

The Popularity of Electronic Mobile Payments: Based on QR Codes

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Abstract

This paper examines the widespread adoption of QR code-based mobile payments in China, analyzing the economic, technological, and social factors driving its popularity, while also addressing the associated security risks and challenges. The convenience, speed, and low infrastructure cost of QR code payments have made them especially prevalent among small businesses and street vendors, supported by government digital initiatives, high smartphone penetration, and consumer willingness to embrace new technologies. However, the rapid growth has also led to rising incidents of fraud, such as counterfeit payment codes, phishing scams, and unauthorized data collection, exacerbated by regulatory gaps and fragmented oversight. In contrast, the limited adoption of QR code payments in many foreign countries is attributed to well-established credit card systems, stricter data privacy laws, and the lack of standardized frameworks. The paper further explores policy responses, drawing on international best practices from countries like Singapore, India, and the European Union, including unified technical standards, strong customer authentication, open banking models, and cross-institutional anti-fraud collaboration. It proposes localized recommendations for China, such as enhancing regulatory oversight, promoting interoperability, strengthening data protection, and improving public awareness. The study concludes that while QR code payments have revolutionized financial transactions in China, a balanced approach integrating innovation with robust security and regulatory frameworks is essential for sustainable development and potential global expansion.

Keywords

QR codes, mobile payments, China.

1. Introduction

In recent years, electronic mobile payments based on QR codes have become an everyday phenomenon in the lives of Chinese people, which has completely changed the way people conduct transactions. Platforms that store electronic change, such as Alipay and WeChat Pay, are fully integrated into Chinese society, with QR codes for everything from street vendors to paying utility bills. However, in most parts of the world, the phenomenon remains relatively small. The application scenarios of QR codes include scanning to order in restaurants, payment in shopping malls, and rental of shared bikes. However, at the same time, the risk of QR code fraud has gradually emerged, with cases including fake merchant QR codes and malicious software stealing information. Merchants post QR codes in their stores and stalls, allowing customers to scan and view them to place orders. Ultimately, they can also complete payments through scanning. This greatly enhances the transaction efficiency between merchants and consumers, reduces waiting times for customers, and alleviates the human resource burden on merchants. Although QR codes are neutral technology, criminals often exploit their "scan-to-jump" feature to commit fraud. Here are some high-profile malicious QR code fraud cases in

recent years. For example, Aunt Wang, a seller of egg pancakes in Hangzhou, noticed that her income had been unusually low for several consecutive days. Upon investigation, it was found that the payment QR code on her stall had been secretly replaced by a fraudulent one, causing customers' money to be directly transferred to the fraudster's account. Criminals can easily forge or replace the real merchant's payment QR code, leading to funds being directed to the wrong account. Another example is that there are often people posing as college students starting businesses on the street, asking passersby to scan and support their vote or follow their store. After users scan the code, WeChat automatically follows multiple spammy official accounts or even authorizes third-party applications, resulting in privacy leakage. This essay mainly studies the reasons for the popularity of electronic mobile payment based on QR code in China in recent years, its advantages and disadvantages, and the reasons why it is not popular in foreign countries.

