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Open innovation dynamics and evolution in the mobile payment industry – comparative analysis among Daegu, Cardiff, and Nanjing

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ABSTRACT

The understanding of smart payment industry in the financialization under digital transformation will be the clue to capture the future directions and dynamics of modern capitalism economy. Is there any differences in smart payment industry according to capitalist economy condition among Daegu, Cardiff, and Nanjing ? By answering to this research question through comparative analysis of 3 regions based on qualitative interview method, this study found out as follows. First, there are different payment industry context among 3 regions; Daegu, card payment majority; Cardiff, transition from card payment to smart payment; Nanjing, Smart payment majority. Second, Economic contexts of regions could give direct impacts of the development of mobile payment industry such as the lock in the card industry at Daegu in South Korea, or the well-developed smart delivery platform of E-commerce at Nanjing in China, or the long history of capitalist economy which had increased the labor condition of laborer at Cardiff in Wales. Third, from the qualitative interview researches on 3 regions, gave 2 additional grounded theories such as the future direction of smart payment industry, and the double locked-in the card industry at Daegu in South Korea.

KEYWORDS

Mobile or smart payment; open innovation; business model; Daegu; Cardiff; Nanjing

1. Introduction; research question, and research scope & method

1.1. Research question

In the 4th industrial revolution exploiting, big data, thes traditional payment system of capitalist exchange is changing dynamically (Mayer-Schönberger and Ramge 2018). This change is motivating the dynamics of the direction and content of capitalist exchnage totally in addition to accelerating the financialization of the economy, which means that an increasingly autonomous realm of global finance has altered the underlying logics (tangibles cf. intangibles) of the industrial economy and the inner workings of democratic society (Van der Zwan 2014). Even though the ratios of manufacturing and finance in total gross domestic product (GDP) of United

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This article has been corrected with minor changes. These changes do not impact the academic content of the article.

States of America (U.S.A.) were 28%, and 11% respectively in 1950, the ratios in 2010 were changed to 11% and 21% (Chomsky 2017, 58).

In addition, with the appearance of digital transformation from the 2nd information technology (IT) revolution, traditional payment systems which have been developed by the credit card industry for the last nearly 100 years are evolving dynamically to very diverse mobile payment systems or smart payment systems, in which no dominant designs have appeared until now (Karnouskos 2004; Yun 2015).

So, the understanding of smart payment industry financialization will be the clue to capture the future directions and dynamics of modern capitalism exchange.

> Are there any differences in paying patterns according to capitalist exchange conditions among Daegu, Cardiff, and Nanjing?
>
> If then, how about any difference of the smart payment industry in smart payment market share, competing with traditional payment systems, and open innovation of smart payment industry among these three regions?

By comparing the mobile payment industry of different capitalist regions, the general understating of the mobile payment industry in the digital transformation, and the forecasting of the future in addition to the appearance of dominant designs in the mobile payment system will be possible. This research question is different from the narrower topic on mobile payment such as 'consumer adoption and technology aspects' (Dahlberg, Guo, and Ondrus 2015).

1.2. Research method, and scope

Economists have long sought to understand why some countries have large banking systems that allocate credit broadly, permitting rapid growth, while other countries scarcely have any banks at all, which constrains growth and limits social mobility. They They have done this by comparing nations as kinds of natural experiment of history (Diamond and Robinson 2010b, 88). Through case studies or social surveys, with the comparison of similar cases or survey targets among different countries, differences in outcomes related to different perturbations or to different initial conditions can be explained (Diamond and Robinson 2010a). Qualitative methods play a crucial role in natural experiments because they often facilitate what is crucial for the method's persuasive use (Dunning 2012, 208). This study uses the interview research method which is based on quasi-natural experiments by comparing regions in the evolving of electronic and mobile payments: Table 1 (Flick 2021).

First, we performed literature reviews on electronic payment, mobile payment, or smart payment, etc. from papers, reports to newspapers such as Electronic Newspaper in South Korea, and Financial Times in United Kingdom to understand the basic situations of mobility in the smart payment industry.

Second, we conducted specialist interviews as a kind of mini focus group interview to facilitate a semi-structured questionnaire on 'the evolving of mobile payments and the context of the payments' to be used in online interviews. We found out additional meanings of our surveys of three 3 economies, by interviewing people who have been working in the card industry, mobile payment or smart payment industry for more than 20 years. Our Korean research team had a chance to interview a specialist who is vice president of a

Table 1. Research method and scope.

Research method		Research scope
In advance research	Literature review	The literature review on electronic payment, mobile payment or smart payment to develop semi-structured questionnaire which will applied 3 regions
	Specialist interview	Specialist which have long career in banking industries, or card industries in 3 countries were interviewed to fascinate the semi-structured questionnaire on from 20th November and the end of 2020.
	In advance applying the semi-structured questionnaire	Applying the questionnaire to 63 Korean customers and 16 shop owners at the face to face to update the questionnaire last time on 5th, 6th, and 11st November in 2020 before applying it to 3 countries.
Main research	Daegu customer interview	Online and mobile interview on 41 DGIST students in Daegu on 23rd of March, 2021. (40 valid interviewees' answers)
	Cardiff customer interview	Online and mobile interview on 53 Cardiff Metropolitan university students (25 undergraduate, and 28 postgraduate) and 6 non-student users in Cardiff on 12th, 16th, 19th March, 2021.
	Nanjing customer interview	Online and mobile interview on 50 Nanjing university of Science and Technology students (15 undergraduate, and 35postgraduate)

Korean bank, and had worked in the payment industry of Korea for more than 20 years on the 20th of November in 2020. The UK team also did specialist interviews to find out additional in-depth meanings of U.K. smart payments. Chinese team did specialist interviews in translating the Appendix in Chinese and applying it to meet the reality of China.

Third, we interviewed 63 customers and 16 shop owners who use diverse payment methods in Daegu, South Korea with the semi-structured questionnaire which were developed as the tool of semi-structured interview on the 5th, 6th, & 11th of November 2020. From these interviews, the survey questionnaire was finalized as in Appendix.

Fourth, we did online interviews - which were mixed with mobile interviews to control high costs and hard to reach in the Covid pandemic - of face-to-face interviews with students from the three 3 regions of the different capitalist economies who are in similar conditions regarding mobile app-based credit card; mobile app & credit card; or smart payment. The interviews were conducted with the semi-structured questionnaire in our Appendix which includes both quantitative questions and qualitative questions. The Korean research team did online and email interviews at the mathematical engineering class of the undergraduate school of Daegu Gyeongbuk Institute of Science and Technology (DGIST) on the 23rd of March in 2021, and received 41 responses, finally using used 40 valid results. The UK research team conducted interviews at the undergraduate business and management studies class with 25 student responses on the 12th of March in 2021, and at the postgraduate international business management-class with 28 student result on the 16th of March in 2021, both at Cardiff Metropolitan University. Additionally, 6 Cardiff-based non-student users were interviewed on the 19th of March 2021. And the research team finally used 53 survey cases received from Cardiff Metropolitan University students to achieve the minimum comparability among survey results of the 3 countries. The China research team did interviews class at the undergraduate science and technology innovation policy at Nanjing University of Science and Technology with 15 students results, and at the graduate internet finance class at Shanghai International Studies university (SISU) with 35 students results on the 20th and 21st of April in 2021.

