



# THE RISE OF MOBILE PAYMENTS IN THE ASIA PACIFIC: OPPORTUNITIES, RISKS AND CHALLENGES

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February 2022

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## About the publication

This paper has been developed with the support of the US Department of State. The sharing of the research undertaken aims to enhance understanding and resilience among policymakers, media, civil society, and the general public relating to the challenges and risks associated with widespread adoption of mobile payments in the Asia Pacific.

‘The rise of mobile payments in the Asia Pacific: Opportunities, risks and challenges’

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# EXECUTIVE SUMMARY

Mobile payment platforms (MPPs) have become the vanguard of financial technology (fintech), enabling instant payment and settlement with the convenience of mobile devices. It is widely seen that the emerging technology and industry will become one of the key drivers of the new digital economy, help foster financial inclusion for those unbanked and underbanked population, and for the first time make the prospect of a cashless society within reach. This report focuses on the mobile payments industry's phenomenal growth in China and the Asia Pacific in recent years, and examine the opportunities and benefits it brings to the international economy, as well as the risks and challenges it presents to regulatory authorities worldwide.

Mobile payment technologies were not originated in China, but later flourished in China since the early 2010s in commercial applications. The explosive growth of mobile payments and the broader Fintech sector in China reflects a perfect storm of conditions, including technological development, business innovation, and conducive regulation. The same trend has also featured in the Asia Pacific region on the back of dynamic economic growth, diversified business patterns and pervasive entrepreneurship. The huge success in the home market propelled Chinese payment providers to go global since 2015, especially in the Asia Pacific, with mixed results so far.

We provide a more nuanced understanding of the mobile payments landscape in this region through four country studies: Australia, New Zealand, Singapore and Thailand. Each case examines the industry trajectory in the local markets, the involvement of the Chinese players, and their regulatory contexts. We find that Southeast Asian markets, such as Singapore and Thailand, are more advanced in adopting the

technology, whilst the Australia and New Zealand markets bear more influence from the banks despite the advent of the tech giants. At the same time, the Chinese MPPs have adopted different strategies in different national contexts. It involves business partnerships with local firms in Australia and New Zealand, but relies on mergers and acquisitions in e-commerce in Singapore; in Thailand, they cooperated with both public and private stakeholders in facilitating business expansion.

A multidisciplinary approach is employed to identify and assess the risks of the system and their challenges for regulatory authorities. These range from vulnerabilities in cybersecurity in the payment processes, lack of security standards and data/privacy protection, to loopholes in international tax evasion, money laundering as well as liquidity risks that may destabilise the wider financial system. In addition, a range of political and legal risks are also identified in particular for the Chinese MPPs and their business partners.

Based on the historical account and technical analysis, a number of recommendations are presented on how to improve the regulation of the emerging industry for the international community. This is a multilevel, holistic approach. On the national level, regulatory authorities should strengthen mechanisms on consumer protection, and ensure market competition and regulatory access to the exclusive data held by mobile payment operators. On the international level, the establishment of a global industry body that collaborates with stakeholders in the community will be the key to establish an efficient, secure and responsible framework for a more sustainable industry and the wider digital economy.





## THE RISE OF MOBILE PAYMENT IN CHINA

A remarkable phenomenon in modern finance and financial markets has been shaped by the development in financial technologies (or Fintech) since the beginning of the twenty first century. Riding the digital wave, modern fintech provides digital and Internet-based financial services with cutting-edge innovations.

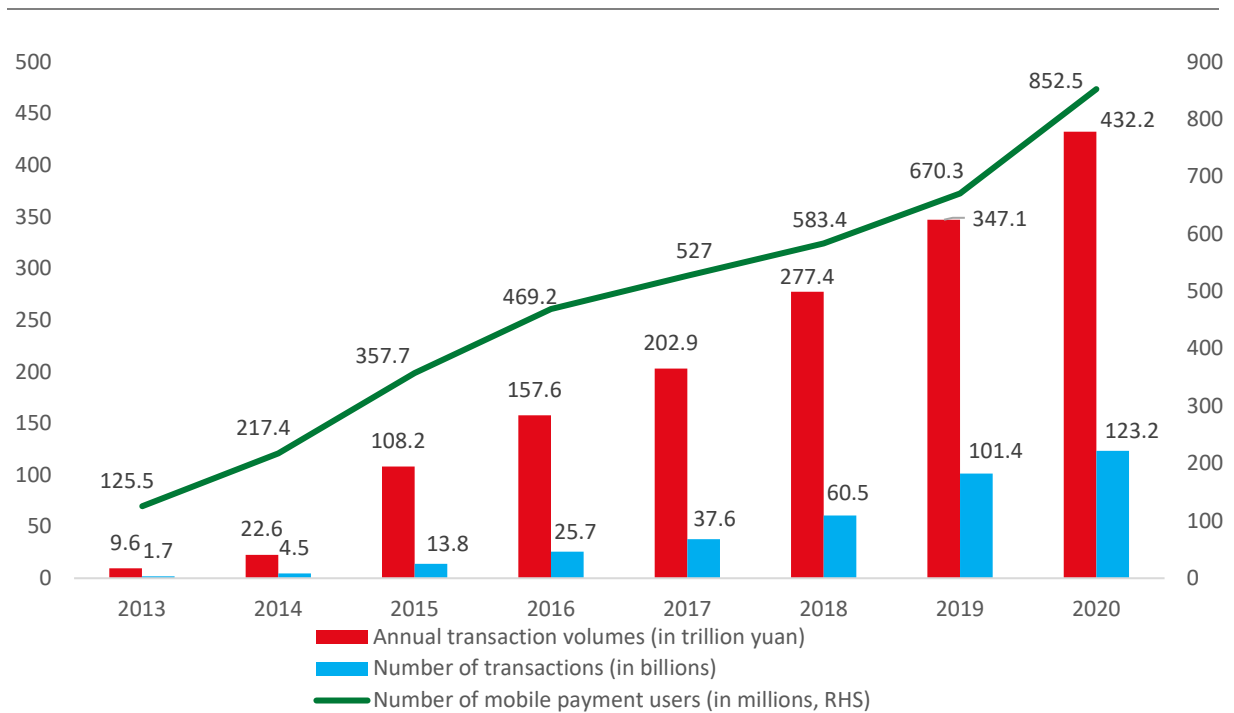
One of the key strands of such innovations has been in the payment sector in the form of Mobile Payment Platforms (MPPs). The MPPs enable users to make payments and transfer money via mobile devices. Payments are settled between accounts ('digital wallets' or 'e-wallets') hosted by the MPPs (in the form of mobile applications, or APPs) that are linked to users' bank/credit card accounts. Driven by the increasing penetration of smartphones and the significant improvements in the network

infrastructure across the globe, mobile payment has been growing on a fast pace in the world in the past decade, valued at \$1.4 trillion in 2018 and projected to reach \$5.4 trillion by 2026.<sup>1</sup>

### THE MOBILE PAYMENT REVOLUTION IN CHINA

Nowhere is this trend more evident than in China. In less than a decade, a mobile payment revolution has transformed the daily lives of more than a billion Chinese consumers and businesses. The market share of mobile payments skyrocketed from 3.5 percent in 2011 to 83 percent of all payments in 2018. The number of mobile payment transactions grew from less than 2 billion in 2013 to 123 billion in 2020, and the annual transaction volumes from less than 10 trillion yuan to more than 430 trillion yuan during the same period (see Figure 1).

Figure 1: The rise of mobile payments in China, 2013–2020

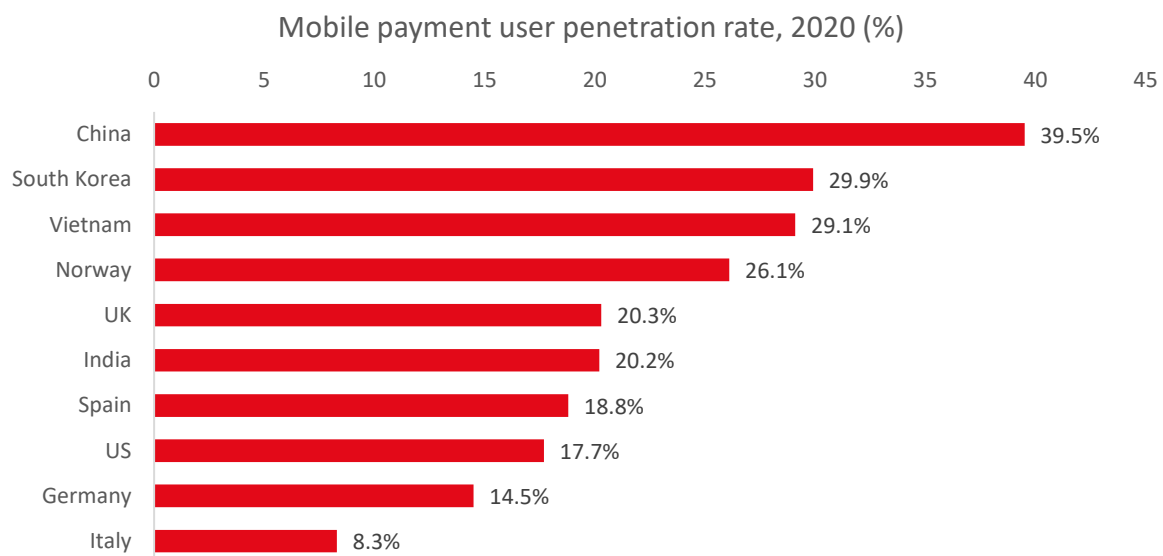


Source: State Administration of Foreign Exchange 2021.<sup>2</sup> CNNIC 2021.<sup>3</sup>

By 2017, mobile payment had already become the favourite payment option in the Chinese market, with cash second and debit/credit cards a distant third.<sup>4</sup> By the end of 2020, more than 850 million Chinese had had the experience paying over their mobile devices,

and 74 percent of mobile payment users used it every day.<sup>5</sup> This brought its user penetration rate at almost 40 percent, topping the global chart over major advanced and emerging economies (see Figure 2).

Figure 2: China stands out in mobile payment penetration



Source: adapted from Katharina Buchholz 2021.<sup>6</sup>

## BEHIND THE RISE OF MOBILE PAYMENT IN CHINA

The explosive growth of mobile payments and the broader Fintech sector in China reflects a perfect storm of conditions, including technological development, business innovation, and conducive regulation.

### Enabling technologies

Firstly, a series of technological innovations at the turn of the century have made possible an alternative mode of payment to the traditional card-based and bank-centred system. These include smart phones that run apps able to perform functions for everyday lives, and the upgrade of telecommunication networks from 2G to 3G and onward that has enabled ever faster data transmission and response time for smooth online transactions and payment processing and clearing. Therefore, it is no surprise that the meteoric rise of mobile payments in China coincided with the rapid popularity of smartphone usage. For instance, mobile phone internet user penetration in China increased from less than 46 percent in 2015 to almost 67 percent in 2020 (and projected to be well over 70 percent in 2021).<sup>7</sup>

In addition, the adoption of the Quick Response (QR) codes has also been instrumental in the mass adoption of mobile payments in China. QR codes are a type of two-dimensional barcodes invented back in the 1990s. Compared with traditional one-dimensional barcodes, QR codes contain larger storage of data and more versatile access (can be read from both paper and screen).<sup>8</sup> While QR codes have been used in areas such as digital marketing and information sharing, their adoption in mobile payment systems have enabled the latter's expansion. QR codes can be generated and scanned by mobile devices by either party in a payment transaction, bringing convenience to both merchants and consumers. They also save merchants hefty costs in the setup and maintenance of the card-based readers and electronic point-of-sale (EFTPOS) facilities.

### Appealing business model

The MPPs represents a new breed of payment system whose business model shifts the centre of payment transactions from the banking system to commerce, facilitated by third-party payment providers, most of which are internet and tech companies. In other words, it transformed the payment industry through disintermediation of banking and realignment of

incentives between consumers, merchants and payment service providers.<sup>9</sup>

It brings convenience and real-time confirmation to both parties in a payment transaction through now readily available mobile devices. This is appealing compared with traditional card payment terminals that were often 'slow, inefficient and expensive' thanks to a government-protected banking system.<sup>10</sup> The MPPs, on the other hand, provide strong incentives for user adoption. Transactions between parties on the same MPP are free, compared with the standard processing fee of around 2 percent on card payments. This could be a substantial saving for small businesses given their profit margin of around 7 percent. For larger merchants, both Alipay and WeChat Pay offered freebies such as free advertisement on their digital platforms as an incentive.<sup>11</sup> It also brings a low-cost payment solution for merchants without investing in expensive card-reading terminals.

The MPPs, as the payment service providers, are also the winner by cutting out the banks. In a credit card transaction, the 2 percent processing fee is split between the banks and the payment processor (usually UnionPay, a major card scheme in mainland China). The banks generally receive over half of this amount. With a payment transaction on an MPP, however, banks get only a fraction of the fees received through traditional payment means.<sup>12</sup> Therefore, the business model of mobile payment enables positive incentives on the part of consumers, merchants and the MPPs but at the expense of the banking system and card issuers.

### Embeddedness in a wider ecosystem

Part of the popularity of the major Chinese MPPs, such as Alipay and WeChat Pay, is also due to their integration into the wider network of services, or ecosystem, of their mother companies. On one hand, the MPPs greatly facilitate online transactions of e-commerce and person-to-person transfers in social networks, becoming essential financial infrastructure for the Internet of Things (IoT). For instance, Alibaba, China's largest e-commerce company, recorded an enormous \$75.8 billion in sales during its Singles Day promotion in 2020, China's version of Cyber Monday, most of which was handled by Alipay.<sup>13</sup> The MPPs' gigantic user base also helped transform internet companies into some of China's largest fund managers. Alibaba's Yu'eobao, a money market fund into which Alipay users can park their digital wallet money in to earn interest, was an instant hit when it was launched in 2013. By the end of 2015, Yu'eobao



had over 260 million users and assets worth RMB627 billion. This turned Tianhong, the asset management firm that manages the Yu'e Bao (in which Alibaba owns a majority stake), into China's largest mutual fund by assets.<sup>14</sup>

On the other hand, by utilising better risk assessments based on real-payment data, internet and tech companies can provide more comprehensive, efficient and tailored services for consumers within the same ecosystem. In other words, a mobile payment system is far more than just a means of payment, but an organic component of a wide *platform* of digital solutions that covers a consumer's daily life. Alibaba, for example, in retail finance alone, provides a range of financial services, such as money market funds, stock brokerage accounts and micro credits for both consumers and small businesses through Ant Financial, the fintech arm of Alibaba that owns Alipay.<sup>15</sup> MYbank, an internet-based commercial bank under Ant Financial, has lent RMB 2 trillion in micro credit to more than 15 million small businesses, with the size of each loan around RMB10,000 (\$1,600).<sup>16</sup>

## A friendly regulatory environment

The rise of mobile payments in China has also been facilitated by light touch regulation, at least in the early stage. For the liberal elements within the regulatory authorities, particularly within the central bank (the People's Bank of China, or PBoC), mobile payments were seen as a tool to increase financial inclusiveness for those underserved by the existing banking system. In addition, the mobile payment sector was regarded as a strategic opportunity for domestic banking and financial system to catch up and lead in the emerging global fintech industry.<sup>17</sup>

China's financial system, including its payment infrastructure, had been dominated by the banking sector.<sup>18</sup> Although China has the largest bankcard network in the world, the credit system has been underdeveloped given the fact that debit cards vastly outnumber credit cards.<sup>19</sup> The credit system also favoured state-owned enterprises against the more dynamic private sector. Mobile payments and the Fintech industry could effectively address the issue by providing the much-needed payment and credit services to small-and-medium-sized enterprises (SMEs) and low-income households, thus spur competition, innovation and entrepreneurship. Therefore, the authorities had created a largely

tolerant regulatory environment that allowed various business innovation and marketing gimmicks without strict regulation, well up until June 2018.<sup>20</sup> However, as will be detailed in later sections, internet and fintech companies, including major Chinese MPPs, were affected by a series of abrupt government policies since late 2020<sup>21</sup> aimed at containing the risks of unfettered market expansion and data security, which brought uncertainties to the future trajectory of the MPP sector.

## MAJOR TECHNOLOGIES AND MARKET PLAYERS

Mobile payment systems can be classified into two camps that adopt different technologies. There are card-based payment systems that store card data in a virtualised way within a customer's mobile device. The other mobile payment system uses other forms of customer identification and does not necessarily require users to have a credit or debit card to participate. These payment systems are characterised by the use of QR codes and offline payments not associated with particular card organisations.

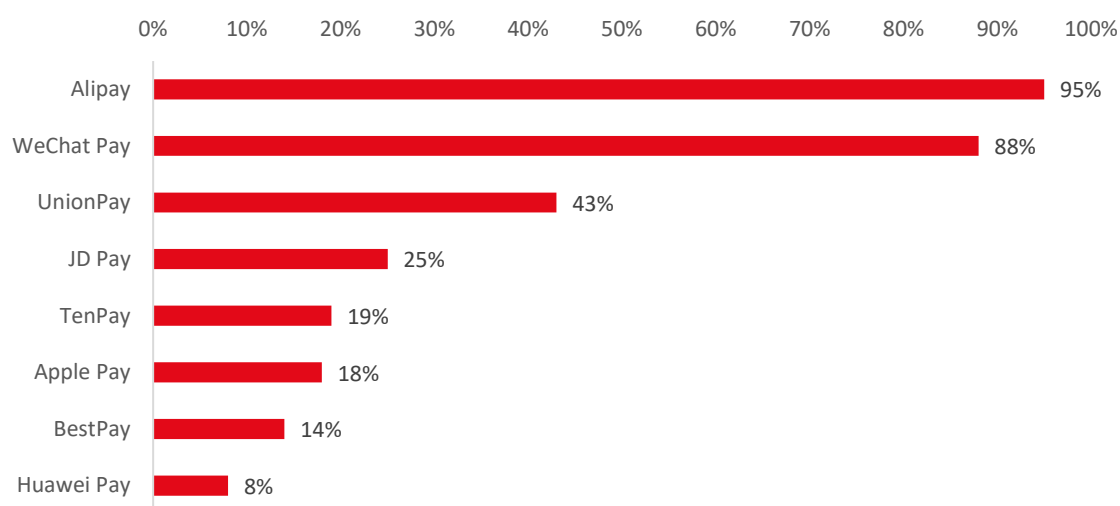
There are three groups of market players in China in terms of their business areas: internet service providers, banks, and hardware companies. As Figure 3 suggests, China's mobile payment market has increasingly featured a duopoly of two Apps/platforms, **Alipay** and **WeChat Pay**, owned by Chinese internet giants Alibaba and Tencent respectively. Both companies are internet service providers. While both have developed into formidable and dominant players in the game, they evolved on distinctive paths. Alipay was originally designed to be a reliable and trustworthy payment option that serves online transactions under Alibaba's e-commerce empire (such as Tmall and Taobao). Overtime, Alibaba's online banking branch developed into a financial platform of its own under the name of Ant Finance, with Alipay the jewel in the crown. Other MPPs associated with e-commerce platforms include **JD Pay** (jd.com) and **Best Pay** (specialised in cross-border e-commerce for Chinese consumers).

WeChat Pay, on the other hand, by making inter-personal payments easier and more convenient, was developed to be integrated into the social engagement system of WeChat, the dominant social media platform in China.<sup>22</sup> **TenPay** is another MPP by Tencent. It has been used in multiple Tencent licenses

and has different wallet software, such as Tencent QQ and QQ Wallet. QQ is an instant messaging app mainly focused on local Chinese market, not open to foreigners. However, underneath the brands they belong to the same group, use the same remit system (QR codes) and work the same way as WeChat Pay.<sup>23</sup> Given the fierce competition and tit-for-tat strategy,

both Alipay and WeChat Pay have evolved into payment platforms with very similar functions and are almost equally accepted in China with both have over 90 percent of market penetration in 2021 if TenPay is combined into Wechat Pay (both owned by Tencent) (See Figure 3).

**Figure 3 Most Popular Mobile Payment Options in China, 2021**



Source: Statista Global Consumer Survey.<sup>24</sup>

Note: 3,100 respondents from Mainland China, 18 to 64 y/o, surveyed between October 2020 to June 2021.

Banks make the second group of market players with China UnionPay (CUP) as the commercial body representing the banking industry. The CUP is a unified interbank bankcard network and clearing system under the auspices of the PBoC. Since 2015, the CUP overtook Visa and Mastercard in terms of total volume of payment transactions over credit cards and debit cards, although less than 1 percent of the transactions are overseas.<sup>25</sup> As the third party, non-bank payment providers largely bypass the banks in mobile payment through QR codes and digital wallet (rather than linking to bank cards), causing the banks to feel threatened by being thrown out of the burgeoning digital payment market. As a response, the CUP has established its own MPP business utilising its bankcard and EFTPOS networks both at home and abroad. The CUP's MPP supports both card-based and QR code-based payment methods under the brand of Cloud QuickPass, with a market penetration of 45 percent by 2021.

There are several popular phone hardware manufacturers that have developed payment systems as

well, such as Huawei and Xiaomi. These are usually card-based payment systems that use Near Field Communication (NFC) technology to transmit transaction information from the phone to the EFT payment device. Popular non-China electronic wallets based on this model include Apple Pay, Samsung Pay and Google Pay. The major China-based wallets in this regard include **Huawei Pay**, Xiaomi's **Mi Pay**, Vivo's **Vivo Pay** and OPPO's **OPPO Pay**. By the end of 2021, the MPPs by hardware companies have been less popular than the other two groups of players because of their late-comer disadvantage. After spinning off its sub-brand Honor into a separate company in late 2020, Huawei has lost its position in the top five of smartphone sales in China, on top of worse performance in overseas markets.<sup>26</sup> Xiaomi, together with other Chinese phone makers, such as Vivo and OPPO, have been the major beneficiaries at the expense of Huawei. Accordingly, these MPPs, particularly Mi Pay, have the potential to become major market contenders given the popularity of their mobile devices in the Chinese and certain overseas markets, such as India.



## THE DEVELOPMENT OF MOBILE PAYMENT IN THE ASIA PACIFIC

The rise of mobile payments is not just a China story. It happened globally. In 2019, mobile wallets overtook credit cards to become the most widely used payment method in the world.<sup>27</sup> The number of e-wallet users exploded from 500 million in 2017 to 2.8 billion in 2020.<sup>28</sup> Mobile payments have great potential in the Asia Pacific as well. It has arguably been the most dynamic region in terms of economic growth and technological innovation. Highly diversified business patterns, large presence of SMEs, and a largely cash culture because of less developed financial services in the bulk of the region, suggest greater potential and the prospect of a digital and cashless society.

