2)} \\ &= \frac{t^2 - \beta^2 - 2tR_s^1 + tR_s^2 + \beta R_b^2 - 2\beta R_b^1}{2(t^2-\beta^2)} \end{aligned} \tag{9}$$

In order to have maximum profit, equation (8) and (9) should equal 0. Therefore we have:

$$-2t < 0$$

and

$$(-2t) * (-2t) - 4\beta^2 > 0$$

The two equations guarantee the existence of profit maximization. In order to have maximal profit, the following condition should be satisfied:

$$t > \beta \tag{10}$$

Hence, when $t > \beta$, both platforms, 1 and 2 have maximum profit.

When platforms take maximum profit, it follows from (8) and (9):

$$\begin{cases} t^2 - \beta^2 - 2tR_b^1 + tR_b^2 + \beta R_s^2 - 2\beta R_s^1 = 0 \\ t^2 - \beta^2 - 2tR_s^1 + tR_s^2 + \beta R_b^2 - 2\beta R_b^1 = 0 \end{cases} \tag{11}$$

Consider the circumstance of symmetric equilibria, in which the prices charged by platforms to the same group are equal, it is assumed that $R_b^1 = R_b^2 = R_b$, $R_s^1 = R_s^2 = R_s$, so there is:

$$\begin{cases} tR_b + \beta R_s = t^2 - \beta^2 \\ tR_s + \beta R_b = t^2 - \beta^2 \end{cases} \quad (12)$$

By solving equation (12), the value of R_b and R_s is:

$$R_b = R_s = t - \beta \quad (13)$$

Using (5) and (7), the number of buyers and sellers and profits are:

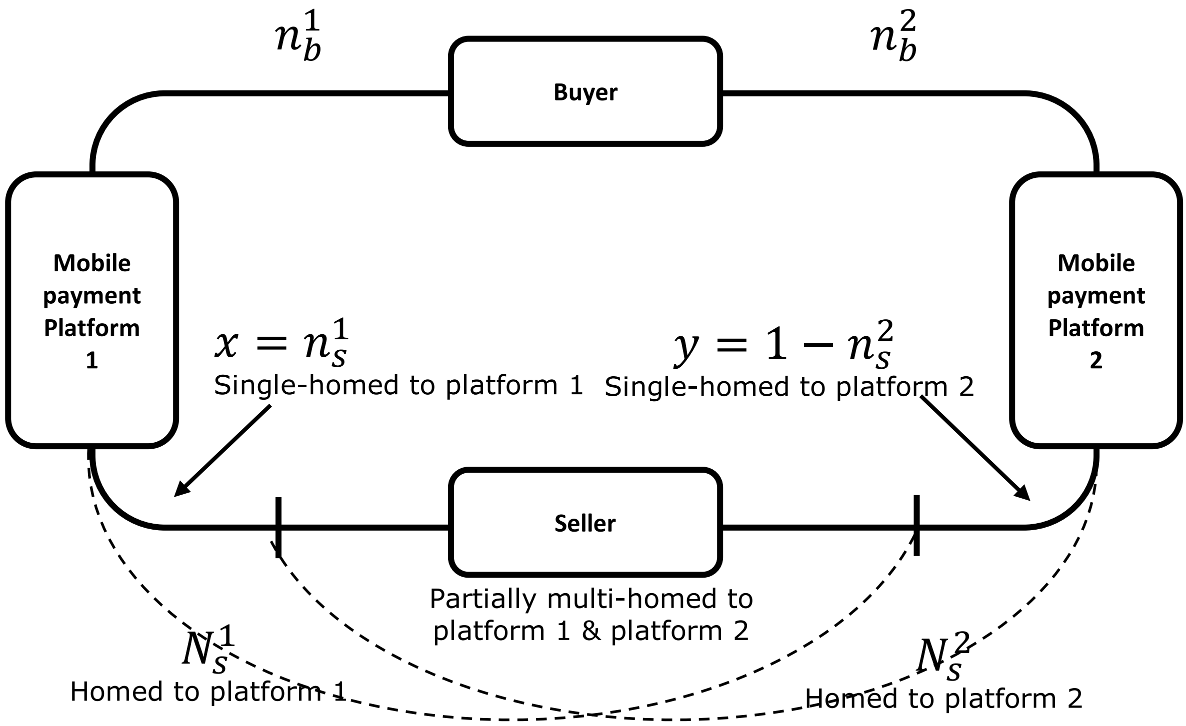
$$n_b^1 = n_b^2 = n_s^1 = n_s^2 = \frac{1}{2} \quad (14)$$

$$\pi_1 = \pi_2 = t - \beta \quad (15)$$

4.2.1.2 Users are partially multi-homed on one side and are single-homed on the other side

I assume that buyers are single-homed, while sellers are partially multi-homed. Such market is presented in Figure 17.

Figure 17. Platforms on two-sided market when users on one side are partially multi-homed, on the other side are single-homed



Source: Own work.

It is already known that n_b^1 and n_b^2 signify how many user b are single-homed to platform 1 and 2 respectively, while N_b^1 signifies how many user b are homed to platform 1, including single-homing and multi-homing. Thus following holds: $N_b^1 + n_b^2 = 1, N_b^2 + n_b^1 = 1$.

Similarly, let us define the distance of a buyer to platform as x, so the utilities he will get from single-homed to platform 1 and 2 are:

$$\begin{cases} U_b^1 = U_0 - R_b^1 - tx + \beta N_s^1 \\ U_b^2 = U_0 - R_b^2 - t(1-x) + \beta N_s^2 \end{cases} \tag{16}$$

Since $U_b^1 = U_b^2$, we can solve for x:

$$x = \frac{1}{2} - \frac{1}{2t}(R_b^1 - R_b^2) + \frac{\beta}{2t}(N_s^1 - N_s^2) \tag{17}$$

On the other side, let us denote the distance of a seller to platform 1 as x. At the same time, let y represent the distance of a seller to platform 2. Utilities of the seller can then be expressed as:

$$\begin{cases} U_s^1 = U_0 - R_s^1 - tx + \beta n_b^1 \\ U_s^2 = U_0 - R_s^2 - t(1-y) + \beta n_b^2 \\ U_s^{12} = U_0 - R_s^1 - R_s^2 - t + \beta \end{cases} \tag{18}$$

where U_s^{12} represents seller's utility if he is multi-homed.

Equating $U_s^1 = U_s^2$ and $U_s^2 = U_s^{12}$, and using equations (17) and (18), one can get following results:

$$U_0 - R_s^1 - tx + \beta n_b^1 = U_0 - R_s^1 - R_s^2 - t + \beta$$
$$x = \frac{t-\beta}{t} + \frac{R_s^2}{t} + \frac{\beta}{t} n_b^1$$

$$U_0 - R_s^2 - t(1-y) + \beta n_b^2 = U_0 - R_s^1 - R_s^2 - t + \beta$$
$$y = \frac{\beta}{t} - \frac{R_s^1}{t} - \frac{\beta}{t} n_b^2$$

The above equations can be rewritten as:

$$\begin{cases} n_s^1 = \frac{t-\beta}{t} + \frac{R_s^2}{t} + \frac{\beta}{t} n_b^1 \\ 1 - n_s^2 = \frac{\beta}{t} - \frac{R_s^1}{t} - \frac{\beta}{t} n_b^2 \end{cases}$$

So equations of number if sellers and buyers are:

$$\begin{cases} n_b^1 = \frac{1}{2} - \frac{t(R_b^1 - R_b^2)}{2(t^2-\beta^2)} - \frac{\beta(R_s^1 - R_s^2)}{2(t^2-\beta^2)} \\ n_s^1 = 1 - \frac{\beta}{2t} - \frac{\beta(R_b^1 - R_b^2)}{2(t^2-\beta^2)} - \frac{\beta^2 R_s^1}{2t(t^2-\beta^2)} + \frac{(2t^2-\beta^2)R_s^2}{2t(t^2-\beta^2)} \\ n_s^2 = 1 - \frac{\beta}{2t} + \frac{\beta(R_b^1 - R_b^2)}{2(t^2-\beta^2)} - \frac{\beta^2 R_s^2}{2t(t^2-\beta^2)} + \frac{(2t^2-\beta^2)R_s^1}{2t(t^2-\beta^2)} \end{cases} \quad (19)$$