2. Literature reviews, and research framework

2.1. Appearance of diverse mobile payment business models with the evolution of 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 automated teller machine (ATM)s in e-payment industry (Gerpott and Kornmeier 2009; Tsai et al. 2010; Turban and Brahm 2000). As the starting point or ascendant of mobile payment, ATM was the Model T of the electronic payment industry which first appeared at Oxford street in London on 1974 (Goldfinch 2018, 14). Currently, there are several mobile payment ecosystems which are competing without any dominant design even in the U.S., which has the most advanced mobile payment industry such as near field communication (NFC) open loop systems including Isis, or Google Wallet, Cloud open loop systems including Paypal, LevelUP, or Closed loop including Starbucks and Dunkin Donuts (Allums 2014, 36). In other words, mobile payments are not all the same, but diverse according to the adoption of mobile payment systems depending on the technology applied. The major mobile payment players include very diverse agencies from different markets, or technology domains such as device manufacturer, financial sector, customer, service provider, government, software provider, merchant, or mobile network operators, which means that the development of the mobile payment industry depends on open innovation and an open business model from diverse markets and technology domains (Al-Nawayseh 2020; Dittrich and Duysters 2007; Herzberg 2003).

The growth of mobile commerce including the increasingly popular ownership and use of mobile phones motivated the effectiveness of authorizing and managing payment and banking transactions, offering security and convenience advantages compared to online payment via PCs at first (Sumanjeet 2009). In fact, the emergence of e-commerce created new financial needs that cannot be effectively fulfilled by traditional payment systems (Sumanjeet 2009). The appearance of digital capitalism which is based on the connection between capital and date specifically requires a creative smart payment system, or digital money which is different from credit card, or money (Mayer-Schönberger and Ramge 2018).

There are a lot of diversities among mobile payment interactions; NFC of Google Wallet which has benefits of transaction speed, no need for data network, and high security, and challenges of merchant adoption, or user education; Barcodes and QR codes of Starbucks which has ubiquity on most devices and OSes, and challenges such as dependence on data connectivity, lack of security standards, or merchant acceptance; Geolocation of PayPal has benefits of works on most devices and OSes, less effort for the user to pay, and challenges such as dependence on data connectivity and GPS accuracy, user education, etc. (Allums 2014, 135). Evolution of payment ways from barter through money, or credit card, to digital payment, digital money in capitalism has motivated the increase of trust with the evolution of individual transportation system from horse carriage through train, automotive, or airplane, to car sharing, autonomous car, etc. (Botsman 2017).

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

Today's financial world is the result of four millennia of economic evolution including money crystallized in the relationship between debtor and creditor, banks creating houses for ever large aggregations of borrowing and lending, Government bonds, from the thirteenth century, equity from the seventeenth, or insurance funds and then pension funds from the eighteenth, etc. (Ferguson 2008, 313). The card industry has also evolved dramatically in the U.S. from its formation in 1960s–1970s, through expansion in 1980s, segmentation in 1990s with debit card, or commercial and purchasing cards, diversity in 2000s with PayPal, eCommerce, to digitalization in 2019s with digital wallets, NFC payments, mobile POS, P2P Bitcoin, Apple Pay, etc. With the appearance of a subscription economy, different approaches with creative 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 for transactions (Evans and Schmalensee 2016, 34). When Apple Pay started on October 20, 2014, consumers could use their existing credit or debit cards associated the card networks such as MasterCard, Visa, etc. or ten thousand commercial banks, savings banks, and credit unions, and the banks agreed to pay Apple 0.15 percent of the value of transactions done through Apple Pay (15 cents for every $100) (Evans and Schmalensee 2016, 157, 158). In Kenya and other countries where just small portion few people have bank credit card, and bank account, Matchmakers such as M-PESA, in other words, multisided platforms of mobile money for payment, are leapfrogging traditional banks or financial services (Evans and Schmalensee 2016, 167). For example, in 2014, more than 84 percent of Kenyan mobile phone users used mobile phones to transfer money, pay their bills, and pay at stores (Evans and Schmalensee 2016, 168).

Several factors such as (1) social influence, or personal innovativeness as contexts, (2) perceived risk or perceived fee as negative factors, or (3) compatibility or relative advantage as positive factors, can give effect to behavioural intention to continuously use mobile or smart payment systems (Yang et al. 2012). Customers' individual differences such as innovativeness, or M-payment knowledge, and the characteristics of mobile payment systems such as mobility, reachability, compatibility, or convenience, decide the intention to use mobile payment through perceived usefulness and perceived ease of use (Kim, Mirusmonov, and Lee 2010). In reality, adequate legislation to protect mobile payment of customers, and to maximize customers' willingness to make mobile payments is also an important requirement to make a mobile payment using the smart phone, meaning smart payment (O'Reilly, Duane, and Andreev 2012). External pressure from suppliers/customers observed by the owners of retail stores, and relative advantages described as how an innovation is perceived as beneficial, have more positive effects on retailer's behavioural intention to adopt mobile payment 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 evolution of payment industry; financialization, and Fintech including crypto currency

The idea of 'financialization' which is used to summarize a broad set of changes in the relation between the 'financial' and 'real' sector, 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 with the financial system both with regard to borrowing and holding financial assets (Dore 2008; Lapavitsas 2011). As these characteristics are motivated by the digital transformation in finance, in other words, Fintech, over the past decade, the concept of financialization has moved from periphery to mainstream of scholarly inquiry across several social-scientific disciplines including human geography (Christophers 2015). For example, the advancements in information technology spur the development of retail investment banking, allowing people from all walks of life to become investors (Van der Zwan 2014).

Recently diverse payment systems, goals of which are minimizing friction and cost, and maximizing trust, are appearing together with Fintech (Goldfinch 2018, 5). Digital money has several characteristics such as (1) frictionless transactions; (2) conducting transactions anonymously; (3) mechanisms for transparency in financial transactions like Blockchain technology; or (4) the possibility of micropayments, which cannot be found in money, or credit card (Lynn et al. 2019, 124, 125). By the way, though blockchain is mostly known for its ability to process monetary and financial transactions, cryptocurrency concerns have led U.S. watchdogs take more active role, bidding to set 'regulatory perimeter' and to break with Trump era because investors are increasingly worried about the impact of market volatility on digital currency this year, with prices plunging after China signalled a crackdown (Gary Silverman 2021). In addition, in online crime, anonymous cryptocurrencies are the payment methods of choice because Crypto laundries answer call form criminal gangs (Murrhy 2021).

