Financial Impacts of Mobile Banking on Banks in Colorado

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ABSTRACT

Due to the proliferation of smartphones and an increased desire for spatial and temporal efficiency, mobile banking has become a popular form of banking in recent years. It has provided benefits for both a financial institution and its customers. However, mobile banking's impact on banks' financial performances remains unclear. This paper analyzes impacts of mobile banking adoption on the financial performance of select banks with large-scale presences in the state of Colorado. Analysis shows that neither ROA nor ROE are impacted by implementation of mobile banking services, while availability of mobile banking opportunities plays a positive effect on the stock performance of Colorado banks.

Keywords: Mobile banking, Colorado banks, Financial performance.

1. INTRODUCTION

The financial sector is the largest economic driver in both the state of Colorado and the United States as a whole, with 18.6% of the state's 2019 GDP being directly linked to financial services (Leeds School of Business, 2020) and 19.3% of the country's GDP holding a connection to the industry during this same calendar year (United States Bureau of Economic Analysis, 2020). These figures are especially reflected when considering the impact of local institutions such as FirstBank, Bank of Colorado, and Alpine Bank, as well as the statewide presence of national banks like Chase Bank, Bank of America, and Wells Fargo.

Due to the proliferation of smartphones and an increased desire for spatial and temporal efficiency, mobile banking has become a popular form of banking in recent years. It has provided benefits for both a financial institution and its customers. For a bank, the introduction of mobile banking has resulted in more opportunities to understand the needs and desires of its customer base. The customer base has benefitted by being able to have more flexibility with regards to when and where they are able to perform financial transactions such as transferring funds and investing in stocks. However, mobile banking's impact on banks' financial performances remains unclear. This paper analyzes impacts of mobile banking adoption on the financial performance of select banks with large-scale presences in the state of Colorado.

Analysis of mobile banking practices can be broken into two parts: quantitative attributes (i.e. financial impact) and qualitative attributes (i.e. trust propensity and adoption trends). Several statistical and data analysis methods are utilized in order to measure trust propensity; these include Harman's single factor test, confirmatory factor analysis, and elaboration likelihood model (Zhou, 2011). Adoption and re-adoption trends are often measured by incorporating customer data into algebraic equations to compute percentage rates of adoption and re-adoption (Saeed and Xu, 2020). This paper falls into a category of the quantitative attributes analysis. It evaluates financial impacts on Colorado banks through examination of the return-on-assets (ROA) and return-on-equity (ROE) ratios, and stock price movements before and after implementation of the mobile banking services.

The literature review is summarized in the next section. Section 3 describes data. Section 4 develops research models and hypotheses. Section 5 presents the analysis results. Section 6 serves as the study's conclusion.

2. LITERATURE REVIEW

Literature on mobile banking can be divided into four groups: popularization, adoption practices, flaws, and effectiveness.

2.1. Popularization

With the proliferation of cellular phones and other mobile devices, mobile banking is becoming a popular means of managing financial assets and liabilities. Bashir and Madhavaiah (2015) and Chandio *et al.* (2017) both note that many banks and financial institutions have recently made mobile banking users a priority through continued investment in such services. Additionally, Tam and Oliveira (2017) found that the investment of labor and financial capital has rewarded banks and financial institutions who provide mobile banking as an option. Mobile banking's overall performance has resulted in more customers being convinced to at least occasionally use the service. It is also becoming popular due to the use of technology for

popularizing personal banking in general. This inference is supported by Rogers (1995), who says that in order to diffuse at somewhat-noticeable speed, a form of technology must stand out and be of a 'revolutionary' nature. By definition, mobile banking can be reasonably considered to be an example of service innovation, as its nascent age and intangible nature allow banks and financial institutions to serve and benefit customers (Saeed and Xu, 2020).

Ensor and Wannemacher (2015) also infer that as mobile banking becomes more popular, many banks and financial institutions -- especially those who emphasize innovative thinking -- have a prerogative to maintain existing mobile banking services as generators of revenue. By incentivizing a service such as mobile banking through the deployment of effective marketing methods such as sales promotions, Gupta (1988) contends that a bank or financial institution is in a much stronger position to increase sales volume in the short-term. A bank or financial institution can also utilize mobile banking as an avenue to measure consumer impulsivity towards the firm's advertising practices, with Puri (1996) defining 'consumer impulsivity' as the decision to make an unplanned purchase in response to a stimulus.