### DEVELOPMENT IN THE ASIA PACIFIC

By 2020, only 7 percent of total transactions were in cash as 46 percent of the people in the region use an e-wallet.<sup>29</sup> In particular, East Asia and the Pacific experienced significant growth in mobile money usage, contributing to 34 percent of all new e-wallet accounts due to the growing market in the Southeast Asia. More than half of the services in the region have

over one million registered accounts. In South Asia, registered accounts grew by 5 percent to surpass 300 million registered mobile money accounts for the first time. This means that one in four registered e-wallet accounts globally are now in South Asia.<sup>30</sup> The most common payment medium is the QR code-based systems with China and India leading in this regard.

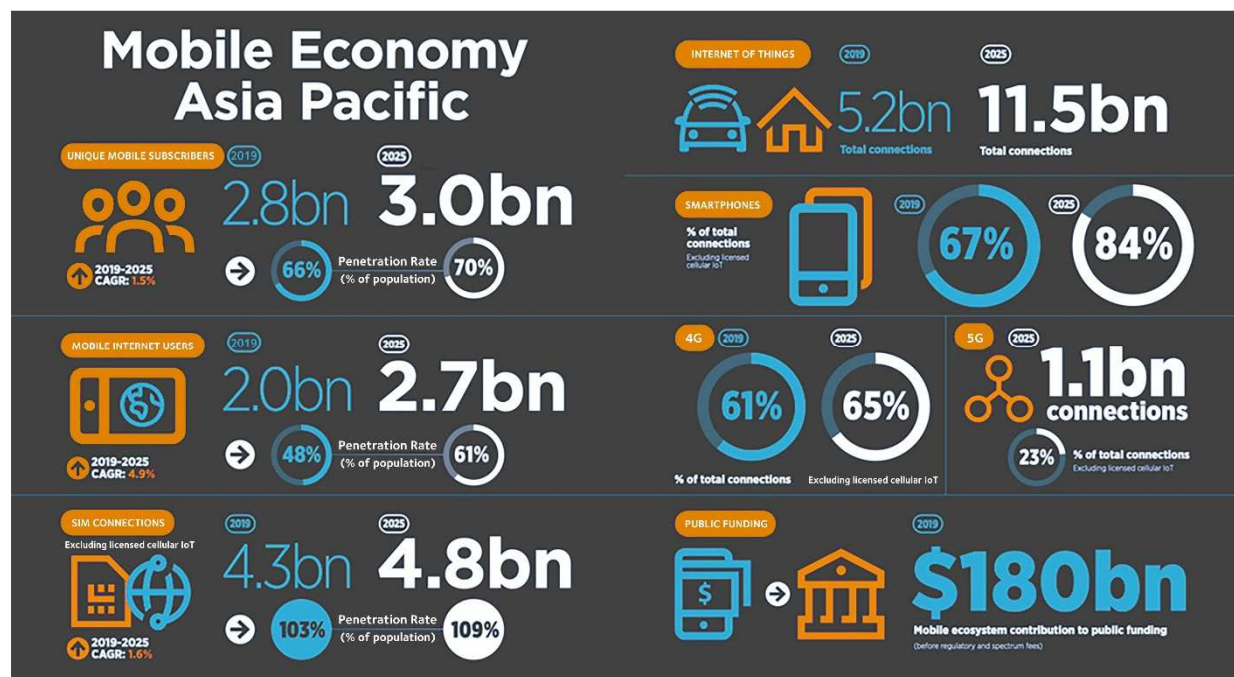
Behind the massive popularity of mobile payments in the Asia Pacific, a combination of key factors played an essential role in creating a unique, almost non-replicable market condition for mobile payment to flourish. The wide availability of a relatively fast and inexpensive internet, especially access through mobile devices, is a critical foundation that enabled the near-ubiquitous use of mobile payments in Asia-Pacific. On the hardware side, the proliferation of affordable, relatively competent smartphones means the average consumer is adaptive to digital means. Chinese smartphone brands, such as Xiaomi, Huawei, Oppo, and Vivo, are selling handsets with quality comparable to those of the big international names but at

significantly lower prices. More importantly, readily available smartphones help fill the so-called digital divide in regions where the penetrations of PC desktops are lower. For many residents of the lower-tier cities and rural areas of the region, smartphones are their first or even only device to access the World

Wide Web. Thus, it is only natural for them to become mobile-first internet users.

As a result, internet and mobile penetration rates have been growing exponentially in the past decade. The Asia-Pacific region is ready for riding the digital wave with an emerging mobile economy (see Figure 4).

Figure 4: The emerging mobile economy in the Asia Pacific



Source: GSMA 2021.<sup>31</sup>

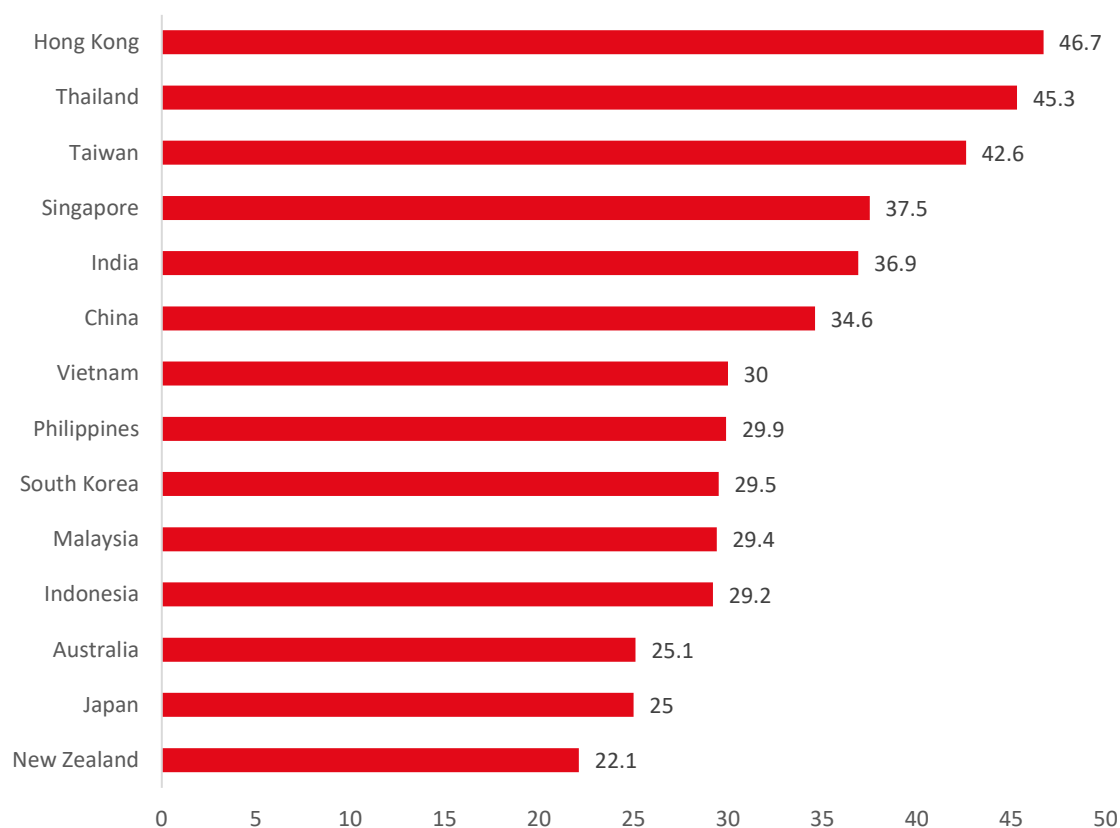
According to GSMA, a global body of mobile operator, 66 percent of the population, or 2.8 billion people in the Asia-Pacific region subscribed to mobile services by 2019. With almost 500 million new subscribers added since 2014, the region is one of the fastest-growing globally and home to over half of the total global subscribers. While top-line growth is slowing, Asia-Pacific may still account for around half of new subscribers globally by 2025, and 266 million new subscribers are expected to be connected across the region, bringing the total to over 3 billion (70 percent of the population).<sup>32</sup> Faster 5G infrastructure and a large and growing base of mobile subscribers will no

doubt further stimulate the growth of mobile payments in the region.

In addition, the lack of a habit of using cards in daily consumption could propel countries to leapfrog plastic-based payments to go straight from cash to mobile. In many countries in the region, such as China, India and Thailand, mobile payments emerged at a time when the credit card system was still at a relatively early stage of development. Offerings of various in-app discounts and lower transaction fees also make mobile payment a more attractive option to both customers and merchants than credit cards (see Figure 5).



Figure 5: Share of internet users who used mobile payment services monthly in the Asia-Pacific Region (percent)



Source: Mordor Intelligence 2021.<sup>33</sup>

The COVID-19 pandemic is likely to enhance the adoption of mobile payments globally and in the region as well. People around the world have relied on the internet to stay connected and access essential services during lockdowns. The need to observe social distancing has also stimulated the use of contactless payment systems, including mobile payments. In cases such as India, consumers were urged by the government to use digital payments for public health and safety.<sup>34</sup> Perhaps more importantly, many popular contact tracing apps are centred on scanning QR codes by mobile devices, a great demonstration of the convenience and accessibilities of QR codes among the population.<sup>35</sup> This will greatly foster mass adoption of other QR code-based apps, including the MPPs in the post-pandemic world. It is projected that total transaction value of mobile payment in the Asia Pacific will grow from \$59 trillion in 2020 to \$113 trillion in 2026.<sup>36</sup>

## THE CHINESE MPPS' OVERSEAS EXPANSION

With over one billion active users and an increasingly saturated urban market in mainland China, it was a logical step for major Chinese MPPs to replicate their success at home in the global arena. At the same time, sustained volume of Chinese tourists' overseas expenditure and cross-border e-commerce for Chinese and foreign consumers also generated huge demand for digital payment. Again, the two giants in the Chinese arena, Alipay and WeChat Pay, together with their smaller rival, China UnionPay, have been leading the pack in the globalisation of the MPPs.

In this regard, WeChat Pay (under Tencent) has been less aggressive than Alipay. Ant Financial (hereafter as Ant), which owns Alipay, announced its globalisation plan in 2016 with the goal of boosting its user base to 2 billion within 10 years.<sup>37</sup> Despite the ambition, it turned out that Ant's international business remained

small compared with its home market. International revenue was only 5 percent of Ant's total revenue in 2019, and international transaction value was a negligible 0.5 percent of the total in the twelve months to mid-2020.<sup>38</sup>

The Chinese MPPs have relied on a combination of business strategies in their overseas expansion. First of all, they tapped on their existing customer base in China who travel, study or migrate overseas. Chinese outbound travellers alone have been a huge user base of the payment market given rising household disposable incomes. In pre-COVID 2019, approximately 169.2 million outbound journeys were recorded in China with a total spending of \$255 billion.<sup>39</sup> A 2018 Nielsen study found 99 percent of Chinese tourists had the Alipay app installed on their mobile phone.<sup>40</sup> Being Chinese expats' established and preferred method of payment helps promote the adoption of the Chinese MPPs by international tourism operators, vendors and institutions alike.

At the same time, the Chinese MPPs sought to grow their overseas payment businesses indirectly through e-commerce. For example, in April 2016, Ant bought controlling stake and later increased its investment in Lazada,<sup>41</sup> a popular e-commerce platform in Southeast Asia (where Amazon is yet to make significant progress), so that Alipay could be promoted as the payment method on Lazada's platform. Tencent, the other internet giant in China that owns WeChat Pay, bought almost 40 percent of stakes in Shopee, Lazada's archrival business competitor in Southeast Asia, in 2017.<sup>42</sup> Both Lazada and Shopee are based in Singapore.

A more direct approach for the Chinese MPPs has been to invest in or partner with local payment companies in international markets since 2015, particularly in the Asia Pacific (Table 1). The list here suggests that most of its international cooperation has been in the form of business alliance through equity investment.

**Table 1: Alipay's business expansion in the Asia Pacific**

Year	Company	Type	Amount	Country
2015	Paytm	40% stakes	\$1bn	India
2016	M-Daq	minority stakes	\$22m	Singapore
2016	Ascend Money	20% stakes	NA	Thailand
2016	Quest Payment	Partnership		Australia
2017	Kakao Pay	minority stakes	\$200m	South Korea
2017	Mynt	45% stakes	NA	Philippines
2018	Easypaisa	45% stakes	\$184.5m	Pakistan
2018	bKash	20% stakes	NA	Bangladesh
2018	Commonwealth Bank	Partnership		Australia
2019	Akulaku	minority stakes	\$40m	Indonesia
2020	Wave Money	minority stakes	\$73.5m	Myanmar

Source: Ruehl and McMorrow 2020;<sup>43</sup> Authors' collection of data.

For Chinese smartphone makers, sales gains in the international market are likely to translate into the user base of their own MPPs as the latter is often integrated seamlessly into the respective hardware–software ecosystems. For instance, Xiaomi, vivo and OPPO were among the top five of smartphone shipments to India for the third quarter of 2021, with Xiaomi topping the chart.<sup>44</sup> Mi Pay, Xiaomi’s payment solution, was launched in India in 2018 with 20 million registered users in a year’s time. By August 2021, Mi Pay had a user base of over 50 million in India.<sup>45</sup> Through Mi Pay, Xiaomi further expanded its services into other financial areas, including lending and insurance.

The global market remains a big challenge for the Chinese MPPs so far. The Chinese companies must compete with major global tech giants with integrated hardware and software platforms, such as Apple (Apple Pay) and Samsung (Samsung Pay), established international players, such as PayPal, as well as rapidly growing startups, such as Square and AfterPay. Their QR code–based payment system also directly clashes with the card–based payment systems in which the banking sector retains influence, especially in markets entrenched with banking presence and card culture. Differences in management style and a general lack of knowledge of local market and society more or less hindered their cooperation with local partners. They also have to face different regulatory priorities and concerns than those at home.

Despite these challenges, however, the Chinese MPPs have great potential in expanding and enhancing their

foreign operations after the initial period of trial and error. Both Alipay and WeChat Pay have solid capital foundation given their leading position in the huge domestic market, which is capable of supporting their overseas expansion. Apart from the two, the CUP could tap into its global POS network and business deals with foreign banks, and hardware tech companies like Xiaomi will utilise handset popularity to advance in the payment market. The Chinese players have ample experience in surviving and thriving amid fierce if not brutal competitions and stand at the international forefront of fintech applications, which will be appealing to potential foreign users, investors and partners. However, as will be detailed in subsequent sections, there are significant risks associated with the adoption of and cooperation with Chinese MPPs, which warrant caution and scrutiny by the international community.

In the next section, we will be focusing on four countries in the Asia Pacific for a better, more nuanced understanding of the Chinese MPPs and the mobile payment landscape in this region. This includes the general development of mobile payments in the local markets, and the involvement of the Chinese MPPs and their regulatory contexts. The four country cases include Australia and New Zealand, which have established influential banking systems; Singapore, an international financial centre with advanced financial services as well as great appetite and ambition in fintech innovation; and Thailand, an active player in the emerging Asia that has been underbanked and started with a largely cash economy.





## AUSTRALIA

This section outlines the state of development in mobile payments in Australia, and the involvement of Chinese MPPs in both commercial and non-commercial sectors. Australia was among the first overseas market for Chinese platforms, which have made great effort in expanding their business but with lacklustre growth.

### Overview of digital payment systems market in Australia

There are two key features of the mobile payment market in Australia: the relatively slow adoption of the mobile payment technologies, and so far the dominance of card-based NFC systems in mobile payment, both of which are due to its powerful banking system.

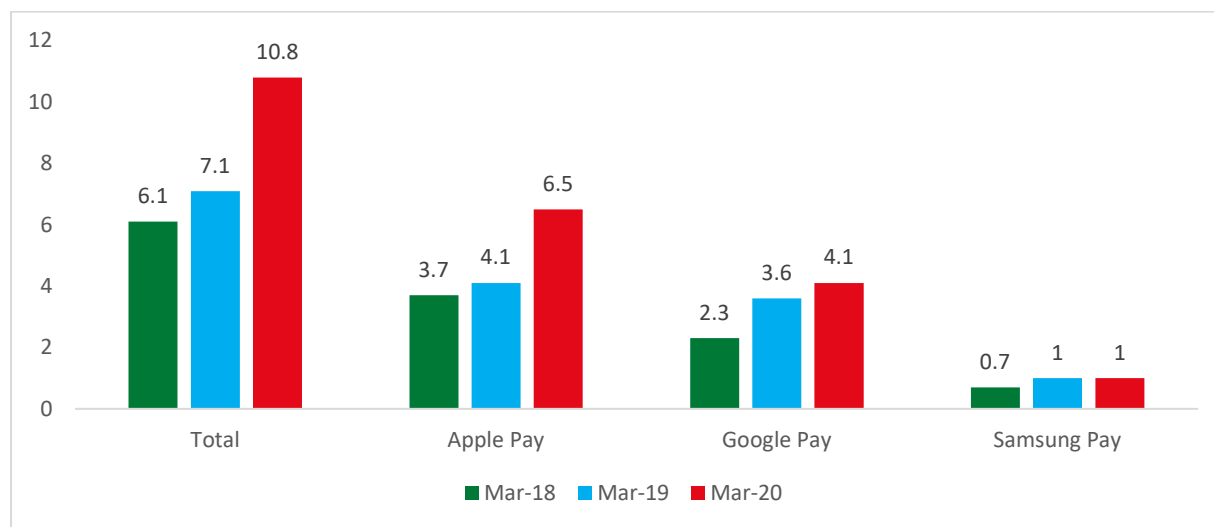
While rating quite highly on most metrics, including things like lifestyle and quality of life, one area in which Australia has consistently fallen behind has been its fintech industry, including the development and adoption of mobile payments. A quick example of that would be to consider when Alipay was created, in February 2004,<sup>46</sup> to only see the Commonwealth Bank of Australia (CBA) agreeing to adopt the technology in 2016.<sup>47</sup> The slow development in

mobile payments can be explained by the dominance of the big four banks in Australia (CBA, NAB, Westpac and ANZ) and their ongoing wars with the telecommunications companies.<sup>48</sup> However, it is contrary to Australia being a very fast adopter of payment systems associated with e-commerce (such as PayPal)<sup>49</sup> and its development into the online market in the early 2000s.<sup>50</sup> This market was originally dominated by the banking sector who was overly cautious and very reluctantly gave payment system access to small businesses.<sup>51</sup>

Agreements made in 2017 between handset makers and the banks<sup>52</sup> saw the rise of NFC-enabled POS terminals, which paved the way for e-wallet apps such as Apple Pay to be developed and deliberated throughout Australian supermarkets and retail outlets. As a result, the mobile payment market exploded in Australia since then, with the introduction of NFC-based models, such as Apple Pay, Google Pay and the somewhat sporadic incorporation of QR code-based model, such as Alipay.<sup>53</sup> Despite these developments, adoption of e-wallets in Australia was only 10.8 percent by March 2020 (see Figure 6).



**Figure 6: Adoption of e wallets in Australia (percent)**

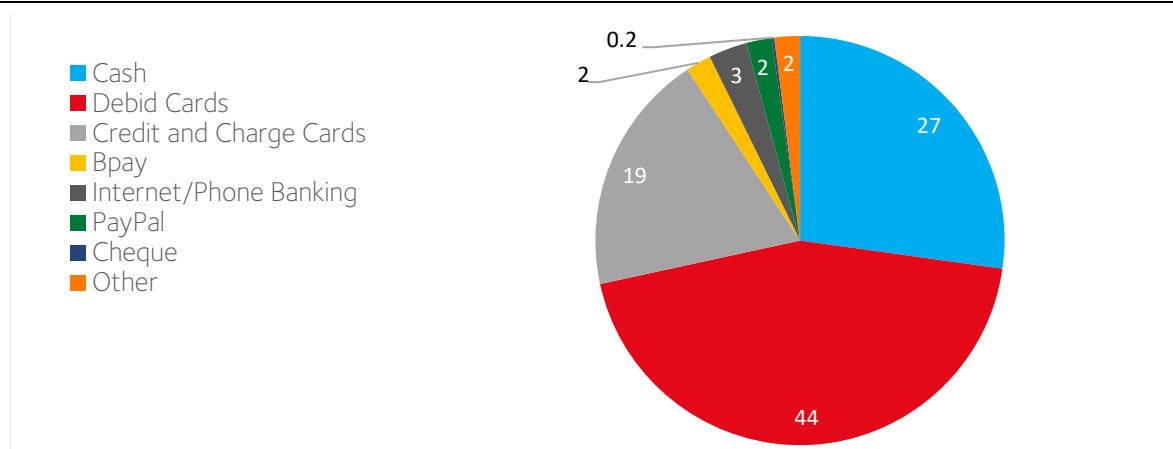


Source: Clark 2020.<sup>54</sup>

From March 2020 to March 2021 Australians started using digital wallets at an increasing rate in terms of actual transaction volume as trust in the system built. As in other nations, concern over safety and security has been the primary factor in user hesitation.<sup>55</sup> Purchases conducted on digital wallets went from \$36 million to \$68 million during this period, which, while not staggering given the low base number, represents almost 90 percent increase in Australian society of the use of digital wallets. When considering all of the transactions using digital wallets during the same period there was a \$1 billion increase to \$2.1 billion.

This means Australians are adopting this technology at a rapid rate and are catching up with the rest of the world. In addition, the adoption of mobile payments rose sharply during the COVID-19 pandemic<sup>56</sup> and it appears it will continue to do so in the near future.<sup>57</sup> However, Australians still prefer the card-based contactless methods tied to their banks when conducting the majority of retail transactions. According to RBA's report, 63 percent of payments were through debit and credit cards in 2019 while digital payment was mere 3 percent in total (see Figure 7).

**Figure 7 Consumer Payment Methods share of number of payments (percent)**



Source: James Caddy, Luc Delaney, Chay Fisher and Clare Noone, "Consumer Payment Behaviour in Australia." RBA Bulletin, March 2020.

Note: 'Other' includes prepaid, gift and welfare cards, bank cheques, money orders, 'buy now, pay later' and CabCharge.

## The Business Expansion of the Chinese MPPs in Australia

Alipay was the pioneer among the Chinese MPPs entering the Australian market in 2016. Despite initial expansions in local Chinese community under cooperation with local companies, the Chinese MPPs presence in Australia has been more or less marginal. The trajectory is arguably not going to change into a model that would follow that of China which would be a digital wallet system that is *outside* the banking infrastructure.