Financial technology as a most important innovation in the financial industry including infrastructure, big data, data analytics, and mobile devices allow Fintech start-ups to disintermediate traditional financial firms with unique, niche, and personalized services (Lee and Shin 2018). Fintech companies, i.e. 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 in 2010s with the provider-oriented digitalization, and in 2020s with the customer-orientated digitalization (Gomber, Koch, and Siering 2017; Puschmann 2017; Thakor 2020). Alibaba started its online payment system in 2004, which is different from Paypal's direct payment method. Alipay keeps money in escrow accounts until buyers receive the products and confirm transactions, so as to establish trust between buyers and sellers at China where bank system is immature (Botsman 2017, 50).

2.4. Economic context of regional innovation system

Regionally asymmetric knowledge capabilities motivate the requirement of different industry open innovation, or different level open innovation in the same industry according to belonging regional innovation system (Cooke 2005). Open innovation in the regional level, in other words, regional open innovation could trigger collaboration for innovation in small and medium enterprise(SME)s with the suitable regional economic condition such as urbanization, industry diversity, or research institutions, and without barriers preventing SMEs from engaging in OI such as IPR, culture, or resource constraints (Leckel, Veilleux, and Dana 2020). There could be multi-level open innovation such as micro-level firm open innovation, meso level open innovation in national innovation system, and macro-level open innovation in global innovation system (Lee, Lee, and Lee 2020). In a regional cluster, there could be several elements of the open innovation ecosystem as follows; (1) regional innovation system actors; (2) culture of open innovation in the region; (3) characteristics of clusters; and (4) open innovation practices including alliances, co-patents, co-publications, etc (Vlaisavljevic, Medina, and Van Looy 2020). According to Ledesdorff, and Ivanova (2016) explained that whereas the film is central in the model of open innovation, the triple helix adds multi-centredness: in addition to firms, universities and (e.g. regional) governments can take leading roles in innovation eco-systems (Leydesdorff and Ivanova 2016). Open innovation strategies of companies benefit from certain regional culture characteristics because there is no uniform 'model of open innovation that applied to all types of regions' even though regional open innovation system could be a kind of platform for SMEs (Tödtling, Prud'homme van Reine, and Dörhöfer 2011; Torkkeli, Kotonen, and Ahonen 2007).

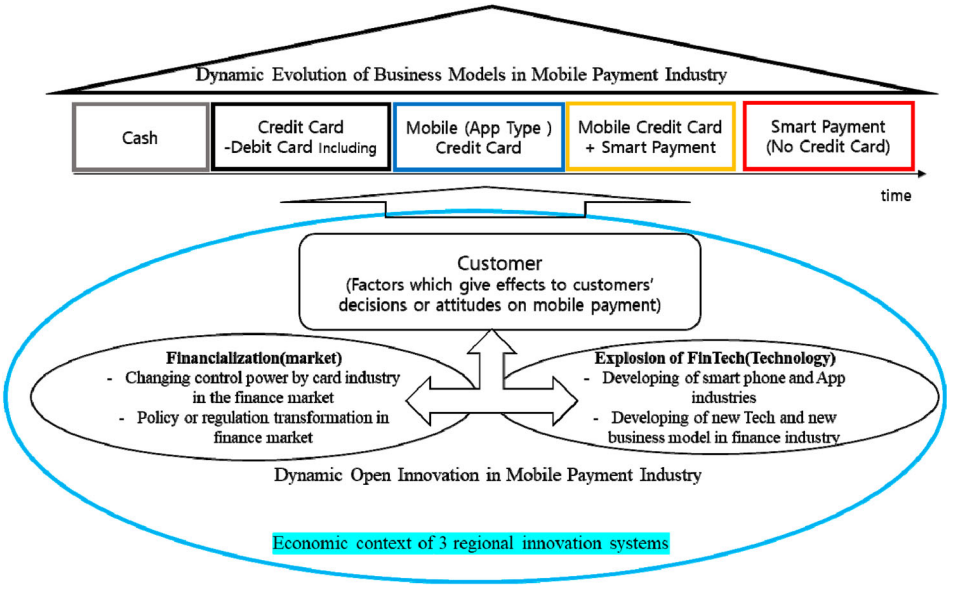

Figure 1. Research framework.

2.5. Research framework

From the literature review, we built research framework as Figure 1. First, business models in mobile payment industry are dynamically evolving with several business models together such as from cash, credit card (including debit card), through mobile app type of credit card, to mobile credit card with smart payment, or smart payment without credit card. We will compare the difference of the business model dynamics among 3 regions by qualitative interview with semi-structured questionnaire.

Second, the evolution of business models in mobile payment industry is based on dynamic open innovation in mobile payment industry between the financialization in market, and the explosion of Fintech. This study will analyze the difference of open innovation dynamics of mobile payment industry between the 3 regions by interviews, contents analysis of newspaper & related reports, or participatory observations.

Third, the difference of factors which give effects to customers' choices of mobile payment business models among the 3 economies will be analyzed through semi-structured questionnaire, and participatory observations too.

Dynamic evolution of business models in mobile payment industry will be different among the 3 regions because these regions are located in different economic context under which open innovation dynamics between the market of mobile payment industry, in other words financialization, and the technology of mobile payment industry, for instance, Fintech, are totally different from one another. Most of all, the difference of business models in mobile payment industry in the context of 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 difference of dynamic evolution of business models in mobile payment industry with qualitative analysis in the context of the open innovation dynamics of the industry, because the research has higher possibilities to find out the grounded theories in the mobile payment industry based on the research framework.

3. Analysis of dynamics of mobile payment business model at Daegu in South Korea

3.1. Preliminary analysis of street customers

As a kind of preliminary survey with the semi-structured questionnaire as shown in Appendix, Korea research team interviewed 19 customers at a 'The + coffee' cafe on November 5th 2020, 25 customers at a 'Twosome Place' café on November 6th 2020, and 18 customers at a '332' café on November 11th 2020, all of which are located in Daegu, south Korea.

First, 73.39% customers used card as the 1st payment method, and in total 88.75% of Daegu street customers used card as payment method as shown in Figure 2. The reasons Korea street customers claimed are diverse as follows; (1) It is continent to use and keep in pocket or wallet; (2) to escape to keep change money in pocket; (3) Using credit card to buy expensive product; (4) Using debit card to keep the private budget; (5) to receive the reduction of tax at a year-end tax adjustment; (6) the lock-in using credit card for long times; (7) to receive discount in price by using the pointed credit card; (8) Card is a kind of safe payment method; (9) to update credit level by using credit card.