Since the platform's profits can be expressed as:

$$\begin{cases} \pi_1 = R_b^1 n_b^1 + R_s^1 N_s^1 \\ \pi_2 = R_b^2 n_b^2 + R_s^2 N_s^2 \end{cases}$$

and following equations hold: $N_b^1 + n_b^2 = 1, N_b^2 + n_b^1 = 1$， $N_s^1 + n_s^2 = 1, N_s^2 + n_s^1 = 1$,

platform's profits can be rewritten as:

$$\begin{cases} \pi_1 = R_b^1 n_b^1 + R_s^1(1 - n_s^2) \\ \pi_2 = R_b^2 n_b^2 + R_s^2(1 - n_s^1) \end{cases} \quad (20)$$

Using equation (19) and (20), above, we can write profit as:

$$\pi_1 = R_b^1\left[\frac{1}{2} - \frac{t(R_b^1 - R_b^2)}{2(t^2-\beta^2)} - \frac{\beta(R_s^1 - R_s^2)}{2(t^2-\beta^2)}\right] + R_s^1\left[\frac{\beta}{2t} - \frac{\beta(R_b^1 - R_b^2)}{2(t^2-\beta^2)} - \frac{(2t^2-\beta^2)R_s^1}{2t(t^2-\beta^2)} + \frac{\beta^2 R_s^2}{2t(t^2-\beta^2)}\right]$$

The first order conditions for profit maximization can then be written as:

$$\frac{\partial \pi_1}{\partial R_b^1} = \frac{1}{2} - \frac{2tR_b^1 - tR_b^2}{2(t^2-\beta^2)} - \frac{\beta R_s^1 - \beta R_s^2}{2(t^2-\beta^2)} - \frac{\beta R_s^1}{2(t^2-\beta^2)} = 0$$

$$\frac{\partial \pi_1}{\partial R_s^1} = \frac{\beta}{2t} - \frac{4t^2 R_s^1 - 2\beta^2 R_s^1}{2t(t^2-\beta^2)} - \frac{\beta^2 R_s^2}{2t(t^2-\beta^2)} - \frac{\beta R_b^1 - \beta R_b^2}{2(t^2-\beta^2)} - \frac{\beta R_b^1}{2(t^2-\beta^2)} = 0$$

Similar to situation of single-homed, it can be easily shown that $t > \beta$ is also the necessary condition for profit maximization.

Consider the circumstance of symmetric equilibria, in which the prices charged by platforms to the same group are equal, it is assumed that $R_b^1 = R_b^2 = R_b$， $R_s^1 = R_s^2 = R_s$. In order to reach maximum profit, the following equation should be satisfied:

$$tR_b + \beta R_s = t^2 - \beta^2$$

and also

$$R_s = 0 \tag{21}$$

Using equation (21), R_b can be written as:

$$R_b = \frac{t^2 - \beta^2}{t} \tag{22}$$

Therefore, number of buyers and sellers and profits can be written as:

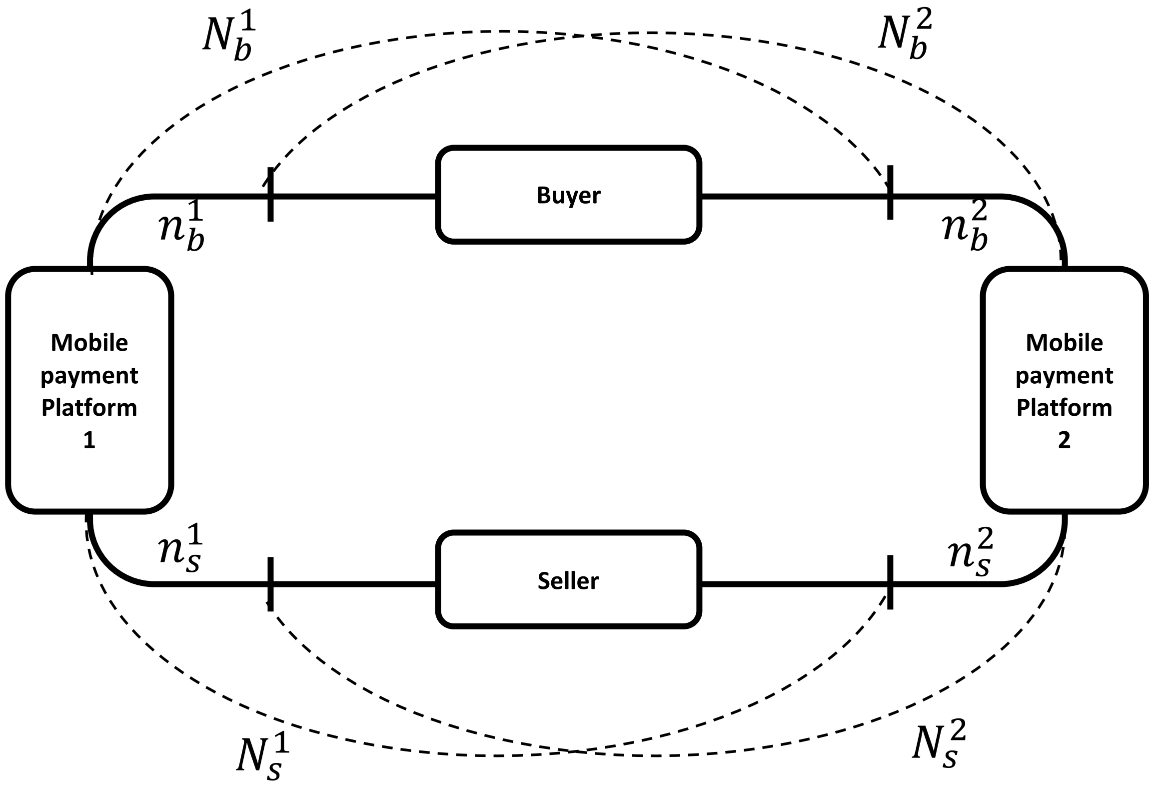
$$n_b^1 = n_b^2 = \frac{1}{2};\ n_s^1 = n_s^2 = 1 - \frac{\beta}{2t} \tag{23}$$

$$\pi_1 = \pi_2 = \frac{t^2 - \beta^2}{2t} \tag{24}$$

4.2.1.3 Users are partially multi-homed on both sides

Now consider the situation, where both, sellers and buyers are partially multi-homed. This implies that, some of the buyers and sellers are still single-homed to platform 1 or platform 2, while the others are multi-homed. Such situation is presented in Figure 18.

Figure 18. Platforms on two-sided market when users on both sides are partially multi-homed



Source: Own work.

Similar as before, let the distance of a buyer to platform 1 be defined as x, and let the distance of a seller to platform 2 be defined as y. Then we can write utilities as:

$$\begin{cases} U_b^1 = U_0 - R_b^1 - tx + \beta N_s^1 \\ U_b^2 = U_0 - R_b^2 - t(1-y) + \beta N_s^2 \\ U_b^{12} = U_0 - R_b^1 - R_b^2 - t + \beta \end{cases} \tag{26}$$

where U_b^{12} represents buyer's utility of being multihomed.

