An analysis on market reaction to mobile payment adoption: comparison between financial and non-financial industry

Hai-Yen Chang

Department of Banking and Finance,
Chinese Culture University,
55, Hwa-Kang Road, Yang-Ming-Shan.,
Taipei, Taiwan
Email: irischang1014@gmail.com

Kuang-Husn Shih*

Graduate School of Financial Management,
CTBC Business School,
No. 600, Sec. 3, Taijiang Blvd., Annan Dist.,
Tainan, Taiwan
Email: president@ctbc.edu.tw
*Corresponding author

Yi-Hsien Wang and Li-Ju Chien

Department of Banking and Finance,
Chinese Culture University,
55, Hwa-Kang Road, Yang-Ming-Shan.,
Taipei, Taiwan
Email: wyx12@faculty.pccu.edu.tw
Email: w1996850517@gmail.com

Abstract: With the rising popularity of financial technology, the use of mobile payments has become a mainstream payment tool option. With the arrival of the mobile payment era, in addition to facing huge business opportunities and potential interests, business owners are also pondering how to combine their own advantages to maximise the wealth of shareholders, which is an important issue worthy of attention. This study found that there was a significant abnormal return before the event date, suggesting that investors had inconsistent opinions. Positive opinions were mainly towards non-financial industry operators, while negative opinions were mainly towards financial industry operators. This phenomenon may be due to investors holding different expectations for different mobile payment companies.

Keywords: mobile payment; FinTech; market reaction; quantile regression; GARCH.

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Biographical notes: Hai-Yen Chang is an Associate Professor at the Department of Banking and Finance, Chinese Culture University in Taiwan. Her current research interests are in the area of financial management and financial markets.

Kuang-Husn Shih is the President of the CTBC Financial Management College in Taiwan. He received his Doctoral degree from the Nova Southeastern University. His current research interests are in the area of financial operations management, finance mergers and acquisitions, finance information systems and financial crime. His recent publications have appeared in the *International Journal of Mobile Communications*, *Journal of Testing and Evaluation*, *Total Quality Management and Business Excellence*, *Energy, Quality and Quantity: International Journal of Methodology*, *African Journal of Business*, *Journal of Computer Information Systems*, *The International Journal of Systems and Cybernetics, Industrial Management and Data System*, and *International Journal of Technology Management*.

Yi-Hsien Wang is a Professor at the Department of Banking and Finance, Chinese Culture University in Taiwan. His current research interests are in the area of applied economics, decision science and financial risk management.

Li-Ju Chien is an MS student of the Graduate Institute of Banking and Finance, Chinese Culture University in Taiwan. Her current research interests are in the area of investment analysis and management.

1 Introduction

The functions of smartphones in recent years have not been limited to just communication and texting, they have been combined with the functions of money transfers, credit cards, and making payments for utilities and insurance premiums. Smartphones have further utilised bank account-based payment tools to provide consumers with more diversified payment methods (Carr, 2007). Therefore, the need for mobile bank services has significantly increased with the rise in smartphone usage, which renders the trading mode of mobile payments an innovative service in the digital financial industry. It has attracted more financial industry operators, information suppliers, and e-commerce-related operators to invest in the mobile payment market to further expand their own market share and the coverage rates of customers receiving services, increase the customer retention rate, improve enterprises' operating efficiency, and enhance market competitiveness (Lin et al., 2012; Shaikh, 2013).

The trend of FinTech has also started to affect six major functions of the financial service industry: payments, insurance, deposits, financing, investment management, and information provision. At present, digital finance is impacting and changing the existing business models and fundamental framework of the financial industry, as well as rapidly affecting consumers' trading mode and usage habits. Moreover, the development of payment functions has been one of the fastest digital financial innovations. The innovation and expanded applications of e-payment services certainly can create huge business opportunities.

Such highly convenient mobile payments also enable consumers to complete payment actions without taking along a physical wallet when going outdoors. The rapid growth of mobile payment services in China in recent years has been astonishing. According to statistics, the mobile payment trading volume increased from 1,219 billion in 2013 to 5,999 billion in 2014, and is expected to reach 180,000 billion in 2018, thus, the China market will become the largest mobile payment trading market in the world (Miao and Jayakar, 2016). However, the current mobile payment usage rate is low in Taiwan, which is due to various factors, such as legal limitations and difficulty in changing consumers' usage habits, thus, the development of mobile payments has been slow and limited. Therefore, the research motivation of this study is to understand whether the introduction of new forms of mobile payment services by listed and OTC-listed financial industry and non-financial industry companies in Taiwan is closely related to the change and volatility of their stock prices.