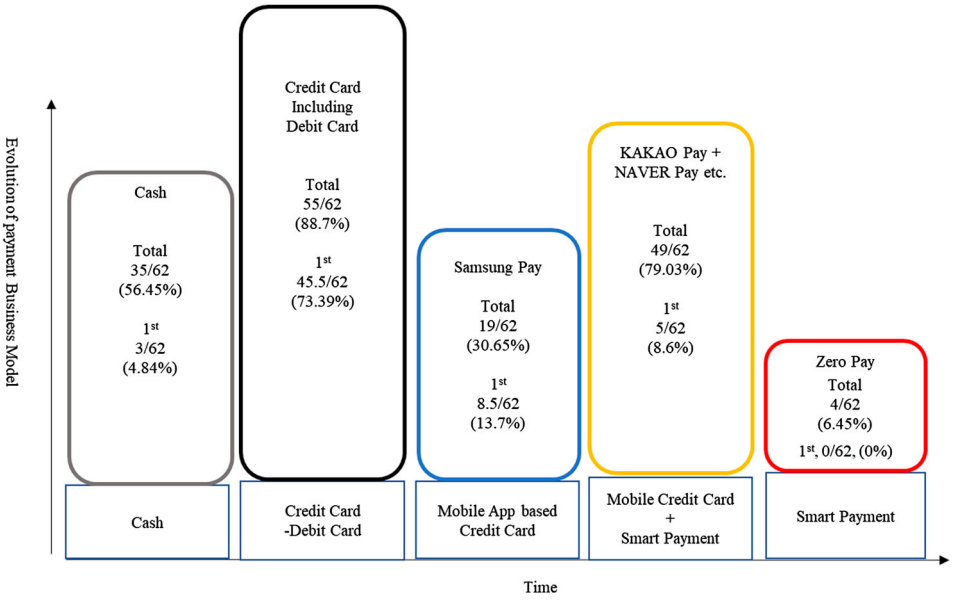

Figure 2. Preliminary study of the Daegu street customers' usage of payment methods.

Second, 8.5% customers used mobile app-based credit card, in other words, Samsung pay as the 1st payment method, and totally 30.65% customers used the mobile app-based credit card. Customers who primarily use credit card or mobile credit card were nearly 87.1% among Daegu street customers. The reasons for using mobile app-based credit card which Korea customers announced are not so diverse as follows; (1) Customers use mobile credit card when they carry mobile phone even though they do not carry card; (2) Customers can carry 2–3 credit cards which are frequently used by the customers at one mobile phone; (3) Do not need to carry card, and no carrying card is safe from lost; (4) Using mobile credit card when doing internet shopping because of convenience; (5) To receive discount by using Samsung Pay.

Third, 8.6% customers used KAKAO Pay or NAVER pay, in other words, the mobile credit card with smart payment at the 1st payment methods, and totally 79.03% customers used the mobile credit card with smart payment. Daegu street customers used KAKAO Pay or NAVER Pay for more various reasons than credit card as follows; (1) Using KAKAO Pay for convenient money transfer to distribute the cost of anything between friends at a meeting; (2) Using NAVER Pay to pay money at the mobile NAVER shopping centre; (3) Direct pay without any fee conveniently; (4) The point scores which are accumulated by the usage of KAKAO Pay or Naver Pay can be used like money easily; (5) Easy using is possible with just inputting passwords; (6) Can use offline with mobile phone; (7) Sending Gift-con, birthday gift, or diverse gift is convenient; (8) Paying for mobile delivery order is convenient; (9) Paying at the convenient store; (10) Sending presents during chatting; (11) Sending small presents such as hand cream, cakes to relatives.

Fourth, no customers used Zero pay, in other words, smart payment method as the 1st payment method, and totally 6.45% customers used the Zero pay. Smart Payment users

rarely used this method when they travel abroad or do international shopping, except to earn promotional benefits.

Fifth, 4.84% Korean street customers used cash as the 1st payment method, and totally 56.45% of Korea street customer used cash as the payment method. Cash were used at the limited conditions as follows; (1) Paying small money at mart; (2) Any place where customers can not use card; (3) At the traditional market; (4) Paying for coin laundry usage; (5) Getting discount with cash payment.

Korea research team did these preliminary interview-based survey to validate the usage of semi-structured questionnaire, and validated the survey of students for the purpose of comparing customers' behaviour of the 3 countries. From the interview, we developed the semi-structured questionnaire as shown in Appendix, which can be easily understood by the survey targets. The respondents can then generate enough answers during the survey, which can be linked to the research questions. And, if the interview results in Figure 2 are similar to the interview results of Korea customers, comparing the results of the survey on students of 3 countries will be rational and could be validated.

Daegu research team interviewed 16 hosts of cafes, restaurants, and other shops in front of DGIST on November 5th 2020, and November 6th 2020 to get supplementary data which can be referenced in this research. Among 16, all hosts announced that they adopt (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 16 claimed that they have the mobile credit card smart payment, in other words, KAKAO Pay, or NAVER Pay for customers to use. Last, just 2 hosts among 16 provide smart pay, in other words, Zero-pay as the payment method for customers to use. Even though, Korean hosts are preparing enough diverse mobile payment methods to meet customer requirement. 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 Korea 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 mobile payment business models at Daegu

Daegu student customers' usage patterns of mobile payment methods in Figure 3 are similar to those of Daegu street customers in Figure 2. So, survey of student customers' using mobile payment methods to compare the 3 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 Daegu mobile payment business models.

First, 82% student customers used card as 1st payment method, and totally 95% Daegu student customers used card as payment method as shown in Figure 3. These usage ratios are slightly higher than street customers. The reasons which Korea student customers announced are a little different from street customers as follows; (1) Students mainly used debit card only like 31 among 38 to manage pocket money

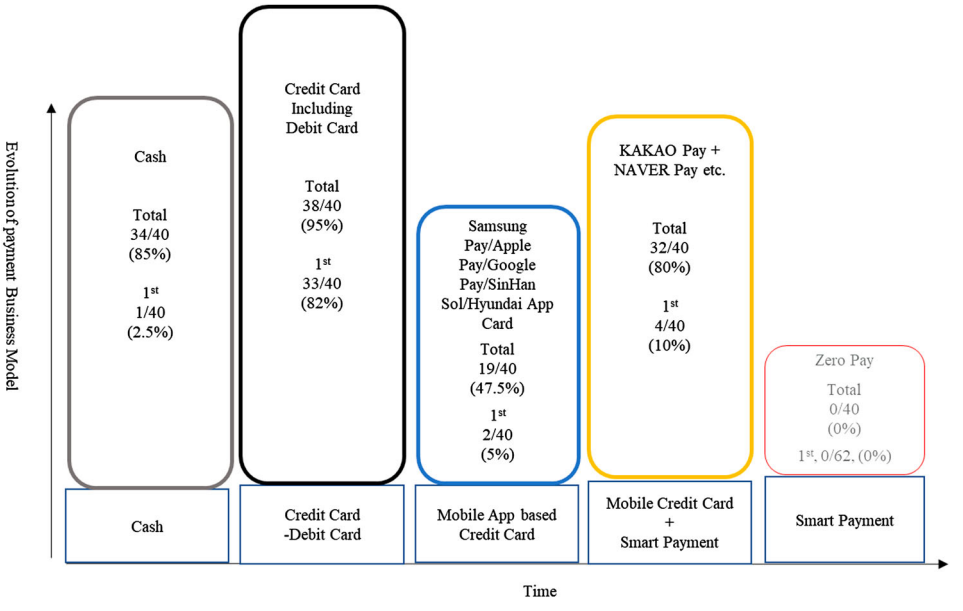

Figure 3. Dynamics of mobile payment business models at Daegu, South Korea.

well, and they did not have credit card; (2) Convenient to keep card in pocket; (3) They use the debit to accumulate the experiments of managing budget; (4) The advantage like cashback points for the using debit card; (5) To respond to the increase of non-cash using shops.