2. Widespread Use of QR Codes in China

One of the main reasons why QR code mobile payment is widely adopted in China lies in the unique economic, technological and social environment. The studies indicate that the willingness of Chinese consumers to accept new technologies, including mobile payments, is significantly shaped by these supportive measures from the government, which foster an environment of trust and convenience. This is particularly relevant as the findings suggest that perceived transaction convenience and government support are among the top factors influencing adoption intentions (Chen et al., 2019). The payment process completed by scanning QR codes through mobile devices such as smart phones is characterized by convenience, speed and security, and is deeply loved by both consumers and merchants. The Chinese market holds a prominent position among these. The rapid urbanization process and the popularization of smart phones have provided fertile soil for the popularization of digital payment, and QR code payment has rapidly grown into one of the main mobile payment methods. According to statistics, the scale of China's QR code payment market continues to grow, maintaining a high growth rate every year. In addition, in many regions, the basic financial facilities represented by traditional banks are underdeveloped, and paper money is not easy to carry and is prone to counterfeiting. According to the report, during the Covid period in 2020, QR code payment methods continued to experience high growth (iResearch, 2020). The COVID-19 pandemic has accelerated the shift towards mobile payments, as consumers sought safer alternatives to cash transactions. This shift has been supported by the technological competencies of small and medium enterprises (SMEs) in China, which have also positively influenced the adoption of mobile payment services (Cao, 2021). All these reasons have led to a lack of a safe and reliable payment method in the country, and the emergence of mobile payment platforms has quickly filled the gap in China's financial market. At the same time, the Chinese government has invested many supportive policies and financial subsidies in digital infrastructure, which has further promoted the development of mobile payment and made Chinese consumers more willing to accept new technologies[1-3].

The Chinese government has been actively researching and developing central bank digital currencies (CBDCs), which include the DCEP system. This initiative is part of a larger strategy to enhance the efficiency of payment systems and to address concerns regarding privacy, competition, and the integrity of digital payment methods. The DCEP system is designed to facilitate digital transactions and is influenced by the characteristics of existing payment methods, including cash and third-party payment services (Xia et al., 2023). Furthermore, the study on user willingness to adopt the DCEP reveals that government support significantly shapes adoption intentions. Factors such as privacy concerns and the technical characteristics of the DCEP are critical in shaping user perceptions and acceptance of digital payment systems,

including those utilizing QR codes(Xia et al., 2023). According to the Digital China Development Report (2022) released by the Cyberspace Administration of China, the number of Internet users in China will reach 1.067 billion in 2022, with an Internet penetration rate of 75.6%. Based on this national condition, Chinese consumers are more willing to accept new Internet technologies[4-6].

3. Risks of QR Code Payment

While the QR code mobile payment system is convenient, it is not without drawbacks. One big advantage is its ease of operation and low cost. QR codes are extremely easy to generate and scan, and require little hardware investment and are easy to replicate and expand compared to card-based financial systems in infrastructure such as banks. This makes them particularly popular among small businesses and street vendors. However, the system has also raised concerns about security and privacy. The risks associated with QR code payments are multifaceted and primarily revolve around security vulnerabilities and the potential for fraudulent activities. One significant concern is the susceptibility of QR codes to tampering, where attackers can replace legitimate QR codes with malicious ones that redirect users to fraudulent sites or accounts. This risk is particularly pronounced in mobile payment scenarios, where users may not easily perceive such alterations, leading to unauthorized transactions (Lu et al., 2017).

In the scan code payment, there are two two-dimensional codes, payment code and collection code, and the payment code is the most commonly used in daily life consumption. In this case, residents only need to show the payment code to the merchant, and the other party can scan it without secret payment, and there is no need to verify that only when the transaction is greater than 500 yuan, consumers need to enter the password. Therefore, if people do not pay attention when they open the QR code to receive and pay, it is very easy to be stolen by criminals. QR codes can be easily tampered with or replaced by malicious actors, leading to potential fraud. At present, there are unclear and even blank areas in the supervision of two-dimensional code and third-party payment. Compared with traditional cash payment, scanning-code payment will make funds flow between multiple parties, including individuals, organizations, enterprises and other social subjects, but also involves financial supervision, commercial banks, non-bank payment institutions, industry and information technology departments and other departments, the use of diverse subjects, regulatory objects are also very complicated, it is difficult to achieve a reasonable standard. In contrast, credit card systems, while more expensive to maintain, generally offer stronger fraud protection and are less dependent on external factors such as network connectivity.

QR code payment systems present several security vulnerabilities that have been highlighted in recent research. One significant concern is the potential for unauthorized access and misuse, particularly due to the rapid adoption of QR codes during the COVID-19 pandemic. The shift towards contactless processes has led to increased usage of QR codes, which, while beneficial for reducing physical contact, has also introduced various security issues related to human factors, software vulnerabilities, and hacking risks (Bhamidipati & Wvs, 2022).

