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Payment Revolution: Development Trajectory of Mobile Payment and International Comparison

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Abstract— *With the advancement of technology, it is now commonplace for everyone to own a smartphone. In recent years, various innovative functions have been developed, among which "mobile payment" has enhanced the convenience of consumption, allowing people to go shopping with just a mobile phone. With the change in consumption patterns and the proliferation of smartphones and the internet, mobile payment is gradually replacing traditional payment methods. Therefore, our project group has chosen "mobile payment" as our theme to explore its development trends in Taiwan and its impact on the public. A cashless society represents the optimization and increased efficiency of the overall financial system, as well as encouraging industrial innovation and providing innovative services. Through this project, we aim to guide the public through the trajectory of this transformation [1]. This project will examine how mobile payment has evolved from its inception to the present, covering Bank 1.0 to 4.0 and the issue of mobile payment penetration in Taiwan. Finally, we will look at future prospects and how to significantly increase the usage rate of mobile payment in Taiwan within an effective timeframe.*

Keywords— ***Mobile Payment, Third-Party Payment, Electronic Payment, Cashless Society, Financial Technology.***

I. INTRODUCTION

1.1 Research Background and Motivation

With the vigorous development of online finance and e-commerce, people's consumption habits are also changing. To enable a more convenient and efficient lifestyle, a variety of payment tools have been created. Driven by the high development of finance and communication technology, along with the prevalence of smartphones, the method of transaction is gradually shifting from cash payments to mobile phone payments, with the proportion increasing daily. This involves methods such as apps, QR codes, NFC wireless sensing, combined with the mobile phone's built-in security features like Face ID and fingerprint recognition, integrated with credit cards and debit cards. Consequently, the mobile phone is gradually becoming a mobile wallet, allowing people to go out carrying just a phone without the need for a wallet [2]. With technological advancement, integrating mobile devices, telecommunications, and banks to create a more user-friendly mobile payment system is the future trend. From the commodity money of early human society to the plastic money of modern economic society and now to mobile payment, the medium of transaction in human society has continuously progressed and changed. The cashless approach not only reduces currency manufacturing costs and administrative expenses but also simplifies payment procedures, lowers transaction costs, and makes transactions more transparent.

1.2 Research Objectives

According to the Institute for Information Industry in 2019, the usage rate of mobile payment in Taiwan was 26.8% in 2016, 39.7% in 2017, and reached 50.3% in 2018. The data shows that Taiwanese consumers' usage of mobile payment is growing year by year, but the

acceptance of mobile payment has not been fully adopted by consumers. In 2014, LINE Pay entered the Taiwanese market. Taiwan also launched its domestically developed t-wallet in 2015. In November 2016, the Financial Supervisory Commission (FSC) officially announced the opening of applications for international mobile payment services such as Apple Pay, Samsung Pay, and Android Pay, which officially launched in Taiwan in March 2017. In September 2018, LINE Pay partnered with iPASS Corporation to launch LINE Pay iPASS, providing more comprehensive functions for LINE's mobile payment service, leading to an increasingly diverse range of mobile payment tools. In 2018, the III conducted a survey on "mobile payment" among consumer groups aged 18 to 65 who use the internet and own smartphones in northern, central, and southern Taiwan. The survey showed that the mobile payment penetration rate in Taiwan reached 50.3% in 2018. However, compared to neighboring countries like South Korea and Hong Kong, Taiwan is still in a developmental stage. The main purpose of this study is to explore why, despite the availability of various mobile payment methods in Taiwan, the adoption rate is relatively low compared to other countries, and to discuss the future prospects of mobile payment in Taiwan.

1.3 Research Process

This project is divided into four chapters. Chapter 1 is the introduction, explaining the research background, motivation, objectives, and process. Chapter 2 covers the evolution of payment tools, detailing the differences in payment methods across various periods. Chapter 3 defines mobile payment, elaborating on its past, present, and future. Chapter 4 presents the conclusion, summarizing the findings of this project and incorporating our perspectives on the development of mobile payment.

II. MOBILE PAYMENT TOOLS

2.1 Evolution of Payment Tools from Bank 1.0 to 4.0

The concepts of Bank 1.0, 2.0, 3.0, and 4.0 originate from the Bank X.0 book series published by financial innovation research expert and futurist Brett King. Brett King is renowned as a "bank disrupter" and "rule-breaker of banking," was named an American Banker Innovator of the Year in 2012, and is the founder of the world's first cardless mobile bank. Since 2010, he has successively proposed four stages of banking development [2].

