

The dynamics of Open Innovation and Business Model in Mobile Payment Industry

-Comparing the 3 different economies of South Korea, China, and UK

Abstract: This study aims to answer the following research questions: *Considering their capitalist economic conditions, is there any difference in paying patterns in Korea, China, and the UK? If so, are there differences in the smart payment industry market share compared with traditional payment systems and open innovation in the smart payment industry among these three economies?* We conducted focus group interviews to develop a semi-structured questionnaire on “the evolution of mobile payments and their context” for survey. In addition, we interviewed people who have worked in the credit card, mobile payment or smart payment industries for more than 20 years. We surveyed students using mobile app-based credit cards, mobile apps and credit cards, and smart payment from the three countries. The evolution of mobile payment is understood by the decrease in cash use, and the increase of smart payment methods not based on or directly connected with credit cards. So far, the most popular payment method for Korean customers is credit card. The UK has a higher usage ratio of mobile app-based credit cards and credit cards than Korea. Chinese customers rarely use payment methods other than smart payment system as the primary payment methods.

Keywords; Mobile Payment Industry, Open Innovation, Credit Card, Mobile Credit Card, Smart Payment

1. Introduction

1.1. Research question

In the current fourth industrial revolution, featuring big data, the traditional payment system of the capitalist economy is changing (Mayer-Schönberger and Ramge 2018). This change motivates the dynamics of the direction and contents of the capitalist economy and accelerates its financialization, which means that an increasingly autonomous realm of global finance has altered the underlying logic of the industrial economy and the inner workings of a democratic society (Van der Zwan 2014). For example, even though the manufacturing and finance ratios in the US total GDP were 28% and 11%, respectively, in 1950, they reduced to 11% and 21% in 2010 (Chomsky 2017). In addition, with the appearance of digital transformation in the 2nd information technology (IT) revolution, traditional payment systems developed by the credit card industry for the last nearly 100 years are evolving to various mobile payment systems or smart payment systems, in which no dominant designs have appeared until now (Karnouskos 2004, Yun 2015).

So, understanding the smart payment industry in financialization is a clue that may capture the future directions and dynamics of the modern capitalist economy. This study considers the following research questions:

Considering their capitalist economic conditions, is there any difference in paying patterns in Korea, China, and the UK?

If so, are there differences in the smart payment industry market share compared with traditional payment systems and open innovation in the smart payment industry among these three economies?

By comparing different capitalist countries' mobile payment industries, a general understanding of the industry in digital transformation and forecasting of the future in addition to the appearance of dominant designs of the mobile payment system is possible. This research question is different from the narrow topic on mobile payment, such as “consumer adoption and technology aspects” (Dahlberg, Guo et al. 2015).

1.2. Research method and scope

For a long time, economists have sought to understand why some countries have large banking systems that

allocate credit broadly, permitting rapid growth, while others scarcely have any banks at all, constraining growth and limiting social mobility, by comparing nations as natural experiments of history (Diamond and Robinson 2010). By comparing similar cases or social survey targets from various countries, differences in outcomes related to different perturbations or different initial conditions can be explained (Diamond and Robinson 2010). Qualitative methods play a crucial role in natural experiments because they often facilitate what is crucial for the method's persuasive use (Dunning 2012). This study is based on quasi-natural experiments comparing three economies at the levels of evolving electronic and mobile payment systems in the context of smart payments.

First, we conducted a literature review on electronic, mobile, or smart payments involving scholarly studies, reports, and newspapers, such as the Electronic Newspaper in South Korea and the Financial Times in the UK, to understand the smart payment industry's mobility.

Second, we conducted focus group interviews to develop a semi-structured questionnaire on "the evolution of mobile payments and their context" for the survey. In addition, we used this method to extract additional information by interviewing people who have worked in the credit card, mobile payment, or smart payment industries for more than 20 years. Our Korean research team interviewed persons who worked in Korea's payment industry for more than 20 years, and had similar careers. The UK team carried out focus group interviews based on the survey responses to find additional in-depth meanings of the UK smart payment. The Chinese team conducted an identical focus group interview, translating Appendix 1 into Chinese and applying it to the reality of China.

Third, we interviewed 63 Korean customers and 16 shop owners who adopted diverse payment methods using a semi-structured questionnaire developed as a tool for quasi-natural experiments on the 5th, 6th, and 11th November 2020. From these interviews, the survey questionnaire was finalized (Appendix 1).

Fourth, we administered a survey on students using mobile app-based credit cards, mobile apps and credit cards, or smart payment from the three countries. The survey was conducted with the semi-structured questionnaire in Appendix 1, including quantitative and qualitative questions. The Korean research team surveyed the mathematical engineering class of the undergraduate school of Daegu Gyeongbuk Institute of Science and Technology (DGIST) on 23rd March 2021 and received 41 responses, among which 40 were valid. The UK research team surveyed an undergraduate business and management studies cohort with 25 student responses on 12th March 2021, and a postgraduate international business management cohort with 28 student responses on 16th March 2021, both at Cardiff Metropolitan University. Additionally, 6 Cardiff-based non-student users were surveyed on 19th March 2021. The research team finally used the 53 survey cases received from Cardiff Metropolitan University students to achieve minimum comparability among the survey results of the three countries. The China research team surveyed undergraduate students of science and technology innovation policy class at Nanjing University of Science and Technology, with 15 students responses, and at the graduate internet finance class at Shanghai International Studies University (SISU), with 35 students responses, on the 20th and 21st of April 2021.

2. Literature review and research framework

2.1. Appearance of diverse mobile payment business models with the evolution of the payment industry

Mobile payment system (MPS) refers to a system using mobile devices to make transactions such as 1) paying bills and performing banking transactions in addition to smart card-based electronic card payment systems in the transportation industry, or the application of Web ATMs in the e-payment industry (Turban and Brahm 2000, Gerpott and Kornmeier 2009, Tsai, Huang et al. 2010). The development of the Internet and the arrival of e-commerce fostered digitalization in the payment processes, providing various electronic payment options such as payment cards, digital and mobile wallets, electronic cash, contactless payment methods (Bezovski 2016). As the starting point or ascendant of mobile payment, ATM was the Model T of the electronic payment industry that first appeared in Oxford Street, London, in 1974 (Goldfinch 2018).

Currently, several mobile payment ecosystems are competing without any dominant design even in the US, which has the most advanced mobile payment industry such as NFC open-loop systems, including Isis or Google Wallet; Cloud open-loop systems, including Paypal and LevelUP; and closed-loop systems, including Starbucks and Dunkin Donuts(Allums 2014). In other words, mobile payments are not all the same, but diverse depending on the technology applied. Mobile payments have four segments: 1) the payment for virtual goods like music, movies, or software; 2) the payment for electronic and mobile commerce services like goods, services, or travel services; 3) the proximity payments like mobile NFC, contactless payment with RFID technology, mobile barcode/short text messaging, or mobile point-of-sale terminal; and 4) mobile money transfers between persons (Lerner 2013).

The major mobile payment players include various agencies from different markets or technology domains such as device manufacturers, financial sectors, customers, service providers, governments, software providers, merchants, or mobile network operators. This means that the development of the mobile payment industry depends on open innovations and open business models from diverse markets and technology domains (Herzberg 2003, Dittrich and Duysters 2007, Al-Nawaseh 2020).

The growth of mobile commerce, including the increasingly popular ownership and use of mobile personal, programmable communication devices such as mobile phones and PDAs, enhanced the effectiveness of the authorization and management of payment and banking transactions, offering security and convenience advantages compared to online payments via PCs at first (Sumanjeet 2009). In fact, the emergence of e-commerce has created new financial needs that cannot be effectively fulfilled by traditional payment systems (Sumanjeet 2009). The appearance of digital capitalism, based on the connection between capital and data, specifically requires a creative, smart payment system or digital money that is different from credit cards or money (Mayer-Schönberger and Ramge 2018).