Related financial service enterprises have invested enormous resources to overcome the technical breakthroughs of mobile banking, and create the application of payment system for electronic ticketing (e-ticketing), third-party payment, electronic payment (e-payment), and mobile payment in the advancement of mobile banking services. Following the structural change of financial service technologies, these application services have contributed to undertaking various transactions through mobile devices, and allowing financial service enterprises to bring their competition advantages in terms of transaction costs to face the challenges brought by various consumer services (Lin et al., 2012; Ahluwalia et al., 2014; Wang et al., 2017). In particular, the application services of mobile payments can directly meet the needs of individual consumers and they have a high degree of flexibility regarding the cash flow between consumers and merchants. Hence, how investors respond to such application services of mobile payment is an academic and practical issue worthy of more attention (Sanakulov and Karjaluoto, 2015; Gan et al., 2016; Lin et al., 2017; Tsai et al., 2018).

Past studies mainly used questionnaires and case studies to investigate mobile payment services. For example, Zhou (2013) looked at the intention to continuously use mobile payments, while De Reuver et al. (2015) examined mobile payment platforms established through cooperation between banks and telecommunications operators. Son et al. (2015b) focused on mobile payment service-related issues derived from smartphone brands, such as Samsung Pay and Apple Pay. Past studies seldom used cross-analysis to investigate the influence of the introduction of mobile payment services on the stock price and return of listed and OTC-listed companies (Lin, 2014; Son and Kim, 2016; Fiedler, 2015; Jawale and Park, 2016).

This study used a market model to test the average abnormal return (AR) and average cumulative abnormal return (CAR) of listed and OTC-listed companies in Taiwan upon their declaration of the introduction of a new form of mobile payment services. Second, this study utilised the Scholes-Williams OLS risk adjustment model and the GARCH risk adjustment model to further analyse the information effect of financial industry and non-financial industry operators after mobile payment adoption (Chuang and Wang, 2010; Wang et al., 2013; Chen et al., 2017). Nevertheless, related studies only observed AR, while ignoring the skewed data and assumption of homoscedasticity of the residuals are violated. Thus, quantile regression is employed to discover important factors affecting the introduction of mobile payment services, as based on the above results (Winkelmann, 2006; Wang et al., 2011; Kidd et al., 2017). This paper is organised, as follows. Section 2 includes the literature review and related work. Section 3 focuses on data processing and the research method. Section 4 shows the empirical results and analysis. Finally, Section 5 discusses the results and presents the conclusion.

2 Related work

From the perspective of consumer's acceptance, Bamasak (2011) explored user's acceptance of mobile payments, and indicated that the problems of concern for most users are safety and privacy, in order to provide relevant operators with suggestions for use in the consumption market. Kemp (2013) also argued that mobile payments require a trustworthy service management system. When users firmly believe that the innovation system is easier used, they will have the stronger attitude towards the adoption of this system (Chen, 2008). Consumers also attach great importance to the safety control issues of authentication, non-repudiation, confidentiality, privacy protection, and data integrity during the further execution of mobile payment (Suh and Han, 2003; Sun et al., 2009). The safety of system use and the privacy of personal data are also very important, as users must exchange information during the transaction process. Therefore, in terms of user's personal data and information exchange, enterprises must have their confidentiality mechanism to gain the user's trust (Chen, 2008). There still exist many risk factors during the consumer's use of mobile payment, such as the restrictions of mobile device and mobile networks (as there is no standard communication agreement, data transmission is easily damaged and personal data are easily stolen), and these risk factors test consumers' trust in mobile payment, as well as their willingness to trade.

Yang et al. (2012) pointed out that mobile payment is an innovative application in mobile commerce, thus, user's acceptance and use of mobile payment service is key for the gains of bankers and investors. Zhou (2013) believed that a high-quality financial system, which enables users to use the mobile payment service conveniently at any time, is an emerging service content that banks should actively develop (Pandy and Tavilla, 2014). Schierz et al. (2010) found that German consumers with subjective norms and personal action are more willing to use the mobile payment service. It was also found in the research of Marianne (2012) that enterprises often use a coupon or discount to attract consumers, which makes the usage rate of mobile payments in the USA increase year by year. In a consumer payment survey report, Schuh and Stavins (2014) found that payments by credit card and charge card increased in 2012, as compared with previous years. Moreover, 52% consumers own one stored-value card: 36% of them have obtained the mobile payment function provided by financial institutions and 18 of them use mobile payments authorised by financial institutions. Thus, in the US market, payment methods are not limited to paper currency. Based on the business operation strategy, and in consideration of consumer's demands and benefits, financial institutions begin to research and develop mobile payment services and functions, and hope to provide consumers with a new transaction model characterised by convenience, safety, and transaction efficiency.

In the past few years, with the continuous global expansion of business opportunities for mobile payments, more and more documents have mentioned the importance of mobile payment services in industrial ecology (Merritt, 2011; Yang et al., 2012; Hedman and Henningsson, 2015; Oliveira et al., 2016; Kasemsap, 2018), and the mobile payment system has even been regarded as one of the important driving forces of social and economic development in emerging countries (Duncombe and Boateng, 2009; Wamuyu, 2014; Dahlberg et al., 2015). In many research works, relevant cases are used as the data to discuss the development trend of mobile payment in various countries. For example, through research into the market cooperation case of the Danish mobile payment ecology system, Hedman and Henningsson (2015) analysed the factors affecting competition and cooperation between traditional and new stakeholders in the payment ecology system. Joutsen (2015) explored how mobile banking and mobile payment services will change the Finnish banking industry, and what role IT, the telecom industry, and other non-bank enterprises will play during this process (Shaikh and Karjaluoto, 2015). Iman (2018) applied three kinds of mobile payment cases: M-PESA (The Republic of Kenya), TCASH (Indonesia), and Oi Paggo (Brazil) to analyse the main economic entity involved, and evaluate the development of its mobile payment system.