The business model of the two major Chinese MPPs, Alipay and WeChat Pay has been based on disintermediation, cutting off banks from payment transactions. This puts them in a direct collision course against the powerful banking sector in Australia. In addition, Alipay and WeChat Pay are QR code-based payment systems. As discussed earlier, Australian consumers are more used to card-based systems underwritten by the banking system they trust rather than scanning QR codes that are generated by Chinese APPs. A PwC report finds that 90 percent of Australians using some kind of NFC-related technology or electronic systems, particularly credit and debit cards with contactless technologies as their preferred means in payment.<sup>58</sup>

Those Chinese MPPs operating on NFC-enabled, card-based systems also have problems in Australia. The China UnionPay has focused on Australian merchants in the tourist industry rather than the mainstream consumer market. At the same time, Chinese smartphone makers (Huawei, Oppo and Xiaomi) have been nowhere near Apple and Samsung in shipment and sales in Australia, with a collective market share of around 10 percent by December 2021.<sup>59</sup> This also limited the popularity of the Chinese MPPs.

There are three main areas in which Chinese payment systems have been adopted in Australia. The first is by Chinese tourists coming to Australia and spending using their preferred payment methods which are normally bifurcated into WeChat Pay, Alipay or UnionPay.<sup>60</sup> According to Tourism Australia, China has been Australia's largest and most valuable tourism market, accounting for 81 percent of the growth in tourism spending in Australia in the pre-COVID era, and for 27 percent of total spend by international visitors. More than 1.4 million Chinese

tourists travelled to Australia and spent more than \$11.5 billion annually.<sup>61</sup>

The second is the ongoing adoption of Chinese students and migrants living in Australia using these payment systems, and the third is the emergence of e-commerce transactions conducted by onshore Chinese migrants and students as shopping agents (*daigou*) for offshore (mainland China) customers, both of whom use the Chinese payment systems.

The Chinese MPPs have teamed up with a variety of local partners in promoting its business. For example, Smartpay, the largest independently-owned EFTPOS provider in Australia has entered into agreement with Alipay and WeChat Pay since 2018. Under the agreement, Smartpay obtains access to all transactions in Australia and New Zealand through the two Chinese MPPs' networks and provide consumers with the ability to use them through Smartpay's EFTPOS terminals.<sup>62</sup>

Novatti, an ASX-listed payment processor, struck deals with the Chinese MPPs, such as Alipay, WeChat Pay and UnionPay, allowing the local Chinese community to pay their bills through BPay using their Chinese e-wallet accounts.<sup>63</sup>

Another case is RoyalPay, a local fintech start-up aiming to act as a bridge between Chinese consumers and Australian merchants through the Chinese MPPs. RoyalPay formed strategic partnership with Tencent (WeChat Pay) in 2015, and entered deals with Alipay and JD Pay in 2017. Nominated for the Australian Fintech Business Awards in 2018, the company handles average A\$80 million per month with over 16,000 merchants.<sup>64</sup>

At the same time, Alipay also teamed up with Australia Post. Back in 2014, Alibaba formed a strategic partnership with Australia Post to connect consumers and merchants in both countries through e-commerce. The deal enabled Australia Post to distribute Alipay purchase card in their retail stores, which local consumers can use to directly purchase products on e-commerce sites, such as Tmall, Taobao that accept AliPay.<sup>65</sup> In 2017, Alipay joined AlphaCommerceHub (ACH) as its payment method.<sup>66</sup> The ACH is Australia Post's new fintech joint venture and Australia's first commerce integration platform.

Alipay has further reached out to relevant government bodies. It signed a deal with Tourism

Australia in February 2019 in launching the Sydney City Card, an interactive mobile map for Chinese tourists promoting key tourist destinations around the city.<sup>67</sup> The mobile map operates through the Alipay app, which saw a 20 percent increase in Alipay users over the first month after the launch. This program was extended to Melbourne in May 2020 with the launching of the Melbourne City Card.<sup>68</sup>

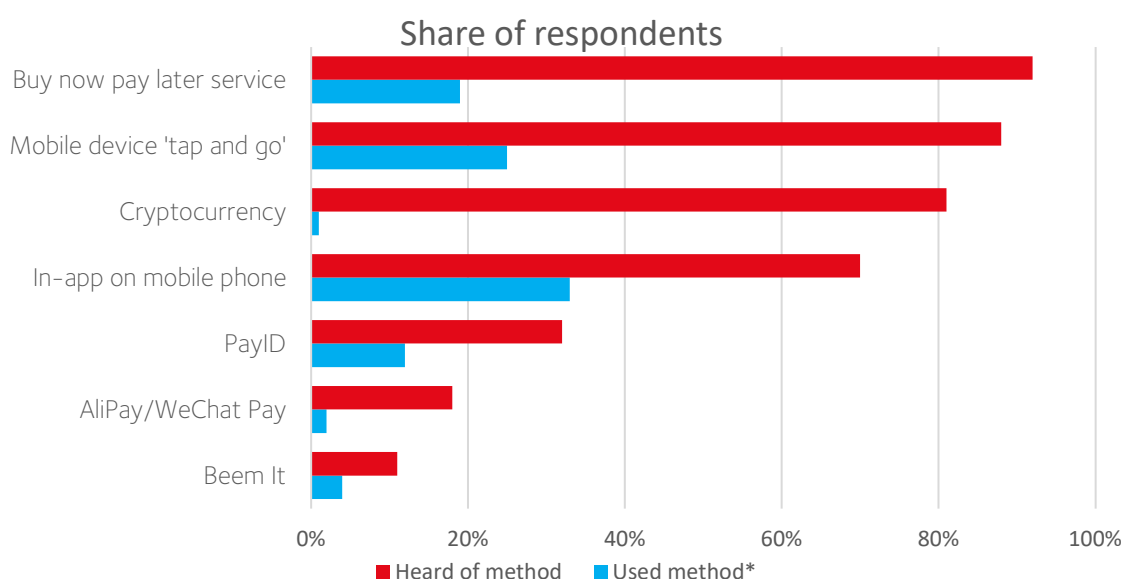
Another major development saw the Commonwealth Bank of Australia reach an agreement with Alipay's parent company Alibaba to allow people to use the digital wallet system in retail stores throughout Australia via CBA's EFTPOS terminals.<sup>69</sup> This deal with one of the big four banks in Australia will allow Alipay users to pay in the Chinese renminbi while Australian merchants get paid in the Australian dollar.<sup>70</sup>

Australia has a very unique mobile payment environment. The mobile payment systems in Australia are often brokered by third-party companies who deal with the banks and the payment provider as a mediator. The payment provider in this regard provides the service of the payment going through in a secure and seamless way. The customer makes a purchase either online or in store, the payment provider validates that transaction between either the digital wallet provider or the bank and returns the secure and safe transaction to the merchant in a matter of seconds. Although Alibaba has signed the agreement with the CBA and another local company called Quest Payments,<sup>71</sup> Chinese digital wallet systems are not deemed 'payment providers' in Australia. With systems like Alipay there is no such 'transaction' initially and as such a merchant might wait up to five business days for the money to appear. This is an issue of trust for many retailers, at which the Chinese MPPs don't have an advantage.

Studies outside of Australia demonstrate that Australians are not easily willing to trust organisations with which they do not have an existing relationship.<sup>72</sup> This is the same kind of phenomena seen in China when Alibaba released Alipay.<sup>73</sup> In a great variety of studies conducted by scholars in the e-commerce field trust is always the most consistent variable but is not negotiable. Trust in this sense is not seen as something that implies a solid relationship but more like the concept of swift trust.<sup>74</sup> For example, in the tourist industry Australian tourist operators have been very quick to adopt Chinese payment systems because of the ease of the business model and the validity of the payment systems process.<sup>75</sup> Given that prior to COVID-19 Chinese tourists accounted for \$9 billion a year it's no surprise that adopting this technology made sense and the fact that it worked and could be trusted made it much easier to adopt. This, coupled with the financial incentive of tourist operators to provide the best service to Chinese tourists, is why this particular part of the Australian economy has adopted these payment platforms more readily. By the same token, as the Chinese MPPs are not marketed to and used in the mainstream consumer market, the trust of the Chinese MPPs is yet to be established, which at least partially explains their negligible share in the local market.

Actual use of the Chinese MPPs in Australia is very hard to estimate given the lack of data in this regard, which is another testimony of their marginal status in the local market. According to a consumer survey by the RBA in 2019, less than 3 percent of respondents used (QR code-based) Alipay or WeChat Pay in the previous 12 months, compared with more than 20 percent who used card-based mobile payments (tap and go).

**Figure 8 Usage of Alternative Payment Methods in Australia**



Source: James Caddy, Luc Delaney, Chay Fisher and Clare Noone, "Consumer Payment Behaviour in Australia." RBA Bulletin, March 2020.

Looking ahead, there is very little evidence to support a substantial increase in the adoption of the Chinese MPPs any time soon in the post-COVID era. COVID-19 has certainly boosted the usage of digital, contactless payments worldwide. The popularity of QR code-based COVID check-in apps in Australia has helped local consumers get used to QR code apps, including the Chinese payment apps. However, this is less likely to be translated into a surge of their market share given the late adoption disadvantage for Australian businesses and more conservative Australian consumers. The other concern is that the Australian tourist market is in a decline, due to the ongoing trade spats with China. In 2020 Australia lost almost 1 million tourists from China and it is not likely to recover any time soon. It remains to be seen if tourist operators will continue to use the technology given that Chinese tourists are not coming to Australia in the required numbers to make it viable; or if the Chinese MPPs will change their business strategy, targeting the mainstream retail market instead of the tourist and diaspora market.

## Conclusion

There are several important points to consider here in Australia when it comes to the adoption of digital wallets and MPPs. Two big drivers are responsible for the adoption of these kinds of technologies. The first one is the integration with the banking

system in general and the second one is the integration with smartphones. Therefore, credit cards and debit cards are the dominant payment methods in Australia, either in the form of the plastic variety or linked to the card-based mobile apps.<sup>76</sup> This trend is on an upward trajectory<sup>77</sup> with very little consideration given to QR code-based mobile payment wallet such as Alipay and WeChat Pay in mainstream stores. Australians are one of the leading adopters of contactless technology but have been very reluctant to move outside of existing bank-centred and card-based infrastructure such as the one behind Apple Pay or Samsung Pay because there is a lack of trust in alternative payment systems.<sup>78</sup> The one glaring exception to this rule is the tourist market which was a very early adopter of the Chinese MPPs

In May 2021, the RBA initiated an inquiry into mobile payments in Australia.<sup>79</sup> While the inquiry hasn't yet been completed, it is apparent that the central bank is looking to try and regulate the industry and introduce stricter rules due to a perceived lack of transparency in digital wallet systems.<sup>80</sup>





## NEW ZEALAND

This section discusses the development of mobile payment in New Zealand, which is similar to that in Australia with a dominant banking industry and a burgeoning tourism market.

### Overview of digital payment systems market in New Zealand

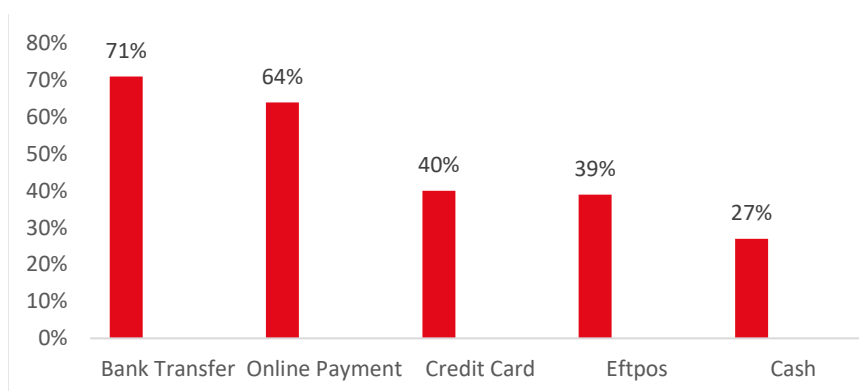
New Zealand has, like most developed nations, a fairly robust set of mobile payment systems in use in multiple markets.<sup>81</sup> In a very similar way to other nations like Singapore and Australia, NZ has a bank-led digital wallet system which has emerged since 2017.<sup>82</sup> The dominant model up until 2019 had been traditional and contactless credit card technology.<sup>83</sup>

There has been quite a shift since 2019, as with many nations, that saw a radical uptake of digital wallet systems.<sup>84</sup>

The majority of people in New Zealand still prefer to do things through their bank even though they might be paying on any one of the card-based iOS or Android payment systems. This is very similar to Singapore and Australia but it's quite different to other Asian nations such as China who have their own QR code-based system for making payments.<sup>85</sup>

The market overall is dominated by the big banks in New Zealand as shown in Figure 9.

Figure 9: Preference of payments options in New Zealand, July 2018 (percent)



Source: Venture Insights 2019.<sup>86</sup>

What is different in New Zealand is the dominance of the banking system and how they entered the space a lot earlier. The following sections discuss this in more detail and explore the current state of play in the New Zealand payments market.

## The financial system and the adoption of mobile payments

While there are secondary payment options, local banks remain the most powerful players in the payment industry.<sup>87</sup> The major banking players are BNZ, ANZ, ASB, and Westpac New Zealand. As shown below the majority of New Zealanders prefer to do their banking with their bank and the adoption of mobile payment systems has been quite slow. At the moment the majority of New Zealand citizens prefer to use existing technology through their banks as it is perceived to be safe and contains less personal risk to the user.<sup>88</sup>

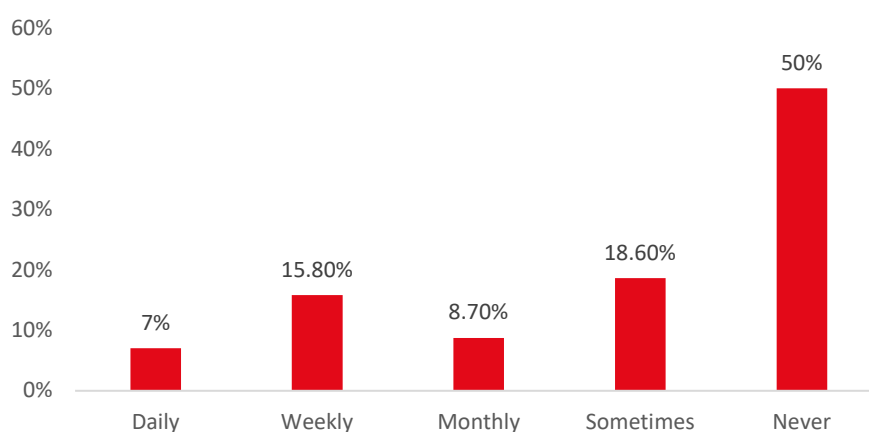
New Zealand customers have taken a long time to warm up to the idea of mobile payments. The majority of consumers prefer to use a credit card, especially those enabled by the tap-and-go PayWave technology in their day-to-day operations. According to the study by the Venture Insights, 50 percent of the population has never used mobile payment (see Figure 10).

Recent study shows that even when international tourists are added in, mobile payments have probably not yet penetrated the payment market outside the tourist industry.<sup>89</sup> When contrasting this with nations

like Singapore one sees a disturbing trend for New Zealand. While New Zealand remains over-reliant on the banking system, the world is rapidly moving into third-party Fintech systems through the development of apps and other related innovations.<sup>90</sup> While there is a movement towards contactless payment innovation and digital wallets since 2019, the industry is yet to take off.<sup>91</sup>

New Zealand has a gross domestic product of about \$206 billion with an internet penetration of approximately 90 percent and a mobile phone adoption rate near 80 percent.<sup>92</sup> Given that New Zealand is heavily reliant on the tourism industry it makes sense that there is an emerging market for WeChat Pay and Alipay and therefore a strong intention to use these apps by Chinese tourists.<sup>93</sup> However, the majority of people coming to New Zealand are not recommended to have any third-party apps on the phone or any kind of digital payment systems at hand. Instead most travel guides recommend having a payment debit card or credit card or something of that nature in which local currency is loaded onto the card in advance of the travel occurring.<sup>94</sup> There is some evidence that hotels, duty-free shops and other such places are adopting the Chinese MPPs.<sup>95</sup> However, the majority of mobile payment systems are still linked to the banks and unless a hotel or tourist operator has an explicit agreement with Alipay itself, international tourists will not be able to use digital wallet systems outside of the major five mentioned banks earlier.

Figure 10: Mobile payments in New Zealand (frequency of usage)



Source: Insights 2019.<sup>96</sup>

## The Chinese presence in the local market

The Chinese MPPs adopted a business model in New Zealand similar to that used in their operations in Australia, which is to team up with local companies and target Chinese tourists and local Chinese community. It is estimated that about 5 percent of the population in New Zealand could be of Chinese origin and with approximately 36,000 Chinese students visiting the nation every year, it is possible to predict a rough estimate of adoption based on the population size of 5 million for New Zealand. Notwithstanding COVID-19, this will make around 220,000 to 280,000 actual yearly regular users of the Chinese MPPs in New Zealand. Adding to this would be the 407,100 Chinese visitors, which would bring a total estimate to be approximately 550,000 to 650,000 active users in New Zealand.

Table 3 is the result of a survey on the potential users of the Chinese MPPs in New Zealand. It found that the majority of people visiting New Zealand actively use Alipay or WeChat Pay while they are visiting.

**Table 3: Potential Users of the Chinese MPPs in New Zealand**

Users	Percentage of Population
401,700 (Tourists)	10%
220,000 – 280,000 (Residents)	4-5%
36,500 (Students)	1-2%

Bank of New Zealand (BNZ) developed a partnership with Alipay in 2018 that allowed the latter to use Vodafone terminals to support the QR code scanning process. These terminals are used in retail outlets, hotels and other places where tourists from China can use their phone to scan the QR code generated by the terminals in order to pay for goods and services.<sup>97</sup> SmartPay also offers terminals to retail merchants that can generate QR codes from both Alipay and WeChat Pay.<sup>98</sup> It is interesting that third-party

providers and the banking industry are offering EFTPOS terminals to merchants who normally have to pay for the setup costs of the terminals.

PayPlus, a local fintech start-up, is also in partnership with both Alipay and WeChat pay and has provided the Chinese MPPs to local merchants since 2016. In particular, PayPlus is recognised for delivering these solutions through integrations with existing local platforms including POS systems, vending machines, parking systems, booking and reservation platforms, EFTPOS terminals and website payment integration.<sup>99</sup>

The adoption of these terminals is predominantly in tourist areas and for the convenience of residents who are still dealing with Chinese currency. However, retail giant Chemist Warehouse now allows Alipay as part of its retail infrastructure.<sup>100</sup> It was reported that 100 percent of Chinese visitors surveyed use Alipay. Given that tourist numbers are down due to COVID-19 it's still important to note that Chinese migrants in New Zealand are active users of Alipay. Part of this is the value merchants see in using e-commerce in general.<sup>101</sup>

A notable trend moving into the future is the adoption of third-party e-commerce tools such as Google's 'Pointy'.<sup>102</sup> The adoption of these tools by merchants could help break the banks' dominance, stimulate some innovation in the space and facilitate the adoption of alternative payment technologies as they become available and are perceived to be less risky.

## Conclusion

New Zealand, like Australia, has been very slow in adopting new payment technologies over the last ten years. New Zealand's financial institutions have adopted Chinese payment systems to foster its tourist industry but the steady and strong reliance on banks as the only trusted financial institution by citizens remains. To develop this economy further would require much more innovation. New Zealanders are moving faster into digital wallet systems, being committed to developing their relationships with the tourist industry and moving towards a high integration of the systems.





## SINGAPORE

A renowned international financial centre sitting on a geographical hub where East meets West, Singapore has every reason to ride the wave embracing the new digital economy. The city state has the financial and technological expertise, highly educated work force, dynamic business culture, and close economic and social relationships with other countries in Asia and beyond. Indeed, digitalisation added a new impetus over the years to transform Singapore into a 'Smart Nation' in Southeast Asia. The government's goal of making Singapore a check-free country by 2025 has been inspired by the rapid rise of the fintech industries, particularly the digital payment sector in recent years.<sup>103</sup>

### Fintech on a blistering pace

The widespread mobile phone penetration, the advancement of technological and telecommunications infrastructure, and the harvesting of big data have created massive opportunities<sup>104</sup> for a fintech revolution to the Singaporean economy.<sup>105</sup> The players in the Fintech wave included traditional financial institutions, digital forms of financial institutions (such as digital banking, virtual banking,

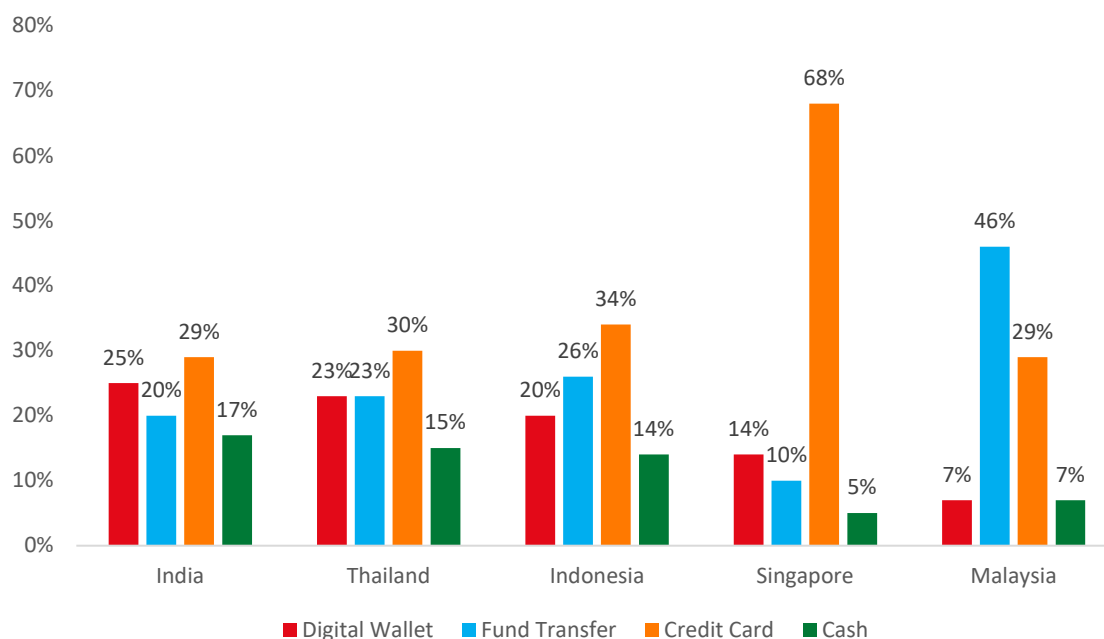
online banking, and mobile banking), as well as international tech giants (such as Apple and Google) providing nonbank financial services.<sup>106</sup>

Singapore's position at the forefront of adopting fintech is better placed today than ever. Singapore sustains fertile ground for digitisation and continues to frame a lucrative environment of opportunity to adopt fintech across various services.<sup>107</sup> In Southeast Asia, Singapore was the first country to issue digital banking licences by harnessing technological innovation, enhancing financial inclusion, and encouraging competition.<sup>108</sup>

The rapid growth in fintech delivered an irreversible trend of cashless payment. By 2020, payment preference by cash reduced to 5 percent in Singapore, the lowest among major Southeast Asian countries. Accordingly, this brings Singapore to an upright position near the top cashless countries of Canada, Sweden, the UK, China and Japan. At the same time, mobile wallets became the second-most popular payment method in Singapore, accounting for 14 percent in payment preferences (see Figure 11).