The integration of QR codes into mobile payment applications raises additional security challenges. These applications often contain sensitive information about the payer or payee, making them attractive targets for cybercriminals. The lack of robust security measures can lead to vulnerabilities that compromise user data and transaction integrity (Khan & Ansari, 2024). Furthermore, the reliance on smart devices for QR code scanning, as opposed to more secure, rugged devices, can exacerbate these vulnerabilities, as smart devices may not be designed with the same level of security in mind (Bhamidipati & Wvs, 2022).

Another critical aspect is the intersection of QR codes with cryptographic models and card payment systems. The integration of QR codes into these systems introduces significant security and privacy concerns, necessitating the implementation of strong cryptographic solutions to protect against potential threats. The literature indicates that vulnerabilities can arise from inadequate encryption methods and the overall security architecture of the payment systems (Ogbodo et al., 2025)[7-10].

4. The Reasons Why QR Code Payment is not Widely Adopted Abroad

The limited adoption of QR code mobile payment abroad can be attributed to multiple factors such as regulation, culture and infrastructure.

The adoption of QR code payment systems abroad faces several challenges that hinder their widespread acceptance. One significant barrier is the issue of digital literacy, which varies across different demographics and regions. Many potential users may lack the necessary skills to navigate digital payment systems effectively, leading to reluctance in adopting QR code payments (Sathish & Vidya, 2025).

Additionally, cybersecurity concerns pose a substantial obstacle. Users are often apprehensive about the security of their financial information when using QR codes, which can deter them from utilizing these payment methods (Sathish & Vidya, 2025). The integration of advanced security measures, while improving system resilience, has not fully alleviated these concerns, as users remain wary of potential cyber threats (Mada, 2025).

Regulatory fragmentation also complicates the landscape for QR code payments. Different jurisdictions may have varying regulations regarding digital payments, which can create confusion and hinder the establishment of a unified payment system. Additionally, the lack of a unified global standard for QR code payment hinders its international expansion, as different countries and companies have developed incompatible systems. For instance, overseas Chinese often encounter problems such as poor payment channels and limited payment scenarios when using WeChat Pay in China. This inconsistency can lead to a lack of trust among consumers and businesses alike, further impeding adoption.

Moreover, infrastructure limitations in developing regions can restrict access to the necessary technology for QR code payments. In areas where internet connectivity is poor or where there is a lack of compatible devices, the feasibility of adopting QR code payment systems diminishes significantly.

Lastly, many developed countries already have well-established financial systems, where the existing dominance of credit and debit cards not only sets a high entry barrier for alternative payment methods but also makes them more inclined to stick to traditional payment systems. Meanwhile, many Western countries have strict financial regulations and data privacy laws, which also slow down the adoption of new payment technologies and reduce the immediate demand for alternative payment methods. In contrast, China's regulatory environment is more lenient, which enables mobile payment platforms to develop rapidly[11-13].

5. Policy Responses to Mitigate the Risks of QR Code Payments.

To mitigate fraud in QR code payment transactions, several measures can be implemented based on recent research findings. One significant approach involves the use of advanced machine learning techniques to detect fraudulent activities and tampering with QR codes. For instance, employing algorithms such as Random Forest, XGBoost, and Isolation Forest can enhance the detection of unauthorized changes and irregularities in transaction behavior, thereby improving security and reducing financial risks for users (Kumar et al., 2025).

One significant approach is enhancing user authentication requirements. The current use of fingerprint and facial recognition technologies may present long-term challenges for users, indicating a need for more robust and adaptable authentication methods. Implementing multi-factor authentication that combines various verification techniques could strengthen security during transactions. The introduction of dynamic authorization protocols, such as the Out-of-Band visual two-factor authorization protocol, can provide a secure method for validating transactions. This protocol utilizes mobile devices to confirm transactions through unique visual codes, which can help prevent phishing and man-in-the-middle attacks. Each transaction is assigned a unique code that must be validated within a specific timeframe, thereby increasing the security of mobile payments (De Melo et al., 2024).