From the angle of market response, it is found that enterprises usually hope to rapidly launch or pre-announce next-generation or upgraded products under the environment of increased market efficiency and highly competitive industrial competition, in order that new innovative products or services can gain the stakeholders' support and create higher commercial value (Son et al., 2015a). Previous literature found that many researches have mentioned the market response to information to launch new products or new services. For instance, when Samsung Pay was introduced into South Korea, Son and Kim (2016) analysed how an alliance enterprise's corporate value fluctuates. Mann and Babbar (2017) explored the effect of the announcements of 83 new products on corporate stock price, as published by the BSE 500 index, and the empirical research found that the release of new products has great effect on stock price and produces AR on the event day. Reddy and Babu (2018) explored the effect of announcing the introduction of mobile payment on the share performance of a commercial Indian bank.

3 Sample and research methodology

3.1 Sample selection

This study mainly enrolled listed and OTC-listed companies that introduced mobile payment services in Taiwan from 2012 to 2016 as the research subjects. The stock price data of the samples were collected from the database of the *Taiwan Economic Journal* (TEJ database). This study first searched the news releases and relevant news reports on the United Daily News Newspaper Database (UDNDATA by United Daily News Group) and various news websites, and then, performed cross-comparison of the databases.

The event study method has been comprehensively applied to fields concerning financial research issues, such as the declaration of public polices, M&A declaration events, major investment events, policy interventions, and patent litigations (Ramiah et al., 2013; Lee et al., 2013; Morgan et al., 2014; Travlos et al., 2015; Fiordelisi and Ricci, 2016). This method is mainly used to investigate whether the occurrence of a major event can cause an abnormal change in a stock price, and thus, result in the phenomenon of AR. The information acquired can be used to understand the correlation between securities market prices and specific events. The length of the estimation period may lead to an unstable estimation of the predictive model. This study considers that there are stock price limits (increases and decreases of 10%) in the domestic stock market, and thus, used a longer observation period. An event period is the period where the influence of a specific event or information is predicted. The event date in this study refers to the time point at which the market learns of the occurrence or potential occurrence of an event. Therefore, the event date of when the mobile payment service was introduced is '0'. If the date was a holiday, the next trading date would be used as the event date. The estimation period selected by this study was before the event period. The estimation period lasted for a total of 90 days, and was 16 to 105 days after the event date. The event period in this study lasted for a total of 31 days, and was 15 days before and after the event date, namely, pre- and post-day 15 of the event date.

3.2 Market model

Empirically, the market model, which is a linear regression model of an individual company and market developed using data of the estimation period and the method of least square, is also the most comprehensively applied prediction model:

$$r_{it} = \alpha_i + \beta_i r_{mt} + \varepsilon_{it} \tag{1}$$

where *r* it denotes the stock return of company *i* at time *t*; r_{mt} denotes the return of the market portfolio at time *t*; α_i and β_i denote the constant and the system risk of company *i*, respectively. The calculation of the AR of an individual company equals the difference between the actual return (r_{it}) and expected return ($E(\hat{R}_{it})$), $AR_{it} = R_{it} - E(\hat{R}_{it})$. AR_{it} denotes the AR of company *i* at time *t*. The calculation of average AR and average CAR are $\overline{AR_t} = \frac{1}{N}\sum_{i=1}^{N} AR_{it}$ and $CAR(\tau_1, \tau_2) = \frac{1}{N}\sum_{i=1}^{N}\sum_{t=\tau_1}^{\tau_2}(AR_{it})$, respectively.

3.3 Quantile regression

Based on the above discussion of market reaction, this study utilises quantile regression to compute the estimator of the relationship between financial market reactions (CAR) and explanatory variables (Koenker and Bassett, 1978; Winkelmann, 2006). Accordingly, the explanatory variables are ROA, ps-pre tax income, the dummy variable for breach of personal data (last five years), and the dummy variable for theft or fraud (last five years) (Hanlon and Slemrod, 2009; Huang et al., 2012; Carboni et al., 2017). These variables are embedded in the quantile regression model, and can be written as:

$$CAR(\tau_1, \tau_2)_i = x_i'\gamma_\theta + \upsilon_{\theta i} \tag{2}$$

Accordingly, the explanatory variables are embedded in the quantile regression model, and can be written as:

$$\text{Quant}_\theta\left(CAR(\tau_1, \tau_2)_i \,|x_i\right) = x_i'\gamma_\theta \tag{3}$$