Figure 11: Payment preferences in major South East Asian countries



Source: Deloitte 2020.<sup>109</sup>

The rapid rise of Fintech has been built on a robust growth in e-commerce and financial deepening enhanced by social media, on the back of growing rate of internet penetration in Singapore, reaching 87.7 percent in 2020. Smartphone users are expected to increase from 4.74 million in 2019 to 5.09 million in 2025.<sup>110</sup> E-commerce is well-adopted in Singapore, which hosts the two largest online retail platforms Southeast Asia, Lazada and Shopee. One notable feature was the popularity of mobile commerce, so much so that several popular ecommerce websites first launched as mobile-only sites. Mobile commerce accounted for more than 42 percent of the total e-commerce market that was valued at \$4.9 billion in 2020. Mobile commerce sales are expected to outpace overall e-commerce growth, reaching 18.1 percent until 2021 valued at \$4 billion.<sup>111</sup>

### A diversified and competitive mobile payments market

The popularity of mobile retailing means commensurate demand for payment systems that can be handled by mobile devices. At the same time, changing lifestyle and daily commerce further geared the demand and expectations for implementing

various digital payment platforms in Singapore. On the other hand, the expectation of a customer-centric approach has become deeply embedded in the local society, resulting in technology companies playing critical roles in designing and accelerating broader adoption of mobile-based payment solutions for consumers.

Over the last decade, interest in payment technology (PayTech) has grown and shifted from the physical realm to the virtual/digital realm enabling payments through various methods and applications to execute payments faster, easier, more reliably, and more secure.<sup>112</sup> The PayTech revolution optimises the operation and delivers significant opportunities to modern businesses by addressing payment speed, efficiency, risk protection, and user experience. The prospects the payment technology offers have expanded across the economy of Singapore, aiming to create the fintech ecosystem as a hub for global trade and finance.<sup>113</sup>

The cashless economy emerged in 1985 with the commencement of NETS EFTPOS for card-based purchases at retail outlets in Singapore.<sup>114</sup> The first digital payment solution integrated into fintech, named FAST, was launched in 2014, allowing users to

access accounts held by bank and nonbank financial institutions.<sup>115</sup> Ongoing shifts toward digital payment solutions and instant payment transactions against cash payments have significantly been pushed forward across financial sectors in Singapore.<sup>116</sup> The digital payment market featured fierce competitions between multiple players. Alternative payment methods in Singapore, such as DashPay and GrabPay, appeared in 2014, while PayNow was launched in 2017, allowing users to perform transactions via their mobile phones without requiring bank account details. These alternative payment solutions underpinned by digital payment systems continued playing critical roles in accelerating online retail revenues to new heights in Singapore. At the same time, big data analysis also enabled deep insight into consumers' preferences and creditworthiness, which resulted in emerging payment-centred financial platforms that provide a wide range of financial services, such as online banking, bill payments, macro and micro-financing.

The transaction value of the mobile payment market in Singapore was \$3.62 billion in 2020 and is expected to reach \$21.56 billion by 2026, registering a CAGR of 30.06 percent between 2021 and 2026.<sup>117</sup>

A study revealed that mobile payments are on the rise in Singapore, increasing by a 53 per cent penetration rate since 2017, which is higher than that in Hong Kong (41 percent), the United States (23 percent), and Australia (14 percent).<sup>118</sup> The rapid growth in mobile payments has been sustained by a range of divergent mobile payment services in Singapore using card-based terminals or scanning QR codes, including several major Chinese MPPs, such as Alipay, WeChat Pay and UnionPay.

The Singaporean government acted as a strategic enabler to address the high fragmentation of the QR-based payment market. In September 2018, the world's first unified QR code for payment, Singapore QR (SGQR), was launched in Singapore in a collaboration between the MAS and the Infocomm Media Development Authority, an industry regulatory body within the government.<sup>119</sup> The first of its kind globally, SGQR combines multiple payment QR codes into a single SGQR label, making QR code-based mobile payments simple for both consumers and

merchants. Adopted by all the major mobile payment apps, the implementation of the SGQR means less clutter on the store front, streamlined payment process and less processing time.<sup>120</sup> It turned out to be a great success, with small retailers and merchants promptly adopting the national scheme from heartland shops to hawker centres in Singapore.<sup>121</sup> To accelerate e-payments adoption, the Singapore Digital Office (SDO) has been tailored to facilitate community awareness, particularly the seniors and the stallholders in hawker centres and heartland merchants, urging them to adopt mobile payment solutions.<sup>122</sup>

## Chinese MPPs in Singapore

Chinese MPPs executed a different business strategy in Singapore and Southeast Asia compared with Australia and New Zealand which relied on cooperation and partnership with local firms and targeted Chinese travellers and local Chinese community. The Chinese MPPs, particularly Alipay, expanded its reach and popularity in Southeast Asia through mergers and acquisitions (M&A) in e-commerce, which brought the brand to the mainstream market, thus having a significant impact on the local mobile payment industry.

By the time the Chinese MPPs entered in Singapore and SE Asia, the region had already become an 'attractive, mobile-driven consumer market' where 'competitive dynamics were more favourable than those in Europe and North America'. However, the market was highly fragmented and diverse.<sup>123</sup> Alibaba saw this as an ideal point of breakthrough given its cashed-up purse from a recent sale of its North American operations, industry knowledge and technology, and ability to integrate the industry across the border and business sectors.

This prompted Alibaba to spend \$1 billion in acquiring a controlling stake in Lazada in 2016, which is an e-commerce platform founded in 2012 and headquartered in Singapore. At the time of the deal, Lazada's network covered Singapore, Indonesia, Malaysia, Thailand, Vietnam, and the Philippines, with local marketing sales operations, online payments (HelloPay), 76 last-mile distribution hubs as well as 10 fulfilment facilities.<sup>124</sup> By the end of 2019, Alibaba owned more than 90 percent of Lazada's stake.<sup>125</sup>

A year later, Alibaba rebranded Lazada's payment arm HelloPay to Alipay across four SE Asia markets it operates in, to be Alipay Singapore, Alipay Malaysia, Alipay Indonesia, and Alipay Philippines.<sup>126</sup> This was a strategic and aggressive move, which awarded the Alipay brand direct exposure in the SEA payment market. Although the four Alipay platforms under Lazada runs separate to the Alipay app, by handling e-commerce transactions on Lazada, it greatly enhanced the popularity of Alipay among consumers and merchants in Singapore and the SEA region.

Before the Lazada deal, Alibaba also acquired 14% stakes in Singapore Post (SingPost) with two rounds of investment in 2014 and 2015 totalling \$435 million.<sup>127</sup> This enabled Alipay to enter SingPost's own e-commerce platform, network of services, as well as the latter's bill payment unit, SAM.<sup>128</sup>

The other Chinese tech giant, Tencent, joined a proxy war in e-commerce against Alibaba in SE Asia. Tencent participated in Sea Group's several financing rounds in the 2010s, becoming the biggest shareholder of Sea, which is also headquartered in Singapore. In December 2020, Tencent held 22.67 percent of Sea's shares.<sup>129</sup> Sea entered the e-commerce sector in 2015 after its success in the gaming industry, launching the e-commerce platform Shopee, which quickly became the most popular online marketplace in the region in terms of monthly active users.<sup>130</sup> Although Tencent controls Shopee, it appears that Shopee runs its own payment service, ShopeePay. For example, both ShopeePay and Tencent's WeChat Pay operate in Singapore independently. Nevertheless, Shopee also accepts WeChat Pay as its payment options, which helps the latter's expansion in the SEA market. In January 2022, Tencent cut its shares in Sea Ltd. by \$3 billion, but still has a sizable hold of its shares at 18.7 percent.<sup>131</sup>

Apart from Alipay's growth associated with Alibaba's e-commerce strategy, there are other factors that have facilitated the expansion of the Chinese MPPs in Singapore and SEA. In 2020, 49% of urban consumers in the region who were commercial bank customers already use e-wallets, and is projected to reach 84% by 2025.<sup>132</sup> In addition, the use of QR code-based

systems is more popular in this region. Many of the non-bank financial institutions that offer payment services run on QR code-based systems. This form of payment has been massively growing and gaining high popularity among consumers and merchants due to its convenient and low-cost features.

Usage of the QR code payments significantly increased in Singapore due to the impact of the COVID-19 pandemic.<sup>133</sup> The COVID-19 outbreak further reinforced the embracing of contactless payments, particularly the MPPs. A recent study revealed that Singapore recorded massive growth in this regard, with 1.2 million monthly QR code transactions.<sup>134</sup> The global Mastercard consumer study showed that approximately 70 percent of Singaporeans acknowledged their contentment with using mobile/contactless payments (i.e., tap-and-go) post-pandemic.<sup>135</sup>

Singapore remained as one of the top favourite destinations for Chinese tourists, and their overseas spending tend to transform the local business landscape, especially in countries with a large share of tourism revenue, such as Singapore. Evidence shows that total spending through mobile payments of Chinese tourists increases significantly in countries where Chinese mobile payments such as Alipay and WeChat Pay are relatively mature.<sup>136</sup> On the other hand, 66 percent Singaporean merchants showed their willingness to carry out digital store operations through Chinese mobile payments solutions.<sup>137</sup>

## Conclusion

The mobile payments market experienced rapid growth in the last decade in Singapore under a concerted effort between the government, tech firms and the banking sector. Alipay's strategy of expansion through M&A in e-commerce turned out to be a relative success so far, and Tencent's strategy for WeChat in this regard remains unclear despite its handsome returns in investing in Lazada's rival, Shopee. The mobile payment market in Singapore remains highly diversified, dynamic and competitive. Local innovations and entrepreneurship will be the challenges for the Chinese MPPs in this market.



## THAILAND

Thailand has persisted in developing a lucrative digital market growth space and affluent segments with tech-savvy and mobile-first nations in Southeast Asia.<sup>138</sup> The massive development of wireless technology, social network, and increased use of smartphones has led to the embrace of various innovative digital payment options, including mobile payment solutions. The government of Thailand is highly motivated to explore the digital sector which could contribute as much as 25 percent of national GDP by 2027.<sup>139</sup> Digital sectors are rapidly growing in Thailand since banks and non-bank financial institutions are pursuing seamless connectivity, partnering with stakeholders and customers for improved digital payments experiences while retaining secured and transparent payment transactions.<sup>140</sup> Thailand has progressed speedily in terms of an enhanced digital experience that has reinforced further demand for robotics, internet of things (IoT) connectivity, cybersecurity, blockchain, artificial intelligence, cloud computing, and big data analytics so as to escalate a digitally-driven economy and ecosystem.<sup>141</sup>

### Rapid growth in Fintech

To start with, Thailand provides stimulating Fintech market opportunities, with a population of 69 million and an increasing per capita income.<sup>142</sup> According to the Economist Intelligence Unit, Thailand's GDP per capita is expected to rise by a third within five years, from \$6,597 in 2017 to \$8,365 in 2022.<sup>143</sup> Further, favourable government Fintech policies as well as Thailand's 4-20 years plan undeniably support Fintech growth by transforming the country into a value-based digital economy with a focus on technological applications and services.<sup>144</sup>

In Southeast Asia, Thailand is in the second position after Singapore in terms of the adoption of financial technologies<sup>145</sup> in providing better financial access and tailored product offerings.<sup>146</sup> A change in the mindset was also at work with over 70 percent of the consumers recorded being either tech-savvy or looking for intelligent solutions.<sup>147</sup>

The advent of digital payment solutions leads to a wide array of payment options resulting in significant revenue growth in e-commerce and social media

platforms than offline business groups. In recent years the e-commerce market in Thailand significantly grew in popularity. This has given the Thai people an opportunity to embrace cashless payments in their daily purchases. Traditional Thai business groups like the CAGR of Robinson, The Mall Group and Siam Piwat achieved an annual growth rate of 5 percent, 3 percent, and 14 percent respectively during 2015-2018.<sup>148</sup> On the other hand, online stores like Lazada and Shopee experienced significant growth accounting for 37 percent and 2,560 percent during the same period, respectively.<sup>149</sup> Thailand has become the second largest e-commerce market in Southeast Asia with cross-border spending constituting up to 50 percent of the country's total e-commerce spending.<sup>150</sup>

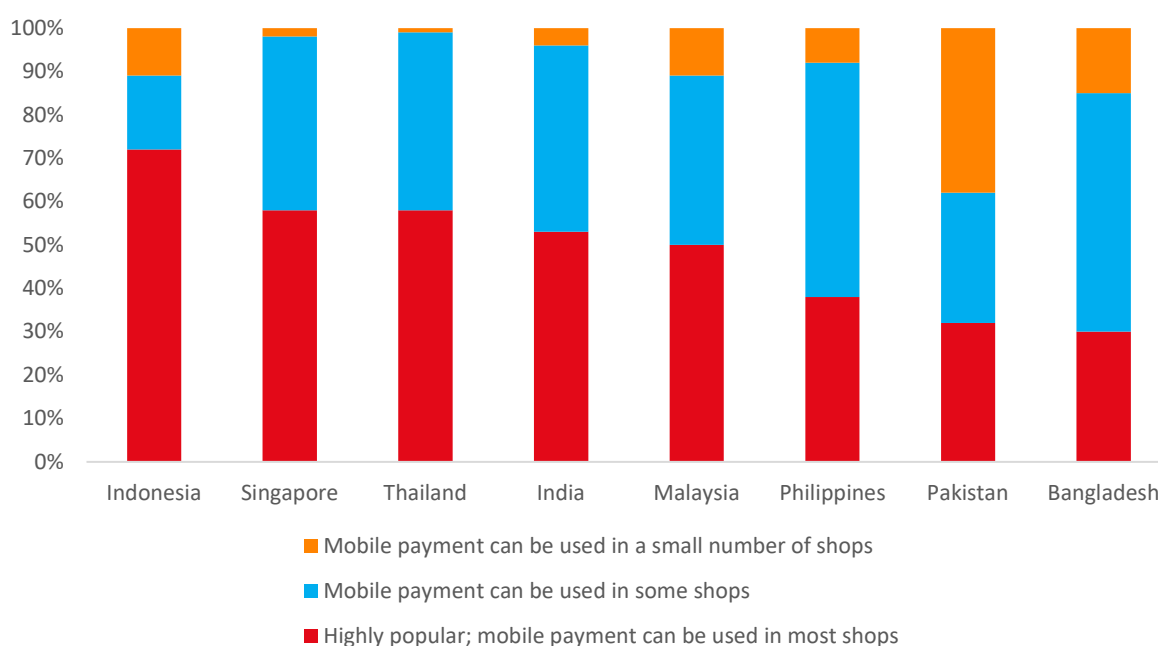
### Mobile payment landscape

The digital era brought substantial technological advancement, particularly in payment technologies, overcoming many limitations of cash-based payments with new, digital cashless solutions.<sup>151</sup> The growing popularity among consumers in alternative forms of payments has contributed to a fast-growing mobile payments market in Thailand. This payment method

has remained a key enabler, connecting digital life for consumers, producing social interactions, creating financial services, and changing shopping habits<sup>152</sup>. A recent report, for instance, noted that Thailand ranked third with 71 percent of Internet users purchases online using their smartphones, behind only Indonesia and China which recorded 76 percent and 74 percent respectively, with the global average accounting for 55 percent.<sup>153</sup>

Mobile payment (in the form of digital wallet) has persisted as a popular payment method among many residents in Thailand because it is contactless, convenient, and offers additional benefits and discounts.<sup>154</sup> The high penetration of smartphone usage, a shift towards online shopping, and enhanced and secured network bandwidth allow consumers to choose mobile payment solutions with greater confidence.<sup>155</sup> The availability and affordability of smartphones have significantly influenced mobile payments penetration growth in Thailand (see Figure 12). Moreover, the offerings from static QR stickers, dynamic QR codes, and low-cost scanners will leverage consumers and boost institutional trust on mobile payment platforms in Southeast Asia, including Thailand.<sup>156</sup>

Figure 12: Penetration of mobile payments in the retail sector in Thailand and other South East Asian countries



Source: Deloitte 2020.<sup>157</sup>



As an emerging digital payment market, 60 percent of Thailand's population prefer digital payment methods either online or offline with only 13.6 percent of buyers choosing cash as a payment method.<sup>158</sup> In 2019, mobile payment accounted for 23 percent of total payment value in Thailand, only lower than that of India yet higher than major SE Asian economies, such as Indonesia, Singapore and Malaysia (Figure 11). Another study has found that digital wallet usage trends will rise by 18 percent in 2021, holding a 28 percent share in the payment market.<sup>159</sup>

Mobile payments remain the most popular and trusted payment method in Thailand. A study found that as of July 2020, 37 percent of Thai users aged between 21 and 37 use mobile payment platforms<sup>160</sup>. For example, PromptPay's subscriptions reached 12.6 million with 127 million transactions worth USD 15.6 billion in March 2018<sup>161</sup>. By 2020, the mobile payment firm recorded over 50 million registered users with more than \$2.5 billion *daily* transactions.<sup>162</sup> KogoPay is another mobile payment method that is on the rise in Thailand, offering instant and affordable transactions between Europe and Asia. The company raised more than £200,000 in crowdfunding and hitting a £10 million valuation<sup>163</sup>. Also, UnionPay and Dolfi E-wallet are persistently popular mobile payment solutions. UnionPay International has facilitated QR code-based mobile payments for merchants and consumers. Other important players in mobile payments market are mPay, BluePay, Alipay, and TrueMoney wallets.

Of the various mobile payments platforms and e-wallet apps, QR code-based payment systems remained an attractive option for small merchants and SMEs to receive e-payments in Thailand.<sup>164</sup> In 2017, the Bank of Thailand allowed five major banks to graduate the QR code-based payment solutions from the regulatory sandbox and take it to the digital market. In 2018, the first QR-code payment standard was introduced to support seamless payments between various sources of funds such as credit/debit cards, bank accounts, and e-wallets<sup>165</sup>. The Thai people showed their preferences for QR code-based systems, including mPay, BluePay and TrueMoney Wallet, using them in gas stations, retail stores, restaurants, convenience stores, and many other scenarios.<sup>166</sup> Banks have also joined the QR-code bandwagon, with five Thai banks (Kasikornbank, Siam Commercial Bank, Krungthai Bank, Bangkok Bank, and

Government Savings Bank) offering the mobile payment solution.<sup>167</sup> A survey reported that 75 percent of consumers habitually used QR codes for payments, making it the most popular mobile payment method in Thailand.<sup>168</sup> In addition, PromptPay offers users more flexibility to set up a unique QR code with encoded data, and users of mobile banking apps can scan the QR code for transferring money to their PromptPay accounts instantly.<sup>169</sup> From a fintech perspective, the most lasting impact of the global pandemic arguably fuelled the adoption of contactless payments due to hygiene concerns where consumers actively seek out touchless payment solutions, and Thailand is not an exception.<sup>170</sup>

## Chinese MPPs taking a foothold

Of the four cases of the Chinese MPPs' overseas expansion covered in this report, Thailand stands out as one that features collaboration and partnership in both public and private spheres. The inclusion of Chinese MPPs like the Alipay and WeChat Pay has significantly contributed to the expansion of the digital payments landscape and ecosystem in Thailand.

The rapid growth in China's outbound tourism and the introduction of mobile payments solutions in their major destinations are mutually reinforcing.<sup>171</sup> The country experienced a paradigm shift in tourism revenue from Chinese tourists. A study found that more than 10 million Chinese visited Thailand in 2018 alone, bringing 586.47 billion baht of tourism revenue.<sup>172</sup> The average spending of Chinese tourists were more than 5,000 baht per person per day, surpassing the average expenditure of tourists from other countries<sup>173</sup>. Much of this spending was handled by mobile payments. For instance, mobile payments by Chinese tourists increased during 2018 and 2019 by 14 percent in Thailand and Singapore.<sup>174</sup>

Alipay has been taking a diversified strategy in advancing in the Thai market. First, it took a regional approach by investing in and controlling one of the major e-commerce platforms in the region, Lazada, whose business remit includes Thailand (see the previous section on Singapore). It then entered the Thai mobile payment market directly in 2017, partnering with Kasikornbank, one of the largest Thai financial institutions, and promoting the QR code-based payment system among Thai businesses eager to lure Chinese tourists.<sup>175</sup>

In 2016, Alipay partnered with PAYSBUY, a leading online payment provider with over 15,000 online merchants in Thailand.<sup>176</sup> The deal led to the launching of the “PAYSBUY Alipay Online-to-Offline (Alipay O2O)” service that integrates Alipay mobile payment service into PAYSBUY’s online payment, enabling the purchases of goods and services by Chinese customers in yuan.<sup>177</sup>

In the same year, Ant invested an undisclosed amount in Thai conglomerate True’s fintech firm Ascend Money, which operates the e-wallet TrueMoney. According to Reuters, Ant’s stake is around 25 to 30 percent. While Ascend Money has a regional presence, Ant is only involved in its Thai operations.<sup>178</sup> At 16.8 percent, TrueMoney tops the list of Thailand’s preferred payment methods by 2021<sup>179</sup>. Alibaba also entered into strategic cooperation with Kaitai Bank, enabling Alipay’s access to the latter’s payment terminals nationwide.<sup>180</sup>

Statistics further show that 3.7 million consumers use Alipay wallets<sup>181</sup> with over 10,000 Thai retailers accepting Alipay mobile wallets<sup>182</sup>, scaling up their digital payment collaboration with the Chinese MPP.