There is significant diversity among mobile payment interactions: Google's NFC Wallet which has benefits such as transaction speed, no need for data network, and high security, and challenges such as merchant adoption or user education; Starbucks's Barcodes and QR codes which have benefits of working on most devices and OSes, and challenges of dependence on data connectivity, lack of security standards, or merchant acceptance; PayPal's Geolocation which has benefits such as working on most devices and OSes, less effort on the part of the user, and challenges such as dependence on data connectivity and GPS accuracy, and user education (Allums 2014). The evolution of payment systems from barter to money credit card, digital payment to digital money in capitalism has increased trust in the evolution of individual transportation systems from horse carriage through train, automotive, airplane, to car sharing and autonomous cars (Botsman 2017).

2.2. Factors influencing customers' choices or attitude on mobile payment business models

Today's financial world is a result of four millennia of economic evolution, including the money crystallized relationship between debtor and creditor; bank creating houses for ever large aggregations of borrowing and lending; Government bonds, from the 13th century; equity, from the 17th century; or insurance funds and pension funds, from the 18th (Ferguson 2008). The card industry has also evolved dramatically in the US, from its formation in the 1960s and 1970s, through the expansion in the 1980s, segmentation in the 1990s with the debit card, or commercial and purchasing cards, diversity in the 2000s with PayPal, eCommerce, to the digitalization in 2019 with digital wallets, NFC payments, mobile POS, P2P Bitcoin, and Apple Pay. With the arrival of the subscription economy, different approaches with innovative payment systems based on intermediary and interactive approaches are required (Baxter 2020).

When customers use credit cards, they do not pay for transactions and sometimes get rewards even though merchants pay the transaction fee for them (Evans and Schmalensee 2016). When Apple Pay started on 20th October 2014, consumers could use their existing credit or debit cards associated with card networks such as MasterCard or Visa, or ten thousand commercial banks, savings banks, and credit unions, and the banks agreed to pay Apple 0.15% of the value of transactions done through Apple Pay (15 cents for every \$100) (Evans and Schmalensee 2016). In Kenya and other places where just a small portion of people have bank credit cards and accounts, matchmakers such as M-PESA, in other words, multisided platforms of mobile money, are leapfrogging

traditional banks or financial services (Evans and Schmalensee 2016). For example, in 2014, more than 84% of Kenyan mobile phone users used mobile phones to transfer money, pay their bills, and pay for goods at the stores (Evans and Schmalensee 2016).

Several factors, including 1) social influence or personal innovativeness as contexts, 2) perceived risk or perceived fee as negative factors, and 3) compatibility or relative advantage as positive factors, can give effect to behavioral intention to use mobile or smart payment systems continuously (Yang, Lu et al. 2012). In addition, perceived benefits and convenience of the mobile payment system in the technology acceptance model, the trust in mobile commerce or mobile payment system, the computer efficacy, or social norm or social influence from opinions of their models can also have an impact on the usage of mobile payment systems (Shin 2010). Normally the acceptance of diverse mobile payments is based on three categories: 1) costs, including no or low costs or no necessity to purchase a new mobile device; 2) security, including confidentiality of data, confirmation of the payment via SMS or e-mail, possibility of cancellation, or anonymity of payment transactions, 3) convenience, including easy handling, fast processing payment transactions, high number of accepting merchants, easy learnability of the payment procedure, no additional software installation, easy abroad payments process, or no pre-registration necessity (Pousttchi 2003).

According to previous studies, customers' differences, such as innovativeness or M-payment knowledge, and the characteristics of mobile payment systems such as mobility, reachability, compatibility, or convenience, determine the intention to use mobile payment through perceived usefulness and ease of use (Kim, Mirusmonov et al. 2010). Qualitative research shows other perspectives on consumer adoption of mobile payments: 1) positive factors such as lack of alternative payment methods or urgency, and 2) negative factors such as premium pricing, complexity, lack of critical mass, and perceived risks (Mallat 2007). Since mobile payment is receiving growing attention globally from consumers to merchants as an alternative to using cash, check, or credit cards, the extended unified theory of acceptance and use of technology (UTAUT2) or simply the technology acceptance model (TAM) with the innovation characteristics of the diffusion of innovations (DOI) or the perceived characteristics of innovating (PCI) are also receiving attention (Christopher, John et al. 2001, Oliveira, Thomas et al. 2016). Adequate legislation to protect customers' mobile payments and maximize customers' willingness to make mobile payments is also an important requirement in making mobile payments using smartphones, meaning smart payments (O'Reilly, Duane et al. 2012). In other words, irrespective of individuals' high levels of personal innovativeness or mobile self-efficacy and irrespective of whether the mobile payment systems are perceived as useful and easy to use, consumers will not make mobile payments until they are convinced that smartphone mobile payment systems are safe and reliable (Duane, O'Reilly et al. 2014). External pressure from suppliers/customers observed by the owners of retail stores, and relative advantages defined by how innovation is perceived as beneficial, have more positive effects on retailer's behavioral intention to adopt mobile payments than others such as top management support, critical mass, compatibility, customization, technological competency, or owner's ability (Khan and Ali 2018).

2.3. Triggers of payment industry evolution: financialization and Fintech, including cryptocurrency

Financialization, as a systemic transformation of mature capitalist economies, has three distinguishing features: 1) large non-financial corporations have come to rely heavily on internal finances; 2) banks have turned toward mediating transactions in open markets, thus earning fees, commissions, and trading profits; and 3) workers have become increasingly involved in the financial system, both with regard to borrowing and holding financial assets (Lapavitsas 2011). Financialization is the term used to summarize a broad set of changes between the "financial" and "real" sector which gives greater weight than heretofore to financial actors (Dore 2008). Since these characteristics have been motivated by the digital transformation in finance, or Fintech, over the past decade, the concept of financialization has moved from the periphery to the mainstream of scholarly inquiry across several social-scientific disciplines, including human geography (Christophers 2015). For example, the advancements in information technology have spurred the development of retail investment banking, allowing people from all walks of life to become investors (Van der Zwan 2014).

Recently, diverse payment systems, which aim to minimize friction and cost and maximize trust, appear together with Fintech (Goldfinch 2018). Digital money has several characteristics: 1) frictionless transactions; 2)

anonymous transactions; 3) transparent financial transactions such as blockchain technology; or 4) micropayments, which cannot be possible with money or credit cards. (Lynn, Mooney et al. 2019). For example, blockchain, which is mainly known for its ability to process monetary and financial transactions, has key features that are common to all: 1) distribution network, the adoption of a blockchain removes all centralized entities and distributes access to all participants; cryptocracy, it enables parties to maintain the privacy of the information they send to each other; and 3) timestamp, every transaction that occurs on the blockchain is timestamped, and no one can change it once recorded (Rosati and Čuk 2019).

However, cryptocurrency concerns have led US watchdogs to take a more active role—bidding to set a ‘regulatory perimeter’ and break with the Trump era because investors are increasingly worried about the impact of digital currency market volatility this year—with prices plunging after China signaled a crackdown (Gary Silverman 2021, 31st May). In addition, anonymous cryptocurrencies are the payment methods of choice in online crime because crypto laundries answer calls from criminal gangs (Murrhy 2021 May 28th). Financial history, which results from institutional mutations and natural selection such as banks, bond markets, stock markets, insurance, and property-owning democracy, has been evolving to the decent of money with the appearance of financialization, Fintech, or cryptocurrency (Ferguson 2008). Electronic payment technology, customers’ adoption factors in the electronic payment industry, and mobile money as the sustainable alternative for SMEs in the less developed financial markets are gaining attraction (Mustapha 2018, Tengeh and Gahapa Talom 2020, Widayat, Masudin et al. 2020). However, the way to conquer the prosperity paradox, how innovation can lift nations out of poverty, is not dependent on the efficiency of electronic payment innovation but the smart payment market creation innovation (Christensen, Ojomo et al. 2019).