2.1.1 Bank 1.0: The Era of Physical Banking

The term "bank" is derived from the Italian word "Banca," meaning "bench" or "chair." Early bankers were also referred to as "people who sat on long benches." Banca Monte dei Paschi di Siena (Banca MPS), also from Italy, is regarded as the oldest bank in the modern global banking system. Its founding in 1472 marked the beginning of the Bank 1.0 era. Bank 1.0 was primarily characterized by "physical banking," referring to a banking business model entirely based on physical bank branches. Customers had to visit branches to conduct related transactions. For this reason, extensive manual operations were required, preventing banks from achieving specialized division of labor and failing to discern customer needs. During this period, payment tools mainly used cash as the medium of exchange. People often had to travel long distances to bank counters to handle many transactions, and the business model essentially remained unchanged.

2.1.2 Bank 2.0: The Era of Automation and Networking

The first iteration phase: Starting in 1950, Bank of America spent ten years developing the Electronic Recording Method of Accounting (ERMA) system, capable of processing 750 million checks annually. This made it the world's first bank capable of offering credit cards linked to user bank accounts, boosting its profitability beyond that of its competitors at the time, and by 1970, it had leaped to become the world's largest bank. Stimulated and bolstered by this successful case of "replacing manual labor with electronic technology," the introduction of online banking rapidly changed customer reliance on physical bank branches, transforming contemporary perceptions and mindsets regarding banking forms. In 1980, ATMs (Automated Teller Machines) gradually became widespread globally. Self-service signified the banking industry's entry into the Bank 2.0 era: users could access ATMs outside physical branches at their desired time and location to autonomously complete simple transactional banking tasks.

The second iteration phase: In October 1995, the world's first online bank, Security First Network Bank (SFNB), was officially established. Its developed electronic financial services not only offered all the functions of traditional banks but also successively launched new online financial products for customer convenience to meet diverse needs. Subsequently, emerging online banks proliferated rapidly. Their considerable convenience and speed quickly altered users' reliance on physical bank branches. In the Bank 2.0 era, payment tools were still primarily cash-based, but they were gradually becoming computerized and networked. Transactions like remittances could be completed through "wire transfers" or "ATMs."

2.1.3 Bank 3.0: The Era of Mobile Banking

In the book *Bank 3.0*, Brett King specifically notes: "Banking is no longer a place you go to, but something

you do!" As long as you have a smartphone, you can conduct banking activities beyond cash at any time and any place. This significantly changed user behavior and consumption habits, breaking away from the banking service model based on physical branch networks. Physical branches were no longer a place customers needed to visit; the choice of financial products shifted, and customers became the dominant party in the bank-customer relationship. In the Bank 3.0 era, third-party payment and electronic payment began to flourish. Bank cards and cash were gradually being replaced by mobile payment.

2.1.4 Bank 4.0: The Era of Embedded Finance

In the book *Bank 4.0*, Brett King begins by proposing to "get back to first principles." Bank 4.0 utilizes technology, enabling not only traditional banks to provide financial services but also embedding financial services into daily life scenarios. The development and popularization of innovative technologies such as artificial intelligence (AI), voice recognition devices, wearable smart devices, 5G communication, and blockchain allow banking functions and experiences to completely detach from physical branches and branch-centric channel extensions, embedding directly into our daily life scenarios. Upon entering the Bank 4.0 era, more than half of bank revenues are expected to come from digital channels, with revenue from external channels such as e-commerce platforms, influencers, and smart speakers also growing simultaneously.

2.2 Third-Party Payment and Electronic Payment

So-called third-party payment refers to a transaction support platform provided by independent third-party institutions that have signed agreements with banks in the product's country and abroad, possessing certain strength and creditworthiness. The payment method involves payment settlement. Classified by payment procedure, settlement methods can be divided into one-step payment methods and step-by-step payment methods. The former includes cash settlement, instrument settlement (such as checks, promissory notes, bank drafts, acceptance bills), and transfer settlement (such as wire transfer, online payment). The latter includes letter of credit settlement, guarantee letter settlement, and third-party payment settlement.

Electronic payment refers to the transfer of funds through electronic payment systems or electronic payment instruments. It involves using networks or electronic payment platforms as intermediaries, accepting user registrations and opening accounts (i.e., electronic payment accounts) that record fund transfers and stored value. These platforms utilize electronic devices to transmit payment and receipt information via network connections, operating businesses that involve "agency collection/payment for actual transactions," "accepting stored value," and "fund transfers between electronic payment accounts" for payers and payees. Taiwan has established a comprehensive electronic payment clearing system. The Central Bank Interbank Fund Transfer and Clearing System (referred to as the Central Bank Interbank System) and the Financial Information Service Co., Ltd. (FISC) interbank transfer system are key financial infrastructures, using central bank money and commercial bank money as settlement assets. Their safe and smooth operation contributes to the development of diverse domestic electronic payment mechanisms.