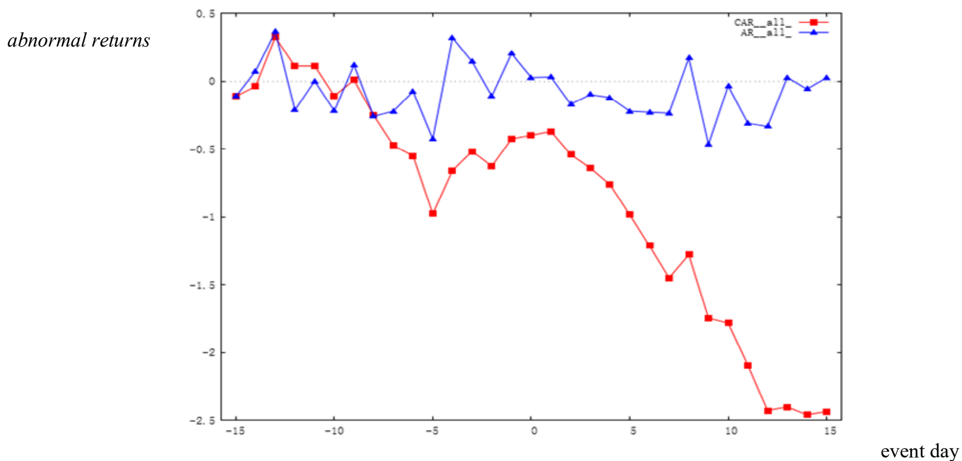
$$\text{Quant}_\theta\left(\upsilon_{\theta i} \,|x_i\right) = 0 \tag{4}$$

where Quant $_\theta(CAR(\tau_1, \tau_2)_i\ |x_i)$ represents the θ^{th} quantile of $CAR(\tau_1, \tau_2)_i$ on the regressor vector x_i, $0 < \theta < 1$, and υ_θ is the error term. γ_θ is the vector of parameters and can be estimated, as well as reduce the robust estimation of the parameters (Mata and Machado, 1996; Fattouh et al., 2005).

4 Empirical analysis

Figure 1 illustrates the AR trend diagram of listed and OTC-listed companies in Taiwan. At nine days after the event date, the minimum average AR was –0.4661. Between two days and seven days after the event date, there was insignificant fluctuation. At 13 days before the event date, the maximum average AR was 0.3631. At 14 days after the event date, the minimum CAR was –2.4613. Between eight days and 14 days after the event date, there was a significant decrease in AR. At 13 days before the event date, the maximum average AR was 0.3237.

Figure 1 ARs and CARs of mobile payment adoption (all samples) (see online version for colours)



This study compares the results of the average AR and CAR after mobile payment adoption among the estimations of the market model, Scholes-Williams OLS risk adjustment model, and the GARCH risk adjustment model, respectively, as shown in Table 1. The similar estimate results indicated that there was a significantly positive AR in listed and OTC-listed companies at 13 days and four days before the declaration date, and a significantly negative average AR at five days before and 9, 11, and 12 days after the declaration date. Therefore, investors' attitudes towards the introduction of mobile payment services by listed and OTC-listed companies in Taiwan were inconsistent.

The AR trend diagrams of listed and OTC-listed financial companies are shown in Figure 2. At 11 days after the event date, the minimum average AR was –0.4566. Between six days and 15 days after the event date, there was more significant fluctuation. Between one day and seven days after the event date, the AR was negative, and changed to positive until day eight. At eight days after the event date, the maximum average AR was 0.1606. At 13 days before the event date, the maximum CAR was –0.0258. The CAR was negative and did not significantly fluctuate between ten days before the event day and event date. At 13 days after the event date, the minimum CAR was –2.6187.

Table 1 ARs of mobile payment introduction

Window	*Market model*	*Scholes-Williams*	*GARCH*
–15	–0.1125	–0.1282	–0.1041
–14	0.0732	0.0388	0.1031
–13	*0.3631***	*0.3350**	*0.3919***
–12	–0.2134	–0.2419	–0.2700
–11	0.0000	0.0163	0.0484
–10	–0.2201	–0.2112	–0.2251
–9	0.1171	0.0850	0.1311
–8	–0.2606	–0.2095	–0.2693
–7	–0.2218	–0.2114	–0.2322
–6	–0.0772	–0.1039	–0.0894
–5	*–0.4265**	*–0.4185***	*–0.3599**
–4	*0.3195**	*0.3596***	*0.3060**
–3	0.1416	0.1660	0.1771
–2	–0.1104	–0.1057	–0.1011
–1	0.2024	0.1837	0.1790
0	0.0255	0.0285	0.0395
1	0.0295	0.0105	0.0314
2	–0.1702	–0.1523	–0.1741
3	–0.1007	–0.1381	–0.1255
4	–0.1221	–0.0915	–0.1220
5	–0.2215	–0.2310	–0.2423
6	–0.2292	–0.1988	–0.2256
7	–0.2365	–0.2495	–0.2342
8	0.1695	0.1954	0.2210
9	*–0.4661****	*–0.4605***	*–0.3653***
10	–0.0365	–0.0472	–0.0126
11	*–0.3104**	–0.2912	–0.2789
12	*–0.3348**	*–0.3404**	*–0.3292**
13	0.0267	0.0380	0.0567
14	–0.0588	0.0245	–0.0182
15	0.0246	0.0628	0.0640

Notes: 1. ***denotes statistical significance at 1% level; **denotes statistical significance at 5%; *denotes statistical significance at 10%.