Financial technology, the most important innovation in the financial industry, including infrastructure, big data, data analytics, and mobile devices, allows Fintech start-ups to disintermediate traditional financial firms with unique, niche, and personalized services (Lee and Shin 2018). Fintech companies, both start-ups and established IT companies, entering the financial domain evolve at the intersection of information and communication technology and finance. Then they focus on business model innovations and new solutions for existing challenges in the financial industry, such as non-intermediated peer-to-peer (P2P) lending, cryptocurrencies, and smart contracts during the 2010s with the provider-oriented digitalization and in the 2020s with the customer-orientated digitalization (Gomber, Koch et al. 2017, Puschmann 2017, Thakor 2020).

Alibaba started its online payment system, different from Paypal’s direct payment method, in 2004. Alipay keeps money in escrow accounts until buyers receive the products and confirm transactions to establish trust between buyers and sellers in China, where the bank system is immature (Botsman 2017). In addition, Fintech firms such as PayPal or Apple Pay can provide payment services to customers at lower costs than traditional banks because they do not need infrastructure costs of banks in data capitalism in the age of big data (Mayer-Schönberger and Ramge 2018). In fact, digital currencies have the potential to compete against other online payment methods such as credit/debit cards and PayPal, and they are likely to have a significant long-term impact on both currency and payments systems (Gandal and Halaburda 2014).

2.4. Research framework

From the literature review, we built a research framework, as shown in Figure 1. First, the mobile payment industry is dynamically evolving with several business models, such as cash, credit card (including debit card), mobile app type of credit card, mobile credit card with intelligent payment, and smart payment without credit card. We will compare the differences in the business model dynamics among the three economies using a semi-structured questionnaire.

Second, the evolution of business models in the mobile payment industry is based on dynamic open innovation between financialization in the market and the explosion of Fintech. This study will analyze the differences in open innovation dynamics in the mobile payment industry between the three economies using focus group interviews, qualitative questionnaires, content analyses of newspaper and related reports, or participatory observations.

Third, the different factors that affect customers’ choices of mobile payment business models between the

three economies will also be analyzed through semi-structured questionnaires and participatory observations.

Dynamic evolution of business models in the mobile payment industry should, likely, be different among the three economies since they are located in different national innovation systems under which open innovation dynamics between the mobile payment industry market—financialization—and the technology, for instance—Fintech—are different from one another. Specifically, the differences in dynamic open innovation in the industry will be the main research goal.

From the research framework (Figure 1), this study shows the value of quasi-natural experiments by comparing the differences in the mobile payment industry’s business models’ dynamic evolution through qualitative analysis in the context of open innovation.

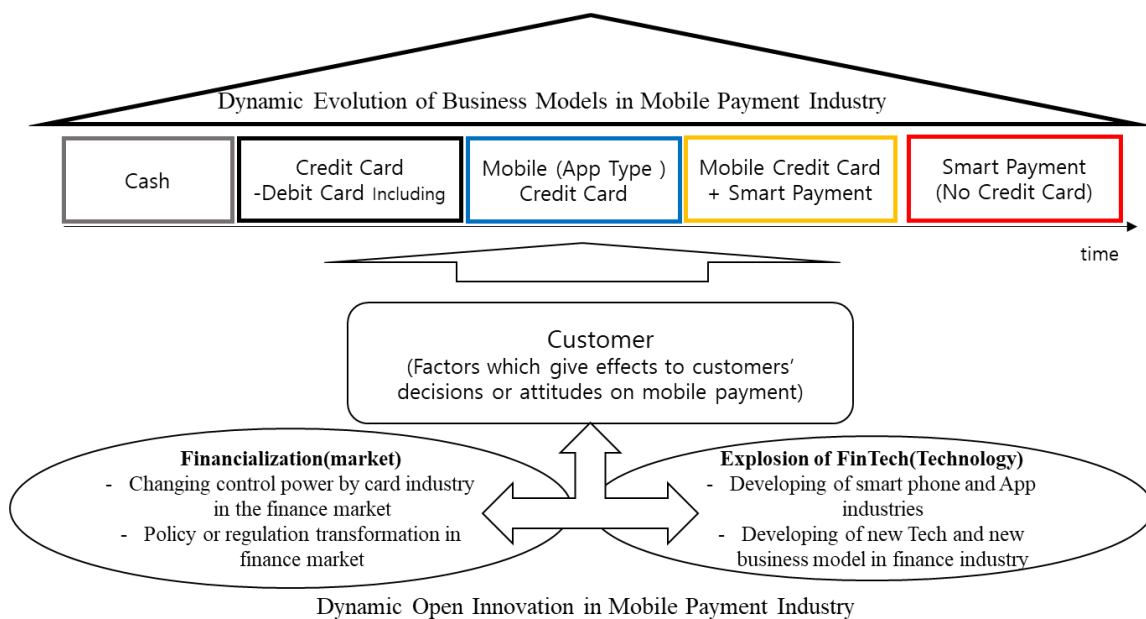


Figure 1. Research Framework

3. Analysis of dynamics of mobile payment business model in Korea

3.1. Preliminary analysis of street customers

As a kind of preliminary survey with the semi-structured questionnaire shown in Appendix 1, the Korean research team interviewed 19 customers at the “The + coffee” cafe on 5th November 2020, 25 customers at the “Twosome Place” café on 6th November 2020, and 18 customers at the “332” café on 11th November 2020.

First, 73.39% of customers used cards as the 1st payment method, and, in total, 88.75 % of Korean street customers used their card as a payment method, as shown in Figure 2. The reasons Korean street customers gave were diverse as follows: 1) it is convenient to use and keep in pocket or wallet; 2) to escape pocket change; 3) using credit cards to buy expensive products; 4) using debit cards to manage the personal budget; 5) to receive the tax deductions at during the year-end tax adjustment; 6) the lock-in using the credit card for long times; 7) to receive discounts by using pointed credit cards; 8) the card is a safe payment method; 9) to raise the credit rating by continuously using the credit card.

Second, 8.5% of customers used a mobile app-based credit card; in other words, Samsung Pay as the 1st payment method, and in total, 30.65% of customers used a mobile app-based credit card. Customers who primarily use credit cards or mobile credit cards were nearly 87.1% among Korean street customers. The reasons for using mobile app-based credit cards were not so diverse as follows: 1) customers use mobile credit cards when they carry a mobile phone and not credit/debit card; 2) customers can carry 2–3 credit cards, which are frequently used, in one mobile phone; 3) they do not need to carry physical cards, which is safe; 4) they use mobile credit cards in internet shopping because of convenience; and 5) they receive discounts by using Samsung Pay.

Third, 8.6% of customers used KAKAO Pay or NAVER pay, in other words, the mobile credit card with smart payment as the 1st payment method, and in total, 79.03% of customers used the mobile credit card with smart payment. Korea street customers use KAKAO Pay, or NAVER Pay compared to credit cards for diverse reasons: 1) Using KAKAO Pay is convenient in distributing the cost of anything among friends; 2) NAVER Pay is convenient for shopping at the NAVER shopping center; 3) direct payments without any fee is convenient; 4) The point scores accumulated by the usage of KAKAO Pay, or NAVER Pay can be used like any money easily; 5) using is easy and only requires a password input; 6) they can be used offline through mobile phones; 7) sending Gift-con, birthday gifts, or diverse gifts is convenient; 8) paying for a mobile delivery order is convenient; 9) Paying at the store is convenient; 11) sending presents during chatting; 12) sending small presents such as hand cream and cakes to relatives is also convenient.

Fourth, no customers used Zero pay; in other words, the smart payment method was the 1st payment method, and in total, 6.45% of customers used Zero pay. Smart Payment users rarely use this method when they travel abroad or do international shopping, except for earning promotional benefits.

Fifth, 4.84% of Korean street customers used cash as the 1st payment method, and 56.45% of Korean street customers used cash as a payment method. Cash was used in limited conditions as follows: 1) paying small money at mart; 2) places where customers can not use cards; 3) at the traditional markets; 4) paying coins for laundry; 5) getting discount with cash payments.