Zhou (2011), Hayashi and Toh (2020) separately corroborate the fact that mobile banking has served as a 'revolutionary' form of banking primarily due to the spatial and temporal autonomy granted to each individual user. Laukkanen and Kiviniemi (2010) bring to light the fact that in turn this increased autonomy typically leads to the user experiencing a greater sense of control. Mobile banking has become especially meaningful with regards to two outcomes: the reduction of in-person financial transactions (i.e. driving to a bank's local office or A.T.M.) (Hayashi and Toh, 2020) and the ability to perform financial transactions on days (i.e. Sundays and federal holidays) or times (i.e. late evenings or early mornings) when banks and other financial institutions typically have physical locations closed (Liebana-Cabanillas, Munoz-Leiva, and Sanchez-Fernandez, 2015).

2.2. Adoption Practices

Two adoption practices -- disadoption and readoption -- are used as metrics for measuring the popularity of mobile banking and other similar technologies. While researchers have traditionally viewed dis-adoption as a binary variable (i.e. a one-time "yes" or "no" answer), Lehmann (2012) deviates from popular opinion by claiming that dis-adoption can be measured as a process; in other words, a user may exhibit dis-adoption practices multiple times due to the cyclical nature of technology usage. Nikolaeva (2016) believes there are three factors influencing dis-adoption: the environment (i.e. a lack of support for technologies considered obsolete), the supply-side factor (loosely described as technology companies and manufacturers influencing demand by taking advantage of the technology industry's innovative nature), and the characteristics and behaviors of consumers changing upon the use of or exposure to new technologies. Saeed and Xu (2020) simply define dis-adoption as suspending the use of a service. With regards to re-adoption, Saeed and Xu (2020) warn that the practice is different from re-purchasing; while re-purchasing involves the user re-integrating themselves into a service after purchasing the service in question for the second or third time, re-adopting does not necessarily require the re-purchasing of a specified service. In other words, all re-purchasers are re-adopters, but not all re-adopters are re-purchasers. Several factors influence re-adoption: the addition of new features and content added to a service, a decrease in service cost, and the service being deemed by consumers to be the 'best' of all available options. Additionally, Anand *et al.* (2016) note that when an original service becomes compatible with 'newer' products (in other words,

products that postdate a service's original product), re-adoption becomes a much more realistic possibility for a user.

2.3. Flaws

It is important to remember that while mobile banking has served as a revolutionary service that benefits both parties involved, it is not without flaws. For instance, as pointed out by Chung and Kwon (2009), it can be difficult for a user to build trust with their bank due to the virtual nature of mobile banking resulting in little to no face-to-face contact. The research conducted by Zhou (2011) states that mobile banking's virtual nature also means that such a service will naturally be vulnerable to hackers and mobile malware. Because of these threats, mobile banking is generally thought of as having lower levels of structural assurance than its online and in-person counterparts; structural assurance is defined as the legal and technological structures to ensure payment security. Mobile banking applications are often built to cater to either a high-context or low-context culture; as a result, Choi *et al.* (2005) insinuates that a member of a high-context culture could potentially feel alienated when utilizing an application whose user interface is designed for members of low-context cultures (and vice versa). Hall (1969) and Nonis *et al.* (2005) believe these cultural differences can also be seen through the perception of time; as a result, it can reasonably be inferred that cultures who place less emphasis on temporality may be less motivated to use mobile banking.

2.4. Effectiveness

Mobile banking's effectiveness is disputed when seen in the context of usability and impact on a bank's financial performance, as the testing of different researchers' hypotheses have produced conflicting results. Ghobakhloo and Fathi (2019) were able to adequately support the theory that a user's satisfaction with a mobile banking service was positively correlated with a tendency to repeatedly use the application. Zhou (2011) used Harman's single factor test and confirmatory factor analysis (CFA) to support the belief that information quality and system quality each positively affect the average perceived usefulness of the service. Mutua (2013) utilized multivariate regression and analysis of variance (ANOVA) to support the argument that mobile banking had an insignificant (but positive) impact on the return-on-equity (ROE) of 43 Kenyan commercial banks. In Rwanda, Harelimana (2017) found that a local microfinance bank saw positive correlations between four financial performance indicators and five aspects of mobile banking. Cleveland (2016) takes a slightly different approach by arguing that the widespread adoption of mobile banking by the American financial services industry could collectively save over $1B in costs and expenses while having little effect on existing income.