Similar as before, it is possible to solve for x and y using equation (26):

$$U_0 - R_b^1 - tx + \beta N_s^1 = U_0 - R_b^1 - R_b^2 - t + \beta$$
$$x = 1 + \frac{R_b^2}{t} - \frac{\beta}{t} n_s^2$$

$$U_0 - R_b^2 - t(1-y) + \beta N_s^2 = U_0 - R_b^1 - R_b^2 - t + \beta$$
$$y = \frac{\beta}{t} n_s^1 - \frac{R_b^1}{t}$$

Since $x = n_b^1$, and $y = 1 - n_b^2$ and also $N_b^1 + n_b^2 = 1, N_b^2 + n_b^1 = 1$, and $N_s^1 + n_s^2 = 1, N_s^2 + n_s^1 = 1$, we can get:

$$\begin{cases} n_b^1 = 1 + \frac{R_b^2}{t} - \frac{\beta}{t} n_s^2 \\ 1 - n_b^2 = \frac{\beta}{t} n_s^1 - \frac{R_b^1}{t} \end{cases}$$

and

$$\begin{cases} n_s^1 = 1 + \frac{R_s^2}{t} - \frac{\beta}{t} n_b^2 \\ 1 - n_s^2 = \frac{\beta}{t} n_b^1 - \frac{R_s^1}{t} \end{cases}$$

Solving for exact number of sellers and buyers result in:

$$\begin{cases} n_b^1 = \frac{t}{t+\beta} - \frac{\beta}{t^2 - \beta^2} R_s^1 + \frac{t}{t^2 - \beta^2} R_b^2 \\ n_b^2 = \frac{t}{t+\beta} - \frac{\beta}{t^2 - \beta^2} R_s^2 + \frac{t}{t^2 - \beta^2} R_b^1 \\ n_s^1 = \frac{t}{t+\beta} + \frac{t}{t^2 - \beta^2} R_s^2 - \frac{\beta}{t^2 - \beta^2} R_b^1 \\ n_s^2 = \frac{t}{t+\beta} + \frac{t}{t^2 - \beta^2} R_s^1 - \frac{\beta}{t^2 - \beta^2} R_b^2 \end{cases}$$

From before, we know that platforms' profit equations are:

$$\begin{cases} \pi_1 = R_b^1 N_b^1 + R_s^1 N_s^1 \\ \pi_2 = R_b^2 N_b^2 + R_s^2 N_s^2 \end{cases}$$

In this case, they can be expressed as:

$$\begin{cases} \pi_1 = R_b^1 (1 - n_b^2) + R_s^1 (1 - n_s^2) \\ \pi_2 = R_b^2 (1 - n_b^1) + R_s^2 (1 - n_s^1) \end{cases}$$

Taking first derivatives of above profit functions and equating them to 0, and considering the symmetric equilibria, $R_b^1 = R_b^2 = R_b$, and $R_s^1 = R_s^2 = R_s$, the results with respect to R_b and R_s are:

$$\begin{cases} 2tR_1 - \beta R_2 = t\beta - \beta^2 \\ 2tR_2 - \beta R_1 = t\beta - \beta^2 \end{cases}$$

By solving above equations, we can easily get:

$$R_1 = R_2 = \frac{\beta(t-\beta)}{2t-\beta} \tag{27}$$

$$n_b^1 = n_b^2 = n_s^1 = n_s^2 = \frac{2t^2-\beta^2}{(t+\beta)(2t-\beta)} \tag{28}$$

$$\pi_1 = \pi_2 = \frac{2t\beta^2(t-\beta)}{(t+\beta)(2t-\beta)^2} \tag{29}$$

4.2.2 Charge of the transaction fee

In this section, I consider the situation of charging transaction fee. I assume that every user will come to transact on at least one platform. And also a user on one side can find only one matched user on the other side. The probability that one user can find his suited trading party is λ, while $\lambda \in [0,1]$. Each user's expected number of transactions are distributed uniformly on $[0,w_b]$ and $[0,w_s]$, so it will save effort by taking $\frac{w_b}{2}$ and $\frac{w_s}{2}$ as expected number of transactions for calculating expected utility and profits. When users from two sides are both single-homed or partial multi-homed, it is reasonable to assume that $w_b = w_s = w$. When single-homing and partial multi-homing simultaneously appear, it is assumed that expected number of transactions from the partial multi-homed side is bigger than the single-homed side. We let expected utilities written as EU while expected profits as Eπ.

4.2.2.1 Users are single-homed on both sides

In accordance with situation of charging registration fee, equations of expected utilities are shown as below:

$$\begin{cases} EU_b^1 = U_0 - \frac{w_b}{2}p_b^1 - tx + \beta n_s^1 \\ EU_b^2 = U_0 - \frac{w_s}{2}p_b^2 - t(1-x) + \beta n_s^2 \end{cases} \tag{30}$$

Similar to last section, we know that there exist $w_b = w_s$, $n_b^1 + n_b^2 = 1$, $n_s^1 + n_s^2 = 1$, and $x = n_b^1$, so the value of n_b^1 and n_s^1 are:

$$\begin{cases} n_b^1 = \frac{1}{2} + \frac{\beta}{2t}(2n_s^1 - 1) + \frac{w}{4t}(p_b^2 - p_b^1) \\ n_s^1 = \frac{1}{2} + \frac{\beta}{2t}(2n_b^1 - 1) + \frac{w}{4t}(p_s^2 - p_s^1) \end{cases}$$

These above equations can be rewritten as:

$$\begin{cases} n_b^1 = \frac{1}{2} - \frac{tw(p_b^1 - p_b^2)}{4(t^2 - \beta^2)} - \frac{\beta w(p_s^1 - p_s^2)}{4(t^2 - \beta^2)} \\ n_s^1 = \frac{1}{2} - \frac{\beta w(p_b^1 - p_b^2)}{4(t^2 - \beta^2)} - \frac{tw(p_s^1 - p_s^2)}{4(t^2 - \beta^2)} \end{cases}$$

Platforms' expected profit equations are:

$$\begin{cases} E\pi_1 = \frac{\lambda w}{2} p_b^1 n_b^1 + \frac{\lambda w}{2} p_s^1 n_s^1 \\ E\pi_2 = \frac{\lambda w}{2} p_b^2 n_b^2 + \frac{\lambda w}{2} p_s^2 n_s^2 \end{cases}$$

Again I consider symmetric equilibria, $p_b^1 = p_b^2 = p_b$ and $p_s^1 = p_s^2 = p_s$. Taking derivative of expected profits with respect to prices and equate those to 0, we can get:

$$\begin{cases} twp_b + \beta wp_s = t^2 - \beta^2 \\ twp_s + \beta wp_b = t^2 - \beta^2 \end{cases}$$

Solving above equations, I get following results:

$$p_b = p_s = \frac{t - \beta}{w} \tag{31}$$

$$n_b^1 = n_b^2 = n_s^1 = n_s^2 = \frac{1}{2} \tag{32}$$

$$E\pi_1 = E\pi_2 = \frac{\lambda}{2}(t - \beta) \tag{33}$$

4.2.2.2 Users are partially multi-homed on one side and are single-homed on the other side

Just as before, simply assume buyers are single-homed while sellers are partially multi-homed. In this situation, a precondition is that $w_b < w_s$. So the expected utilities of buyers and sellers can be written as:

$$\begin{cases} EU_b^1 = U_0 - \frac{w_b}{2} p_b^1 - tx + \beta N_s^1 \\ EU_b^2 = U_0 - \frac{w_b}{2} p_b^2 - t(1 - x) + \beta N_s^2 \end{cases} \tag{34}$$

$$\begin{cases} eU_s^1 = U_0 - \frac{w_s}{2} p_s^1 - tx + \beta n_b^1 \\ EU_s^2 = U_0 - \frac{w_s}{2} p_s^2 - t(1 - y) + \beta n_b^2 \end{cases} \tag{35}$$

$$EU_s^{12} = U_0 - \frac{w_s}{2}p_s^1 - \frac{w_s}{2}p_s^2 - t + \beta \tag{36}$$