We conducted these preliminary interview-based surveys to validate the usage of a semi-structured questionnaire and the survey of students to compare customers' behavior of the three countries. We developed the semi-structured questionnaire from the interview, as shown in Appendix 1, which can be easily understood by the survey targets. The respondents can then generate answers with details during the survey, which can be linked to the research questions. Moreover, if the interview results in Figure 2 are similar to the interview results of Korean customers, comparing the survey results on students of three countries will be rational and can be validated.

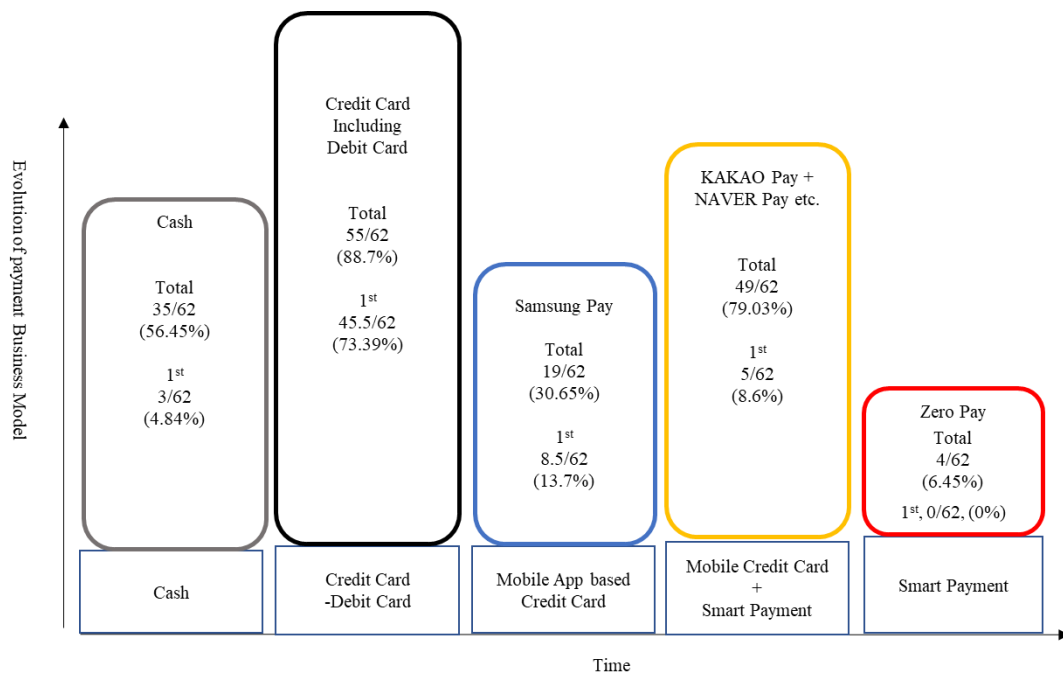


Figure 2. Preliminary study of the Korean street customers' usage of payment methods

The Korea research team interviewed 16 cafes, restaurants, and other shops closed to DGIST campus on 5th and 6th November 2020 to get supplementary data referenced in this research. Among the 16 shops, all hosts claimed that they accept 1) card; 2) mobile app-based card, for instance, Samsung Pay; and 3) cash as the payment methods for customers to consider. Eight hosts among the 16 shops claimed that they have the mobile credit card smart payment—KAKAO Pay or NAVER Pay—for customers. Last, among the 16 shops, only two hosts provided the smart pay—Zero Pay—as the payment method for customers to use. Even though Korean hosts have enough diverse mobile payment options to meet customer requirements, the acceptance of the mobile credit card with smart payment (KAKAO Pay, or NAVER Pay) or Smart Payment (Zero Pay) are normally not provided as the payment method. Except for one shop which did not provide the ratio, even though the usage of payment methods varied from shop to shop, on average, customers' usage at these 15 shops are similar to the 1st usage of Korean street customers shown in Figure 2, as follows: 1) the usage ratio of credit card, 55%; 2) the usage ratio of the mobile app-based credit card, 21%; 3) the usage ratio of cash, 18%; 4) the usage ratio of the mobile credit card with smart payment, 4%; and 5) the usage ratio of Smart Payment, Zero Pay, 0.13%.

3.2. Analysis of the dynamics of the Korean mobile payment business models

Korean student customers' usage patterns of mobile payment methods in Figure 3 are similar to those of Korean street customers in Figure 2. So, a survey of student customers' using mobile payment methods to compare the three countries can have enough values. This is because the use of mobile payment by students is representative of all customers, in a sense that mobile payment methods by students are similar to those of street customers and shop hosts in the Korean mobile payment business models.

First, 82% of student customers used the card as the first payment method, and in total, 95 % of Korean student customers used the card as a payment method, as shown in figure 3. These usage ratios are slightly higher than street customers. The reasons stated for this by Korean student customers are a little different from street customers:

1) students mainly use debit cards as only 31 among 38 manage their pocket money well, and they do not have credit cards; 2) it is convenient to keep a card in the pocket; 3) they use the debit card to accumulate the experiments of managing a budget; 4) advantages like cashback points for the using debit card; 5) to respond to the increase of non-cash using shops.

Second, only 5% of Korean student customers used mobile app-based credit cards such as Samsung Pay, Apple Pay, Google Pay, SinHan Sol, or Hyundai App Card as the first payment method, and in total, 47.5% of student customers used the mobile app-based credit card. The number of users who primarily adopt credit cards and mobile credit cards accounts for nearly 89% of Korean student customers, similar to the ratio of street customers 87.1%. According to Korean student customers, the reasons for choosing mobile app-based credit cards are simpler than street customers: 1) most Samsung Galaxy smartphone users only used Samsung Pay. 2) using Google Pay for paying on the Internet; 3) using Samsung Pay which is connected with NongHeub bank, SihHan bank, Kakao bank, Kukmin bank; 4) when not having a card, students use Samsung Pay like a debit card; 5) using Apple Pay which is connected with bank credit cards; 6) using SihHan Sol app card to receive discounts when buying clothes.

Third, 10% of Korean student customers used KAKAO Pay, NAVER Pay, or PAYCO; in other words, the mobile credit card with smart payment as the first payment method. In total, 80% of Korean student customers used a mobile credit card with smart payment, almost the same as the Korean street customers. Half of the Korean student users used only KAKAO PAY, a quarter of KAKAO Pay users used only NAVER Pay, and Nearly a third used most of them together. Korea student customers used KAKAO Pay, NAVER Pay, or PAYCO for the following reasons: 1) to receive the cashback points which are accumulated at the NAVER Pay or KAKAO Pay; 2) using Kakao Pay for the free transfer of money, and the free withdraw of money; 3) easy KAKAO Pay or NAVER Pay registration; 4) using KAKAO Pay to transfer money easily; 5) using NAVER Pay because charging money is easy at convenient stores; 6) using Payco because connecting with Samsung Pay is easy; 5) it is easy to use due to the confirmation by fingerprint check; 6) using Naver Pay for Internet-based payments; 7) using Kakao Pay for sending presents through KAKAO talk, or for buying products through bar-code sensing; 8) using Kakao Pay to distribute the cost of all members; 9) using Hemin Pay to use Hemin delivery service; 8) Webcomic use is easy.

Fourth, Korean student customers never used smart payments such as Zero Pay, Paypal, or others, maybe because Korean customers use smart payment only for international paying which is unlikely to be considered by Korean student customers.

Fifth, 2.5% of Korean student customers used cash as the 1st payment method, and in total, 85% of Korean student customers used cash as a payment method. The high ratio of cash payment by student customers is due to 1) the usage of dormitory laundry service; 2) buying gift certificates at discounted prices; 3) using cash when the cost of cash payment is low; 4) when using vending machines; 5) when using coin karaoke. Maybe students' lifestyle is more appropriate for coin usage than street customers.