2. Scholes-Williams denotes Scholes-Williams OLS risk adjustment mode (Scholes and Williams, 1977)

$$\hat{\beta}_i^* = \frac{\hat{\beta}_i^- + \hat{\beta}_i + \hat{\beta}_i^+}{1 + +2\hat{\rho}_m}$$

3. GARCH denotes GARCH risk adjustment model (Bollerslev, 1986).

$$h_t = \omega + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j h_{t-j}$$

Figure 2 ARs and CARs of mobile payment adoption (financial sample) (see online version for colours)

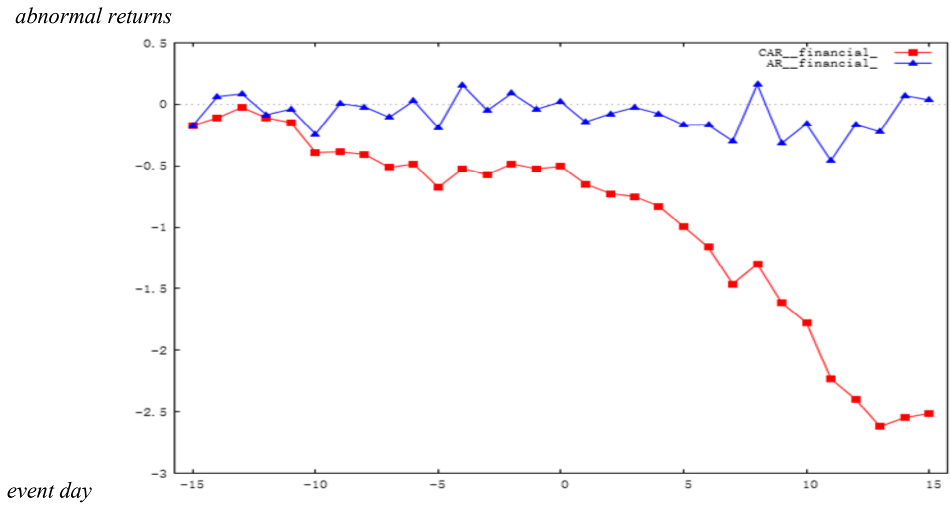
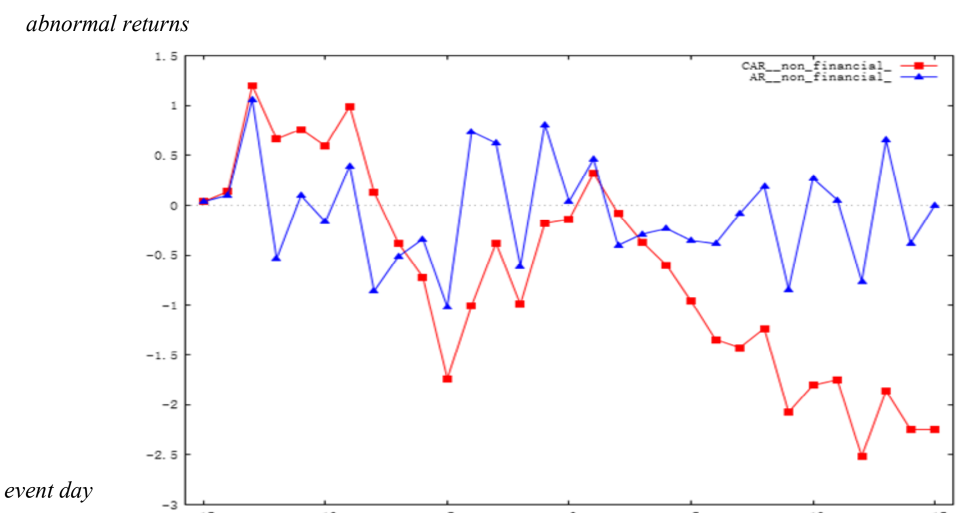


Figure 3 shows the AR trend diagram of listed and OTC-listed companies in the non-financial industry. At five days before the event date, the minimum average AR was –1.0158. At 13 days before the event date, the maximum average AR was 1.06. Between five days before and two days after the event date, there was a more significant fluctuation. Between two days and six days after the event date, there was no significant fluctuation. Between 15 days and eight days before the event date, the CAR was positive. At 13 days before the event date, the maximum CAR was 1.1974. At 12 days after the event date, the minimum CAR was –2.5133.

Figure 3 ARs and CARs of mobile payment adoption (non-financial sample) (see online version for colours)



The results of the average AR and CAR after the introduction of mobile payment services by listed and OTC-listed companies in Taiwan in the financial industry and non-financial industry are shown in Figure 4.