By solving above equations, we can get the number of users :

$$\begin{cases} n_b^1 = \frac{1}{2} - \frac{tw_b(p_b^1 - p_b^2)}{4(t^2-\beta^2)} - \frac{\beta w_s(p_s^1 - p_s^2)}{4(t^2-\beta^2)} \\ n_s^1 = 1 - \frac{\beta}{2t} - \frac{\beta w_b(p_b^1 - p_b^2)}{4(t^2-\beta^2)} - \frac{\beta^2 w_s p_s^1}{4t(t^2-\beta^2)} + \frac{(2t^2-\beta^2)w_s p_s^2}{4t(t^2-\beta^2)} \\ n_s^2 = 1 - \frac{\beta}{2t} + \frac{\beta w_b(p_b^1 - p_b^2)}{4(t^2-\beta^2)} - \frac{\beta^2 w_s p_s^2}{4t(t^2-\beta^2)} + \frac{(2t^2-\beta^2)w_s p_s^1}{4t(t^2-\beta^2)} \end{cases}$$

Platforms' expected profit equations are:

$$\begin{cases} E\pi_1 = \frac{\lambda w_b}{2}p_b^1 n_b^1 + \frac{\lambda w_s}{2}p_s^1(1-n_s^2) \\ E\pi_2 = \frac{\lambda w_b}{2}p_b^2 n_b^2 + \frac{\lambda w_s}{2}p_s^2(1-n_s^1) \end{cases}$$

Taking derivative of expected profits with respect to p_b^1 and $p_s^1$and equating those to 0, and considering the circumstance of symmetric equilibria, $p_b^1 = p_b^2 = p_b$, $p_s^1 = p_s^2 = p_s$, we can get:

$$\begin{cases} \beta^2 p_2 - 4tp_1p_2 - 4\beta(p_2)^2 + \beta^2 p_2 = 0 \\ tw_bp_1 - 2(t^2-\beta^2) = 0 \end{cases}$$

Solving above equations, I get following results:

$$p_b = \frac{2(t^2-\beta^2)}{tw_b};\ \ p_s = 0 \tag{37}$$

$$n_b^1 = n_b^2 = \frac{1}{2};\ n_s^1 = n_s^2 = 1 - \frac{\beta}{2t} \tag{38}$$

$$E\pi_1 = E\pi_2 = \frac{\lambda(t^2-\beta^2)}{2t} \tag{39}$$

4.2.2.3 Users are partially multi-homed on both sides

In this case we can write expected utilities U_b^1, U_b^2 and U_b^{12} as follows:

$$\begin{cases} EU_b^1 = U_0 - \dfrac{w_b}{2} p_b^1 - tx + \beta N_s^1 \\ EU_b^2 = U_0 - \dfrac{w_b}{2} p_b^2 - t(1-y) + \beta N_s^2 \\ EU_b^{12} = U_0 - \dfrac{w_b}{2} p_b^1 - \dfrac{w_b}{2} p_b^2 - t + \beta \end{cases} \tag{40}$$

Since users on both sides show the same homing condition, it is reasonable for us to assume $w_b = w_s = w$, we can solve for number of buyers and sellers as:

$$\begin{cases} n_b^1 = \dfrac{t}{t+\beta} - \dfrac{\beta w}{2(t^2-\beta^2)} p_s^1 + \dfrac{tw}{2(t^2-\beta^2)} p_b^2 \\ n_b^2 = \dfrac{t}{t+\beta} - \dfrac{\beta w}{2(t^2-\beta^2)} p_s^2 + \dfrac{tw}{2(t^2-\beta^2)} p_b^1 \\ n_s^1 = \dfrac{t}{t+\beta} + \dfrac{tw}{2(t^2-\beta^2)} p_s^2 - \dfrac{\beta w}{2(t^2-\beta^2)} p_b^1 \\ n_s^2 = \dfrac{t}{t+\beta} + \dfrac{tw}{2(t^2-\beta^2)} p_s^1 - \dfrac{\beta w}{2(t^2-\beta^2)} p_b^2 \end{cases}$$

And platforms' expected profit equations are:

$$\begin{cases} E\pi_1 = \dfrac{\lambda w_b}{2} p_b^1 (1 - n_b^2) + \dfrac{\lambda w_s}{2} p_s^1 (1 - n_s^2) \\ E\pi_2 = \dfrac{\lambda w_b}{2} p_b^2 (1 - n_b^1) + \dfrac{\lambda w_s}{2} p_s^2 (1 - n_s^1) \end{cases}$$

Let us consider symmetric equilibria of $p_b^1 = p_b^2 = p_b$, $p_s^1 = p_s^2 = p_s$. Taking partial derivatives of expected profit with respect to p_b^1 and p_s^1 and equating them to 0 results in:

$$\begin{cases} twp_1 - \dfrac{\beta}{2} wp_2 = t\beta - \beta^2 \\ twp_2 - \dfrac{\beta}{2} wp_1 = t\beta - \beta^2 \end{cases}$$

Solving above equations, I get following results:

$$p_1 = p_2 = \frac{2\beta(t-\beta)}{(2t-\beta)w} \tag{41}$$

$$n_b^1 = n_b^2 = n_s^1 = n_s^2 = \frac{2t^2 - \beta^2}{(t+\beta)(2t-\beta)} \tag{42}$$

$$E\pi_1 = E\pi_2 = \frac{2\lambda t \beta^2 (t-\beta)}{(t+\beta)(2t-\beta)^2} \tag{43}$$

4.2.3 Charge of the two-part tariff

In the case of charging two-part tariff, it is supposed that in order to join and transact on platforms, users would be charged twice. To join the platforms, users need to pay a fixed registration fee. Then if successfully matched and if they make transaction, users need to pay extra transaction fee depending on the number of trades.

4.2.3.1 Users are single-homed on both sides

Expected utilities of U_b^1 and U_b^2 are:

$$\begin{cases} U_b^1 = U_0 - R_b^1 - \frac{w_b}{2} p_b^1 - tx + \beta n_s^1 \\ U_b^2 = U_0 - R_b^2 - \frac{w_s}{2} p_b^2 - t(1-x) + \beta n_s^2 \end{cases} \tag{44}$$

Since users on both sides show the same homing condition, we consider condition of symmetrical balance of $w_b = w_s = w$. We can then solve the number of users:

$$\begin{cases} n_b^1 = \frac{1}{2} - \frac{t(R_b^1 - R_b^2)}{2(t^2-\beta^2)} - \frac{tw(p_b^1 - p_b^2)}{4(t^2-\beta^2)} - \frac{\beta(R_s^1 - R_s^2)}{2(t^2-\beta^2)} - \frac{\beta w(p_s^1 - p_s^2)}{4(t^2-\beta^2)} \\ n_s^1 = \frac{1}{2} - \frac{\beta(R_b^1 - R_b^2)}{2(t^2-\beta^2)} - \frac{\beta w(p_b^1 - p_b^2)}{4(t^2-\beta^2)} - \frac{t(R_s^1 - R_s^2)}{2(t^2-\beta^2)} - \frac{tw(p_s^1 - p_s^2)}{4(t^2-\beta^2)} \end{cases}$$

In this situation, platforms' expected profit equations are:

$$\begin{cases} E\pi_1 = R_b^1 n_b^1 + \frac{\lambda w}{2} p_b^1 n_b^1 + R_s^1 n_s^1 + \frac{\lambda w}{2} p_s^1 n_s^1 \\ E\pi_2 = R_b^2 n_b^2 + \frac{\lambda w}{2} p_b^2 n_b^2 + R_s^2 n_s^2 + \frac{\lambda w}{2} p_s^2 n_s^2 \end{cases}$$

Taking derivative of expected profits with respect to R_b^1 and R_s^1 and considering the circumstance of symmetric equilibria, $R_b^1 = R_b^2 = R_b$, $R_s^1 = R_s^2 = R_s$, $p_b^1 = p_b^2 = p_b$, $p_s^1 = p_s^2 = p_s$, we can get:

$$\begin{cases} R_b = \frac{t^2-\beta^2}{t} - \frac{\beta}{t} R_s - \frac{\lambda w}{2} p_b - \frac{\beta \lambda w}{2t} p_s \\ R_s = \frac{t^2-\beta^2}{t} - \frac{\beta}{t} R_b - \frac{\lambda w}{2} p_s - \frac{\beta \lambda w}{2t} p_b \end{cases}$$