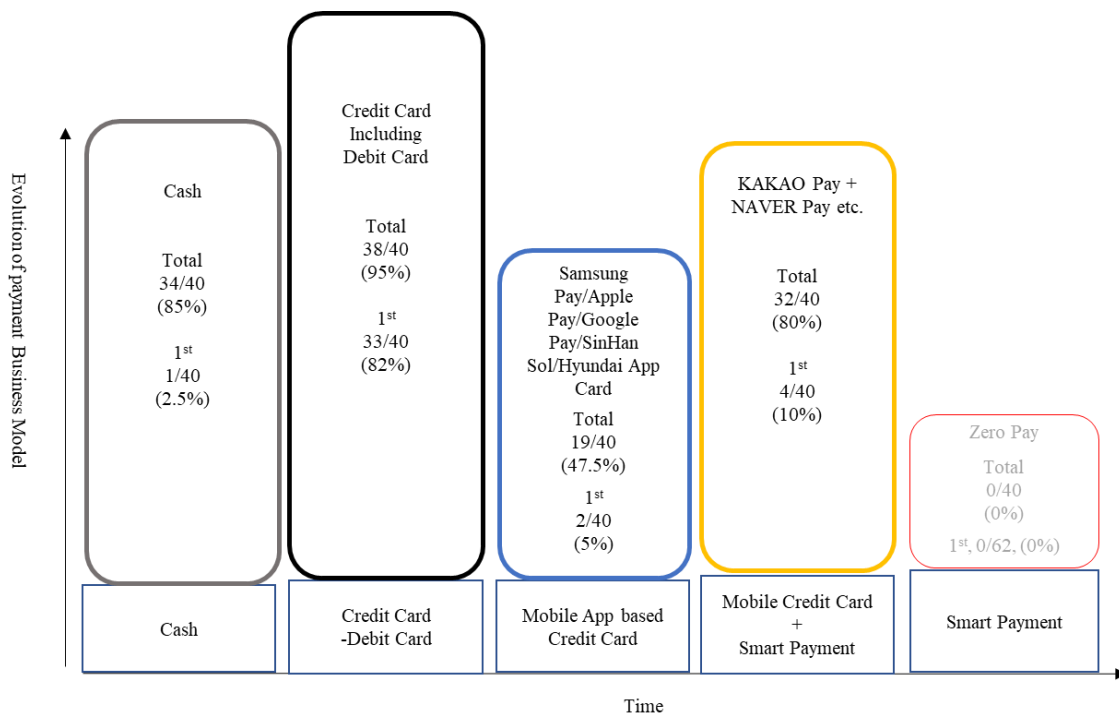


Figure 3. Dynamics of Korea mobile payment business models

4. Analysis of the dynamics of the UK mobile payment business model

UK student customers' usage patterns of mobile payment methods, in Figure 4, are dramatically different from those of Korean student customers, in Figure 3. Thus, a survey of student customers' mobile payment methods to compare their usage and the changing dynamics between the two countries is significant.

First, only 49.5% of the UK student customers used cards as the first payment method, nearly half of the Korea student ratio 82%. However, the total usage ratio of cards by UK student customers is 98.11%, which is a little higher than Korea's 95%. Probably because, though the card has been the dominant payment business model in the UK for a long time, young customers are moving to other payment business models. The reasons for using credit cards that UK student customers pointed out are simple: 1) UK students mainly use a debit card for its convenience, especially under the budget usage; 2) all families in the UK use cards because card usage in the UK is widespread; 3) online shopping because it is a little cheap and convenient; 4) it is a safe and convenient method of payment. The reasons for using a credit card by UK student customers are much simpler than Korean student customers.

Second, just 5.6% of UK student customers used mobile app-based credit cards such as Apple Pay, Google Pay, or Samsung Pay as their first payment method. Apple Pay users are 7 times bigger than Google Pay, and the frequency of using Apple pay per customer per week is 3 times compared to Google Pay's 1.4 times. Nevertheless, 64.15% of UK student customers used the mobile app-based credit card, higher than Korea's 47.5%. UK student customers use mobile app-based credit cards even though they do not use credit cards as their first payment method. The reasons for the usage of the mobile app-based credit card which UK student customers announced are a little

simpler: 1) people prefer digital payment solutions nowadays; 2) it is easy, fast, and convenient for transactions; 3) Apple Pay, which is connected with Mastercard, Visa, is convenient and easy to carry around; 4) Google Pay is easy to pay when people have no cash or swiping machines; 5) it is easier to access a mobile phone than the wallet; 6) Apple Pay is very popular in the UK; 7) it entails a seamless and efficient process with safe ways; 8) using for quick payment.

Third, 41.8% of UK student customers used Contactless, a Chip and a Pin, Tesco Pay, or Shop club card. In other words, the mobile credit card with smart payment function is the first payment method, and in total, 98.11% of UK student customers used the mobile credit card with smart payment, higher than Korean at 10% and 80%. Moreover, more than 60% of student customers used Contactless among the mobile credit cards with smart payment functions. The usage of the mobile credit card with smart payment function by UK student customers is more popular than that of Korean student customers. UK student customers used Contactless, Chip & pin, Tesco Pay, or Shop club card for the following reasons; 1) for quick and safe payment below 20 pounds; 2) for small amount shopping, and big amount supermarket shopping; 3) people prefer easy money payment nowadays; 4) I use contactless payment wherever I can; 4) it is convenient and saves time; 5) I use Contactless because it does not require PINs. However, over 30 pounds the pin must be pushed; 6) during the pandemic time, Contactless is more secure than other payments, including cash; 7) popular and safe payment methods in the UK; It let customers avoid losses from fraud; 8) for security purpose, they prefer to use traditional Chip & Pin card payment; 9) convenient to buy groceries, food, online shopping; 10) saving time, and it is easy, fast, and convenient to use. The main reason for using a mobile credit card with smart payment by UK student customers is the convenience of this payment method which is oriented from the mobile phone and additional functions made by SW engineering and business model innovation.

Fourth, 52.83% of UK student customers used smart payment such as PayPal, Yoyo Wallet, Ali Pay, or others even though those are not from the 1st usage method of payment. More than 60% of UK student customers who use smart payment methods used PayPal. UK student customers are becoming accustomed to smart payment already. This means that UK customers are now moving from credit cards through mobile app-based credit cards to smart payment methods. The reasons for UK student customers to use the smart payment are as follows: 1) it is very easy to use and connects with Lloyds Bank, Bank of America, or other nationwide banks; 2) it is useful for fast payment; 3) online banking, Security and returned guaranteed as PayPal hold to the money; 4) TSB bank they use it for online shopping; 5) convenient for online shopping; 6) transaction is safe and fast with connection with UBA bank; 7) because PayPal is very popular for converting the money from dollar to pounds with connection with HSBC; 8) using Alipay for online shopping, some international online shopping with connection with Bank of China; 9) using this with connection to Halifax; 10) it is seamless, convenient and efficient for online shopping with connection with HSBC. Banks connected with smart payment such as PayPal, Yoyo Wallet, Ali Pay are different from banks for the mobile credit card with smart payment from TSB bank, HSBC, Lloyds Bank, to Bank of America, or Bank of China.

Fifth, 2.4% of UK student customers used cash as their first payment method, and in total, 64.15% of UK student customers used cash as the payment method. The ratio of cash usage by UK student customers is not so high, meaning that the UK payment business model has moved to the credit card system and now towards the smart payment. The concrete reasons for using cash by UK student customers are similar to Korea student customers: 1) cash only in some shops such as kebab shops or taking buses; 2) I use cash when I happen to have cash with me; 3) convenient for some small shops; 4) I use cash when the payment requires cash only; 5) I use cash to pay lunch at university café; 6) at some Chinese groceries (in the UK); 7) sometimes I use cash if there is termination/failure of card transactions.