Second, only 5% Daegu student customers used mobile app-based credit card such as Samsung Pay, Apple Pay, Google Pay, SinHan Sol, or Hyundai App Card as the 1st payment method, and totally 47.5% student customers used the mobile app-based credit card. The total number of users who primarily adopt credit card and mobile credit card account for nearly 89% of Korean student customers, which is similar to the ratio of street customers 87.1%. The reasons for choosing mobile app-based credit card according to Daegu student customers are simpler than street customers as follows; (1) Most Samsung Galaxy smart phone users only used Samsung Pay. (2) Using Google Pay for paying at the Internet; (3) Using Samsung Pay which is connected with NongHeub bank, SihnHan bank, Kakao bank, Kukmin bank; (4) When not having card, students use Samsung Pay like a Debit card; (5) Using Apple Pay which is connected with bank credit cards; (6) Using ShinHan Sol app card to receive discount when buying clothes.

Third, 10% Daegu student customers used KAKAO Pay, NAVER Pay, or PAYCO, in other words, the mobile credit card with smart payment at the 1st payment methods. In total 80% Daegu student customers used mobile credit card with smart payment, the ratio of which is almost the same as Korea street customers. Half of Korean student users used only KAKAO PAY, and the 1/4 KAKAO Pay users used only NAVER Pay, and nearly 1/3 used several Pay together. Daegu 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 for the free withdraw of money; (3) Easily registering at

the site for the usage of Kakao Pay or Naver Pay; (4) Using Kakao Pay to transfer money easily; (5) Using Naver Pay because charging money is easy at the convenient stores; (6) Using Payco because of money transfer is easyby connecting with Samsung Pay; (5) It is easy to use with the confirmation by fingerprint check; (6) Using Naver Pay for Internet based payment; (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) Using for webcomic.

Fourth, Daegu student customers never used smart payment such as Zero Pay, Paypal or others. Maybe because Daegu customers use smart payment only for international paying, and Korean student customers never use smart payment method.

Fifth, 2.5% Daegu student customers used cash as the 1st payment method, and totally 85% Daegu student customers used cash as the payment method. The high ratio of cash payment by student customers is due to; (1) Using for the usage of laundry service of dormitory; (2) Buying gift certificate at discounted price; (3) Using cash when the price of cash payment is cheap; (4) When using vending machine; (5) When using coin karaoke. Maybe student's life style is more related with cash usage than street customers in terms of coin usage.

4. Analysis of the dynamics of the mobile payment business model at Cardiff in Wales

Cardiff student customers' usage patterns of mobile payment methods in Figure 4 are dramatically different from those of Korea student customers in Figure 3. So, survey

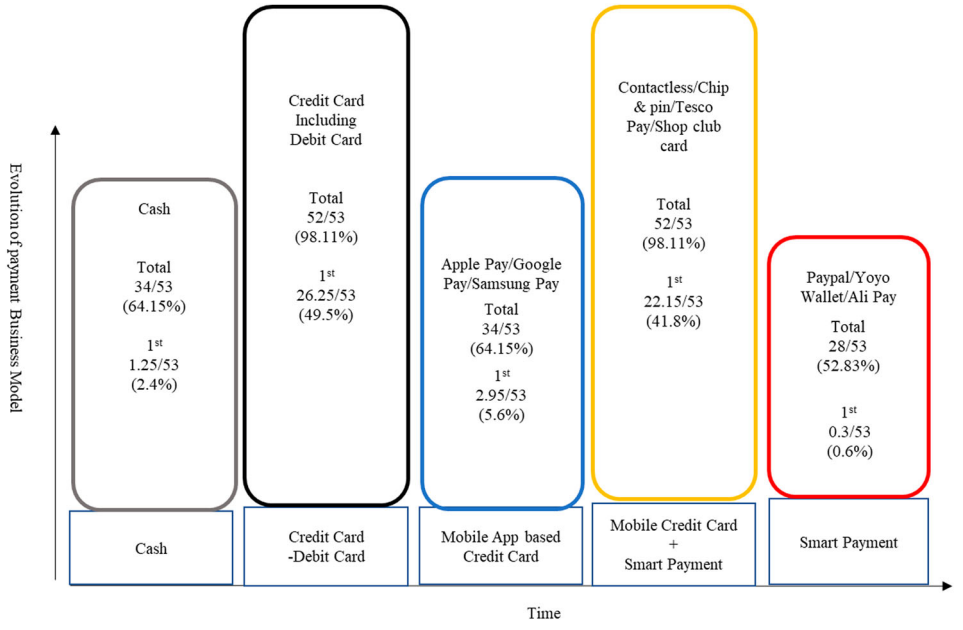

Figure 4. Dynamics of mobile payment business models at Cardiff, Wales.

of student customers' mobile payment methods to compare these 2 countries is significant by pursuing the reasons of the usage situation and comparing the changing dynamics.

First, only 49.5% Cardiff student customers used card as 1st payment method, which is nearly half of the Daegu student ratio 82%. But, the total usage ratio of card by Cardiff student customers is 98.11%, which is a little higher than that of Daegu 95%. Maybe though card has been the dominant payment business model in Cardiff for long time, young customers like students are moving to other payment business models. The reasons of using credit card which Cardiff student customers pointed out are simple as follows; (1) Cardiff students mainly use debit card for its convenience and for the usage under the budget; (2) All family in Cardiff use card together because card usage in Cardiff is popular; (3) Using for online shopping because it is a little cheap and convenient; (4) Because card is safe and convenient methods of payment. The reasons of using credit card by Cardiff student customers are simpler than Daegu student customers.

Second, just 5.6% of Cardiff student customers used mobile app-based credit card such as Apple Pay, Google Pay, or Samsung Pay as the 1st 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. But that of Google Pay is only 1.4 times. But totally 64.15% U.K. student customers used the mobile app-based credit card, which is higher than the ratio of Daegu 47.5%. Cardiff student customers use mobile app-based credit card a lot until now even though they do not use credit card as the 1st method of payment. The reasons for usage of the mobile app-based credit card which Cardiff student customers announced are a little simple as follows: (1) People prefer digital payment solution nowadays; (2) It is easy, fast, and convenient for transaction; (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 are not having cash or swiping machines; (5) It is easier to access mobile phone rather than getting it out of the wallet; (6) Apply Pay are very popular in Cardiff; (7) It entails a seamless and efficient process with safe ways; (8) Using for quick payment.