The second popular Chinese mobile wallet, WeChat Pay, entered the Thai local mobile payment market in late 2016 with a partnership with Asset Bright, mainly targeting Chinese tourists.<sup>183</sup> In the same year, Kasikornbank formed an alliance with WeChat Pay (partnership with Alipay in the next year), providing mobile payment solutions to Chinese travellers over its 200,000 terminals.<sup>184</sup>

UnionPay International (UPI) has been another important Chinese MPP in Thailand. UPI is the international arm of China UnionPay and has been a payment brand familiar to Thai consumers. UnionPay cards are accepted by all ATMs, over 90 percent of Thai merchants and eight major Thai banks issue UnionPay in the country. Thailand is also the first country outside mainland China that has adopted UnionPay specifications for all its chip cards.<sup>185</sup> UPI, powered by Huawei and Industrial and Commercial

Bank of China (Thai), launched its Huawei Pay e-wallet app in Thailand in 2020.<sup>186</sup> Huawei Pay enables Thailand users to make tap-and-go payment, without unlocking their device or opening the app, after adding their UnionPay card issued by ICBC (Thai) to their Huawei wallet or Honor mobile phones.<sup>187</sup> This further boosted the popularity of tap-and-go payments in supermarkets and convenience stores.<sup>188</sup>

A notable development in Chinese MPPs’ expansion in Thailand has been Alibaba’s cooperation with the Thai government. The increasing integration of the Chinese MPPs into the local Thai mobile payment market makes it imperative for the Thai government to help develop a sustainable business model enabling higher revenue growth while remaining consumer-focused and market competitive. The Thai government has entered into a strategic partnership with Chinese giant Alibaba to kick start a series of projects. For example, the Thai government’s Industry Promotion Agency and the International Trade Promotion Agency has collaborated with Alibaba’s business school in launching measures to promote a digital economy.<sup>189</sup> This partnership provides potential opportunities for Thai banks, financial institutions, and IT industries to collaborate with Chinese mobile payment providers (i.e., Alipay, WeChat Pay, and UnionPay) to create Thailand’s most advanced digital ecosystems. This reflects the implementation of the Thai government’s recent reforms to strengthen local digital payment markets. It has also facilitated the Chinese MPPs to establish a local presence.<sup>190</sup>

## Conclusion

The movement away from cash-based payment ecosystems to cashless systems has been sustained in Thailand under government and corporate efforts as well as incentives for consumers and merchants. Changing mindsets, greater accessibility, and higher flexibility in contactless transaction is bound to leapfrog the existing underdeveloped financial system and transform the Thai economy in a digital age.



# MITIGATING RISKS OF MOBILE PAYMENTS

Payment systems are vital building blocks for market transactions, social exchanges, and cross-border capital flows. They are the artillery of the economy and the financial infrastructure of the global market. With the ubiquitous popularity of smartphones, payments systems built on mobile devices, transnational in nature, have recorded remarkable expansion in the Asia Pacific, and are well poised to become the crown of the digital economy and a key pillar of the global financial infrastructure. Because of the huge stakes at hand, it is equally vital for security and regulatory authorities to understand and address the major risks and challenges the MPPs entail, particularly those of the Chinese MPPs given their leading positions both at home and in a growing number of countries in this region. Such risks and challenges can be broadly grouped into three categories: security, regulatory, and political and legal risks. Based on an analysis of the state of market development, country experiences and the risks and concerns of the industry, some recommendations can be drawn to inform on best practices in the area of mobile payments for the international community.

## CYBERSECURITY AND DATA SECURITY

The risks with regard to cybersecurity refer to online digital transactions.

Mobile payments can be divided into two types of systems based on the entity that controls the settlement of the transaction. Alipay, Tencent (who distribute the WeChat Pay application) and PayPal are examples of Third-party Payment Providers (TPP) who are responsible for payment settlement. The other mobile payment type uses major banks as settlement parties. The bank-based settlement model is commonly used by Google, Apple, and Samsung. This section is a comparative study of the security of two mobile payment systems, particularly the TPP model on which the major Chinese MPPs are based and which represent more risks in terms of cybersecurity.

Based on the TPP payment model on Alipay<sup>191</sup> and WeChat Pay documentation<sup>192</sup> and relevant academic literature<sup>193</sup>, there are two major processes that are conducted as part of the TPP payment model. The first process is the card registration and binding process that links the customers card to the electronic

wallet application. The second process is the payment process itself which combines the payment authorisation from the customer with the merchant transaction details and sends it to the payment settlement provider.

**Customer:** the customer is the entity who initiates the transaction.

**Electronic Wallet:** the application installed on the customer mobile device that conducts with the payment process on behalf of the customer.

**Merchant:** the merchant is the entity that provides goods or services to the customer.

**Third-party Payment Provider (TPP):** the entity that manages the payment settlement process for the transaction.

**Bank Authorised Payment Provider (BAPP):** the entity that manages the payment settlement process for the transaction on behalf of the bank.

**Card Organisation:** the entity that authorises banks to issue cards and authorises card transactions.

**Bank:** the entity that issues cards and holds customer accounts.

## System overview

The aim of the payment process is to provide an authorised transfer of payment funds from the customer account to the merchant account. There are two types of payment process that are commonly seen in the QR Code payment model. The first is the

Customer Presenting mode and the other is the Merchant Order mode. The main difference between these modes is that in the Customer Presenting mode, the Customer generates a QR code that is scanned by the merchant and in the Merchant Order mode, the Merchant generates a QR code that is scanned by the customer (see Figure 13).

Both payment modes use a time-based one-time password protocol to authenticate the customer to the TPP to ensure that the customer has authorised the payment. The time-based one-time password (TOTP) protocol produces a secret code that is the same on the TPP and the electronic wallet for a given time period. Therefore, if the TPP is able to compare the code received from the customer's electronic wallet with the code that was generated by the customer, and they are the same code, then the TPP can be confident that the customer has authorised the payment. It is difficult for anyone who is not the customer to generate the same code. Also, the code changes every time period (usually 30 seconds) so it makes it difficult for anyone to guess the code.

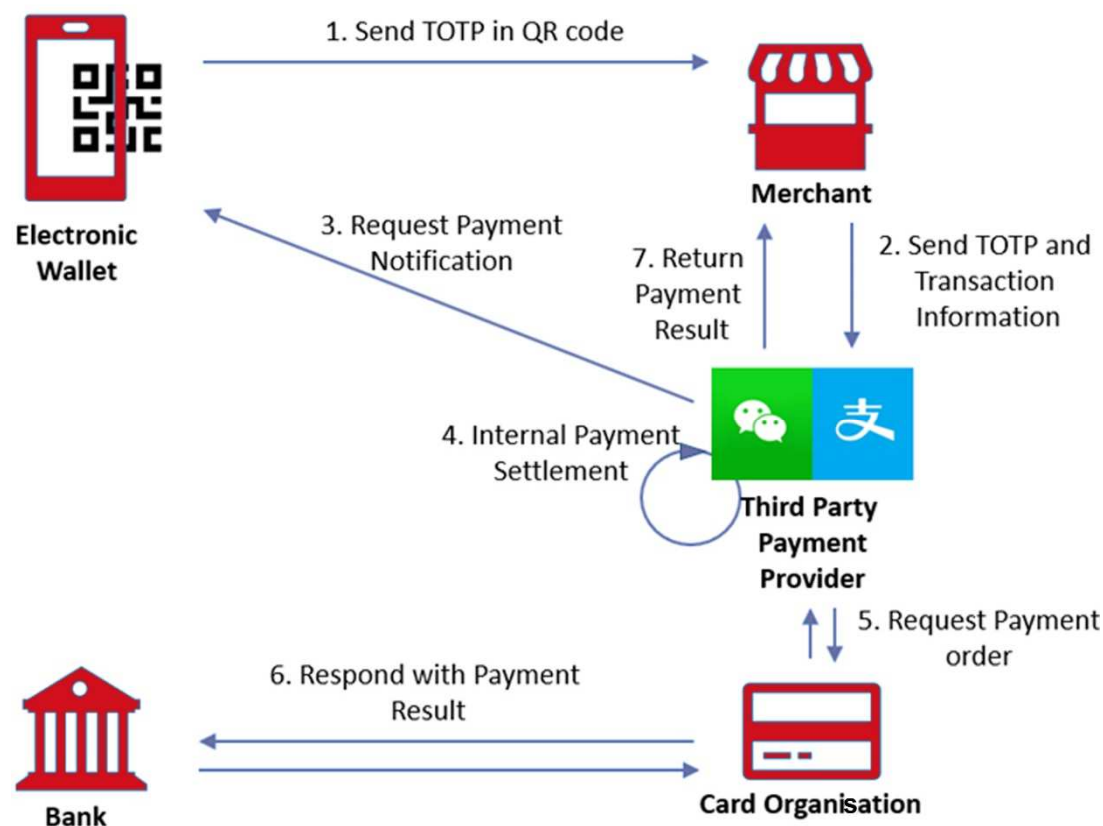
Payments are considered to be offline as the authorisation does not have to return to the bank. This is only the case for transactions that occur between customers who have account balances at the TPP. It is assumed that all Merchants have account balances with the TPP. In China, almost all local transactions are conducted using account balances held with Alipay or WeChat Pay.

Figure 13: Alipay user interface for payment mode



Source: Alipay 2021.<sup>194</sup>

Figure 14: Payment Process (Customer Presenting Payment Mode)



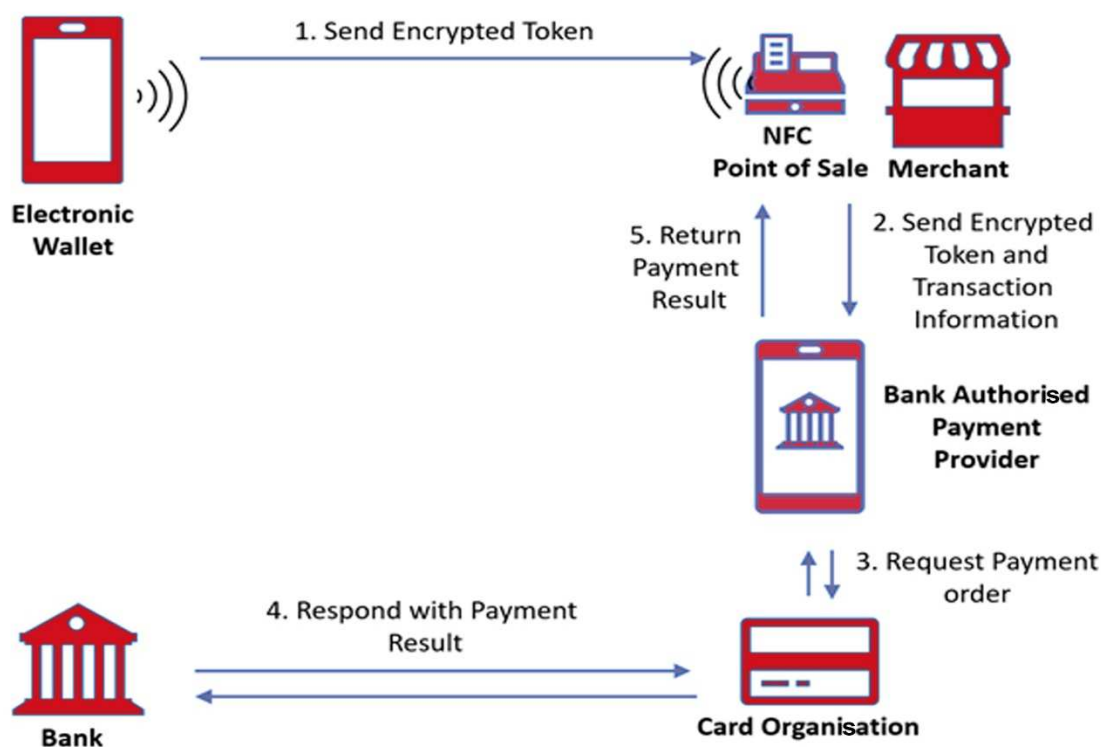
The payment process, illustrated in Figure 14 with the Customer Presenting model as an example, are as follows:

1. The electronic wallet generates a TOTP and sends it to the Merchant Point of Sale (POS) application. This is usually done by generating a dynamic QR code that is scanned by the Merchant. The Merchant POS can also be an application on the Merchant's mobile device.
2. The Merchant sends the TOTP and transaction information to the TPP. Transaction information can include the name of the merchant, items purchased and the price of the items.
3. The TPP then validates the TOTP and sends a confirmation notification with transaction information to the customer to verify.
4. The customer sends their verification notice to the TPP. If the customer is paying a merchant where both entities hold an account balance at the TPP, the TPP updates the internal ledger for the customer and the merchant. The transaction is completed.
5. If the customer does not have an internal account balance at the TPP, the TPP sends the stored electronic token for the customer and the transaction information to the card organisation. Card organisations are typically China Union-Pay, Visa or Mastercard, etc.
6. The card organisation retrieves the original bank account number from the token and sends the account details to the bank where the transaction is completed.

As a comparison we provide a brief description of the card-based payment.



Figure 15: Card Based Payment Process



The steps for a traditional Card Based payment process are as follows:

1. The user activates the electronic wallet using their fingerprint, PIN or face recognition. The electronic wallet uses near-field communication (NFC) to simulate the process of contactless card payment which sends an encrypted token to the Merchant Point of Sale (POS).
2. The Merchant POS authenticates the electronic wallet as a mobile terminal and obtains the encrypted card token. The conversion of the account details into a token using encryption is also known as Tokenisation. The Merchant adds the transaction information and passes it along with the encrypted card token to the Bank Authorised Payment Provider (BAPP).
3. The BAPP then interacts with the Card organisation sending the encrypted card token and the payment order.
4. The card organisation retrieves the original bank account number from the token and sends the account details to the bank where the transaction is completed.
5. The outcome of the payment is returned from the bank through the card organisation to the Merchant POS.

## Cybersecurity analysis

As discussed earlier, the setup costs and running costs of using QR code-based mobile payments are low, but the trade-off is the security of the payment process. There are several recognised threats for mobile payment systems. Mobile payments are inherently less secure than traditional cash payment processes because components of the payment process are conducted over open public networks such as the Internet.<sup>195</sup> However, it is also noted that mobile payment fraud is reported to be very low at less than \$1 in \$10 million transacted.<sup>196</sup> This may be because mobile payments are in a closed ecosystem making tracking fraud easier or that transactions are limited to micro payments. The following section discusses common cyber security threats against mobile payment systems.

## Application security

The e-wallet application security is an area of vulnerability for mobile payment systems. The electronic wallet contains sensitive information that is

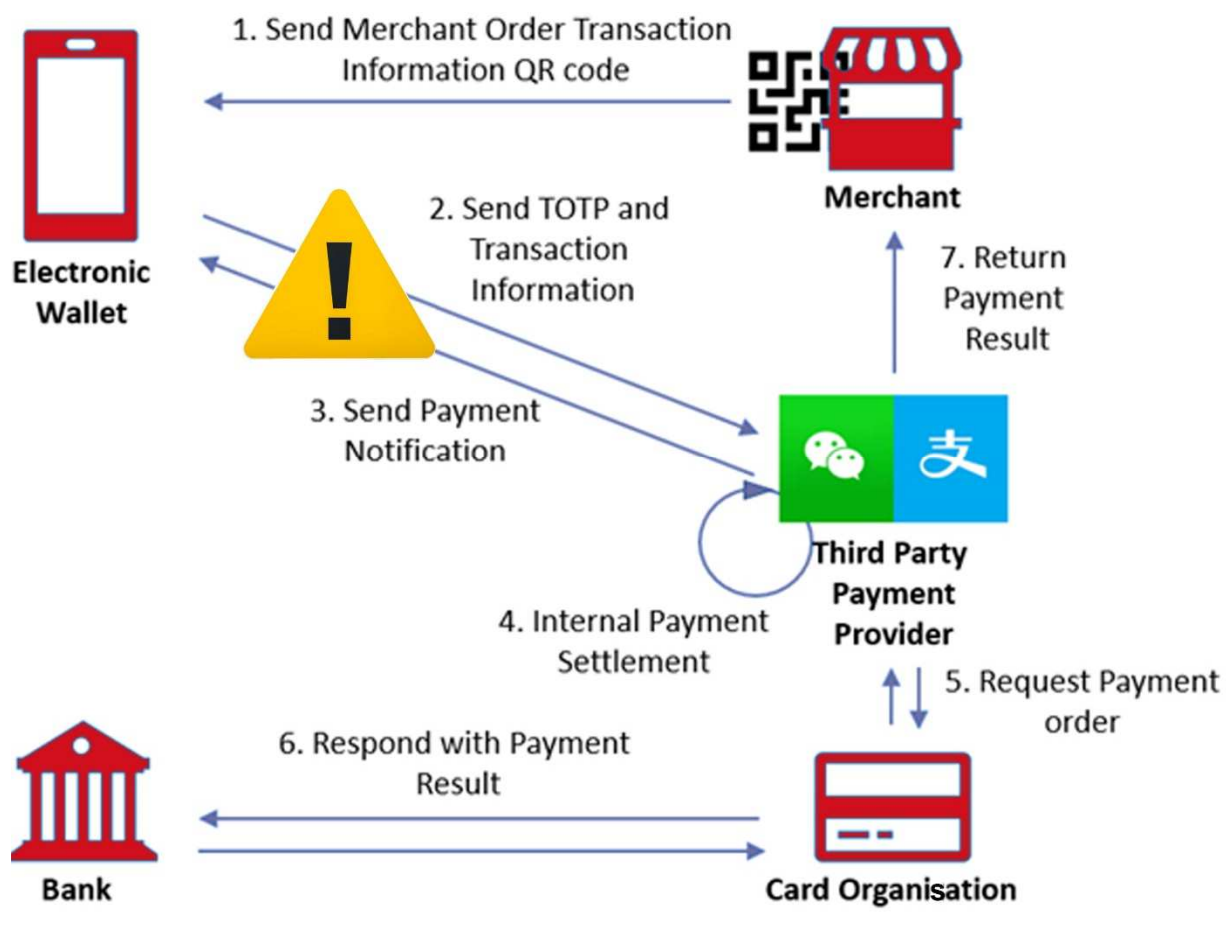
used to conduct payment transactions. It is possible that a malicious application could monitor the electronic wallet and attempt to extract or steal information from it, or at least examine data coming in and out of the electronic wallet.<sup>197</sup>

Mobile devices do not have the same level of data protection as dedicated hardware, such as card-based EFTPOS devices, would need to have to protect account information. Alipay and WeChat Pay applications rely mainly on software-based protection of sensitive data usually determined by the mobile device operating system

### Man-in-the-middle attacks

Man-in-the-middle attacks occur when an adversary compromises the connection between two communicating entities. Man-in-the-middle attacks allow adversaries to observe and control messages between the communicating entities. Adversaries can inject new messages, replay messages, delete messages, or alter existing messages as well as view the content of messages. As aspects of the mobile payment process are conducted on open networks, it is possible for adversaries to conduct such attacks on the mobile payment process.<sup>198</sup>

Figure 16: Man-in-the-middle attacks



The attack will likely occur on communications inbound and outbound from the Customer's mobile device. A successful attack in the case of Figure 16 would be able to change the merchant information and the transaction amount so a large amount could be transferred to another account. In addition, the notification to the customer could be blocked or altered so the customer is not aware of the attack.

Man-in-the-middle attacks can also affect the Merchant. The attacker could alter transaction amounts or merchant information to another account then block or alter notification messages such that the merchant is unaware of the attack.

Alipay and WeChat Pay are susceptible to this type of cyber-attacks because the protocol does not ensure mutual authentication between the three main payment entities, namely the customer, the merchant and the TPP. The attacker can impersonate both the TPP and the customer. Mobile payments are dependent on TOTP to provide payment authorisation. However, TOTP does not provide the same security as slower and more computationally complex digital signature schemes.

Man-in-the-middle attacks are possible, but they are challenging to conduct successfully. It is much easier for the attacker to implement such attacks if they have control of the communication network between communicating entities. Card based transactions avoid this issue because those systems use leased lines and private networks as well as dedicated tamper resistant hardware for point-of-sale equipment, although the latter bears costs to the merchants in setup and maintenance.

## Relay attacks

Relay Attacks are attacks that mainly act at the point where data is sent from the Customer's mobile device to the Merchant POS device. The idea is that a relay attack could be quick enough to transmit an authorisation QR code to another POS at another location to conduct another transaction. Relay attacks are possible with mobile payments. The relay attack must be done between the time the mobile device generates the QR code and before it is accepted by the Merchant.<sup>199</sup>

The capture of the QR code is possible because it is visual and may be scanned effectively up to 0.6 to 1m depending on the scanning device. Card-based payment system, in this regard, is also safer compared with the QR

code system. Its POS terminal utilises NFC technology for wireless card transactions, which is only effective within 0.1m, so devices must almost touch for data to be transmitted. Also, customers in mobile payment systems are often unaware that they should protect the displayed QR code from other devices.

## Security standard

The major standard that drives the card payment industry is the one under the Payment Card Industry Security Standards Council (PCI SSC). The Council is made up of major card organisations, such as Visa, Mastercard and American Express. The PCI SSC promotes the adoption of data security standards (DSS) for secure card-based payments.<sup>200</sup> The PCS DSS define specific technical and process requirements in hardware and software that meet the following goals.<sup>201</sup>

- Build and maintain a secure network.
- Protect cardholder data.
- Maintain a vulnerability management program.
- Implement strong access control measures.
- Regularly monitor and test networks.
- Maintain an information security policy.

However, the mobile payment industry that includes Alipay and WeChat Pay are not currently regulated in this regard and do not come under the PCI SSC standards, as QR code-based systems do not rely on the hardware and software-integrated terminals. Avoiding expensive infrastructure and regulations reduces the entry, maintenance and transaction fees that make mobile payments more attractive but less secure for their users.

## Data security and privacy

Apart from the risks that could incur during the running of the application and transaction process, data security and privacy is another major issue for the mobile payment industry. This could happen on both corporate and government levels.

On the corporate level, the TPP model usually requires customers to open an e-wallet account to store all data and transaction records. The distribution of data within a payment system is different between the QR code-based system and the card-based one. In a card-based payment system in which banks are involved as settlement parties, such as Apple Pay, both Apple and the banks share the transaction data. In a QR code-based system, such as the Chinese MPPs, transactions are settled between e-wallet accounts within one or

between two payment platforms, transaction data is exclusive to the TPP (such as Alipay and WeChat Pay).

The exclusive position of the MPPs in possession of user data has significant ramifications. First, It could lead to data access by unauthorised third parties for unwanted purposes, providing opportunities for identity theft to gain financial advantages illegally. For example, a Chinese software developer trawled Alibaba's online platform for eight months, collecting more than 1.1 billion pieces of user information before Alibaba noticed the massive data leak in June 2021.<sup>202</sup>

In addition, while data could be used by the MPP, and its wider business ecosystem, to design and deliver better and more tailored services for their customers, it could also be subject to misuse and abuse. In the realm of mobile payments, both personal and transaction data might be used for corporate gain without user consent. The Chinese MPPs' records in this regard have been less than solid. For example, in May 2021, several apps developed by Alibaba and Tencent were found of user privacy violations by China's internet regulator in May 2021. The practices included illegally obtaining data without users' consent, collecting more information than they need to operate, and demanding excessive numbers of permissions.<sup>203</sup> In August 2021, China's Zhejiang provincial authority also found that the Alibaba Cloud, the cloud computing unit of Alibaba, 'disclosed user registration information to a third-party partner without consent.'<sup>204</sup>

## Best practice recommendations

It is apparent from the above discussion that consumers and businesses are the most vulnerable to such security risks during and after transactions. A series of measures can be taken to mitigate these risks.