Figure 4 Comparative analysis for mobile payment adoption (see online version for colours)

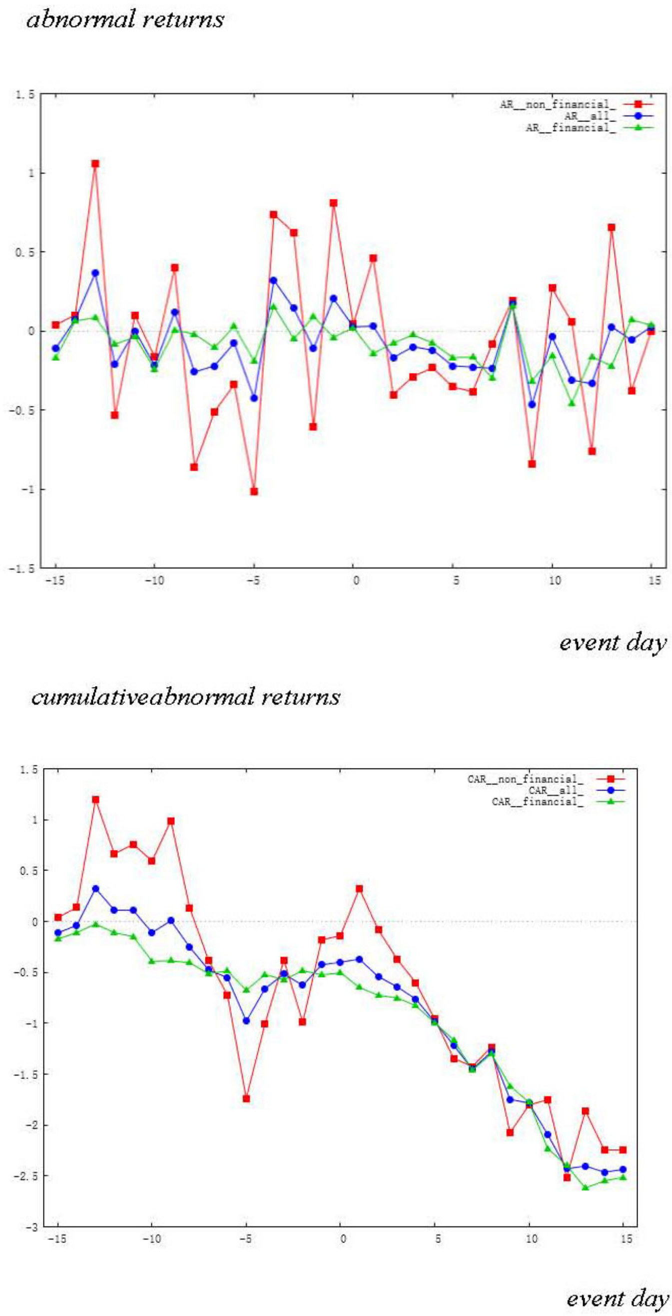


Table 2 Comparative analysis for introduction of mobile payment services

Event window	*Financial industry*		*Non-financial industry*	
	AR	*CAR*	*AR*	*CAR*
–15	–0.1725	–0.1725	0.0374	0.0374
–14	0.0624	–0.1101	0.1001	0.1374
–13	0.0843	–0.0258	1.0600*	1.1974
–12	–0.0844	–0.1102	–0.5359	0.6615
–11	–0.0391	–0.1493	0.0975	0.7590
–10	–0.2419*	–0.3911	–0.1657	0.5933
–9	0.0054	–0.3858	0.3966	0.9899
–8	–0.0211	–0.4068	–0.8593	0.1305
–7	–0.1054	–0.5122	–0.5130	–0.3825
–6	0.0274	–0.4848	–0.3388	–0.7212
–5	–0.1907	–0.6755	–1.0158**	–1.7370
–4	0.1533	–0.5222	0.7349	–1.0021
–3	–0.0504	–0.5726	0.6215	–0.3806
–2	0.0894	–0.4832	–0.6098	–0.9904
–1	–0.0403	–0.5236	0.8092	–0.1813
0	0.0194	–0.5042	0.0409	–0.1403
1	–0.1437	–0.6479	0.4626	0.3223
2	–0.0772	–0.7252	–0.4027	–0.0804
3	–0.0255	–0.7507	–0.2887	–0.3691
4	–0.0773	–0.8279	–0.2343	–0.6034
5	–0.1683	–0.9962*	–0.3544	–0.9578
6	–0.1668	–1.1630*	–0.3852	–1.3431
7	–0.2980**	–1.4610**	–0.0826	–1.4256
8	0.1606	–1.3005**	0.1918	–1.2338
9	–0.3161**	–1.6165**	–0.8411	–2.0749
10	–0.1592	–1.7757***	0.2704	–1.8045
11	–0.4566***	–2.2323***	0.0549	–1.7497
12	–0.1633	–2.3956***	–0.7637	–2.5133
13	–0.2232*	–2.6187***	0.6514	–1.862
14	0.0703	–2.5484***	–0.3814	–2.2434
15	0.0348	–2.5137***	–0.0009	–2.2443

Note: ***denotes statistical significance at 1% level; **denotes statistical significance at 5%; * denotes statistical significance at 10%.