Solving above equations, I get following results:

$$R_b = t - \beta - \frac{\lambda w}{2} p_b;\ R_s = t - \beta - \frac{\lambda w}{2} p_s \tag{45}$$

$$n_b^1 = n_b^2 = n_s^1 = n_s^2 = \frac{1}{2} \tag{46}$$

$$E\pi_1 = E\pi_2 = t - \beta \tag{47}$$

4.2.3.2 Users are partially multi-homed on one side and are single-homed on the other side

Given the know conditions, the equations of expected utilities are as below:

$$\begin{cases} EU_b^1 = U_0 - R_b^1 - \frac{w_b}{2} p_b^1 - tx + \beta N_s^1 \\ EU_b^2 = U_0 - R_b^2 - \frac{w_b}{2} p_b^2 - t(1-x) + \beta N_s^2 \end{cases} \tag{48}$$

$$\begin{cases} EU_s^1 = U_0 - R_s^1 - \frac{w_s}{2} p_s^1 - tx + \beta n_b^1 \\ EU_s^2 = U_0 - R_s^2 - \frac{w_s}{2} p_s^2 - t(1-y) + \beta n_b^2 \end{cases} \tag{49}$$

$$EU_s^{12} = U_0 - R_s^1 - R_s^2 - \frac{w_s}{2} p_s^1 - \frac{w_s}{2} p_s^2 - t + \beta \tag{50}$$

With above equations, the number of users can be solved as:

$$\begin{cases} n_b^1 = \frac{1}{2} - \frac{t(R_b^1 - R_b^2)}{2(t^2-\beta^2)} - \frac{tw_b(p_b^1 - p_b^2)}{4(t^2-\beta^2)} - \frac{\beta(R_s^1 - R_s^2)}{2(t^2-\beta^2)} - \frac{\beta w_s(p_s^1 - p_s^2)}{4(t^2-\beta^2)} \\ n_s^1 = 1 - \frac{\beta}{2t} - \frac{\beta(R_b^1 - R_b^2)}{2(t^2-\beta^2)} - \frac{\beta^2 R_s^1}{2t(t^2-\beta^2)} + \frac{(2t^2-\beta^2)R_s^2}{2t(t^2-\beta^2)} \\ \quad - \frac{\beta w_b(p_b^1 - p_b^2)}{4(t^2-\beta^2)} - \frac{\beta^2 w_s p_s^1}{4t(t^2-\beta^2)} + \frac{(2t^2-\beta^2)w_s p_s^2}{4t(t^2-\beta^2)} \\ n_s^2 = 1 - \frac{\beta}{2t} + \frac{\beta(R_b^1 - R_b^2)}{2(t^2-\beta^2)} - \frac{\beta^2 R_s^2}{2t(t^2-\beta^2)} + \frac{(2t^2-\beta^2)R_s^1}{2t(t^2-\beta^2)} \\ \quad + \frac{\beta w_b(p_b^1 - p_b^2)}{4(t^2-\beta^2)} - \frac{\beta^2 w_s p_s^2}{4t(t^2-\beta^2)} + \frac{(2t^2-\beta^2)w_s p_s^1}{4t(t^2-\beta^2)} \end{cases}$$

It is known that platforms' expected profit equations are:

$$\begin{cases} E\pi_1 = R_b^1 n_b^1 + \frac{\lambda w_b}{2} p_b^1 n_b^1 + R_s^1(1 - n_s^2) + \frac{\lambda w_s}{2} p_s^1 (1 - n_s^2) \\ E\pi_2 = R_b^2 n_b^2 + \frac{\lambda w_b}{2} p_b^2 n_b^2 + R_s^2(1 - n_s^1) + \frac{\lambda w_s}{2} p_s^2 (1 - n_s^1) \end{cases}$$

Taking derivative of expected profits with respect to R_b^1 and R_s^1, equating them to 0 and considering the circumstance of symmetric equilibria, $R_b^1 = R_b^2 = R_b$, $R_s^1 = R_s^2 = R_s$, $p_b^1 = p_b^2 = p_b$, $p_s^1 = p_s^2 = p_s$, we can get:

$$\begin{cases} R_b = \dfrac{t^2-\beta^2}{t} - \dfrac{\lambda w_b}{2} p_b - \dfrac{\beta}{t} R_s - \dfrac{\beta\lambda w_s}{2t} p_s \\ R_s = \dfrac{2t\beta R_b - 2t^2\beta + 2\beta^3 + 2t^2 w_s p_s - 2\beta^2 w_s p_s + t\beta\lambda w_b p_b + 2t^2\lambda w_s p_s - \beta^2\lambda w_s p_s}{6\beta^2 - 8t^2} \end{cases}$$

Solving above equations, I get following results:

$$R_b = \frac{t^2-\beta^2}{t} - \frac{\lambda w_b}{2} p_b + \frac{\beta w_s(1-\lambda)}{4t} p_s;\ R_s = \frac{-(1+\lambda)w_s}{4} p_s \tag{51}$$

$$n_b^1 = n_b^2 = \frac{1}{2};\ n_s^1 = n_s^2 = 1 - \frac{\beta}{2t} + \frac{(1-\lambda)w_s}{4t} p_s \tag{52}$$

$$E\pi_1 = E\pi_2 = \frac{t^2-\beta^2}{2t} + \frac{(1-\lambda)^2(w_s)^2}{16t}(p_s)^2 \tag{53}$$

4.2.3.3 Users are partially multi-homed on both sides

The equations of expected utilities are as below:

$$\begin{cases} EU_b^1 = U_0 - R_b^1 - \dfrac{w_b}{2} p_b^1 - tx + \beta N_s^1 \\ EU_b^2 = U_0 - R_b^2 - \dfrac{w_b}{2} p_b^2 - t(1-y) + \beta N_s^2 \\ EU_b^{12} = U_0 - R_b^1 - R_b^2 - \dfrac{w_b}{2} p_b^1 - \dfrac{w_b}{2} p_b^2 - t + \beta \end{cases} \tag{54}$$

Since users on both sides show the same homing condition, we consider condition of symmetrical balance of $w_b = w_s = w$. We can then solve the number of users:

$$\begin{cases} n_b^1 = \dfrac{t}{t+\beta} - \dfrac{\beta}{t^2-\beta^2} R_s^1 - \dfrac{\beta w}{2(t^2-\beta^2)} p_s^1 + \dfrac{t}{t^2-\beta^2} R_b^2 + \dfrac{tw}{2(t^2-\beta^2)} p_b^2 \\ n_b^2 = \dfrac{t}{t+\beta} - \dfrac{\beta}{t^2-\beta^2} R_s^2 - \dfrac{\beta w}{2(t^2-\beta^2)} p_s^2 + \dfrac{t}{t^2-\beta^2} R_b^1 + \dfrac{tw}{2(t^2-\beta^2)} p_b^1 \\ n_s^2 = \dfrac{t}{t+\beta} + \dfrac{t}{t^2-\beta^2} R_s^1 + \dfrac{tw}{2(t^2-\beta^2)} p_s^1 - \dfrac{\beta}{t^2-\beta^2} R_b^2 - \dfrac{\beta w}{2(t^2-\beta^2)} p_b^2 \end{cases}$$

Platforms' expected profit equations are:

$$\begin{cases} E\pi_1 = R_b^1((1-n_b^2) + \frac{\lambda w_b}{2}p_b^1(1-n_b^2) + R_s^1(1-n_s^2) + \frac{\lambda w_s}{2}p_s^1(1-n_s^2) \\ E\pi_2 = R_b^2(1-n_b^1) + \frac{\lambda w_b}{2}p_b^2(1-n_b^1) + R_s^2(1-n_s^1) + \frac{\lambda w_s}{2}p_s^2(1-n_s^1) \end{cases}$$