2.3 Differences Between Third-Party Payment and Electronic Payment

Third-party payment and electronic payment have clear distinctions in terms of competent authority, regulations, capital requirements, and business scope. The competent authority for electronic payment is the Financial Supervisory Commission (FSC), governed by the "Regulations Governing Electronic Payment Institutions," with a minimum paid-in capital requirement of NT$500 million. Accounts can engage in stored value, transfers, collection and payment agency, etc., with a maximum stored value of NT$50,000. The competent authority for third-party payment is the Ministry of Economic Affairs (MOEA), governed by the self-disciplinary rules for credit card acquiring institutions, with no minimum capital requirement. Accounts cannot hold stored value or conduct transfers, only agency collection and payment services. Through this classification, consumers can choose the most suitable mobile payment platform based on different payment scenarios and functional needs.

III. DEFINITION AND DEVELOPMENT OF MOBILE PAYMENT

3.1 Origin of Mobile Payment in Taiwan

Taiwan only established the Regulations Governing Electronic Payment Institutions in 2015, which also gave rise to many models. The Financial Supervisory Commission (FSC) [3] defines mobile payment as follows: "Mobile payment refers to operators applying emerging technologies to download physical payment tools such as credit cards and electronic tickets onto mobile devices, transforming the mobile device into a wallet. After consumers go through application and identity verification processes, they can use the mobile device to conduct consumption transactions." According to the Bank for International Settlements (BIS) Committee on Payments and Market Infrastructures, it involves initiating and transmitting payment instructions using voice, text

communication, or Near Field Communication (NFC) technology. In layman's terms, "mobile payment" achieves the goal of a cashless transaction process through handheld mobile devices.

3.2 Current State of Mobile Payment in Taiwan

Mobile payment has grown rapidly. After January 2017, three international operators—Apple Pay, Samsung Pay, and Google Pay—entered the Taiwanese market, sparking a wave of mobile payment adoption domestically. According to the "Taiwan Mobile Payment Consumer Survey" published by the Market Intelligence & Consulting Institute (MIC) of the Institute for Information Industry (III) in January 2018, the proportion of people in Taiwan who had used mobile payment increased from 19% over the previous two years to 39.7%. In 2019, the top five mobile payment services used by consumers were, in order, "Line Pay (59.6%)," "JKO Pay (40.7%)," "PX Pay (32.6%)," "Taiwan Pay (27.3%)," "Apple Pay (25.3%)," and FamilyMart's "Fami Pay (25.3%)."

A major mobile payment survey for the first half of 2020 showed that among all payment methods supported by merchants, the ratio of domestic consumers preferring mobile payment (40.91%) surpassed that of physical credit and debit cards (33.9%) for the first time. Additionally, among consumers' commonly used transaction methods, mobile payment usage grew from 43.8% in 2018 to 59.7% in the first half of 2020, tying with electronic tickets (60.1%) for the first time, which ranked third. Senior industry analyst Hu Zili stated that while there is no immediate direct substitution relationship between mobile payment and physical electronic tickets in the short term, it is worth observing whether the two will enter a golden cross in the medium to long term. Furthermore, if the Regulations Governing Electronic Payment Institutions and the Regulations Governing Issuance of Electronic Stored Value Cards are merged into one law in the future, the subsequent impact on the industry is also worth observing [1].

Delving into user usage patterns, MIC pointed out four major trends worth noting: "an increase in the proportion of users using only one mobile payment app"; "the Taiwanese mobile payment market beginning to converge"; "Apple Pay users have high spending power, while JKO Pay users have high transaction frequency"; and "due to the impact of the pandemic in 2020, hygiene factors have become an important reason for continued user usage." The survey showed that 80% of users used between 1 and 3 apps. However, the proportion of users using only one app increased from 23.6% in 2019 to 37.9% in the first half of 2020; conversely, the proportion of users using 2 to 3 apps generally decreased. Observing the rankings of the most frequently used mobile payment services, the top five general-purpose services were LINE Pay (28.1%), JKO Pay (15.5%), Apple Pay (9.7%), Easy Wallet/EasyCard Pay (6.2%), and E.Sun Wallet (5.1%). The top five merchant-specific services were PX Pay (11%), Fami Pay (3.8%), Open Wallet (1.7%), Carrefour Pay (1%), and HAPPY GO Pay (0.7%). These ten mobile payment services already accounted for 82.8% of total users, indicating a converging trend in Taiwan's mobile payment market.