The empirical results (Table 2) indicate that there was a significantly negative average AR in the financial industry at ten days before and 7, 9, 11, and 13 days after the declaration date. It was apparent that investors' attitudes towards the introduction of mobile payment services into the financial industry were not optimistic. There was a significantly positive average AR in the non-financial operators at 13 days before the declaration date, while there was a significantly negative AR at five days before the declaration date. Therefore, investors' attitudes towards the introduction of mobile payment services into the non-financial industry operators were more opposite.

For the CAR in listed and OTC-listed financial companies, there was a significantly negative AR during five to 15 days after the declaration date. The results of the CAR indicate that there were no significantly positive or negative ARs in the financial industry before the declaration date. However, there was a significantly negative return for 11 consecutive days after the declaration date. Obviously, the introduction of mobile payment services into the financial industry led to a negative return for shareholders. There were no significantly positive or negative average ARs in the listed and OTC-listed non-financial companies, suggesting that the event of the introduction of mobile payment services into the non-financial industry did not lead to a significant AR in stock prices.

Meanwhile, this study adopts quantile regression to analyse the explanatory variables, ROA, ps-pre tax income, dummy variable for the breach of personal data (last five years), and dummy variable for theft or fraud (last five years), that influence CAR (Chen et al., 2007). According to Table 3, in all samples, the CAR only had significant correlation with the ps-pretax income at the 0.25 quantile. However, there were statistically significant relationships among these variables at the 0.5 and 0.75 quantiles. Moreover, the estimated values of the ps-pretax income variables at the 0.25, 0.5 and 0.75 quantiles reported statistically significant correlation with the CAR in the non-financial industry samples; however, the estimated values of the ps-pretax income variable had insignificant correlation in the financial industry samples. The empirical results found the estimated values are not the same under different quantiles of CAR, and the significance was also different. This phenomenon may be due to investors holding different expectations for different mobile payment companies.

Table 3 Quantile regression analyses of factors affecting CAR

Panel A. All samples						
Quant	*Intercept*	*Ps-pre tax income*	*ROA*	*Dummy for breach of personal data (last five years)*	*Dummy for theft or fraud (last five years)*	*Dummy for financial industry*
tau = 0.25	–0.8949	0.7561***	–0.0678	0.2235	0.3783	–0.6011
tau = 0.50	0.3275**	0.3034***	–0.1014***	0.5083***	0.5058***	–1.0314***
tau = 0.75	3.4630***	–0.0723	–0.2772***	1.6116***	0.5624	–3.4372***
Panel B. Financial industry						
tau = 0.25	–1.6187***	0.5715	0.2914	0.3493	0.6817	
tau = 0.50	–0.7197***	0.2688	–0.0844	0.5451***	0.5836***	
tau = 0.75	–0.7982***	–0.2600	3.7745***	1.6134***	0.5559***	
Panel C. Non-financial industry						
tau = 0.25	–1.1332***	0.5705***	0.0448	3.4368***	–4.4658***	
tau = 0.50	–0.1603	0.8332**	–0.0395	–3.7647**	3.1502***	
tau = 0.75	5.4177***	–1.5094***	–0.4799**	–1.7921	8.4922***	

Note: ***denotes statistical significance at 1% level; **denotes statistical significance at 5%.

5 Conclusions

During the financial industry operators' declaration of the introduction of mobile payment services, there was significantly negative average AR before and after the event date. In addition, there was significantly negative average CAR after the event date, reflecting the decrease in the wealth of shareholders. Obviously, investors were not optimistic about the financial industry operators' introduction of mobile payment services. This result might be caused by the fact that the role of mobile payment services in the samples (companies) of the finance holding industry was mainly limited to remittance services at the consumer end, and its application had not been widely expanded, which led to lower efficiency and failure to have a direct and positive effect on market value.

There were both positive and negative average ARs before the event date during the non-financial industry operators' declaration of the introduction of mobile payment services. Moreover, there was no significant CAR before or after the event date. Apparently, the non-financial industry operators provided mobile payment services, in which more diversified service suppliers participated with the mobile payment participants. While the divisions of labour and efficiency were relatively higher, the security of payment transactions was doubted, leading to inconsistent significant ARs before the event date.

The research results could be provided as a reference for the different aspects of relevant operators and market participants during the introduction of similar payment service activities. According to the research conclusions, during the re-introduction of mobile payment-related services, financial industry operators are advised to consider the consumer habits of their existing users and try to change the competitive relationships they have with other operators into cooperative relationships in order to jointly trigger consumers' motivation to use mobile payment services, increase the usage rate of mobile payment services, and create differentiated services between themselves and other operators in the same industry. The research results could be provided as a reference for the different aspects of relevant operators and market participants during the introduction of similar payment service activities.