Firstly, governments should enhance consumer protection in relation to the technical weaknesses in the payment process of the MPPs. This include raising public awareness in protecting QR codes from access by third parties to prevent relay attacks. To mitigate the risks of a man-in-the-middle attack, mobile payment users should be recommended to make such transactions on a 4G or 5G data network provided by a third-party telecommunications ISP or a trusted Wi-Fi network, and never on a public open Wi-Fi network, especially a Wi-Fi network controlled by the merchant.

Furthermore, national authorities are recommended to establish sweeping mechanisms to protect mobile

payment users (both customers and merchants) from online fraudulent transactions. In card-based payment systems, such as Apple Pay, the card organisation provides guarantees against fraud and there is a fixed process for customers to be able to claim back funds lost in fraudulent transactions. This guarantee accounts for the larger fees and administration incurred by the card organisation.

Alipay has a range of customer-protection policies, which have greatly boosted public confidence in the new technology, but these are only offered in mainland China.<sup>205</sup> In the international market, Alipay offers a member protection program with various strings attached, subject to the nature and amount of the transaction as well as the terms and conditions of Alipay's business deal with local partners.<sup>206</sup> Compared with PayPal that leans more to the buyer's side, Alipay and WeChat Pay play the role of 'a real escrow agent' – they do not get involved directly in any disputes and have no specific process for dispute resolutions.<sup>207</sup> As part of the terms and agreements for WeChat Pay it is stated that it is the responsibility of the customer to resolve any dispute or liability arising from the transaction of goods or services. Therefore, national consumer watchdogs should be tasked to address this issue to enhance consumer protection.

For businesses, the adoption of mobile payment systems would be a risk management issue. For the QR code-based system in particular, smaller businesses would benefit from the lower start-up and minimal ongoing costs if the popularity of mobile payments increased in the customer base. Smaller businesses may be willing to accept the risk of fraud and lack of support in case of a dispute. However, organisations that have a lower risk appetite and can afford to maintain the card-based NFC terminal systems should continue to do so.

For consumers, it is important to raise their vigilance of online fraud and potential pitfalls in a dispute scenario. Mechanisms are recommended to provide privacy of customer data or at least require the customer to recognise the choice that has been made to release transaction data to the mobile payment provider. In addition, protections should be in place for any funds held within any new payment systems and outside the formal banking sector to ensure that customers have confidence that they may be able to withdraw their funds from these payment systems. More importantly,

the third-party payment providers have to be subject to national consumer protection regimes (through legislation if necessary).

The experiences of Singapore and Thailand suggest that national governments can play a central role in fostering a healthy development of the market. The Thai government established FAST and PayNow, a national payment infrastructure that connects banks and third-party providers. In Singapore, the government unified a fragmented market with a single QR code, the Singapore QR (SGQR) code. Both strategies have enhanced the security and public confidence in adopting the new technology.

## REGULATORY CHALLENGES

MPPs, especially the Chinese ones, also pose regulatory challenges on three fronts: liquidity risk, financial fraud, and market competition.

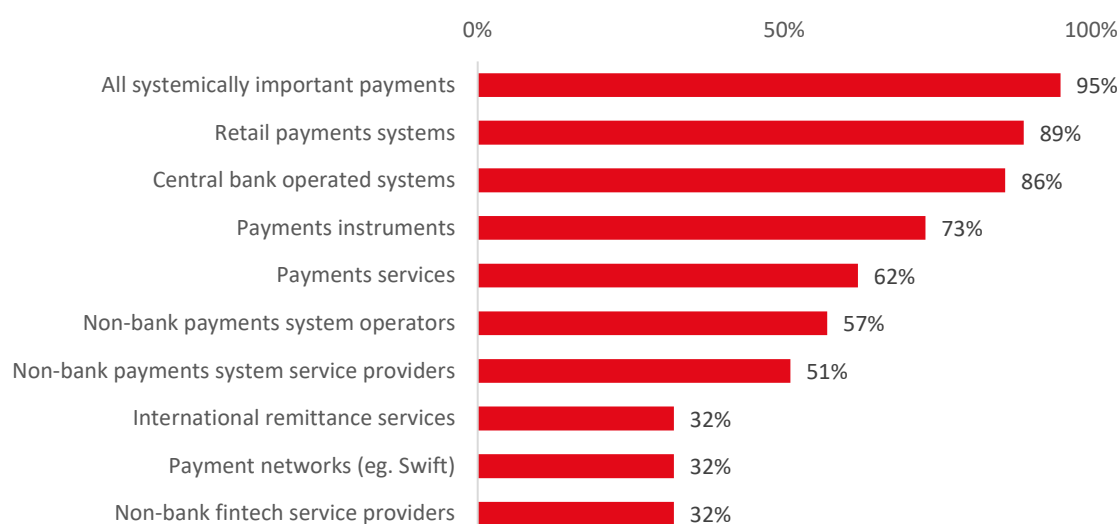
### Financial risks

The liquidity capacity of the TPPs could be a major financial risk factor. These TPPs require users preload funds into their e-wallet accounts, which means they hold money in trust for users. Therefore, it is essential that they, like traditional financial institutions, have sufficient cash or reserves in possible scenarios of withdrawal or transferal request in a timely manner. Failure to meet these obligations will likely lead to no-confidence crisis.

So far national regulators have invariably taken an arms-length, light touch approach in dealing with the fintech industries, treating them mainly as tech companies. Although the majority of the TPPs are registered as separate corporate entities from their parent groups, their business model dictates that they are highly integrated with their business and financial ecosystem as well as other financial institutions, which could see a liquidity issue of one company have an impact over the whole financial industry.<sup>208</sup> Therefore, it is essential to apply to the MPPs the same micro-prudential regulatory measures for traditional financial institutions.

One of the key objectives of central banks has been to ensure the safety and efficiency of national payments infrastructure. This is often done by central banks owning and operating core payments infrastructure. Over time, this has expanded to include the oversight of payments. A recent survey found that less than one third of the central banks in the world have non-bank fintech service providers, including those in the mobile payment sector, under their supervision (see Figure 17). Given the rapid popularity of mobile payments in terms of transaction volumes and value as well as its broad linkage with other parts of the financial system, it is important that national authorities recognise the digital payments infrastructure as 'systemically important' and consider granting central banks supervisory powers over the rising digital payments infrastructure.

**Figure 17 Scope of central banks' payments oversight function**



Source: Rachael King and Joasia E. Popowicz 2021.<sup>209</sup>



## Tax evasion and money laundering

As discussed earlier, the QR code-based MPPs mostly cut out banks in settlement, therefore have exclusive access to data. Current taxation and anti-money-laundering regimes are built on service providers' obligations of customer identification, suspicious act reporting and legitimated access to banking data by regulatory and law enforcement institutions. For example, both domestic and foreign banks operating in Australia are subject to anti-money laundering and counter terrorism financing laws via their local partners.<sup>210</sup>

However, the Chinese MPPs are not subject to the same rules. This means that online transactions over their ecosystems and settled with their own payment arms are not visible to local tax authorities. By the same token, cross-border money transfers between e-wallet accounts within the same MPP, particularly those settled in RMB, are outside the traditional banking system, therefore beyond government radar against illicit fund movement.<sup>211</sup> This in effect creates a hidden digital economy with tax leakage as its very business model.<sup>212</sup> While regulatory technologies could be developed to identify potential transactions, it is only possible if the Chinese MPPs grant data access, which is currently still on a voluntary basis. For instance, PayPal has domiciled its operations in Australia, but Alipay and WeChat Pay decline to open their books to the Australian financial regulator. During a parliamentary joint hearing on the payment business, the Australian Transaction Reports and Analysis Centre (AUSTRAC), a national body against financial fraud, admitted that "Alipay and WeChat Pay are not reporting entities under the *Anti-Money Laundering and Counter-Terrorism Financing Act 2006* and have therefore not been subject to any regulatory investigations".<sup>213</sup>

Therefore, national authorities must ensure their legitimated access to data generated in their own jurisdictions from foreign entities, including transaction data from mobile payments, to combat illegal transnational activities. A number of countries now have designated legislations on electronic data and online cross-border transactions, such as Thailand, Indonesia and the United Kingdom.<sup>214</sup> In addition, foreign service providers should be

mandated to establish local permanent entities so that they are subject to the 'geographical link' requirement that dictates reporting obligations.<sup>215</sup> However, the transnational nature of online tax evasion and money laundering necessitates an international approach. In this regard, the G20 will be ideal to lead this effort, given its commitment to international taxation<sup>216</sup> and tackling criminal financial activities,<sup>217</sup> as well as its institutionalised meetings for finance ministers and central bankers.

## Market competition

Another concern in relation to the MPPs is their implications over market competition. A key feature of the MPPs is their embeddedness in a platform economy. Although the fintech and mobile payment industry has been a highly dynamic arena that boasts start-ups and early career firms, they are increasingly dominated by big tech companies in major markets. These tech giants, such as Alibaba and Tencent, tend to reduce competition in retail money and financial markets through platform consolidation and intensive capitalisation, leading to oligopoly or even monopoly.<sup>218</sup>

In China where the payment market has been in the shape of a duopoly between Alipay and WeChat Pay, this issue has been recognised and dealt with in a heavy-handed approach. Since late 2020, the Chinese government has resorted to a series of measures against the two, which included suspending Ant Financial's blockbuster initial public offering (IPO), filing formal anti-monopoly investigations, and ordering a record amount of fines.<sup>219</sup> Tencent was not spared in the crackdown with Beijing blocking its merger deal in online gaming platforms.<sup>220</sup> In addition, Chinese authorities have further issued new draft guidelines to prevent internet companies from anticompetitive practices, including controlling user traffic, blocking competitors' products and discriminatory pricing.<sup>221</sup>

The recent antitrust campaign in the world's largest emerging digital economy should serve as a timely reminder of the danger of a potentially uncompetitive market that would choke innovation and entrepreneurship. Although the powerful Chinese MPPs are on harness at home, little has been done to their international operations given their rapid business expansion in recent years,

especially in the smaller and therefore more vulnerable markets in the Asia Pacific. As the case studies in this report suggest, the expansion has been achieved through complicated deals through complicated business networks over multiple years. It involves both mergers and acquisition and partnerships; Some are of direct investment and partnerships between payment firms, others are through deals of their parent groups/companies. Therefore, national regulators must be vigilant in monitoring and actively assessing cross-border merger and acquisition deals in this area and their potential implications over market competitive structure.

In addition, many of the technical, security and regulatory risks can be tackled and addressed by self-regulation of the mobile payments industry, which has been mostly absent so far. It is

recommended that a global industry body be established with the participation of major corporate players and stakeholders. It is in the interests of the industry to take a collective and proactive approach to work with other stakeholders in the national and international community on an efficient, secure and responsible framework for the sustainable development of the industry and the wider digital economy. For example, the industry body could cooperate with the PCI SSC, given the latter's expertise and experiences, on drafting an industry-wide safety standards across the MPPs; it could collaborate with the Basel Committee on Banking Supervision, the key body behind global banking regulation, on measures to mitigate financial risks of the MPPs; it could also work with the G20 to eliminate loopholes in tax evasion and money laundering; and to work with national authorities to address particular regulatory challenges.



## POLITICAL AND LEGAL RISKS

The emerging mobile payment industry and the associated issues of privacy and data security also face government-induced political and legal risks where there is a lack of the rule of law. This is an especially salient issue for the Chinese MPPs, their overseas partners, and other national regulatory authorities.

### Political risks

Chinese enterprises are subject to the arbitrary discretions of the government under the country's political system, and the power of the state over business and society has been growing in the last decade. This poses political and policy risks not just for Chinese firms, but foreign firms operating in China and overseas, including those in the mobile payment industry.

The Chinese government's crackdown of industries ranging from tech companies, finance to after-school education since late 2020 serves a good footnote to such risks. For a brief recount, Beijing suspended Ant Finance's massive IPO, punished Alibaba and Tencent with record fines, forced Tencent to abolish its exclusive music licensing deals with record labels around the world, ordered Didi (China's equivalent of Uber) to be delisted from the US stock market, and literally wiped out the \$120 billion private tutoring industry with a stroke of pen.<sup>222</sup> Investors suffered a huge loss from slumps in the stock market. Foreign capital is barred from investing in some of these areas. Hundreds of thousands of people found themselves unemployed overnight.

In addition, President Xi has pushed for 'common prosperity' through 'tertiary distribution'. However, in practice this only involved coercing businesses to raise their 'voluntary' charitable donations. As a result, both Chinese entrepreneurs and companies have had to jump on the wagon and scramble to initiate and expand programs of social giving.

While many of these regulatory moves were backed by rationales on anti-monopoly, data security, and national security, the big picture is the growing discretionary power of the government at the expense of business and commerce. As Barry Naughton notes, this is a timely reminder that 'every

company that operates in China—including foreign companies—will from now on have to figure out what President Xi Jinping and the party want, and be prepared to respond nimbly.'<sup>223</sup>

As we have seen, the Chinese MPPs have sought to expand their business globally through investment and partnerships with foreign companies. This also exposed the latter to the disruptive political and policy risks borne by their Chinese parent companies or partners. For instance, the halt of Ant's IPO plan will no doubt jeopardise its existing and future investment plans overseas.

### Legal risks

The Chinese MPPs and their partners also face legal risks. The privacy and data security issues associated with the mobile payment industry is governed by three interlocking legislations (hereafter as the Laws) in China promulgated in recent years. They are the Cybersecurity Law (CL), the Data Security Law (DSL) and the Personal Information Protection Law (PIPL).

The CL was enacted on 7 November 2016 and implemented since 1 June 2017, which covers rules on data protection, data localisation and cybersecurity in the interests of national security. The DSL was enacted on 10 June 2021 and took effect on 1 September 2021 that governs the creation, use, storage, transfer, and exploitation of data within China. The PIPL was adopted on 20 August 2021 and effective on 1 November 2021 with an aim to protect personal information rights and interests, standardise personal information handling activities, and promote the rational use of personal information.

Combined, these legislations form a framework for the managing data flow and access by the Chinese government, and have direct implications for the mobile payment industry operating in China and overseas.

### Applicability

The mobile payment sector is subject to each of the Laws. The CL is applicable to network operators and businesses in 'critical sectors', which include financial services.<sup>224</sup> Article 21 of the DSL stipulates that 'important data' and 'national core data' require

significantly higher protection, but the specific guidance on how to define 'important' and 'national core data' has yet to be released, leaving everyone to guess. Given the fact that Beijing's referral of its recent crackdown on fintech to national security, it is reasonable to include financial data in this category.

The PIPL also features Long Arm Jurisdiction over data collection and processes offshore by foreign entities that provide products and services to, or analysing or assessing activities of, natural persons in China. This implies that any offshore payment service that processes transactions involving users in China are held accountable by the Chinese law in terms of data security and privacy.

## Data localisation

According to the CL, 'Critical information infrastructure operators that gather or produce personal information or important data during operations within the mainland territory of the People's Republic of China, shall store it within mainland China.' (Section 2, Article 37).

The implication for the MPPs is that, for any given payment transactions involving Chinese and foreign parities, the data generated will have to be stored in China, including the data of the foreign party as it is technically difficult and costly for payment firms to separate the data within the same transaction. This paves the way for the Chinese government to access foreign users' data through the Chinese MPPs' overseas networks.

## Data access by the government

While the Laws stipulate at length on the regulation of cross-border transfer of important data and the protection of data and personal information from unauthorised access, they do not prevent the Chinese government from accessing data stored and processed by digital payment providers.

While it is common wisdom that Chinese companies are not in a position to deny government access to their corporate data, the Laws further enable almost unchecked government access to data. It is true that all governments collect growing amount of information from corporates (including the MPPs) to fulfill diverse regulatory, security, law enforcement,

and social welfare tasks. However, the collection of personal data by public authority without the checks and balances through rule of law may lead to public abuse and violation of citizens' privacy. In fact, similar regulations in the past have forced foreign companies to leave the Chinese market in fear of compliance, such as Google.<sup>225</sup>

According to the CL, 'Network operators shall provide technical support and assistance to public security organs and national security organs that are safeguarding national security and investigating criminal activities in accordance with the law.' (Section 1, Article 28). 'Network operators' are interpreted to include social media platforms, application creators and other tech firms, including fintech companies. In our concern, this Article clearly compels the MPPs to allow government access to payment and transaction data for government audit to ensure national security. However, the scope of 'national security' is loosely and vaguely defined in China's National Security Law, subjecting it to the government's discretion.<sup>226</sup> This implies that the Chinese MPPs and their foreign partners whose servers are located in China will be legally bound to give data access to the Chinese government upon request, which potentially include the data of foreign users (both individuals and institutions).

## Data access by foreign entities

According to DSL, 'The competent authorities of the PRC are to handle foreign justice or law enforcement institution requests for the provision of data, according to relevant laws and treaties or agreements concluded or participated in by the PRC, or in accordance with the principle of equality and reciprocity. Domestic organisations and individuals must not provide data stored within the mainland territory of the PRC to the justice or law enforcement institutions of foreign countries without the approval of the competent authorities of the PRC.' (Chapter IV, Article 36).

This provision is problematic on two fronts. First, there is no definition of which agencies the 'competent authorities of the PRC' refers to. Second, this Article, can make it difficult for foreign authorities and organisations to obtain data that has been generated in China. This includes information that are generated as part of a digital payment



transaction if the payment servers are based in China. In addition, the PIPL stipulates the conditions that must be satisfied in transferring personal data outside of China:

- Passing a security assessment organised by the State cybersecurity and information department (Article 40);
- Undergoing personal information protection certification conducted by a specialised body according to provisions by the State cybersecurity and information department;
- Concluding a contract with the foreign receiving side in accordance with a standard contract formulated by the State cyberspace and information department, agreeing upon the rights and responsibilities of both sides;
- Other conditions provided in laws or administrative regulations or by the State cybersecurity and information department.

These provisions imply that, if there is a dispute or other action that occurs requiring a foreign and international law enforcement organisation to access digital payment information, such as to determine if tax evasion or money laundering has occurred, then the Laws can make it difficult or even deny access to the requested data at the discretion of the Chinese government. It also put multinational operators in a difficult situation when responding to judicial inquiries in other countries involving a Chinese citizen in those countries.

## Digital Renminbi

The upcoming rollout of digital sovereign currencies (central bank digital currency, or CBDC) poses the political risks of government access to data. China stands at the forefront of developing its own CBDC.<sup>227</sup> According to its 'controlled anonymity' model, transaction dataset will be segregated into portions of transaction information collected by designated e-wallet applications.

The PBoC, however, will have access to all the data as the issuer of the digital currency used by e-wallets.<sup>228</sup> This means that, even without the knowledge, awareness or consent of the MPPs, digital renminbi used on mobile payment transactions will grant the Chinese government full access to transaction data.

In summary, the Chinese government, through political pressures and legal provisions, has ensured its access to data obtained both at home and abroad through Chinese companies, but at the same time ringfenced data access by foreign governments and the international community. This poses spill-over risks for foreign governments to mitigate in their potential deals with the Chinese MPPs.

We need a multi-dimensional approach in addressing such a complicated issue. First, foreign firms should be aware of these risks when assessing potential deals with Chinese companies. In this context, commercial interests should not be the only top considerations. Firms are also urged to consult with the international law society in gauging the implications and ramifications of doing business without compromise in data security and privacy.

At the same time, the international law society, national governments and other related international organisations should continue to convey their concerns to the Chinese government over its legislation on data, cybersecurity and privacy. In particular, this includes the relaxation of the provisions on data localisation requirements, and ensuring legitimate and unhindered access to data stored in China by foreign and international entities. It is also important to include China in a global conversation on the governance of data and to strike an acceptable balance between data sovereignty and the protection of human rights.

# CONCLUSION

The phenomenal development of the mobile payments industry and fintech in the Asia Pacific disrupted the traditional bank-centred payment system but has greatly facilitated commerce, financial inclusion and social exchanges. Mobile payments emerge in the intersection of digital, telecommunications, market and financial regulation, which makes the new sector of the economy complicated and challenging. The Chinese players have

been riding the wave and increasing their business reach in the Asia Pacific region. At the same time, the emerging industry also brings myriad risks and challenges to stakeholders at home and abroad. The future development of the industry, therefore, rests in our capacity to strike a fine balance between risk mitigation and fostering a conducive environment that boasts competition, innovation and entrepreneurship.



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## ACKNOWLEDGEMENT

The research team would like to thank the Department of State of the United States of America for funding this project.

As usual, the Griffith Asia Institute, Griffith University have provided an ideal base for our research. The authors are indebted to Vanessa Lao, Meegan Thorley, Jill Moriarty and Michael Vaughan for their administrative and editorial support throughout this project.