3.3 Development of Mobile Payment in Various Countries

3.3.1 Development of Mobile Payment in China

Driven by operators like Alipay and WeChat, China's mobile payment penetration rate has reached 86%, ranking first globally. The development of mobile payment in China is inseparable from the contributions of the two giants, Alipay and WeChat Pay. Alipay, a subsidiary of Alibaba Group, began providing services on December 8, 2004, primarily offering payment, transfer, stored value, bill payment, wealth management, insurance, and charity services. WeChat Pay, developed by Tencent, began providing services on August 5, 2013, primarily offering features like sending red packets, Li Cai Tong (wealth management), biometric identification, ride codes, and license plate payment. The reason for promoting mobile payment is that physical channel development is not comprehensive in many regions of China; convenience stores and banks are not ubiquitous, and the damage and counterfeiting of circulating banknotes are serious issues, making the implementation of mobile payment necessary [4].

3.3.2 Development of Mobile Payment in Japan

Due to its historically stable financial market, Japan started developing mobile payment later than many other countries. To prepare for hosting the Tokyo Olympics in 2020, Japanese operators began developing mobile payment services two years earlier to avoid missing out on business opportunities from tourists visiting Japan. Major operators include LINE Pay, Rakuten Pay, Amazon Pay, and PayPay. Factors affecting mobile payment development include consumer preference for cash payments and the cost considerations for physical store operators regarding the installation and maintenance of equipment. A 2018 government survey in Japan showed that only 19.9% of the population used mobile payment. Consequently, in October 2018, the government proposed a Cashless Vision report, raising the consumption tax from 8% to 10%. The government allocated 81.2 billion yen to merchants, enabling consumers to receive 2-5% cashback when using mobile payment at stores. The goal is to

increase the mobile payment usage rate to 40% by 2025, with an ultimate target of 80% [5].

3.3.3 Development of Mobile Payment in South Korea

In South Korea, the original intention behind introducing mobile payment models was to simplify the online credit card payment process. Major operators include Naver Pay, Kakao Pay, Samsung Pay, Payco, Zero Pay, and LINE Pay. The reason for developing mobile payment is that South Korea began implementing tax reduction policies for both merchants and consumers in 1994, using tax incentives to attract participants. For merchants, those willing to accept card and electronic payments were offered reductions in value-added tax and business income tax. For consumers, those using credit cards and debit cards for electronic payments were offered comprehensive income tax deductions. By providing tax incentives to both supply and demand sides of the market, the South Korean government successfully promoted the development of electronic payment in the country [6].

3.3.4 Development of Mobile Payment in Singapore

Singapore promoted mobile payment in 2015. However, in the initial stage, the multitude of electronic payment systems and the proliferation of various technologies, coupled with the lack of interoperability between systems, created inconvenience for consumers and added costs for merchants. Consequently, most people still used cash and credit cards. The Singaporean government planned to standardize payment methods using QR codes, allowing users to pay by scanning QR codes with their mobile phones. By 2019, the Singaporean government successfully integrated various device models and over 20 payment models using QR codes, achieving the vision of "one device, one code." The main reason was the 0.5% merchant discount rate introduced by the Singaporean authorities, which was lower than the market average of 2% to 5%, significantly increasing merchant willingness to participate [7].

3.4 Future Prospects of Mobile Payment

According to MIC research, future mobile payment will develop towards four major cross-border directions: cross-border, cross-device, cross-context, and cross-physical-virtual integration.

Cross-border: Although mobile payment has localization characteristics, operators seek to increase the locations where their users can use mobile payment. This serves both to expand the usage areas for existing users and to attract consumers from other international markets, driving the development of mobile payment solutions across borders. The first type consists of multinational operators like MasterCard and Visa. The second type includes emerging startups that have risen to prominence in recent years, such as Sweden's iZettle and Klarna. The third type refers to multinational non-payment sector operators like Apple, Samsung, Google, and LINE.

Cross-device: The most widely recognized form of mobile payment involves completing payment processes in physical merchant environments through mobile devices. However, to accommodate various consumer habits and accelerate market penetration, operators are gradually extending from mobile devices to other platforms, such as apparel accessories, smart in-vehicle systems, and smart home appliances. For apparel accessories, operators are attempting to integrate mobile payment into items worn on the body, such as wristbands, clothing, glasses, gloves, and rings. Regarding smart in-vehicle systems, US automaker Ford launched "Ford Pass," allowing car owners to use it to complete parking payments, book car-sharing services, and more.