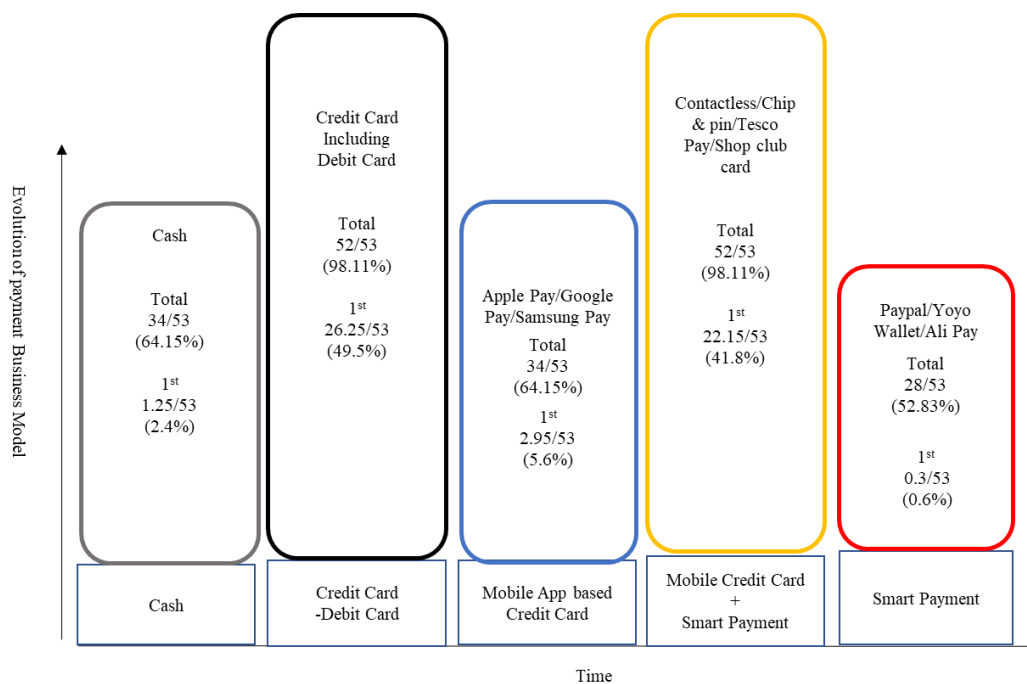


Figure 4. Dynamics of United Kingdom mobile payment business models

5. Analysis of the dynamics of China's mobile payment business model

The Chinese student customers' usage patterns of mobile payment methods in Figure 4 are entirely different from those of Korean student customers, with a small amount of casher payment and a considerable amount of smart payment. Furthermore, they are somewhat similar to the UK student customers because the smart payment method usage ratio is increasing, and the cash usage ratio is not very high.

First, only 2 % of Chinese student customers used cards as the first payment method, and in total, 34 % of Chinese student customers used a credit card as a payment method, as shown in Figure 5. These usage ratios are much lower than Korean student customers, with 82% and 95%, respectively. The low usage ratio of the credit card by Chinese student customers means that China has not been locked in the usage of credit cards because young customers have not succeeded in the habit of using credit cards. The reasons for using a credit card which Chinese student customers advanced are slightly different from those of street customers in terms of: 1) convenience; 2) online shopping, water, and electrical fee, phone bills.

Second, only 1% of Chinese student customers used mobile app-based credit cards such as Huawei Pay, Apple Pay, or Oppo Pay as their first payment method, and in total, only 22% of Chinese student customers used the mobile app-based credit card. This ratio is smaller than half the ratio of Korean students, 47.5%, and nearly one-third the ratio of UK students, 64.15%. The small mobile app-based credit card ratio by the Chinese student customers confirms that China has not experienced the dominance of credit cards even in the mobile credit card. The reasons for using a mobile app-based credit card by Chinese student customers were summarized as follows: 1) using Apple Pay for VIP payment; 2) convenient for paying for meals.

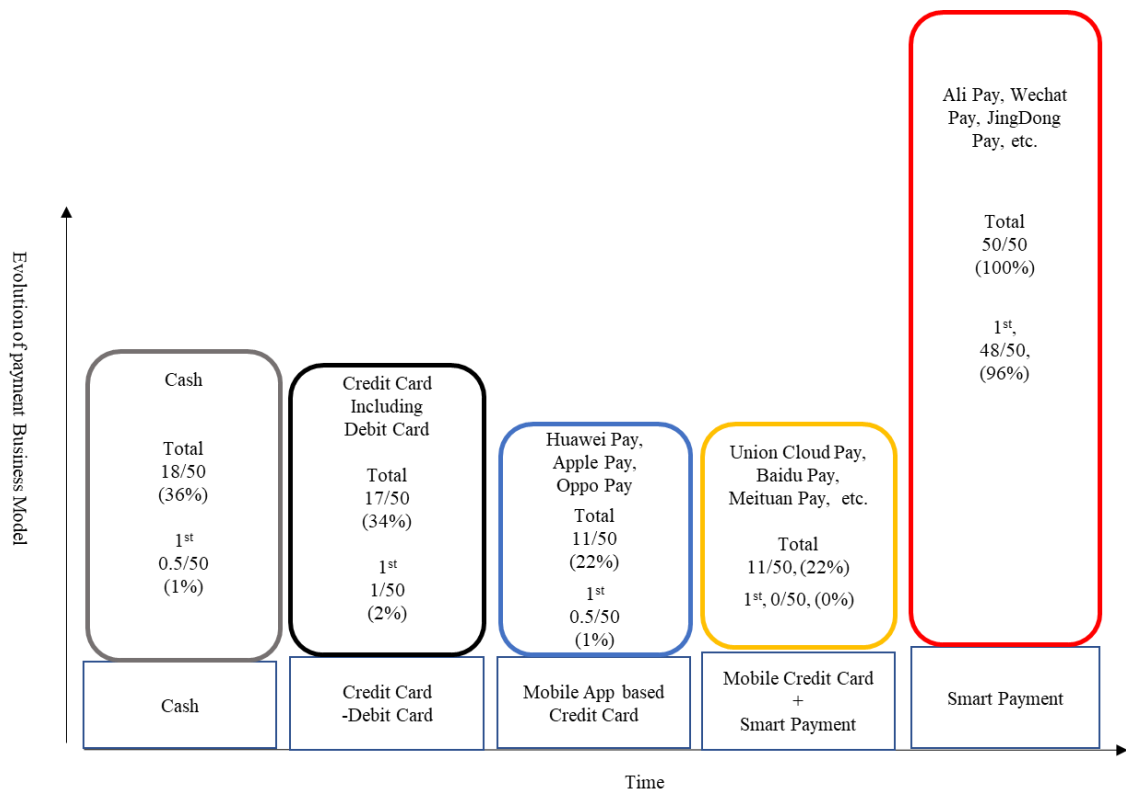


Figure 5. Dynamics of China mobile payment business models

Third, only 1% of Chinese student customers used mobile credit cards with smart payments such as Union Cloud Pay, Baidu Pay, and Meituan Pay. Altogether only 22% of Chinese student customers used the mobile credit card with smart payment. This ratio is a quarter of Korea's, 80%, and nearly a quarter of the UK's ratio, 98.11%. This means that mobile credit card with smart payment system in China has not received attention from even young customers, which is different from the situation in Korea and UK. Chinese student customers used Union Cloud Pay, Baidu Pay, or Meituan Pay. for the following reasons: 1) using Union Cloud Pay for the credit upgrade or shopping; 2) using Union Cloud Pay because of convenience; 3) using Union Cloud Pay to get benefits; 4) using Meituan Pay for meal delivery to get advantage and upgrade user grade for better delivery service.