# NOTES AND REFERENCES

- 1 Mordor Intelligence, "Mobile Payments Market, 2021–2026." July 2021.
- 2 State Administration of Foreign Exchange, *Report on Payment Systems in China 2020*, p. 19. <http://www.gov.cn/xinwen/2020-03/17/5492275/files/53314a9224dd4b78b6dcafa3493da503.pdf>.
- 3 CNNIC (China Internet Network Information Center), *47th Statistical Report on Internet Development in China*, February 2021, p. 41. [https://tech.sina.com.cn/zt\\_d/cnnic47/](https://tech.sina.com.cn/zt_d/cnnic47/).
- 4 Steven Millward, "WeChat sees bigger spenders as China goes cashless," *Tech in Asia*, 24 April 2017, <https://www.techinasia.com/wechat-cashless-china-data>.
- 5 "Mobile payment users survey report," Payment and Clearing Association of China, 14 January 2021.
- 6 Katharina Buchholz, "China's Mobile Payment Adoption Beats All Others," *Statista*, 12 August 2021. <https://www.statista.com/chart/17909/pos-mobile-payment-user-penetration-rates/>.
- 7 Statista, "Statista Digital Market Outlook," July 2021.
- 8 Emily Sorensen, "QR code payments – what is it and how does it work?" *mobiletransaction.org*, 4 January 2021, <https://www.mobiletransaction.org/qr-code-payment-works/>.
- 9 Aaron Klein, "China's Digital Payments Revolution," *Brookings Institution*, April 2020, [https://www.brookings.edu/wp-content/uploads/2020/04/FP\\_20200427\\_china\\_digital\\_payments\\_klein.pdf](https://www.brookings.edu/wp-content/uploads/2020/04/FP_20200427_china_digital_payments_klein.pdf).
- 10 Yiping Huang, Xue Wang and Xun Wang, "Mobile Payment in China: Practice and Its Effects," *Asian Economic Papers* 19 (3), 2020, p. 6.
- 11 Cameron Caldwell and Jennifer Liu, "Dominance of WeChat Pay and Alipay in the Chinese Digital Payments Industry," 10 March 2021, <https://www.focusfinance.org/post/dominance-of-wechat-pay-and-alipay-in-the-chinese-digital-payments-industry>.
- 12 PriceWaterhouseCoopers, "Banking and finance in China: The outlook for 2015," 28 January 2015.
- 13 Thomas Hale and Ryan McMorrow, "Chinese consumers move towards forefront of economic recovery," *Financial Times*, 29 November 2020.
- 14 "Yu'ebao users exceed 260 million," *Shenzhen tequ bao*, 27 January 2016.
- 15 Ryan McMorrow, "Jack Ma's Ant Group receives consumer finance licence," *Financial Times*, 3 June 2021.
- 16 Yiping Huang, Xue Wang and Xun Wang, "Mobile Payment in China: Practice and Its Effects," *Asian Economic Papers* 19 (3), 2020, p. 6.
- 17 Hui Feng, "Internet Finance in China: Digital Disruption and Regulatory Dilemma," in David Chaikin and Derwent Coshott (eds) *Digital Disruption: Impact on Business Models, Regulation and Financial Crime* (Sydney: Australian Scholarly Publisher), 2017, p. 53–68; Stephen Bell and Hui Feng, *Banking on Growth Models: China's Troubled Pursuit of Financial Reforms and Economic Rebalancing* (Ithaca and London: Cornell University Press), 2022.
- 18 Hui Feng, "The Emergence of a Modern Payment Infrastructure in China," *Settlement, Payment, E-money and E-trading Development* (SPEED), 1 (2), 2006, p. 17–21.
- 19 Aaron Klein, "China's Digital Payments Revolution," p. 2.
- 20 Andrew Liu, "An Analysis of the PBOC's New Mobile Payment Regulation," *Cato Journal*, 39 (1), 2019, p. 87–98.
- 21 Barry Naughton, "What's behind China's regulatory storm," *The Wall Street Journal*, 13 December 2021, <https://www.wsj.com/articles/what-is-behind-china-regulatory-storm-11638372662>.
- 22 Edward Lehman and Jed Rothstein, "In China, Cashless is King," *The Diplomat*, 23 June 2021, <https://thediplomat.com/2021/06/in-china-cashless-is-king/>.
- 23 "Best Payment Gateways in China," *Vapulus*, 11 July 2019, <https://www.vapulus.com/en/best-payment-gateways-in-china/>.
- 24 Statista Global Consumer Survey, "China's Most Popular Digital Payment Options," <https://www.statista.com/chart/17409/most-popular-digital-payment-services-in-china/>.
- 25 "UnionPay takes top spot from Visa in \$22 trillion global cards market – RBR," *Finextra*. London: Finextra Research Limited, 22 July 2016.
- 26 "China Smartphone Market Share: By Quarter," *Counterpoint*, 30 November 2021, <https://www.counterpointresearch.com/china-smartphone-share/>.
- 27 "Mobile Wallets Report 2021," *Boku and Juniper Research*, <http://boku.mobilewallet.report>.
- 28 Dashveenjit Kaur, "Almost half of Asia Pacific prefers digital payments," *Techwire Asia*, 11 February 2021, <https://techwireasia.com/2021/02/almost-half-of-asia-pacific-prefers-digital-payments/>. "Mobile Wallets Report 2021," *Boku and Juniper Research*, <http://boku.mobilewallet.report>.
- 29 Dashveenjit Kaur, "Almost half of Asia Pacific prefers digital payments," *Techwire Asia*, 11 February 2021, <https://techwireasia.com/2021/02/almost-half-of-asia-pacific-prefers-digital-payments/>.
- 30 Mordor Intelligence, "Mobile Payments Market, 2021–2026."
- 31 GSM Association, *The Mobile Economy 2021*, 2021, [https://www.gsma.com/mobileeconomy/wp-content/uploads/2021/07/GSMA\\_MobileEconomy2021\\_3.pdf](https://www.gsma.com/mobileeconomy/wp-content/uploads/2021/07/GSMA_MobileEconomy2021_3.pdf).
- 32 Ibid.

- 
- 33 Mordor Intelligence, "Mobile Payments Market, 2021–2026."
- 34 Navneet Dubey, "RBI urges customers to use digital banking facilities amid coronavirus outbreak," *The Economic Times*, 16 March 2020, <https://economictimes.indiatimes.com/wealth/personal-finance-news/rbi-urges-customers-to-use-digital-banking-facilities-amid-coronavirus-outbreak/articleshow/74653847.cms?from=mdr>.
- 35 Alice Walker and Beth Gibson, "QR codes skyrocket in popularity due to COVID-19. Here's the history behind the 2020 technology of choice," Australian Broadcasting Corporation, 2 December 2020, <https://www.abc.net.au/news/2020-12-02/history-of-qr-codes-as-popularity-skyrockets-due-to-covid-19/12942318>.
- 36 Mordor Intelligence, "Mobile Payments Market, 2021–2026."
- 37 Meng Jing, "Ant Financial targets global customers," *China Daily*, 4 September 2016.
- 38 Mercedes Ruehl and Ryan McMorrow, "Ant faces challenge in reviving global expansion," *Financial Times*, 19 October 2020.
- 39 World Tourism Organization, *Compendium of Tourism Statistics Dataset 2020*, September 2020.
- 40 "Sydney to Host Alipay Global Pilot Program," Tourism Australia, <https://www.tourism.australia.com/en/news-and-media/news-stories/Sydney-to-host-Alipay-global-pilot-program.html>.
- 41 Saheli Roy Choudhury and Arjun Kharpal, "Alibaba buys controlling stake in Southeast Asian retailer Lazada," CNBC, 12 April 2016, <https://www.cnbc.com/2016/04/12/alibaba-group-invests-1-billion-dollars-in-lazada-group-and-eyes-southeast-asia.html>.
- 42 Mercedes Ruehl and Henny Sender, "The battle for south-east Asia's online shoppers," *Financial Times*, 20 July 2020.
- 43 Mercedes Ruehl and Ryan McMorrow, "Ant faces challenge in reviving global expansion," *Financial Times*, 19 October 2020.
- 44 "Xiaomi Leads Indian Smartphone Market in Q3 2021, Apple Fastest Growing Brand: Counterpoint," 29 October 2021, <https://gadgets.ndtv.com/mobiles/news/xiaomi-leads-indian-smartphone-market-q3-2021-apple-fastest-growing-brand-counterpoint-2592193>.
- 45 Danish Khan, "Xiaomi to soon offer business loans, gold loans and credit line card services," *The Economic Times*, 23 August 2021, <https://economictimes.indiatimes.com/industry/banking/finance/xiaomi-to-offer-full-spectrum-of-financial-services-in-india-via-partners/articleshow/85535677.cms?from=mdr>.
- 46 Vineet Chaudhary, "Alipay: The Success Story of Jack Ma's Billion Dollar Startup," 14 July 2019, <https://coinnounce.com/alipay-the-success-story-of-jack-ma-billion-dollar-startup/>.
- 47 Robb M. Stewart, "Apple Wins Battle With Australian Banks Over Mobile Payments," *The Wall Street Journal*, 29 November 2016, <https://www.wsj.com/articles/apple-wins-battle-with-australia-banks-over-mobile-payments-1480402380>.
- 48 Jamie Smyth, "Apple defeats Australia banks over mobile payments," *Financial Times*, 31 March 2017; Robb M. Stewart, "Apple Wins Battle with Australian Banks Over Mobile Payments;" E. Teo, B. Fraunholz, and C. Unnithan, "Inhibitors and facilitators for mobile payment adoption in Australia: A preliminary study," In 4th Annual International Conference on Mobile Business, ICMB, 2005, p. 663–666. Institute of Electrical and Electronics Engineers Inc., <https://doi.org/10.1109/ICMB.2005.47>.
- 49 Daren Flood, Tim West, and Daniel Wheadon, "Trends in Mobile Payments in Developing and Advanced Economies," *RBA Bulletin*, p.71–80, <https://ideas.repec.org/a/rba/rbabul/mar2013-08.html>.
- 50 E. Teo, B. Fraunholz, and C. Unnithan, "Inhibitors and facilitators for mobile payment adoption in Australia: A preliminary study," In 4th Annual International Conference on Mobile Business, ICMB, 2005, p. 663–666. Institute of Electrical and Electronics Engineers Inc., <https://doi.org/10.1109/ICMB.2005.47>.
- 51 Reserve Bank of Australia, "The Use of Online and Newer Payment Methods: Results of the Reserve Bank of Australia's 2010 Consumer Payments Use Study," June 2011, <https://www.rba.gov.au/publications/consultations/201106-strategic-review-innovation/results/online-newer-payment-methods.html>.
- 52 Jamie Smyth, "Apple defeats Australia banks over mobile payments," *Financial Times*, 31 March 2017.
- 53 Bien Perez, "Alipay steps up mobile payments expansion in Australian stores," *South China Morning Post*, 7 December 2016.
- 54 Sarah Clark, "Australia records sharp increase in NFC mobile payments adoption," 14 May 2010, <https://www.nfcw.com/2020/05/14/366515/australia-records-sharp-increase-in-nfc-mobile-payments-adoption/>.
- 55 M. Najib and F. Fahma, "Investigating the adoption of digital payment system through an extended technology acceptance model: An insight from the Indonesian small and medium enterprises," *International Journal on Advanced Science, Engineering and Information Technology*, 10 (4), 2020, p. 1702–1708.
- 56 Sarah Clark, "Australia records sharp increase in NFC mobile payments adoption," 14 May 2010, <https://www.nfcw.com/2020/05/14/366515/australia-records-sharp-increase-in-nfc-mobile-payments-adoption/>.
- 57 PriceWaterhouseCoopers, "Future of Payments in Australia: The future of transaction banking and payments in 2020," 2020, [https://www.pwc.com.au/pdf/pwc\\_future-of-payments.pdf](https://www.pwc.com.au/pdf/pwc_future-of-payments.pdf).
- 58 Jacob Koroneos, "Tap and go: contactless payments on the rise in Australia," 22 June 2020, <https://www.mobiletransaction.org.au/tap-and-go-trending-in-australia/>; PriceWaterhouseCoopers "Future of Payments in Australia," 2020, [https://www.pwc.com.au/pdf/pwc\\_future-of-payments.pdf](https://www.pwc.com.au/pdf/pwc_future-of-payments.pdf).

- 
- 59 "Mobile vendor market share in Australia – December 2021," Statcounter, <https://gs.statcounter.com/vendor-market-share/mobile/australia>.
- 60 Vineet Chaudhary, "Alipay: The Success Story of Jack Ma's Billion Dollar Startup," 14 July 2019, <https://coinnounce.com/alipay-the-success-story-of-jack-ma-billion-dollar-startup/>.
- 61 "Sydney to Host Alipay Global Pilot Program," Tourism Australia, 2019, <https://www.tourism.australia.com/en/news-and-media/news-stories/Sydney-to-host-Alipay-global-pilot-program.html>.
- 62 George Tchertvertakov, "Smartpay secures fintech connection with Alipay," 13 March 2018, <https://smallcaps.com.au/smartpay-secures-fintech-connection-alipay/>.
- 63 "Novatti launches brand new payments bridge between Australian BPAY and Chinese Alipay," 9 April 2018. <https://australianfintech.com.au/novatti-launches-payments-bridge-australian-bpay-chinese-alipay/>.
- 64 RoyalPay, "About Us," <https://www.royalpay.com.au/about.html>.
- 65 Australia Post, "How Alipay is unlocking eCommerce growth in Australia," 21 November 2017. <https://auspost.com.au/enterprise-gov/insights-and-reports/digitising-services/how-alipay-is-unlocking-ecommerce-growth-in-australia>.
- 66 Ibid.
- 67 "Sydney to Host Alipay Global Pilot Program," Tourism Australia, 2019.
- 68 Richard Blank, "Alipay launches Melbourne City card to connect business with tourists," 20 May 2020. <https://businesschief.asia/leadership-and-strategy/alipay-launches-melbourne-city-card-connect-business-tourists>.
- 69 Natasha Gillezeau, "CBA launches Alipay," *Australian Financial Review*, 19 December 2018. <https://www.afr.com/companies/financial-services/cba-launches-alipay-20181219-h19ahq>.
- 70 Bien Perez, "Alipay steps up mobile payments expansion in Australian stores," *South China Morning Post*, 7 December 2016.
- 71 Ibid.
- 72 E. Teo, B. Fraunholz, and C. Unnithan, "Inhibitors and facilitators for mobile payment adoption in Australia: A preliminary study," In 4th Annual International Conference on Mobile Business, ICMB, 2005, p. 663–666. Institute of Electrical and Electronics Engineers Inc., <https://doi.org/10.1109/ICMB.2005.47>.
- 73 Vineet Chaudhary, "Alipay: The Success Story of Jack Ma's Billion Dollar Startup," 14 July 2019, <https://coinnounce.com/alipay-the-success-story-of-jack-ma-billion-dollar-startup/>.
- 74 Zhijie Li, Xixi Li, Xunhua Guo, and Qingchen Guo, "Milking the Social Network: A Chinese Indigenous Psychology Perspective on WeChat C2C Commerce," In *ICIS 2017: Transforming Society with Digital Innovation*. <http://aisel.aisnet.org/icis2017/Peer-to-Peer/Presentations/6/>.
- 75 James Evers, "CBA in payments deal with China's Alipay," *Australian Financial Review*, 31 October 2016.
- 76 Jacob Koroneos, "Tap and go: contactless payments on the rise in Australia," 22 June 2020, <https://www.mobiletransaction.org/au/tap-and-go-trending-in-australia/>.
- 77 Feng Zhu, "Apple Pay and Mobile Payments in Australia (A) and (B)," James Caddy, Luc Delaney, Chay Fisher and Clare Noone, "Consumer Payment Behaviour in Australia," *RBA Bulletin*, March 2020.
- 78 Jack Parkin, "Cashless payment is booming, thanks to coronavirus. So is financial surveillance," *The Conversation*, 10 September 2020, <https://theconversation.com/cashless-payment-is-booming-thanks-to-coronavirus-so-is-financial-surveillance-145179>.
- 79 William Jolly, "CBA: Apple Pay, Google Pay to become biggest payment method," 20 May 2021, <https://www.savings.com.au/credit-cards/cba-says-apple-pay-google-pay-to-become-the-most-popular-way-to-pay>.
- 80 Clancy Yeates, "Digital wallets such as Apple Pay lack transparency: RBA," *Sydney Morning Herald*, 14 June 2021, <https://www.smh.com.au/business/banking-and-finance/digital-wallets-such-as-apple-pay-lack-transparency-rba-20210611-p580bj.html>.
- 81 Martin Kovacs, "Digital Wallets: Options For New Zealand," 17 July 2017, <https://www.canstarblue.co.nz/banking-insurance/mobile-payments-turning-smartphones-digital-wallets/>.
- 82 Ministry of Business, Innovation and Employment, "Retail payment systems in New Zealand," <http://www.mbie.govt.nz/info-services/business/competition-policy/retail-payment-systems/issues-paper/retail-payment-systems-issues-paper.pdf>.
- 83 J. P. Morgan, "2019 Global payments trends report – New Zealand," <https://www.jpmorgan.com/merchant-services/insights/reports/new-zealand>.
- 84 Priscilla Dickinson, "Digital wallets replacing real wallets as cashless culture arrives," 16 September 2019, <https://www.newshub.co.nz/home/money/2019/09/digital-wallets-replacing-real-wallets-as-cashless-culture-arrives.html>.
- 85 Yuqian Xu, Anindya Ghose, and Bingqing Xiao, "Mobile Payment Adoption: An Empirical Investigation on Alipay," 7 March 2021, <https://dx.doi.org/10.2139/ssrn.3270523>.
- 86 "Mobile payments – New Zealand moving from cashless to walletless," Venture Insights.
- 87 Paris (Linlin) Xu, "Chinese Travellers' Adoption of Mobile Payment Applications of WeChat Pay and Alipay in New Zealand Hotels," Auckland University of Technology, <https://openrepository.aut.ac.nz/handle/10292/13285>.
- 88 Priscilla Dickinson, "Digital wallets replacing real wallets as cashless culture arrives."

- 
- 89 Paris (Linlin) Xu, "Chinese Travellers' Adoption of Mobile Payment Applications of WeChat Pay and Alipay in New Zealand Hotels," Auckland University of Technology, <https://openrepository.aut.ac.nz/handle/10292/13285>.
- 90 Simon Jensen and Renee Stiles, "The potential for payments innovation in New Zealand," 28 April 2015, <https://www.buddlefindlay.com/insights/the-potential-for-payments-innovation-in-new-zealand/>; "Widespread Adoption of Contactless Payments in New Zealand," 8 May 2018, <https://www.mastercard.com/news/ap/en/newsroom/press-releases/en/2018/may/widespread-adoption-of-contactless-payments-in-new-zealand/>.
- 91 J.P.Morgan, "2019 Global payments trends report – New Zealand."
- 92 Ibid.
- 93 Paris (Linlin) Xu, "Chinese Travellers' Adoption of Mobile Payment Applications of WeChat Pay and Alipay in New Zealand Hotels," Auckland University of Technology, <https://openrepository.aut.ac.nz/handle/10292/13285>; Yuqian Xu, Anindya Ghose, and Bingqing Xiao, "Mobile Payment Adoption: An Empirical Investigation on Alipay." 7 March 2021, <https://dx.doi.org/10.2139/ssrn.3270523>.
- 94 "The Best Way to Pay in New Zealand," 2020, <https://nzpocketguide.com/the-best-way-to-pay-in-new-zealand/>.
- 95 Paris (Linlin) Xu, "Chinese Travellers' Adoption of Mobile Payment Applications of WeChat Pay and Alipay in New Zealand Hotels," Auckland University of Technology, <https://openrepository.aut.ac.nz/handle/10292/13285>.
- 96 "Mobile payments – New Zealand moving from cashless to walletless," Venture Insights.
- 97 "Alipay – BNZ," BNZ, <https://www.bnz.co.nz/business-banking/payments/alipay>.
- 98 "Alipay & WeChat Pay – Smartpay EFTPOS solutions," SmartPay, <https://www.smartpay.co.nz/alipay-wechat/why/>.
- 99 PayPlus, "About us," <https://www.payplusinc.com/about-us/>.
- 100 "Alipay and Chemist Warehouse announce payment partnership," 10 August 2020, <http://www.voxy.co.nz/business/5/370928>.
- 101 T. Tangit, "Value co-creation in mobile payment," The Hong Kong Polytechnic University, 2010.
- 102 Gordana Redzovski, "The top trends set to influence New Zealand retail in 2021," *The Register*, 18 January 2021, <https://theregister.co.nz/2021/01/18/the-top-trends-set-to-influence-new-zealand-retail-in-2021/>.
- 103 Taisha Grace Antony, "Booming adoption of digital payments in Singapore," 9 November 2020, <https://ps-engage.com/booming-adoption-of-digital-payments-in-singapore/>.
- 104 Sumit Agarwal, Wenlan Qian, and Ruth Tan, "Financial Inclusion and Financial Technology," *Household Finance*, 2020, Palgrave Macmillan, Singapore. [https://doi.org/10.1007/978-981-15-5526-8\\_9](https://doi.org/10.1007/978-981-15-5526-8_9).
- 105 Lin Lin, "Regulating Fintech: the case of Singapore."
- 106 David Kuo Chuen Lee and Linda Low, *Inclusive fintech*.
- 107 Jungkiu Choi, Prasanna Santhanam, Pauline Wray, Shobhit Shubhankar, and Jeroen Vandenstee. "The Rise of Digital Banking in Southeast Asia," 9 December 2020, <https://www.bcg.com/en-sea/the-rise-of-digital-banking-in-southeast-asia>.
- 108 Jason Han, "Singapore Fintechs off to a flying start in 2021," 13 May 2021, <https://www.bcg.com/en-sea/singapore-fintechs-off-to-flying-start-in-2021>.
- 109 Deloitte, "The Next Wave: Emerging digital life in South and Southeast Asia," September 2020, <https://www.businesswire.com/news/home/20200924005941/en/Deloitte-Launches-The-Next-Wave-Emerging-Digital-Life-in-South-and-Southeast-Asia-Report-At-Ant-Group-percentE2-percent80-percent99s-INCLUSION-Fintech-Conference>.
- 110 Mordor Intelligence, "Mobile Payments Market 2021-2026."
- 111 Penser, "Exploring P2P Payment Apps in Southeast Asia," May 2020, <https://www.penser.co.uk/article/exploring-p2p-payment-apps-in-southeast-asia/>.
- 112 Deloitte, "SME Digital Payments New opportunities to optimise: The Paytech Revolution Series," 2018, <https://www2.deloitte.com/content/dam/Deloitte/au/Documents/financial-services/deloitte-au-fs-sme-digital-payments-270218.pdf>.
- 113 Lin Lin, "Regulating Fintech: the case of Singapore," *Banking and Finance Law Review*, 2019, [https://www.researchgate.net/publication/335012999\\_Regulating\\_Fintech\\_The\\_Case\\_of\\_Singapore](https://www.researchgate.net/publication/335012999_Regulating_Fintech_The_Case_of_Singapore).
- 114 Alby Anand Kurian, Khairina Zan, and Sagar Dham, "Adoption of Cashless Payments in Singapore: An Analysis," *ASBM Journal of Management*, XIII (1), 2020, p. 1-20.
- 115 Tang See Kit, "Singapore rolls out unified payment QR code SGQR in latest cashless push," *Channel News Asia*, 17 September 2018, <https://www.channelnewsasia.com/singapore/sgqr-qr-code-cashless-payment-singapore-rolls-out-unified-797951>.
- 116 Philip Bruno, Olivier Denecker, and Marc Niederkorn, "The accelerating winds of change in global payments," *The 2020 McKinsey Global Payments Report*, 1 October 2020, <https://www.mckinsey.com/industries/financial-services/our-insights/accelerating-winds-of-change-in-global-payments>.
- 117 Mordor Intelligence, "Mobile Payments Market, 2021-2026."
- 118 "Mobile payment adoption in Singapore is on the rise despite security concerns," *Asian Banking & Finance*, 2018, <https://asianbankingandfinance.net/cards-payments/news/mobile-payment-adoption-in-singapore-rise-despite-security-concerns>.
- 119 MAS, "Singapore Introduces World's First Unified Payment QR Code – SGQR," 17 September 2018, <https://www.mas.gov.sg/news/media-releases/2018/singapore-introduces-worlds-first-unified-payment-qr-code>.