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Appendix

This study utilised the Scholes-Williams OLS risk adjustment model and the GARCH risk adjustment model to compare the effects of mobile payment adoption between the financial industry and non-financial industry, and the empirical results are shown in Tables 4 and 5 on page 15–16, respectively.

Table 4 Empirical analysis of Scholes-Williams OLS risk adjustment model

Event window	*Financial industry*		*Non-financial industry*	
	AR	*CAR*	*AR*	*CAR*
–15	–0.2193*	–0.2193*	0.0996	0.0996
–14	0.0471	–0.1722	0.0179	0.1175
–13	0.0778	–0.0944	0.9782*	1.0957
–12	–0.1221	–0.2166	–0.5414	0.5543
–11	–0.0722	–0.2887	0.2374	0.7917
–10	–0.2963**	–0.5850*	0.0015	0.7933
–9	0.0048	–0.5802*	0.2853	1.0786
–8	0.0586	–0.5216	–0.8796	0.1990
–7	–0.0713	–0.5929	–0.5619	–0.3629
–6	0.0506	–0.5423	–0.4900	–0.8529
–5	–0.1518	–0.6941	–1.0851**	–1.9380
–4	0.1480	–0.5461	0.8886*	–1.0495
–3	–0.0744	–0.6205	0.7670	–0.2824
–2	0.1081	–0.5124	–0.6402	–0.9226
–1	–0.0461	–0.5585	0.7583	–0.1642
0	0.0014	–0.5571	0.0965	–0.0678
1	–0.1602	–0.7173	0.4371	0.3693
2	–0.0715	–0.7888	–0.3544	0.0149
3	–0.1610	–0.9498*	–0.0808	–0.0660
4	–0.0398	–0.9896*	–0.2206	–0.2866
5	–0.1226	–1.1122*	–0.5020	–0.7885
6	–0.1682	–1.2804**	–0.2754	–1.0640
7	–0.3221**	–1.6024**	–0.0681	–1.1321
8	0.1843	–1.4181**	0.2232	–0.9089
9	–0.3538***	–1.7719***	–0.7274	–1.6362
10	–0.1466	–1.9185***	0.2012	–1.4350
11	–0.4632***	–2.3816***	0.1387	–1.2963
12	–0.1622	–2.5439***	–0.7858	–2.0822
13	–0.1805	–2.7244***	0.5843	–1.4979
14	0.1034	–2.6210***	–0.1726	–1.6704
15	0.0384	–2.5826***	0.1237	–1.5468

Note: ***denotes statistical significance at 1% level; **denotes statistical significance at 5%; * denotes statistical significance at 10%.

Table 5 Empirical analysis of GARCH risk adjustment model

Event window	*Financial industry*		*Non-financial industry*	
	AR	*CAR*	*AR*	*CAR*
–15	–0.1623	–0.1623	0.0397	0.0397
–14	0.0640	–0.0983	0.1997	0.2394
–13	0.0779	–0.0203	1.1685*	1.4079
–12	–0.1385	–0.1588	–0.5955	0.8124
–11	0.0061	–0.1526	0.1528	0.9652
–10	–0.2650**	–0.4177	–0.1262	0.8391
–9	–0.0126	–0.4302	0.4865	1.3256
–8	–0.0368	–0.4670	–0.8444	0.4812
–7	–0.1549	–0.6219*	–0.4235	0.0577
–6	0.0013	–0.6206	–0.3137	–0.2560
–5	–0.1242	–0.7448*	–0.9428*	–1.1989
–4	0.0934	–0.6514	0.8318	–0.3671
–3	–0.0296	–0.6810	0.6883	0.3213
–2	0.1176	–0.5634	–0.6422	–0.3209
–1	–0.1293	–0.6928	0.9419*	0.6210
0	–0.0014	–0.6942	0.1408	0.7618
1	–0.1691	–0.8633*	0.5274	1.2892
2	–0.0912	–0.9545*	–0.3792	0.9100
3	–0.0764	–1.0309*	–0.2471	0.6629
4	–0.1006	–1.1315**	–0.1750	0.488
5	–0.1869	–1.3184**	–0.3793	0.1087
6	–0.1748	–1.4932**	–0.3514	–0.2427
7	–0.3357***	–1.8289***	0.0167	–0.2260
8	0.2099	–1.6190***	0.2484	0.0224
9	–0.1772	–1.7962***	–0.8305	–0.8081
10	–0.1552	–1.9514***	0.3400	–0.4681
11	–0.4070***	–2.3584***	0.0381	–0.4300
12	–0.1786	–2.5370***	–0.7016	–1.1316
13	–0.2455*	–2.7825***	0.8042	–0.3275
14	0.1351	–2.6475***	–0.3973	–0.7247
15	0.0871	–2.5604***	0.0068	–0.7179

Note: ***denotes statistical significance at 1% level; **denotes statistical significance at 5%; * denotes statistical significance at 10%.