Cross-context: Mobile payment was initially developed to solve the inconvenience of consumer payments and overcome the efficiency issues of checkout processes in physical stores. However, as the number of operators entering the mobile payment market increases, the basic function of transaction payment will gradually fail to meet consumer demands. To differentiate their target markets from competitors, operators are increasingly adding more financial activity contexts supported by mobile payment. Additional contexts already developed include peer-to-peer (P2P) expense splitting and transfers, bill payment and withdrawals, crowdfunding and donations, lending, and financial wealth management.

Cross-physical-virtual: Mobile payment emphasizes the payment method used by consumers to complete transactions, obtain goods, or use services with physical merchants. However, due to industry co-opetition dynamics, the boundary between mobile payment and mobile online shopping is gradually blurring. This means consumers can directly use mobile payment to complete e-commerce purchases or directly use online payment tools to transact with physical merchants. This involves development from physical mobile payment towards virtual online payment, such as Apple Pay expanding from supporting only physical mobile payment and in-app purchases to supporting in-web payment functions. Conversely, it also involves development from virtual online payment towards physical mobile payment, as operators originally focused on online payments, like Alipay, Amazon, Google, and PayPal, have launched services integrating mobile payment.

Emerging Technology Applications: In terms of artificial intelligence, smart assistants like Alexa, Siri, Google

Assistant, and Microsoft's Cortana are already highly useful question-answering systems. In the future, through contextual artificial intelligence, they will enable true conversation or dialogue, becoming genuine personal assistants that provide tailored financial advice based on contexts and goals important to the user. Regarding Bitcoin and blockchain technology, decentralized technologies can help establish real-time, secure, cross-border payment systems, allowing users to access services directly without needing intermediaries [2].

Taiwan's Future Development Strategy: The most crucial aspect in the development process of mobile payment is constructing an ecosystem. Taiwan's approach to developing mobile payment involves creating a payment ecosystem integrated with daily life, utilizing diverse scenario applications to invigorate the payment system. By expanding the business scope of electronic institutions and opening up cross-institution interoperable fund transfer services, payment convenience for the public can be increased, fostering a favorable environment for the development of electronic and mobile payment in Taiwan. The FSC has promoted amendments to the "Regulations Governing Electronic Payment Institutions," focusing on four key areas: expanding the business scope of electronic payment institutions, opening cross-institution interoperable fund transfer services, increasing payment convenience for the public, and creating a friendly environment for sound industry development. Citing an MIC survey, the National Development Council (NDC) indicated that the domestic mobile payment penetration rate has reached 60%. It will continue to expand the consumption scenarios for domestic mobile payment to achieve the policy goal of a 90% penetration rate by 2025 [3, 8].

IV. CONCLUSION AND RECOMMENDATIONS

For merchants, willingness to cooperate with government policies is variable. For many businesses operating in Taiwan, accepting cash remains the top priority. The primary reason is that vendors or small shops can use cash transactions to "avoid taxes." Another reason is the issue of "transaction fees." For small businesses like breakfast shops, profit margins are already slim. A 2% transaction fee means that for every NT$50 meal sold, NT$1 is deducted as a fee. While this may seem insignificant, it accumulates into a considerable expense over time.

For consumers, among the many who have not yet used mobile payment, the first concern is certainly "security." Compared to traditional credit cards, where the card number is directly exposed during a transaction and even store clerks handling the card may come into contact with sensitive information such as security codes and expiration dates, digital credit card payment services do not actually transmit the real card number but rather a virtual token, offering greater security than physical cards. Therefore, compared to credit cards, using mobile payment is actually more secure. However, for new, unfamiliar technologies, the "early adopters" willing to try them first are ultimately a minority; more time is still needed for further widespread adoption.

Regarding policies and regulations, relevant laws concerning third-party payment have only recently been passed. The Taiwanese government should promote more related policies to support the promotion and development of third-party payment, thereby enabling more widespread mobile payment services. This would allow the public to understand the convenience of mobile payment services and gradually change their previous consumption patterns. The Taiwanese government also needs to use the promotion of mobile payment to break down barriers between banks and end the monopoly of credit card payments in the market. Because mobile payment platforms collaborate with numerous banks, users can conduct transactions on these platforms using any of their bank cards, simplifying the transaction process. Simultaneously, the Taiwanese government should strengthen the market regulatory system and improve the development environment for the mobile payment industry. For Taiwan's nascent mobile payment service industry, government support through policies is needed, along with the introduction of more regulations to improve market conditions, cultivate more talent related to mobile payment technology, and develop new technologies. This would provide greater support for mobile payment in terms of laws, technology, and talent.

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