Taking derivative of expected profits with respect to R_b^1 and R_s^1, equating them to 0 and considering the circumstance of symmetric equilibria, $R_b^1 = R_b^2 = R_b$, $R_s^1 = R_s^2 = R_s$, $p_b^1 = p_b^2 = p_b$, $p_s^1 = p_s^2 = p_s$, we can get:

$$\begin{cases} R_b = -\frac{\beta^2}{2t} + \frac{\beta}{2} - \frac{(1+\lambda)w}{4}p_b + \frac{\beta}{2t}R_s + \frac{\beta w}{4t}p_s \\ R_s = -\frac{\beta^2}{2t} + \frac{\beta}{2} - \frac{(1+\lambda)w}{4}p_s + \frac{\beta}{2t}R_b + \frac{\beta w}{4t}p_b \end{cases}$$

Solving above equations, I get following results:

$$\begin{cases} R_b = \frac{t\beta - \beta^2}{2t-\beta} - \frac{2(1+\lambda)t^2w - \beta^2 w}{2(4t^2-\beta^2)}p_b + \frac{(1-\lambda)t\beta w}{2(4t^2-\beta^2)}p_s \\ R_s = \frac{t\beta - \beta^2}{2t-\beta} - \frac{2(1+\lambda)t^2w - \beta^2 w}{2(4t^2-\beta^2)}p_s + \frac{(1-\lambda)t\beta w}{2(4t^2-\beta^2)}p_b \end{cases} \quad (55)$$

$$\begin{cases} n_b^1 = n_b^2 = \frac{2t^2-\beta^2}{(2t-\beta)(t+\beta)} + \frac{(1-\lambda)(2t^2-\beta^2)tw}{2(t^2-\beta^2)(4t^2-\beta^2)}p_b - \frac{(1-\lambda)t^2\beta w}{2(t^2-\beta^2)(4t^2-\beta^2)}p_s \\ n_s^1 = n_s^2 = \frac{2t^2-\beta^2}{(2t-\beta)(t+\beta)} + \frac{(1-\lambda)(2t^2-\beta^2)tw}{2(t^2-\beta^2)(4t^2-\beta^2)}p_s - \frac{(1-\lambda)t^2\beta w}{2(t^2-\beta^2)(4t^2-\beta^2)}p_b \end{cases} \quad (56)$$

$$\begin{aligned} E\pi_1 = E\pi_2 = & \left[\frac{t\beta-\beta^2}{2t-\beta} - \frac{(1-\lambda)(2t^2-\beta^2)w}{2(4t^2-\beta^2)}p_b + \frac{(1-\lambda)t\beta w}{2(4t^2-\beta^2)}p_s\right] \\ & * \left[\frac{t\beta}{(2t-\beta)(t+\beta)} - \frac{(1-\lambda)(2t^2-\beta^2)tw}{2(t^2-\beta^2)(4t^2-\beta^2)}p_b \right. \\ & \left. + \frac{(1-\lambda)t^2\beta w}{2(t^2-\beta^2)(4t^2-\beta^2)}p_s\right] \\ & + \left[\frac{t\beta-\beta^2}{2t-\beta} - \frac{(1-\lambda)(2t^2-\beta^2)w}{2(4t^2-\beta^2)}p_s + \frac{(1-\lambda)t\beta w}{2(4t^2-\beta^2)}p_b\right] \\ & * \left[\frac{t\beta}{(2t-\beta)(t+\beta)} - \frac{(1-\lambda)(2t^2-\beta^2)tw}{2(t^2-\beta^2)(4t^2-\beta^2)}p_s \right. \\ & \left. + \frac{(1-\lambda)t^2\beta w}{2(t^2-\beta^2)(4t^2-\beta^2)}p_b\right] \end{aligned} \quad (57)$$

4.3 Summary

Under a duopoly competition model, as we can see, third-party mobile payment should use different pricing strategies and charge fees differently under different user-homing patterns. From Table 2 to Table 7, when third-party mobile payment platforms aim to reach maximum profit, we can find some meaningful results.

Table 2. Pricing and profitability when charging registration fee

	Pricing	Number of users	Profit
Both sides single-homed	$R_b = R_s = t - \beta$	$n_b^1 = n_b^2 = n_s^1 = n_s^2 = \frac{1}{2}$	$\pi_1 = \pi_2 = t - \beta$
Users on one side partially multi-homed, on the other side single-homed	$R_s = 0$ $R_b = \frac{t^2-\beta^2}{t}$	$n_b^1 = n_b^2 = \frac{1}{2}$ $n_s^1 = n_s^2 = 1 - \frac{\beta}{2t}$	$\pi_1 = \pi_2 = \frac{t^2-\beta^2}{2t}$
Both sides partially multi-homed	$R_b = R_s = \frac{\beta(t-\beta)}{2t-\beta}$	$n_b^1 = n_b^2 = n_s^1 = n_s^2 = \frac{2t^2-\beta^2}{(t+\beta)(2t-\beta)}$	$\pi_1 = \pi_2 = \frac{2t\beta^2(t-\beta)}{(t+\beta)(2t-\beta)^2}$

Source: Own work.

Table 3. Pricing and profitability when charging transaction fee

	Pricing	Number of users	Profit
Both sides single-homed	$p_b = p_s = \frac{t-\beta}{w}$	$n_b^1 = n_b^2 = n_s^1 = n_s^2 = \frac{1}{2}$	$E\pi_1 = E\pi_2 = \frac{\lambda}{2}(t - \beta)$
Users on one side partially multi-homed, on the other side single-homed	$p_s = 0$ $p_b = \frac{2(t^2-\beta^2)}{tw_b}$	$n_b^1 = n_b^2 = \frac{1}{2}$ $n_s^1 = n_s^2 = 1 - \frac{\beta}{2t}$	$E\pi_1 = E\pi_2 = \frac{\lambda(t^2-\beta^2)}{2t}$
Both sides partially multi-homed	$p_b = p_s = \frac{2\beta(t-\beta)}{(2t-\beta)w}$	$n_b^1 = n_b^2 = n_s^1 = n_s^2 = \frac{2t^2-\beta^2}{(t+\beta)(2t-\beta)}$	$E\pi_1 = E\pi_2 = \frac{2\lambda t\beta^2(t-\beta)}{(t+\beta)(2t-\beta)^2}$

Source: Own work.