- 
- 120 Ibid.
- 121 Eileen Yu, "Singapore to develop common QR code to drive e-payments," ZDNet, 29 August 2017, <https://www.zdnet.com/article/singapore-to-develop-common-qr-code-to-drive-e-payments/>.
- 122 Ibid.
- 123 Eileen Yu, "Alibaba bolsters SEA biz with \$1B Lazada deal," Zdnet, 12 April 2016. <https://www.zdnet.com/article/alibaba-bolsters-sea-biz-with-1b-lazada-deal/>.
- 124 Ibid.
- 125 Rebecca Ren, "Lazada, Shopee Battle It out as Backer Alibaba, Tencent Shift Power in Southeast Asia," 15 November 2019. <https://en.pingwest.com/a/4088>.
- 126 Eileen Yu, "Alipay brand expands into Southeast Asia via Lazada," Zdnet, 21 April 2017. <https://www.zdnet.com/article/alipay-brand-expands-into-southeast-asia-via-lazada/>.
- 127 Eileen Yu, "Alibaba bolsters SEA biz," Zdnet, 12 April 2016. <https://www.zdnet.com/article/alibaba-bolsters-sea-biz-with-1b-lazada-deal/>.
- 128 Elaine Huang, "SingPost sees opportunity in Southeast Asia last-mile fulfilment," KrAsia, 16 August 2018, <https://kr-asia.com/singpost-sees-opportunity-in-southeast-asia-last-mile-fulfilment>.
- 129 "Tencent Emerges as Winner in its Proxy War with Alibaba, For Now," 17 June 2021, <https://en.tmtpost.com/post/5402876>.
- 130 Ibid.
- 131 Julia Fioretti, "Tencent Sells \$3 Billion in Shares of Singapore's Sea," Bloomberg, 4 January 2022, <https://www.bloomberg.com/news/articles/2022-01-04/tencent-to-sell-a-stake-in-singapore-s-sea-for-up-to-3-billion>.
- 132 Diego de Sartiges, Aparna Bharadwaj, Imran Khan, Justine Tasiaux, and Patrick Witschi, "Southeast Asian Consumers Are Driving a Digital Payment Revolution," 20 May 2020, <https://www.bcg.com/en-au/publications/2020/southeast-asian-consumers-digital-payment-revolutions>.
- 133 Mordor Intelligence, "Mobile Payments Market, 2021–2026."
- 134 Tang See Kit, "Singapore rolls out unified payment QR code SGQR in latest cashless push," *Channel News Asia*, 17 September 2018, <https://www.channelnewsasia.com/singapore/sgqr-qr-code-cashless-payment-singapore-rolls-out-unified-797951>.
- 135 Globalpayments, "2021 Commerce and Payments Report," <https://www.globalpaymentsinc.com/en-gb/commerce-payment-trends>.
- 136 Nielsen, "2019 New Trends for Mobile Payment in Chinese Outbound Tourism," <https://www.nielsen.com/wp-content/uploads/sites/3/2020/01/2019-new-trends-for-mobile-payment.pdf>.
- 137 Ibid.
- 138 "The Most Popular Thailand Payment Methods," <https://thepayers.com/paymentmethods/thailand/27#:~:text=Bank%20transfer%20is%20the%20most,Krung%20Thai%20Bank%20and%20Kasikornbank>.
- 139 Australian Trade Commission, "Digital sectors to Thailand Trends and opportunities."
- 140 Sukrit Bansal, Phillip Bruno, Oliver Denecker, Madhav Goparaju, & Marc Niederkorn, "Global payments 2018: A dynamic industry continues to break new ground," *Global Banking McKinsey*, 2018.
- 141 Thailand Trends and Developments, " <https://practiceguides.chambers.com/practice-guides/fintech-2021/thailand/trends-and-developments>.
- 142 The Economic Intelligence Unit, "Fintech in ASEAN: Unlock the opportunity," *The Economist*, 2018, <https://eiperspectives.economist.com/financial-services/fintech-asean/white-paper/fintech-asean-unlock-opportunity>.
- 143 Ibid.
- 144 Ibid.
- 145 Ploypalin Kijkasiwat, "Opportunities and challenges for Fintech Startups: The case study of Thailand," *ABAC Journal*, 41(2), 2021, p. 41–60.
- 146 David Lee & Linda Low. "Inclusive fintech: blockchain, cryptocurrency and ICO. World Scientific," 2018.
- 147 The Payers, *The Most Popular Thailand Payment Methods*, <https://thepayers.com/payment-methods/thailand/27>.
- 148 "The Thailand Digital Transformation Survey Report 2020." <https://www2.deloitte.com/content/dam/Deloitte/th/Documents/technology/th-tech-the-thailand-digital-transformation-report.pdf>.
- 149 Ibid.
- 150 "Singapore and Thailand to link national payment systems in 2021," *Fintech Futures*. <https://www.fintechfutures.com/2020/12/singapore-and-thailand-to-link-national-payment-systems-in-2021/>.
- 151 "Bolstering financial inclusion in Indonesia How QR Codes can drive digital payments and enable financial inclusion," <https://www2.deloitte.com/content/dam/Deloitte/id/Documents/financial-services/id-fsi-financial-inclusion.pdf>.
- 152 "The Next Wave: Emerging digital life in South and Southeast Asia," <https://www.businesswire.com/news/home/20200924005941/en/Deloitte-Launches-The-Next-Wave-Emerging-Digital-Life-in-South-and-Southeast-Asia-Report-At-Ant-Group%20percentE2%20percent80%20percent99s-INCLUSION-Fintech-Conference>.



- 
- 153 "Thailand is now the world's leader in mobile banking users as Thailand 4.0 road continues," <https://pattayatoday.net/worlds-leader-mobile-banking/>.
- 154 "The Next Wave: Emerging digital life in South and Southeast Asia," <https://www.businesswire.com/news/home/20200924005941/en/Deloitte-Launches-The-Next-Wave-Emerging-Digital-Life-in-South-and-Southeast-Asia-Report-At-Ant-Group's-INCLUSION-Fintech-Conference>.
- 155 "Global payments 2018: A dynamic industry continues to break new ground," [https://www.mckinsey.com/~media/mckinsey/industries/financial\\_percent20services/our\\_percent20insights/global\\_percent20payments\\_percent20expansive\\_percent20growth\\_percent20targeted\\_percent20opportunities/global-payments-map-2018.ashx](https://www.mckinsey.com/~media/mckinsey/industries/financial_percent20services/our_percent20insights/global_percent20payments_percent20expansive_percent20growth_percent20targeted_percent20opportunities/global-payments-map-2018.ashx).
- 156 "Thailand is now the world's leader in mobile banking users as Thailand 4.0 road continues," <https://pattayatoday.net/worlds-leader-mobile-banking/>.
- 157 "The Next Wave: Emerging digital life in South and Southeast Asia," <https://www.businesswire.com/news/home/20200924005941/en/Deloitte-Launches-The-Next-Wave-Emerging-Digital-Life-in-South-and-Southeast-Asia-Report-At-Ant-Group's-INCLUSION-Fintech-Conference>.
- 158 "The Most Popular Thailand Payment Methods," <https://thepayers.com/payment-methods/thailand/27#:~:text=Bank percent20transfer percent20is percent20the percent20most,Krung percent20Thai percent20Bank percent20and percent20Kasikornbank>.
- 159 J. P. Morgan, "E-commerce Payments Trends: Thailand," 2019.
- 160 "Singapore and Thailand to link national payment systems in 2021," <https://www.fintechfutures.com/2020/12/singapore-and-thailand-to-link-national-payment-systems-in-2021/>.
- 161 "Bolstering financial inclusion in Indonesia How QR Codes can drive digital payments and enable financial inclusion," <https://www2.deloitte.com/content/dam/Deloitte/id/Documents/financial-services/id-fsi-financial-inclusion.pdf>.
- 162 "The Next Wave: Emerging digital life in South and Southeast Asia," <https://www.businesswire.com/news/home/20200924005941/en/Deloitte-Launches-The-Next-Wave-Emerging-Digital-Life-in-South-and-Southeast-Asia-Report-At-Ant-Group's-INCLUSION-Fintech-Conference>.
- 163 "Payments app KogoPay crowdfunds £200k and hits £10m valuation," <https://www.fintechfutures.com/2020/01/payments-app-kogopay-crowdfunds-200k-and-hits-10m-valuation/>.
- 164 Thammarak Moenjaj, Anyarat Kongprajya, and Chompoonoot Monchaitrakul, "Fintech, Financial Literacy, and Consumer Saving and Borrowing: The Case of Thailand," ABDI Working Paper Series, 2020.
- 165 Ibid.
- 166 "The Next Wave: Emerging digital life in South and Southeast Asia," <https://www.businesswire.com/news/home/20200924005941/en/Deloitte-Launches-The-Next-Wave-Emerging-Digital-Life-in-South-and-Southeast-Asia-Report-At-Ant-Group's-INCLUSION-Fintech-Conference>.
- 167 Shiow-luan Wang, Sarawut Kankham, Shiow-luan. Wang, "Study of marketing communications and attitude toward QR code payment: A comparison between Thailand and Taiwan," *International Journal of Arts and Commerce*, 7, 2018, p. 88-99.
- 168 Ibid.
- 169 "Bolstering financial inclusion in Indonesia How QR Codes can drive digital payments and enable financial inclusion," <https://www2.deloitte.com/content/dam/Deloitte/id/Documents/financial-services/id-fsi-financial-inclusion.pdf>.
- 170 "The future of payments in Asia," [https://www.mckinsey.com/~media/mckinsey/industries/financial\\_percent20services/our\\_percent20insights/the\\_percent20next\\_percent20frontier\\_percent20in\\_percent20Asia\\_percent20payments/the-future-of-payments-in-asia-vf.pdf](https://www.mckinsey.com/~media/mckinsey/industries/financial_percent20services/our_percent20insights/the_percent20next_percent20frontier_percent20in_percent20Asia_percent20payments/the-future-of-payments-in-asia-vf.pdf).
- 171 "Alibaba and Nielsen Identify Top Chinese Travel and Mobile Payment Trends In 2020," <https://www.webintravel.com/alibaba-and-nielsen-identify-top-chinese-travel-and-mobile-payment-trends-in-2020/>.
- 172 Ibid.
- 173 "Asian E-Wallets Plant Their Flags: An In-Depth Analysis of the Top-10 Players," [https://cdn2.hubspot.net/hubfs/3926179/content-downloads/Smartkarma\\_percent20Originals\\_percent20percent207C\\_percent20Asian\\_percent20E-Wallets\\_percent20Plant\\_percent20Their\\_percent20Flags.pdf](https://cdn2.hubspot.net/hubfs/3926179/content-downloads/Smartkarma_percent20Originals_percent20percent207C_percent20Asian_percent20E-Wallets_percent20Plant_percent20Their_percent20Flags.pdf).
- 174 Ibid.
- 175 Lui Feng, *Alipay and WeChat Pay Comparative Study in Bangkok*, Siam University, Thesis.
- 176 "Alipay and PAYSBUY partner to provide online payment services for over 10 million Chinese tourists," *The Nation Thailand*, 16 September 2016, <https://www.nationthailand.com/tech/30295461>.
- 177 "Alipay, WeChat Pay storm mobile scene," <https://www.bangkokpost.com/business/1099673/alipay-wechat-pay-storm-mobile-scene>.
- 178 "Factbox: Ant Group's investments overseas," *Reuters*, 29 October 2020. <https://www.reuters.com/article/us-ant-group-ipo-strategy-international-idUSKBN27E07C>.
- 179 "Thailand is on the verge of an ecommerce boom – are you ready to capitalize on it?" *Rapyd*, 29 November 2021, <https://www.rapyd.net/blog/the-most-popular-thailand-payment-methods/#eWallets>.
- 180 Luo Feng, "Alipay and WeChat Pay Comparative Study in Bangkok," Siam University, 2020. <https://e-research.siam.edu/wp-content/uploads/2020/08/IMBA-2019-IS-Ali-Pay-and-WeChat-Pay-Comparative-Study-in-Bangkok-compressed.pdf>.

- 
- 181 "Factbox: Ant Group's investments overseas."
- 182 "Alipay, WeChat Pay storm mobile scene," <https://www.bangkokpost.com/business/1099673/alipay-wechat-pay-storm-mobile-scene>.
- 183 Sucheera Pinijparakarn, "Thai, Chinese firms join for WeChat Pay," *The Nation*, 26 September 2016, <https://www.nationthailand.com/business/30296504>.
- 184 "Thai Kasikornbank, WeChat tie up for payment services to Chinese tourists," *Reuters*, 6 October 2016, <https://www.reuters.com/article/kasikornbank-wechat-idUSL3N1CC1L7>.
- 185 "UnionPay-Powered Huawei Pay Debuts in Thailand Following Launch in Three Other Markets in H1," <https://www.unionpayintl.com/en/mediaCenter/newsCenter/companyNews/6732.shtml>.
- 186 Ibid.
- 187 Ibid.
- 188 Ibid.
- 189 The Next Wave: Emerging digital life in South and Southeast Asia," <https://www.businesswire.com/news/home/20200924005941/en/Deloitte-Launches-The-Next-Wave-Emerging-Digital-Life-in-South-and-Southeast-Asia-Report-At-Ant-Group's-INCLUSION-Fintech-Conference>.
- 190 "Fintech in ASEAN Unlock the opportunity," <https://eiuperspectives.economist.com/financial-services/fintech-asean/white-paper/fintech-asean-unlock-opportunity>.
- 191 Alipay, "China's leading online payment solution," <https://global.alipay.com/docs/>.
- 192 WeChat Pay, "Documents - WeChat Pay," [https://pay.weixin.qq.com/wechatpay\\_guide/help\\_docs.shtml](https://pay.weixin.qq.com/wechatpay_guide/help_docs.shtml).
- 193 Wenzheng Liu, Xiaofeng Wang, and Wei Peng, "State of the Art: Secure Mobile Payment," *IEEE Access*, 8, 2019, p. 13898-914, doi:10.1109/ACCESS.2019.2963480.
- 194 Alipay, "China's leading online payment solution," <https://global.alipay.com/docs/>.
- 195 Xiaolong Bai, Zhe Zhou, Xiaofeng Wang, Zhou Li, Xianghang Mi, and Nan Zhang, "Picking up my tab: Understanding and mitigating synchronized token lifting and spending in mobile payment," Paper presented at the 26th USENIX Security Symposium, 16-18 August 2017, Vancouver, Canada, <https://www.usenix.org/system/files/conference/usenixsecurity17/sec17-bai.pdf>
- 196 Maria Nikolova, "Alipay enhances AI-powered risk engine AlphaRisk to help businesses tackle fraud," 15 May, 2020, <https://financefeeds.com/alipay-enhances-ai-powered-risk-engine-alpharisk-help-businesses-tackle-fraud/>.
- 197 Xiaolong Bai, Zhe Zhou, Xiaofeng Wang, Zhou Li, Xianghang Mi, and Nan Zhang. "Picking up my tab: Understanding and mitigating synchronized token lifting and spending in mobile payment," Paper presented at the 26th USENIX Security Symposium, 16-18 August 2017, Vancouver, Canada, <https://www.usenix.org/system/files/conference/usenixsecurity17/sec17-bai.pdf>.
- 198 Ibid.
- 199 Eddie Lee, "NFC hacking: The easy way," Paper presented at the Defcon hacking conference, 2012, <https://www.xinmeow.com/wp-content/uploads/2018/01/DEFCON-20-Lee-NFC-Hacking.pdf>.
- 200 PCI Security Standards Council, "Verify PCI Compliance, Download Data Security and Credit Card Security Standards," [https://www.pcisecuritystandards.org/pci\\_security/](https://www.pcisecuritystandards.org/pci_security/).
- 201 Ibid.
- 202 Yang Jie and Lisa Lin, "Alibaba Falls Victim to Chinese Web Crawler in Large Data Leak," *Wall Street Journal*, 15 June 2021, <https://www.wsj.com/articles/alibaba-falls-victim-to-chinese-web-crawler-in-large-data-leak-11623774850>.
- 203 Office of the Central Cyberspace Affairs Commission, "Announcement regarding the illegal and irregular collection of user information by 84 apps," 10 May 2021, [http://www.cac.gov.cn/2021-05/10/c\\_1622225924090817.htm](http://www.cac.gov.cn/2021-05/10/c_1622225924090817.htm) (in Chinese).
- 204 Coco Feng, "Alibaba Cloud data leak 'violated Cybersecurity Law' in 2019 and must rectify, local Chinese telecoms regulator says," *South China Morning Post*, 24 August 2021, <https://www.scmp.com/tech/policy/article/3146141/alibaba-cloud-data-leak-violated-cybersecurity-law-2019-and-must>.
- 205 Robin Hui Huang, Cynthia Sze Wai Cheung, and Christine Meng Lu Wang, "The Risks of Mobile Payment and Regulatory Responses: A Hong Kong Perspective," *Asian Journal of Law and Society*, 7 (2), 2020.
- 206 "Disputes and Chargebacks on the Alipay Platform," <https://www.chargebackgurus.com/blog/alipay-chargebacks>.
- 207 "Is Alipay safe? 7 facts you should know about Alipay," <https://jingsourcing.com/b-is-alipay-safe/>; Yue Liu, "Consumer protection in mobile payments in China: A critical analysis of Alipay's service agreement," *Computer Law & Security Review*, 31 (5), 2015, p. 679-688.
- 208 Robin Hui Huang, Cynthia Sze Wai Cheung, and Christine Meng Lu Wang, "The Risks of Mobile Payment and Regulatory Responses: A Hong Kong Perspective," *Asian Journal of Law and Society*, 7 (2), 2020, p.329.
- 209 Rachael King and Joasia E. Popowicz, "Payments Benchmarks 2021 report – looking forward to a digital future," Central Banking Publications, 26 August 2021, <https://www.centralbanking.com/benchmarking/payments/7868531/payments-benchmarks-2021-report-looking-forward-to-a-digital-future>.

- 
- 210 David Ross, "How WeChat and Alipay slip Austrac's net," 13 April 2021, <https://www.news.com.au/finance/business/how-wechat-and-alipay-slip-austracs-net/news-story/7efdb3b781c93bcf5c44c4f3a409efe1>
- 211 Ibid.
- 212 Eva Huang and Xi Nan, "Transaction-based Tax Evasion in the Cross-border Digital Economy: The Case of Daigou Activities on Social Media Platforms," *New Zealand Journal of Taxation Law and Policy*, 26, 2020, p. 269-98.
- 213 AUSTRAC, "Parliamentary Joint Committee on Corporations and Financial Services," QoN Number: QoN022-03. [https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKewiQ58\\_t-Kv1AhVcxzqGHfndBNsQFnoECacQAO&url=https%3A%2F%2Fwww.aph.gov.au%2FDocumentStore.ashx%3Fid%3Df4eddf1-8031-4735-a619-7f62af098b31&usq=AOvVaw2BSzK1odNG6VbRdCVUKj5Q](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKewiQ58_t-Kv1AhVcxzqGHfndBNsQFnoECacQAO&url=https%3A%2F%2Fwww.aph.gov.au%2FDocumentStore.ashx%3Fid%3Df4eddf1-8031-4735-a619-7f62af098b31&usq=AOvVaw2BSzK1odNG6VbRdCVUKj5Q).
- 214 Robin Hui Huang, Cynthia Sze Wai Cheung, and Christine Meng Lu Wang, "The Risks of Mobile Payment and Regulatory Responses: A Hong Kong Perspective," *Asian Journal of Law and Society*, 7 (2), 2020, p.329.
- 215 'Geographical Link', AUSTRAC. <https://www.austrac.gov.au/glossary/geographical-link>.
- 216 Michael Motala, "G20 Performance on International Taxation," *G20 Insights*, 8 April 2020, [https://www.g20-insights.org/policy\\_briefs/g20-performance-on-international-taxation/](https://www.g20-insights.org/policy_briefs/g20-performance-on-international-taxation/).
- 217 Denessi Rudich, "G20 Performance on Anti-Money Laundering, Corruption," *G20 Insights*, 1 April 2020, [https://www.g20-insights.org/policy\\_briefs/g20-performance-japan-anti-money-laundering-corruption/](https://www.g20-insights.org/policy_briefs/g20-performance-japan-anti-money-laundering-corruption/).
- 218 Paul Langley and Andrew Leyshon, "The Platform Political Economy of Fintech: Reintermediation, Consolidation and Capitalisation," *New Political Economy*, 26 (3), 2021, p. 376-388.
- 219 Keith Zhai, "Alibaba Hit With Record \$2.8 Billion Antitrust Fine in China," *The Wall Street Journal*, 10 April 2021.
- 220 Keith Zhai and Frances Yoon, "Beijing Blocks Merger, Tightens Data Rules as Post-Didi Crackdown Speeds Up," *The Wall Street Journal*, 10 July 2021.
- 221 Stephanie Yang, "China Unveils New Rules Targeting Anticompetitive Practices by Internet Companies," *The Wall Street Journal*, 17 August 2021.
- 222 Peter Hoskins, "China says crackdown on business to go on for years," *BBC News*, 12 August 2021, <https://www.bbc.com/news/business-58182658>.
- 223 Barry Naughton, "What's Behind China's Regulatory Storm," 14 December 2021. <https://www.wsj.com/articles/what-is-behind-china-regulatory-storm-11638372662>.
- 224 Hauke Johannes Gierow, "Cyber Security in China: Internet Security, Protectionism and Competitiveness: New Challenges to Western Businesses," *China Monitor*, Merics: Mercator Institute for China Studies, 2015.
- 225 Matt Sheehan, "How Google took on China—and lost," *MIT Technology Review*, 19 December 2018, <https://www.technologyreview.com/2018/12/19/138307/how-google-took-on-china-and-lost/>.
- 226 "The Impact of the National Security Law on Media and Internet Freedom in Hong Kong," *Freedom House*, 19 October 2021, <https://freedomhouse.org/article/impact-national-security-law-media-and-internet-freedom-hong-kong>.
- 227 Hui Feng, "What is behind China's digital currency aspirations?" *centralbanking.com*, 6 November 2019, <https://www.centralbanking.com/fintech/cbdc/4531196/what-is-behind-chinas-digital-currency-aspirations>.
- 228 Karen Yeung, "China's e-yuan like 'a double-edged sword', and mishandling it carries considerable financial risks," *South China Morning Post*, 18 July 2021.