Fourth, nearly all (96%) Chinese student customers used smart payment methods such as Ali Pay, Wechat Pay, or JingDong Pay as their first Payment method. This is opposite to the ratio of Korea, 0%, and the UK, 0.6%. Altogether 100% of Chinese student customers used this Smart payment system which did not require a connection with any credit card. The main payment method for China, according to Chinese student customers, is the smart payment system. China probably moved from cash-based payment method directly to the smart payment system without card payment system and the mobile credit card with the smart payment system. This is the traditional example of leapfrog innovation in a catch-up economy (Mu and Lee 2005). Chinese student customers used Ali Pay, Wechat Pay, or JingDong Pay for the following reasons: 1) using Alipay for shopping at Taobao, or transferring money; 2) using WeChat for food delivery payment; 3) using Alipay or WeChat Pay because cash includes a lot of bacteria and virus; 4) using Alipay to buy daily necessities including meals, entertainment, or subway tickets; 5) using Alipay because of convenience, quick payment, and discount; 6) using WeChat because

of convenience with QR code; 7) keeping all money in WeChat for convenient usage; 8) using WeChat for strong liquidity and linking with bank cards; 9) the Alipay page looks better, and has more functions than WeChat and is more convenient than WeChat; 10) using WeChat for daily consumption, offline consumption, or online consumption.

Fifth, only 1% of Chinese student customers used cash as their first payment method, and in total, 36% of Chinese student customers used cash as the payment method. Chinese student customers' total usage ratio of cash is smaller than Korea, 85%, and UK, 64.15%. This means that China is almost moving towards the world Number 1 cashless society. The only reasons why Chinese student customers use cash are as follows: 1) paying for bus tickets; 2) using cash at specific places.

6. Discussion: Grounded Theories in the evolution of mobile payment business models

6.1. Comparing the three economies in the evolutionary dynamics of the mobile payment industry

By comparing the three economies in terms of the mobile payment industry, the evolution direction of the mobile payment industry can be understood. If the evolution of mobile payment is understood by the decrease in using cash, and the increase of smart payment methods which are not based on or directly connected with credit cards, then the evolution of the mobile payment industry can be illustrated as shown in Figure 6.

First, Korea has the highest ratio of cash usage. The UK has a smaller ratio of cash usage than Korea, and China has a tiny ratio of cash usage. The most popular payment method among Korean customers has been credit cards until now. The next popular payment method among Korean customers is the mobile credit card with a smart payment function, and the third method is the mobile app-based credit card. While cash is mainly used as a supplementary payment method, Korean customers adopt all credit card-connected payment methods, including credit cards, mobile app-based credit cards, or mobile credit cards with smart payment functions. To summarize, Korea is a credit card locked-in economy that depends on the expanded card-based payment business models.

Second, the UK has the highest ratio in using mobile credit cards with smart payment functions. Korea shows a smaller usage ratio than the UK, even though it is still higher than China. In addition, the UK has a higher usage ratio in mobile app-based credit cards and credit cards than Korea. The result indicates that the adoption of credit cards by UK customers is higher than Korean customers. Moreover, UK customers are accustomed to smart payment methods as their second payment method with a usage ratio of 52.83%, the opposite of Korea, where 0% of customers choose smart payment. The UK represents a transformational economy in terms of the payment system, from cards to smart payment.

Third, China has the highest ratios, 100% in total and 96% first usage of the smart payment methods, compared with the UK's usage ratio of 52.83%, ranking second, and Korea with the total usage ratio of 0%. In addition, China customers rarely use other payment methods as the primary payment methods as shown in the evidence: 1) cash 1%; 2) credit card 1%; 3) mobile app-based credit card 1%; and 4) mobile credit card with smart payment function 0%. However, they use these as supplemental payment methods as revealed from the data: 1) cash 36% of total usage; 2) credit card 34% of total usage; 3) mobile credit card 22% of total usage; and 4) the mobile credit card with smart payment function 22%. In conclusion, China ranks first in the smart payment economy.

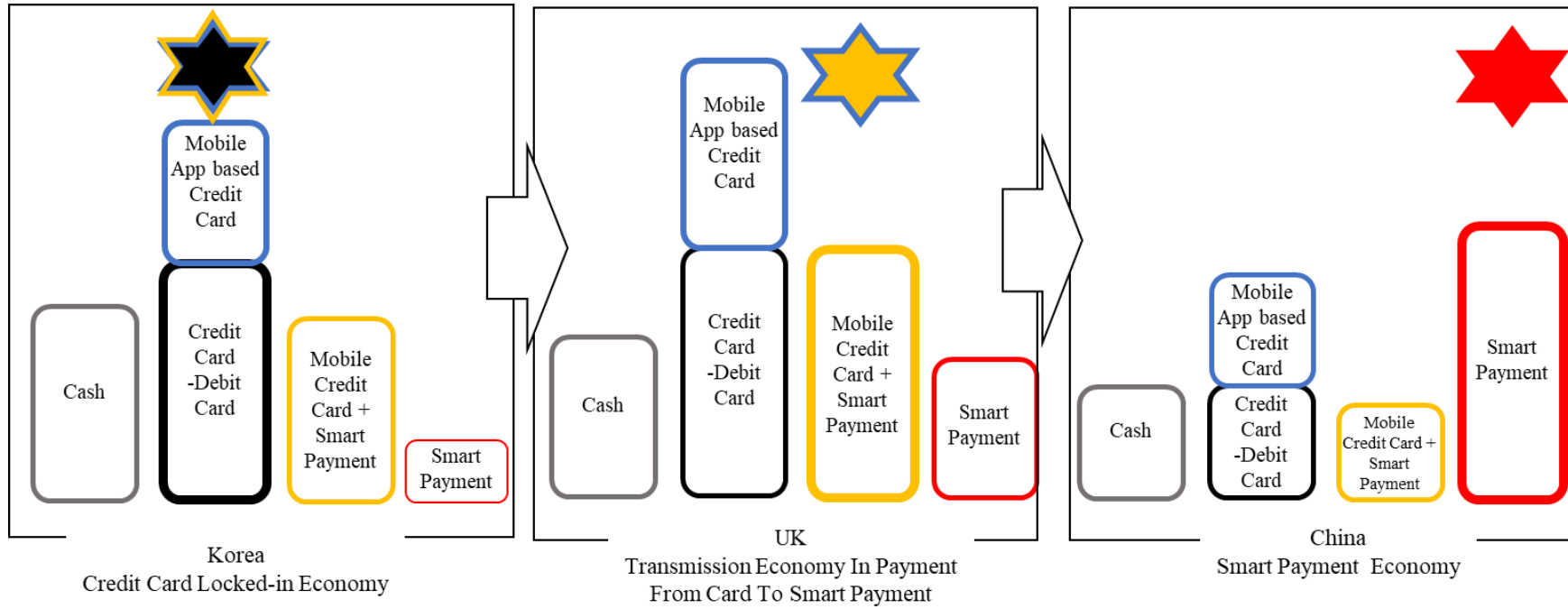


Figure 6. Comparing three economies from the perspective of mobile payment business model evolution

6.2. Grounded theory 1: the scenario of the evolutionary dynamics of mobile payment business models

Based on the data analysis and the comparison of business models in three economies as a natural experiment, three additional scenarios of the evolutionary dynamics of mobile payment business models (A-1), (B-1), and (C-1), as shown in Figure 7, can be proposed.

First, the mobile app card-focused payment business model can appear in all credit card lock-in economies such as Korea (A). Maybe, if the card industry defends the existing benefits against newcomers from Fintech firms through maintaining the regulation of the finance industry, and card firms successfully transform to mobile app card platforms, (A-1) will emerge as new dominant mobile business models. (A-1) can be the future of Korea, Japan, and many other countries featuring the locked-in credit card industry.