Table 4. Pricing and profitability when charging two-part tariff

	Pricing	Number of users	Profit
Both sides single-homed	$R_b = t - \beta - \frac{\lambda w}{2} p_b$ $R_s = t - \beta - \frac{\lambda w}{2} p_s$	$n_b^1 = n_b^2 = n_s^1 = n_s^2 = \frac{1}{2}$	$E\pi_1 = E\pi_2 = t - \beta$
Users on one side partially multi-homed, on the other side single-homed	$R_b = \frac{t^2-\beta^2}{t} - \frac{\lambda w_b}{2} p_b + \frac{\beta w_s (1-\lambda)}{4t} p_s$ $R_s = \frac{-(1+\lambda) w_s}{4} p_s$	$n_b^1 = n_b^2 = \frac{1}{2}$ $n_s^1 = n_s^2 = 1 - \frac{\beta}{2t} + \frac{(1-\lambda) w_s}{4t} p_s$	$E\pi_1 = E\pi_2 = \frac{t^2-\beta^2}{2t} + \frac{(1-\lambda)^2 (w_s)^2}{16t} (p_s)^2$
Both sides partially multi-homed	$R_b = \frac{t\beta-\beta^2}{2t-\beta} - \frac{2(1+\lambda)t^2 w - \beta^2 w}{2(4t^2-\beta^2)} p_b + \frac{(1-\lambda)t\beta w}{2(4t^2-\beta^2)} p_s$ $R_s = \frac{t\beta-\beta^2}{2t-\beta} - \frac{2(1+\lambda)t^2 w - \beta^2 w}{2(4t^2-\beta^2)} p_s + \frac{(1-\lambda)t\beta w}{2(4t^2-\beta^2)} p_b$	$n_b^1 = n_b^2 = \frac{2t^2-\beta^2}{(2t-\beta)(t+\beta)} + \frac{(1-\lambda)(2t^2-\beta^2)tw}{2(t^2-\beta^2)(4t^2-\beta^2)} p_b - \frac{(1-\lambda)t^2\beta w}{2(t^2-\beta^2)(4t^2-\beta^2)} p_s$ $n_s^1 = n_s^2 = \frac{2t^2-\beta^2}{(2t-\beta)(t+\beta)} + \frac{(1-\lambda)(2t^2-\beta^2)tw}{2(t^2-\beta^2)(4t^2-\beta^2)} p_s - \frac{(1-\lambda)t^2\beta w}{2(t^2-\beta^2)(4t^2-\beta^2)} p_b$	$E\pi_1 = E\pi_2 = \left[\frac{t\beta-\beta^2}{2t-\beta} - \frac{(1-\lambda)(2t^2-\beta^2)w}{2(4t^2-\beta^2)} p_b + \frac{(1-\lambda)t\beta w}{2(4t^2-\beta^2)} p_s\right] * \left[\frac{t\beta}{(2t-\beta)(t+\beta)} - \frac{(1-\lambda)(2t^2-\beta^2)tw}{2(t^2-\beta^2)(4t^2-\beta^2)} p_b + \frac{(1-\lambda)t^2\beta w - 2\beta^3 w}{2(t^2-\beta^2)(4t^2-\beta^2)} p_s\right] + \left[\frac{t\beta-\beta^2}{2t-\beta} - \frac{(1-\lambda)(2t^2-\beta^2)w}{2(4t^2-\beta^2)} p_s + \frac{(1-\lambda)t\beta w}{2(4t^2-\beta^2)} p_b\right] * \left[\frac{t\beta}{(2t-\beta)(t+\beta)} - \frac{(1-\lambda)(2t^2-\beta^2)tw}{2(t^2-\beta^2)(4t^2-\beta^2)} p_s + \frac{(1-\lambda)t^2\beta w - 2\beta^3 w}{2(t^2-\beta^2)(4t^2-\beta^2)} p_b\right]$

Source: Own work.

Table 5. Pricing and profitability when users on both sides are single-homed

	Pricing	Number of users	Profit
Charge registration fee	$R_b = R_s = t - \beta$	$n_b^1 = n_b^2 = n_s^1 = n_s^2 = \frac{1}{2}$	$\pi_1 = \pi_2 = t - \beta$
Charge transaction fee	$p_b = p_s = \frac{t-\beta}{w}$	$n_b^1 = n_b^2 = n_s^1 = n_s^2 = \frac{1}{2}$	$E\pi_1 = E\pi_2 = \frac{\lambda}{2}(t - \beta)$
Charge two-part tariff	$R_b = t - \beta - \frac{\lambda w}{2} p_b$ $R_s = t - \beta - \frac{\lambda w}{2} p_s$	$n_b^1 = n_b^2 = n_s^1 = n_s^2 = \frac{1}{2}$	$E\pi_1 = E\pi_2 = t - \beta$

Source: Own work.

Table 6. Pricing and profitability when users on one side are partially multi-homed, and on the other side are single-homed

	Pricing	Number of users	Profit
Charge registration fee	$R_s = 0$ $R_b = \frac{t^2-\beta^2}{t}$	$n_b^1 = n_b^2 = \frac{1}{2}$ $n_s^1 = n_s^2 = 1 - \frac{\beta}{2t}$	$\pi_1 = \pi_2 = \frac{t^2-\beta^2}{2t}$
Charge transaction fee	$p_s = 0$ $p_b = \frac{2(t^2-\beta^2)}{tw_b}$	$n_b^1 = n_b^2 = \frac{1}{2}$ $n_s^1 = n_s^2 = 1 - \frac{\beta}{2t}$	$E\pi_1 = E\pi_2 = \frac{\lambda(t^2-\beta^2)}{2t}$
Charge two-part tariff	$R_b = \frac{t^2-\beta^2}{t} - \frac{\lambda w_b}{2} p_b + \frac{\beta w_s(1-\lambda)}{4t} p_s$ $R_s = \frac{-(1+\lambda)w_s}{4} p_s$	$n_b^1 = n_b^2 = \frac{1}{2}$ $n_s^1 = n_s^2 = 1 - \frac{\beta}{2t} + \frac{(1-\lambda)w_s}{4t} p_s$	$E\pi_1 = E\pi_2 = \frac{t^2-\beta^2}{2t} + \frac{(1-\lambda)^2(w_s)^2}{16t}(p_s)^2$

Source: Own work.

Table 7. Pricing and profitability when users on both sides are multi-homed

	Pricing	Number of users	Profit
Charge registration fee	$R_b = R_s = \frac{\beta(t-\beta)}{2t-\beta}$	$n_b^1 = n_b^2 = n_s^1 = n_s^2 = \frac{2t^2-\beta^2}{(t+\beta)(2t-\beta)}$	$\pi_1 = \pi_2 = \frac{2t\beta^2(t-\beta)}{(t+\beta)(2t-\beta)^2}$

table continues

Table 7. Pricing and profitability when users on both sides are multi-homed (continued)

	Pricing	Number of users	Profit
Charge transaction fee	$p_b = p_s = \frac{2\beta(t-\beta)}{(2t-\beta)w}$	$n_b^1 = n_b^2 = n_s^1 = n_s^2 = \frac{2t^2-\beta^2}{(t+\beta)(2t-\beta)}$	$E\pi_1 = E\pi_2 = \frac{2\lambda t\beta^2(t-\beta)}{(t+\beta)(2t-\beta)^2}$
Charge two-part tariff	$R_b = \frac{t\beta-\beta^2}{2t-\beta} - \frac{2(1+\lambda)t^2w-\beta^2w}{2(4t^2-\beta^2)}p_b + \frac{(1-\lambda)t\beta w}{2(4t^2-\beta^2)}p_s$ $R_s = \frac{t\beta-\beta^2}{2t-\beta} - \frac{2(1+\lambda)t^2w-\beta^2w}{2(4t^2-\beta^2)}p_s + \frac{(1-\lambda)t\beta w}{2(4t^2-\beta^2)}p_b$	$n_b^1 = n_b^2 = \frac{2t^2-\beta^2}{(2t-\beta)(t+\beta)} + \frac{(1-\lambda)(2t^2-\beta^2)tw}{2(t^2-\beta^2)(4t^2-\beta^2)}p_b - \frac{(1-\lambda)t^2\beta w}{2(t^2-\beta^2)(4t^2-\beta^2)}p_s$ $n_s^1 = n_s^2 = \frac{2t^2-\beta^2}{(2t-\beta)(t+\beta)} + \frac{(1-\lambda)(2t^2-\beta^2)tw}{2(t^2-\beta^2)(4t^2-\beta^2)}p_s - \frac{(1-\lambda)t^2\beta w}{2(t^2-\beta^2)(4t^2-\beta^2)}p_b$	$E\pi_1 = E\pi_2 = \left[\frac{t\beta-\beta^2}{2t-\beta} - \frac{(1-\lambda)(2t^2-\beta^2)w}{2(4t^2-\beta^2)}p_b + \frac{(1-\lambda)t\beta w}{2(4t^2-\beta^2)}p_s\right] * \left[\frac{t\beta}{(2t-\beta)(t+\beta)} - \frac{(1-\lambda)(2t^2-\beta^2)tw}{2(t^2-\beta^2)(4t^2-\beta^2)}p_b + \frac{(1-\lambda)t^2\beta w-2\beta^3w}{2(t^2-\beta^2)(4t^2-\beta^2)}p_s\right] + \left[\frac{t\beta-\beta^2}{2t-\beta} - \frac{(1-\lambda)(2t^2-\beta^2)w}{2(4t^2-\beta^2)}p_s + \frac{(1-\lambda)t\beta w}{2(4t^2-\beta^2)}p_b\right] * \left[\frac{t\beta}{(2t-\beta)(t+\beta)} - \frac{(1-\lambda)(2t^2-\beta^2)tw}{2(t^2-\beta^2)(4t^2-\beta^2)}p_s + \frac{(1-\lambda)t^2\beta w-2\beta^3w}{2(t^2-\beta^2)(4t^2-\beta^2)}p_b\right]$

Source: Own work.