Third, 41.8% Cardiff student customers used Contactless, Chip & pin, Tesco Pay, or Shop club card, etc. In other words, the mobile credit card with smart payment function at the 1st payment methods, and totally 98.11% of U.K. student customer used the mobile credit card with smart payment, which ratios are higher than those of Daegu, each 10%, and 80%. And more than 60% student customers used Contactless among the mobile credit cards with mart payment functions. The usage of mobile credit card with smart payment function by Cardiff student customers are more popular than that of Daegu student customers. Cardiff 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; (5) It is convenient and saves time; (6) I use Contactless because it does not require pin numbers. But over 30 pounds the pin must be pushed; (7) During the pandemic time, Contactless is more secure than other payments including cash; (8) Popular and safe payment methods in Cardiff; It let customers to avoid losses from fraud; (9) For security purpose, I prefer use traditional Chip & Pin card

payment; (10) convenient to buy groceries, food, online shopping; (11) Saving time, and it is easy, fast, and convenient to use. The main reason of using mobile credit card with smart payment by Cardiff 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, totally 52.83% of Cardiff student customers used the 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% Cardiff student customers who use smart payment methods used PayPal. Cardiff student customers are becoming accustomed to the smart payment already. This means that Cardiff customers are moving from credit card through mobile app-based credit card to smart payment method now. The reasons for Cardiff student customers to use the smart payment are as follows; (1) It is very easy to use with connecting with Lloyds Bank, Bank of America, or other nationwide bank; (2) It is useful for fast payment; (3) Online banking, Security 7 Returned guaranteed as PayPal hold to the money; (4) TSB bank I 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. The banks which are connection with smart payment such as PayPal, Yoyo Wallet, Ali Pay, etc. 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 Cardiff student customers used cash as the 1st payment method, and totally 64.15% of Cardiff student customers used cash as the payment method. The ratio of cash usage by Cardiff student customers is not so high, meaning that Cardiff payment business model has moved to credit card system, and now towards the smart payment. The concrete reasons for using cash by Cardiff student customers are similar to those of Daegu; (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; (7) Sometimes I use cash if there is termination/failure of card transactions.

5. Analysis of the dynamics of mobile payment business model at Nanjing in China

Nanjing student customers' usage patterns of mobile payment methods in Figure 4 are completely different from that of Korea student customers, with small amount of casher payment and big amount of smart payment. Furthermore, they are somewhat similar to the Cardiff student customers in the sense that the smart payment method usage ratio is increasing and the cash usage ratio is not so high.

First, only 2% Chinese student customers used card as the 1st payment method, and totally just 34% Nanjing student customers used credit card as payment method as shown in Figure 5. These usage ratios are much lower than Daegu student customers, with ratios

82% and 95% respectively. The low usage ratio of credit card by Nanjing student customers means that Nanjing has not been locked in the usage of credit card, because young customers have not succeeded the habit of using credit card. The reasons for using credit card which Nanjing student customers claimed 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% Nanjing student customers used mobile app-based credit card such as Huawei Pay, Apple Pay, or Oppo Pay as the 1st payment method, and totally only 22% Nanjing student customers used the mobile app-based credit card. This ratio is smaller than half the ratio of Daegu students, 47.5%, and nearly one/third the ratio of U.K. students, 64.15%. The small ratio of mobile app-based credit card by the Nanjing student customers confirms that Nanjing has not experienced the dominance of credit card even in the type of mobile credit card. The reasons for using mobile app-based credit card by Nanjing student customers are summarized as; Using Apple Pay for VIP payment; Convenient for paying meals.

Third, only 1% Nanjing student customers used mobile credit card with smart payment such as Union Cloud Pay, Baidu Pay, or Meituan Pay, etc. Altogether only 22% Nanjing student customers used the mobile credit card with smart payment. This ratio is 1/4 of Daegu's, 80%, and nearly 1/4 of the Cardiff ratio, 98.11%. This means that mobile credit card with smart payment system in Nanjing has not received attentions from even young customers, which is totally different from the situation of Daegu and Cardiff. Nanjing student customers used Union Cloud Pay, Baidu Pay, or Meituan Pay, etc. for the following reasons; (1) Using Union Cloud Pay for the credit upgrade,

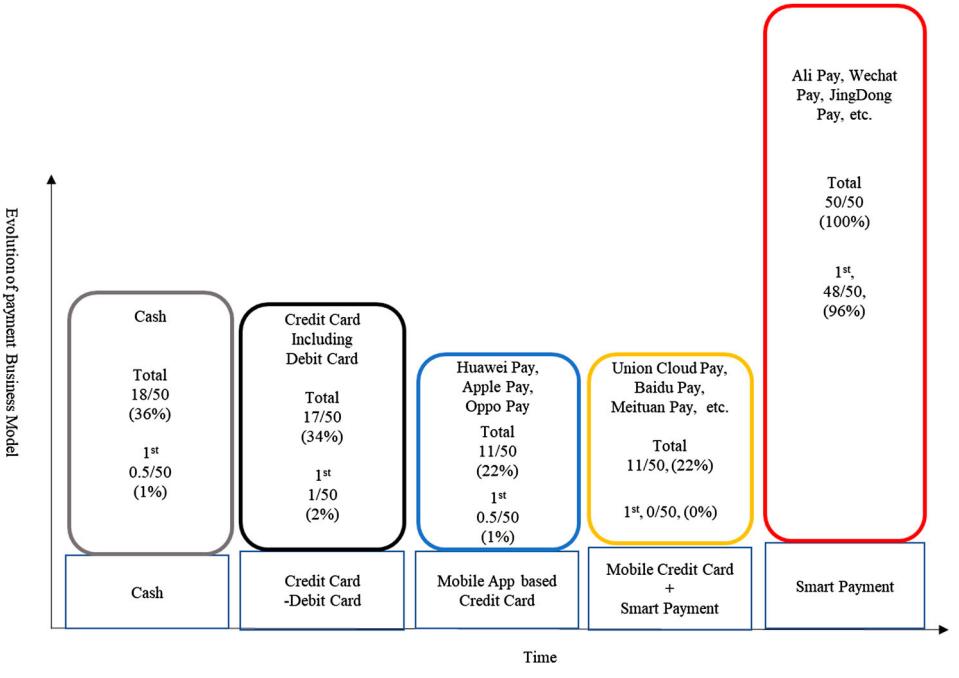

Figure 5. Dynamics of mobile payment business models at Nanjing, China.