On the other hand, some researchers have found that mobile banking has negative or no correlation with the financial performance of banks. Al-Smadi and Al-Wabel (2020) argue that the innovation supposedly perpetuated by mobile banking has been counterproductive to the financial situation of banks, with the author noting that banks could have a stronger return on investment if they focused on incentivizing the use of mobile banking while simultaneously working to improve users' confidence in the service. In Lebanon, El Chaarani and El Abiad (2018) substantiated through goodness-of-fit tests that while other technological innovations in banking – namely internet banking and automated teller machines (ATMs) – positively correlated with increases in the return-on-assets (ROA) and ROE ratios across the Middle Eastern country's financial services industry, mobile banking had no significant influence on

these indicators. The researchers' findings were echoed by Imamah and Safira (2021); although Imamah and Safira hypothesized that mobile banking would have slightly positive influences on the ROA and ROE ratios of major Indonesian banks, their research deduced that mobile banking did not impact financial performance of banks.

3. DATA

This study focuses on banks and other financial institutions that are either headquartered in the state of Colorado or otherwise are national banks with operations in the state. For the purpose of ensuring a similar number of banks comprise each category, targeted Colorado-based banks must carry at least $400MM in estimated total assets, whereas nationally based banks must carry at least $100B in total assets (in addition to having physical operations within the state). Furthermore, all targeted firms must also provide personal banking services. Note that these numbers are arbitrary and were chosen to adequately capture the majority of personal banking activities within Colorado.

The total assets values of targeted banks were downloaded from the iBanknet website which aggregates regulatory reports and financial news to create lists of financial institutions by type and location (iBanknet, n.d.). After compiling lists of banks that met the conditions outlined within the paragraph above, the websites of each bank were visited to further evaluate their ties to the state of Colorado. If the bank in question is headquartered in Colorado, the only criteria to evaluate was if the bank offered personal banking services; if the bank was headquartered elsewhere within the United States, the 'branch locations' webpage of the bank's website was viewed to determine if the bank held any presence within Colorado. Note that a bank must have a physical branch location; in other words, any bank that only offered ATMs or non-personal banking services within the state were excluded from the study.

All considered Colorado Banks offered mobile banking services of some type, negating the need to compare the financial performance of banks without mobile banking services to those with such services. However, banks demonstrated the use of the different innovation-minded approaches to implementation of banking services. Primarily, the different launch years led to different mobile banking services. To avoid showing a preference towards Apple's or Android's operating systems, the year of launch is defined as the year in which a bank launched mobile banking for the first time (regardless of operating system).

After factoring in the criteria listed above, 14 financial institutions were identified and recorded for the purpose of the study. These 14 institutions include 3 Colorado-based banks and 11 national banks with operations within the state (with JPMorgan Chase, Bank of America, and Citi being the richest institutions in terms of total asset value). Due to data constraints, the analysis considers publicly-traded institutions, as they have publicly-viewable financial reports and other data relevant to the study. A list of analyzed banks is provided in Table 1 (Appendix).

National banks averaged $1.037T in total assets, while Colorado-based banks averaged $4.110B in total assets. Some data limitations were present during research. Most notably, while every national bank had stock price data available, Solera National Bank was the only surveyed Colorado-headquartered firm with available daily prices.

Financial statements and stock price history for all publicly-traded banks were downloaded from the Eikon Refinitiv database. As the vast majority of publicly-traded banks were national banks, financial data from Colorado-based banks was collected via a combination of publicly-viewable data extracted from the banks' websites, personal requests to the banks'

public relations departments (often performed via email), and statistics derived from third-party websites with established ties to the banking and financial services industries.

Data for both national and Colorado-based banks was limited to the three years before and after the bank's adoption of mobile banking (for a total of six years per firm). Special care was undertaken to ensure that the range of years was correct for each company; this was primarily undertaken by ensuring from at least two separate sources that each bank commenced mobile banking operations on the specified date.

National banks tended to start offering of mobile banking services several years earlier than its Colorado-based counterparts. Three national banks – Bank of America, Wells Fargo, and Citibank – all propagated the idea of mobile banking when they each unveiled their own mobile banking services in 2007, with the eight other national banks involved within the study launched mobile banking initiatives as late as 2011. Colorado-based banks only released such initiatives as early as 2013, when Solera National Bank launched their service on September 12th of that year. The other two banks – First Western and Alpine Bank – unveiled mobile services for its clients the following year. The year of launching mobile banking by a bank was found through at least one of the following: press release(s) from the firm describing the launch of the service, social media post(s) from the firm describing the launch of the service, oral conversation(s) with a firm officer, article(s) from a third-party source mentioning the firm's mobile banking launch date, and/or analysis of app version histories on Apple's App Store or the Google Play Store. The last method was only utilized if it was possible to see 'Version 1.0.0' or an equivalent term on the app's webpage, as this term has historically been used to describe the launch of a service; as Apple's App Store and the Google Play Store each only show the most recent app updates within the app page's version history, it was impossible to use this method for the majority of banks.