Another effective strategy is the integration of mobile One-Time Password (OTP) systems alongside QR code transactions. This dual authentication method can provide an additional layer of security, making it more difficult for attackers to exploit vulnerabilities associated with online banking. The OTP is sent to the user's mobile device, which helps to safeguard against various types of attacks, including phishing and eavesdropping (Subpratatsavee & Kuacharoen, 2015). Furthermore, the design of payment systems can be optimized to ensure that customer payment information is inaccessible to merchants. Allowing customers to send their payment information directly to a payment gateway minimizes the risk of exposure to potential threats. This method not only enhances security but also simplifies the transaction process through the use of QR codes. The implementation of Scan and Pay ATMs represents a novel advancement in banking technology that can further reduce fraud risks. These ATMs allow users to initiate transactions by scanning a QR code generated on their mobile devices, which eliminates the need for physical cards and PIN codes, thereby decreasing the likelihood of card skimming and shoulder surfing (Anand et al., 2025)[14-16].

As one of the countries with the most widespread mobile payment adoption globally, China has deeply integrated QR code payments into its socio-economic life. However, with the expansion of payment scenarios, risks such as fraud, information leakage, and even money laundering have become increasingly prominent. To effectively address these challenges, China can draw on advanced international experience and localize it based on its national conditions. For instance, the Monetary Authority of Singapore (MAS) has launched a nationally unified QR code payment standard, SGQR, which is compatible with multiple wallets, enabling universal use of one code. Additionally, users undergo strong identity verification through the government-certified SingPass system, ensuring transaction traceability. Therefore, China can draw on Singapore's policy to promote a nationally unified QR code technology standard. Although China already has UnionPay's "QuickPass online payment platform" and some industry standards, there are still barriers posed by proprietary protocols such as Alipay and WeChat. It is suggested that the central bank take the lead in formulating mandatory national standards to achieve cross-platform scanning recognition, reduce merchant access costs, and minimize user confusion risks. Deepen the integration of "digital RMB + digital identity": bind digital RMB wallets with the Ministry of Public Security's "Internet ID" (CTID) to achieve high-security identity verification, especially for sensitive scenarios such as large-value transfers and cross-border payments.

The European Union has introduced the General Data Protection Regulation (GDPR) to strictly limit companies' collection, storage, and use of user payment data, with a maximum fine of 4% of global revenue for non-compliance. It also requires banks to open account information (with user authorization) to third-party payment providers (TPPs), and introduces Strong Customer Authentication (SCA)-each transaction must meet at least two of the requirements of "knowledge + possession + biometric". Finally, an independent regulatory body, the European Banking Authority (EBA), has been established to coordinate and guide member states in implementing payment security standards.

Drawing from the experience gained, China can introduce the "Regulations on the Management of Payment Data Security", which clarifies the boundaries of collection, retention periods, and usage permissions for user transaction data by payment institutions, and prohibits unauthorized data sharing and profiling analysis. At the same time, it will fully implement "Strong Customer Authentication" (SCA) and establish a national-level payment security coordination mechanism. The "Payment Security Committee" will be jointly established by the People's Bank of China, the Ministry of Public Security, and the Ministry of Industry and Information Technology to uniformly formulate policies, monitor risks, and respond to emergencies.

6. Conclusion

In summary, the widespread popularity of QR code-based electronic mobile payments in China is the result of a combination of economic, technological and social factors. While this method of payment offers significant advantages in terms of convenience and cost-effectiveness, there are also challenges in terms of security and reliability. In contrast, the slow adoption of QR code payments in countries apart from China reflects differences in the regulatory environment, consumer behavior, and existing financial infrastructure. With the increasing closeness of countries around the world, it is expected that two-dimensional code payment can overcome these obstacles to achieve global popularity, and is no longer mainly limited to China, bringing convenience to people around the world.

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