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%) Nanjing student customers used the smart payment methods such as Ali Pay, Wechat Pay, JingDong Pay, etc. as the 1st Payment method. This is opposite to the ratio of Daegu 0%, and Cardiff o.6%. Altogether 100% Nanjing student customers used this Smart Payment System which did not required connection with any credit card. The main payment methods of Nanjing according to Nanjing student customers are the smart payment system. Maybe Nanjing moved from cash-based payment method directly to the smart payment system without card payment system and the mobile credit card with smart payment system. This is the traditional example of leap-frog innovation in catch-up economy (Mu and Lee 2005). Nanjing student customers used Ali Pay, Wechat Pay, or JingDong Pay, etc. 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 the linking with bank card; (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% Nanjing student customers used cash as the 1st payment method, and totally 36% Nanjing student customers used cash as the payment method. The total usage ratio of cash by Nanjing student customers is smaller than Daegu 85%, and Cardiff 64.15%. This means that Nanjing is almost moving towards the No. 1 cashless society in the world. The only reasons why Chinese student customers use cash are as follows; (1) Paying for bus tickets; (2) Using cash at specific places, etc.

6. Discussion: grounded theories in the evolution of mobile payment business models

6.1. Evolution of smart payment industry under the context of 3 regional innovation system

Through the comparison of the 3 regions in terms of mobile payment industry, the diverse directions of mobile payment industry could be understood under the context of evolution of open innovation in the regional innovation system including the value-based network (Kim and Shin 2021). If the evolution of mobile payment is understood at the decrease of using cash, and the increase of smart payment methods which are not connected with credit card, then the evolution of mobile payment industry can be illustrated as Figure 6.

First, Daegu has the highest ratio of cash usage. Cardiff has smaller ratio of cash usage than Daegu, and Nanjing has very small ratio of cash usage. The most popular payment method among Daegu customers is credit card until now. The next popular payment

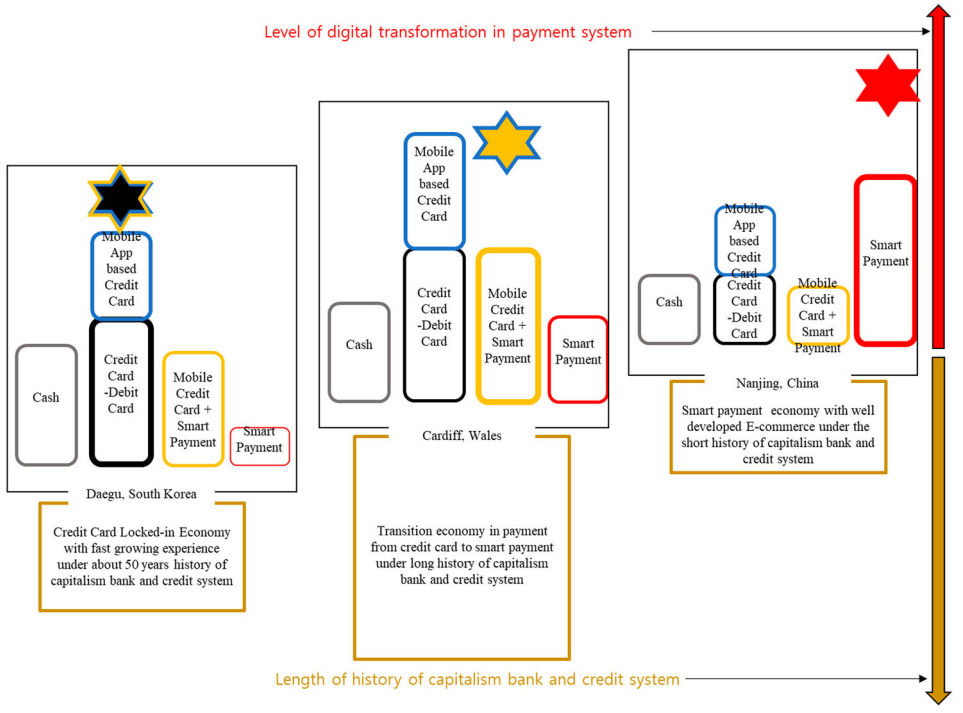

Figure 6. Comparing 3 regions from the perspective of mobile payment business model evolution.

method among Daegu customers is mobile credit card with smart payment function, and the 3rd method is mobile app-based credit card. While cash is mainly used as supplementary payment method, Daegu customers adopt all credit card connected payment methods including such as credit card, mobile app-based credit card, or mobile credit card with smart payment function. To summarize, Daegu is in the credit card locked-in economy which depends on the expanded card-based payment business models. Daegu has credit card locked-in economy with fast growing experience under about 50 years history of capitalism bank and credit system even though the level of digital transformation in payment system is located behind than Nanjing.

Second, Wales has the highest ratio in terms of using mobile credit card with smart payment function. Daegu shows smaller usage ratio than Wales, even though it is higher than Nanjing. In addition, Cardiff has higher usage ratio in mobile app-based credit card, and credit card than Daegu. The result indicates that the adoption of credit card by Cardiff customers are higher than Daegu customers. Moreover, Cardiff customers become accustomed to smart payment methods as the second payment method with the usage ratio of 52.83%, which is opposite to Daegu where 0% customers choose smart payment. Cardiff represents transformational economy in terms of payment system from card to smart payment. Cardiff is in transition from credit card to smart payment industry under long history of capitalism bank and credit system.

Third, Nanjing has the highest ratios, 100% in total and 96% 1st usage of the smart payment methods, in contrast to Cardiff with the usage ratio 52.83% ranking the second place, and Korea with the total usage ratio 0%. In addition, Nanjing 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%, even though 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, Nanjing is in the first place of the smart payment economy. Nanjing is located in the smart payment economy with well-developed E-commerce, and smart delivery economy even though it has very short history of capitalism bank and credit system than Daegu and Cardiff (Yun et al. 2020).

6.2. Grounded theory 2: the scenario of the evolution dynamics of mobile payment business models

Based on the data analysis with the comparison of business models in 3 regions as a kind of natural experiment, 3 additional scenarios of the evolution dynamics of mobile payment business models (A-1), (B-1), and (C-1) as shown in Figure 7 can be proposed.

First, mobile app card focused payment business model can appear at all credit card lock-in economies such as Daegu like (A). Maybe, if card industry defends the existing benefits against newcomers from Fintech firms through maintaining the regulation of 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 featured by locked-in credit card industry.