4. HYPOTHESES AND MODELS

In order to evaluate impacts of mobile banking services on financial performance of Colorado banks, the paper investigates changes in ROA, ROE, and stock prices prior and following implementation of the services. Three hypotheses were considered:

H1: Banks see a greater percentage increase in ROA after mobile banking service implementation.

H2: Banks see a greater percentage increase in ROE after mobile banking service implementation.

H3: Banks see a lesser percentage increase in stock price after mobile banking service implementation.

Thus, ROA, ROE, and stock prices are dependent variables. In modeling these variables, the paper utilized the following explanatory variables: mobile banking availability, quarterly GDP per capita, bank capitalization, cost efficiency, net profit margin, operating income/sales ratio. The mobile banking availability variable is a binary variable defined as: (i) 0 if a year is prior to mobile banking services launch; (ii) 1 if a year is equal to or following year of launch. Due to the varying sizes of banks within the study, two control variables were normalized: bank capitalization is calculated as total equity/total assets and cost efficiency is found as operating expenses/operating income.

5. RESULTS OF ANALYSIS

The empirical analysis is based on backwards stepwise regressions of three dependent variables (ROA, ROE, and stock prices) across all banks against the explanatory variables. The regressions were performed across all three dependent variables with quarterly frequencies. Cronbach's alpha value (in other words, the alpha level used to define statistical significance) used to test the study's hypotheses is $\alpha = 0.05$. A regression with the *ln(stock price)* as the dependent variable had the highest adjusted R^2 score of 0.2435. The natural logarithm of Stock Price was used as a dependent variable instead of Stock Price to ensure stationarity of the series. Table 2 (Appendix) presents the Stock Price regression results. The ROE and ROA regressions had low adjusted R^2 scores. It should also be noted that *ln*(Stock Price) was the only model to incorporate the mobile banking binary variable (its coefficient value is positive 0.2210 with the p-value of 0). This is important due to the paper's primary focus being to identify any potential trends regarding the effect of mobile banking services and initiatives on a bank's financial bottom line. The statistical significance of this variable within the *ln*(Stock Price) regression model means that the availability of mobile banking plays a significant positive impact on the stock prices of surveyed banks. This finding demonstrates that mobile banking comprises a tangible role within the financial power of banks.

6. CONCLUSION

As seen through the multivariate regression analysis performed on the three dependent variables, only one model – the *ln*(Stock Price) model – indicated that the presence of mobile banking services played a tangible role on a specified bank's financial performance. When combined with the model's intercept and GDP/Capita variables, approximately 24.86% of variation in the model's data (24.35% when adjusted for the number of observations) can be explained by these three variables. The low R^2 values in the ROA and ROE regressions – combined with a lack of mobile banking binary variable – give the impression that neither ROA nor ROE are impacted by the availability of mobile banking services.

Some challenges and limitations should be considered when reflecting on the analysis results. Stock prices and other financial data was limited for First Western Bank and Alpine Bank; as a result, while there should be 350 observations (data points) per model, the *ln*(Stock Price) model only had 296 observations, while the ROE and ROA models each had 321 total records. A larger sample size of data could have been considered, but the paper assumes that three years before and after the introduction of a firm's mobile banking service are sufficient for the scale and scope of this project. Three years on either side are the most optimal range of time with regards to capturing the 'average financial state' of a bank; in other words, a total of six years was viewed as enough time to analyze a bank's overall financial performance.

Overall, the availability of mobile banking services plays a tangible positive role on the stock performance of Colorado banks.

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APPENDIX

Table 1. Analyzed Banks

Bank Name	Category	Total Assets (in thousands USD)
JPMorgan Chase Bank	National	3,290,398,000
Bank of America	National	2,400,819,000
Wells Fargo Bank	National	1,786,611,000
Citibank	National	1,703,923,000
US Bank	National	556,810,647
PNC Bank	National	462,385,600
Charles Schwab	National	379,309,000
Capital One	National	372,048,692
KeyBank	National	184,659,457
Huntington National Bank	National	173,438,393
Bank of the West	National	105,411,908
Alpine Bank	Colorado-Based	6,107,092
First Western Bank	Colorado-Based	5,669,695
Solera National Bank	Colorado-Based	551,853

Table 2. Stock Price Regression Results

Dependent Variable	Explanatory Variables	Coefficients	P-Value	Number of observations	Adjusted R^2
Ln(Stock price)	Intercept	6.3739	0.00	296	0.2435
	GDP/Capita	-0.001	0.00		
	Mobile Banking dummy variable	0.2210	0.00		