Firstly, we find that platforms perform differently when pricing modes are different. When users on both sides are single-homed, the profit from charging registration fee is equal to charging two-part tariff. Both of them are bigger than the profit of charging transaction fee. When users are partially multi-homed on one side and are single-homed on the other side, the profit from charging two-part tariff is the highest. The profit from charging transaction fee is the lowest and the profit from charging registration fee is in the middle. When users on both sides are multi-homed, the profit from charging registration fee is still higher than charging transaction fee. But the profit from charging two-part tariff is obscure because of indeterminate value of t, w and λ.

Secondly, we find that, platforms price differently when users on them show different homing choices. Under situations of charging registration fee, platforms of users on one side are partially multi-homed and on the other side are single-homed price the highest, followed by platforms of users on both sides are single-homed. Platforms of users on both sides are partially multi-homed price the lowest. Situation of charging transaction fee is the same as charging registration fee. However, because of the existence of negative pricing, the value of price when charging two-part tariff is ambiguous. We also find that platforms achieve different maximum profits if users on them show different homing choices. Under the situation of charging registration fee, platforms of users on one side are partially multi-homed and on the other side are single-homed have the highest profit while platforms of users on both sides are partially multi-homed have the lowest profit. Situation of charging transaction fee is the same as charging registration fee. Same as the results shown in price, the profit is unclear when charging two-part tariff.

Thirdly, we find that parameters have relations with variables. No matter in which pricing mode, transportation cost (t) has positive relation with registration fee (p), transaction fee (R) and profit (π). At the same time, no matter in which pricing mode, network externality (β) has negative relation with registration fee (p), transaction fee (R) and profit (π). As to λ, when charging transaction fee, a bigger λ has positive relation with profit (π). When charging two-part tariff, a bigger λ will reduce the ratio of registration fee in the total profit.

Fourthly, we find that when charging two-part tariff, platforms may charge users who are on the other side a zero price or negative price. And the value of registration fee of charging two-part tariff is relative to the transaction fee platforms take.

CONCLUSION AND SUGGESTION

Third-party mobile payment as a new means of payment has greatly changed living habits of Chinese people, increased both efficiency and security of trade. The market for third-party mobile payment has still much room for further growth, and each platform has its unique competitive strength. From analysis of its development mode and pricing model, I suggest following.

For Chinese third-party mobile payment platforms, they should choose different pricing methods depending on their users' homing situations. When users on both sided are single-homed, platforms should choose charging them registration fee to get lump-sum payment at the beginning. In this charging mode, platforms can also avoid funding risk. When users on one side are single-homed while the other side are partially multi-homed, platforms should charge two-part tariff to maximize profit. When users on both sides are partially multi-homed, platforms may choose charging them registration fee to make a stable and safe profit.

If third-party mobile payment platforms tend to fix their pricing modes, they need to check two things to ensure their profits can reach the maximum. First, their users should be single-homed on both sides. Second, the platforms should take pricing modes of charging registration fee or charging transaction fee.

Facing situation when users on both sides are single-homed or users on one side are single-homed while on the other side are partially multi-homed, platforms can raise their charging fee and enhance profit by improving differentiation.

When charging two-part tariff, in order to achieve maximum profit, platforms can charge zero or negative price on one side to attract new users and then get compensated by profit achieved from the other side.

No matter in which situations, platforms need to improve their matching technology so as to gain more profit.

Considering it's features, this study generates special suggestions for China UnionPay QuickPass. In Chineses third-party mobile payment market, users on both sides of platforms show behaviors of partially multi-homing in most regions. So it is wise for QuickPass to only charge registration fee on users. However, market may change its features. When the value of t, w and λ change and reach certain values, the profit of charging two-part tariff may take the lead.

In some remote areas in China, third-party mobile payment is not very common and the users don't have many other electronic payment choices. QuickPass should stabilize its users, price and profit by emphasizing differentiated services. For example, it can cooperate with regional famous sellers to promote new products. And also collaborate with regional banks to get payment discount. Also, under certain circumstance, it is wise to give subsidies to users on one side. When consumer price elasticity is large, it is advisable to subsidy consumers.

QuickPass needs to become differentiated and innovative to increase user stickiness and raise barrier to entry. Furthermore, user big data can be used to help build price discrimination, which help the platform maximize profit and get users' surplus. Quickpass can be profitable or enhancing platform's initial attractiveness by improving level of matching. Placing commercial advertisements in UnionPay application, giving payment discount to certain products or shops, introducing diversified business are all good actions to bring in advertisement income and enhance its performance and improve profit.

My study has some limitations. First, my theoretical models do not take into account different network externalities on each side. Second, my models do not take into account platform service fees. Finally, my models lack empirical research. Therefore, future study should include also empirical research. This would allow me to better understand the logic of China third-party mobile payment industry.

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APPENDIX

Appendix 1: Povzetek (Summary in Slovene language)

Ta teza govori o Kitajski UnionPay QuickPass, znani tretji mobilni plačilni platformi na Kitajskem s stališča dvostranskega trga.Teza je razdeljena na pet delov. Sestavljen je iz industrijskega pregleda mobilnega plačila tretjih oseb, seznama z razvojnimi modeli China UnionPay, predstavitve raziskovalne vsebine in pregleda literature, analize cenovne strategije in zaključka..

Ko je na Kitajskem zorela tehnologija hitrega komunikacijskega omrežja, se mobilni terminali, kot so pametni telefoni, hitro širijo.Kitajska spletna trgovina na drobno se je v letu 2019 že razvila na trg z 10,6 trilijona CNY letnega obsega transakcij. Obenem trg prehaja z osebnega računalnika na mobilne terminale. Število mobilnih plačilnih transakcij bi v letu 2019 doseglo 1,22 trilijona, kar pomeni 199,39 trilijona CNY po vrednosti transakcije. Rast mobilnega plačila na Kitajskem je bila tako hitra, da je postala najpogostejše plačilno sredstvo, saj predstavlja več kot 61% celotnega zneska transakcij.China UnionPay je kot vodilni igralec na plačilnem trgu leta 2017 predstavil svojo najnovejšo mobilno plačilno platformo QuickPass in dosegel nekaj uspeha.Vendar na kitajskem trgu mobilnega plačila tretjih strank prevladujeta Alipay in WeChat Pay.QuickPass mora najti način za povečanje svojega tržnega deleža.Poskušam črpati izkušnje iz zgodovine QuickPass-a in drugih uspešnih igralcev in ponudim predhodne predloge za QuickPass.

Prav tako opažam, da industrija mobilnih plačil tretjih strank kaže značilnost dvostranskega trga.Torej je dober način za analizo cenovne strategije QuickPass z vidika dvostranskega trga.Upoštevajo se razlike v statusih poti in modelih cen.Glede na modele Armstrong in Hotelling sestavim novo, da izračunam najboljšo ceno platform za namen doseganja največjega dobička.Izračun prikazuje pomembne rezultate.

Za China UnionPay QuickPass je pametno, da uporabnikom zaračunamo registracijsko pristojbino, da dosežejo največji dobiček.Na nekaterih oddaljenih območjih Kitajske naj bi QuickPass stabiliziral svoje uporabnike, ceno in dobiček z upoštevanjem metode diskriminiranih storitev.V določenih okoliščinah je koristno uporabnikom ponuditi subvencije.Kadar je elastičnost potrošniških cen velika, je priporočljivo subvencionirati potrošnike. Poleg tega mora QuickPass izboljšati inovacije in diferenciacijo storitev, da bi povečal oprijemljivost uporabnikov in zvišal vstopni prag.