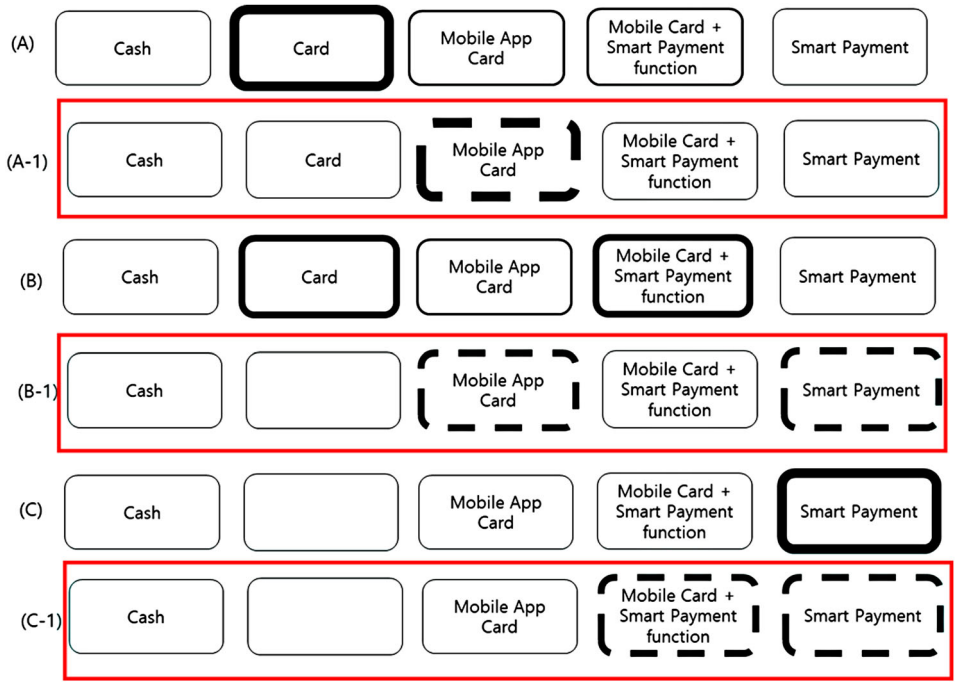

Figure 7. Additional scenarios of the evolution dynamics of mobile payment business models.

Second, if the transition economy from card payment to smart payment continues for a long time at Cardiff in Wales, the parallel economies between mobile app card and smart payment can appear like (B-1). This scenario is based on the full development of mobile card industry, and the sufficient growth of smart payment firms from Fintech industry. The full development of mobile app card can satisfy customers differently from smart payment method. Furthermore, the growth of smart payment methods can generate customer satisfactions which could not be provided by mobile app card. If U.S. continues to evolve in mobile payment business models (B-1) can appear. (B-1) can be the future of many countries which are in the similar condition with U.K., for example, U.S., Australia, Canada, etc.

Third, if the smart payment economy like Nanjing continues to invite various ideas of card industry, or increasely collaborate with card industry, the future of 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 has not experienced locked-in card industry like Nanjing, can develop smart payment economy and mobile card with smart payment function together with the support from card industry of western countries and smart payment industry of China (Christensen, Ojomo, and Dillon 2019, 140).

6.3. Grounded theory 2: the double locked-in credit card effects in Korea payment industry

First, according to the natural experiments, the pattern of Daegu refers to countries where new financial business cannot be established without the setting up of related laws. In contrast, the situation of Cardiff 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 Cardiff where customers have experience to be locked in credit card industry, and Nanjing where customers have no experience to be locked in credit card industry, Cardiff system is locked-in with the long experience of using credit card as shown in Figure 8.

According to natural experiments, the evolution of mobile payment industries of the 3 economies can be compared. Daegu shows the pattern of double locked-in credit card

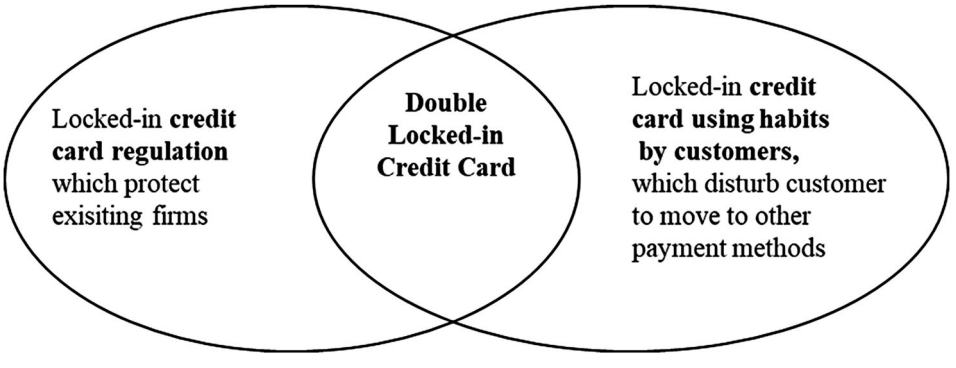

Figure 8. Korea model with double locked-in credit card.

industry in terms of (1) locked-in credit card regulation which protects existing firms, and (2) locked-in credit card using habits by customers, which prevent customers switching to other payment methods. The double locked-in nature of credit card can explain the reasons why Daegu is still lagging behind in the smart payment industry, even though Korea has the global number one internet speed which is essential to develop smart payment industry and Korea is advanced in Fintech industry (Jeon and Pak 2020; Shin and Choi 2019).

7. Conclusion

7.1. Implication

First, this study found out diverse evolution dynamics of business models on smart payments, which are different according to economic context of regions, and motivate diverse effects of R&D alliance and network position on firm innovation performance (Wang and Quan 2017). Second, this research found out additional scenarios of business model evolution dynamics, which can be used to analyze the development trend and formulate the plan of payment industries. Third, this study found out the double locked-in effects in payment industries. This effect exists in Korea, and half in U.K.

7.2. Limits and future research topic

First, the context of the evolution dynamics of payment business models, in other words, the financialization and the explosion of Fintech in 3 economies not just in 3 regions should be analyzed totally in the next research under the context of political economics. This will provide clues for understanding the difference in open innovation dynamics of payment industry among the 3 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 could be analyzed directly in engineering approach to understand the future of mobile payment industry.

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Appendix

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 of **credit cards do** you use per week?
What kinds of credit cards among (1) Credit card(Visa, master, Amex, JCB, UnionPay, et al.), (2)Debit card, or others (3) others. do you use?
Why do you use them?

(2) How many time(s) do you use the **credit cards based mobile phone payment** per week?
What kinds of the credit cards based mobile phone payment among (1) Samsung Pay, (2) LG Pay, (3) Apple Pay, (4) Google Pay, (5) Others which are connected with any credit card, do you use?
Why do you use them?

(3) How many times do you use the **credit cards connected easy payment** per week?
What kind of the credit cards connected easy payment among (1) Kakao Pay, (2) Naver Pay, (3) Payco Pay(NHN Pay), (4) UB Pay, 50 Others, do you use?
Why do you use them?

(4) How many times do you use the **credit cards non-connected easy payment** per week?
What kind of the credit cards non-connected easy payment among (1) Zero Pay, (2) Ali Pay, (3) Wechat Pay, (4) Pay Pal, (5) Others, do you use?
Why do you use them?
*Even though Pay Pal is based on the credit card registration, it is treated as the credit cards non-connected easy payment because it has weak link with credit card in reality.

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

(6) What do you use as payment method?