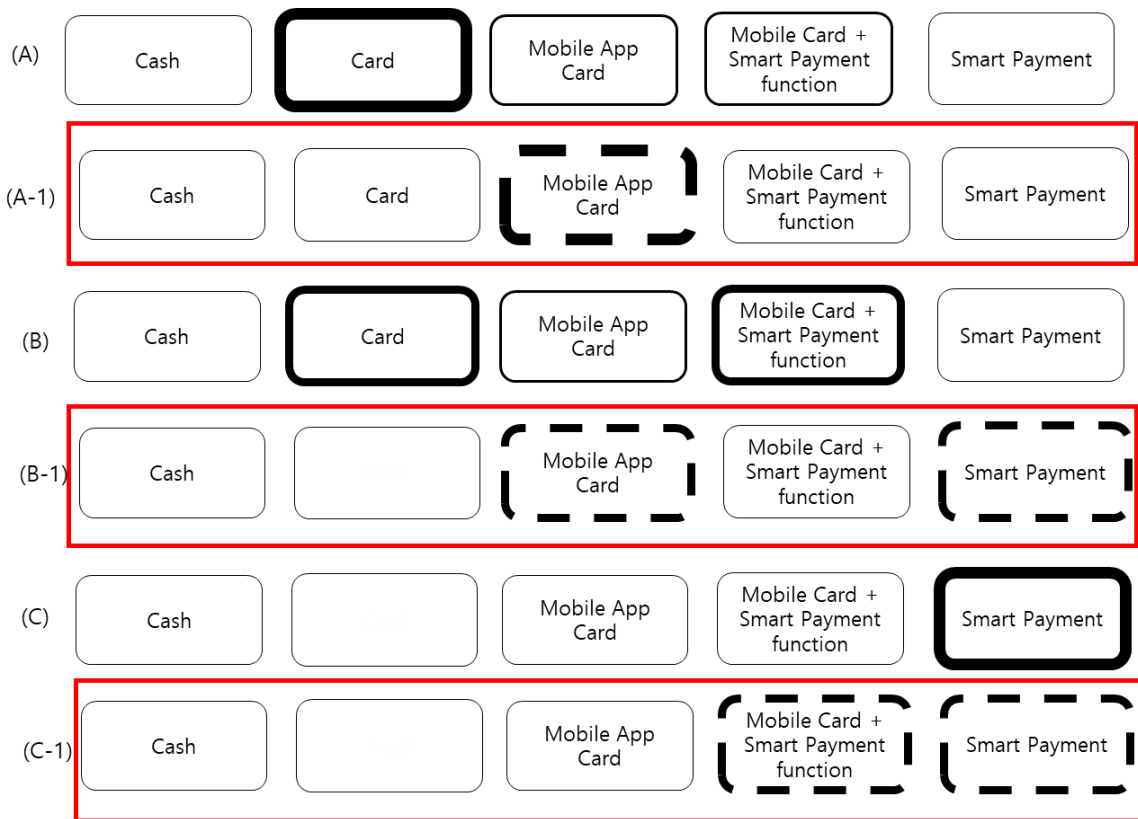


Figure 7. Additional scenarios of the evolutionary dynamics of mobile payment business models

Second, if the transformational economy from card payment to smart payment continues for a long time in the UK, the parallel economies between mobile app card and smart payment can appear (B-1). This scenario is based on the full development of the mobile card industry and the sufficient growth of smart payment firms from the Fintech industry. The full development of mobile app cards can satisfy customers differently from smart payment methods. Furthermore, the growth of smart payment methods can generate customer satisfaction that mobile app cards could not provide. If the US continues to evolve in mobile payment business models, (B-1) can appear. (B-1) can be the future of many countries in a similar condition with the UK, for example, the US, Australia, Canada.

Third, if the smart payment economy like China continues to invite various ideas of the card industry or increasingly collaborate with the card industry, the future of the smart payment industry can be (C-1). In addition, many less developed countries in South-East Asia, or Africa, including M-PESA in Kenya, which have not experienced the locked-in card industry like China, can develop smart payment economies and a mobile card with smart payment function together with the support from the card industry in western countries and smart payment industry in China (Christensen, Ojomo et al. 2019).

6.3. Grounded theory 2: The double locked-in credit card effects

First, according to the natural experiments, the pattern of Korea refers to countries where new financial business cannot be established without the setting up of related laws. In contrast, the situation in the UK can be applied to countries where new financial business can be created without the availability of related laws. Korea has adopted locked-in credit card regulations which protect existing financial firms, as shown in Figure 8.

Second, according to the natural experiments which can compare the UK where customers have experience with the locked-in credit card industry, and China, where customers have no experience with the locked-in credit card industry, the UK system is locked-in with the long experience of using credit card as shown in Figure 8.

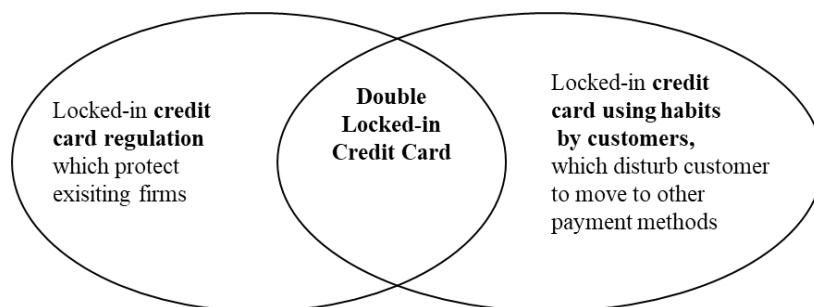


Figure 8. Korea model with double locked-in credit card

According to the natural experiments, the evolution of mobile payment industries of the three economies can be compared. Korea shows the pattern of a double locked-in credit card industry in terms of: 1) locked-in credit card regulation, which protects existing firms; and 2) locked-in credit card industry using habits by customers, which prevent customers switching to other payment methods. The double locked-in nature of the credit card industry can explain why Korea is still lagging in the smart payment industry, even though Korea has the global Number One Internet speed essential to develop the smart payment industry and Korea is advanced in the Fintech industry (Shin and Choi 2019, Jeon and Pak 2020).

7. Conclusion

7.1. Implication

First, this study found diverse evolutionary dynamics of business models, which are different according to economies. Second, this research found additional scenarios of business model evolution dynamics, which can be used to analyze the development trends and formulate plans in payment industries. Third, this study revealed the double locked-in effects in payment industries, which fully exist in Korea and partially in the UK.

7.2. Limitations and future research direction

First, the context of the evolutionary dynamics of payment business models, financialization, and the explosion of Fintech in the three economies, should be analyzed in subsequent research. This will provide clues for understanding the differences in open innovation dynamics of the payment industry among the three economies. Second, the difference in effects among 1) the smart payment business model, 2) the mobile card with the smart payment function, and 3) the mobile card business model should be analyzed to understand the future of the mobile payment industry.

Appendix 1

Semi-structured questionnaire for the usage of smart payment

*Please tell us how many time (s) of the payment methods below you use **per week**.

1) How many times do you use **credit cards** per week?

Types	①Credit card (Visa, Master, Amex, JCB, UnionPay et.al.)	②Check Card (Including Debit Card)	③Others()
Time(s) of use	()Time(s)	()Time(s)	()Time(s)
Reasons of use			

2) How many **credit cards based mobile phone payments** do you use per week?

Types	①Samsung Pay	② LG Pay	③Apple Pay	④Google Pay	⑤Others()
	Connect with() Credit Card/ () Bank Credit Card				
Time(s) of use	()Time(s)	()Time(s)	()Time(s)	()Time(s)	()Time(s)
Reasons of use					

3) How many **credit cards connected to easy payment** do you use per week?

Types	①Kakao Pay	②Naver Pay	③Payco Pay (NHN Pay)	④UB Pay	⑤ Others()
Time(s) of use	()Time(s)	()Time(s)	()Time(s)	()Time(s)	()Time(s)
Reasons of use					

4) How many of the **credit cards non-connected easy payments do** you use per week?

Types	①Zero Pay	② Ali Pay	③ Wechat Pay	④Pay Pal	⑤Others()
	① When choosing Zero Pay, Connect with () Bank Zero Pay/Bizplay Zero Pay/ Others()				

Time(s) of use	()Time(s)	()Time(s)	()Time(s)	()Time(s)	()Time(s)
Reasons of use					

*Even though Pay Pal is based on credit card registration, it has a weak link with a credit card in reality.

5) How many times (s) do you use **cash** per week?

Types	①Cash	②Check	③Gift Card	④Others()
Time(s) of use	()Time(s)	()Time(s)	()Time(s)	()Time(s)
Reasons of use				

6) Today you paid by ()

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