

## Research Article

# An Integrated DEMATEL-ANP Approach for Mobile Banking Adoptions in China Market

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With the rapid development of the mobile device and Internet usage, the mobile banking has seen remarkable growth across the world, especially in the past few years, as one of the emerging financial innovations. This paper attempts to explore the mobile banking services offered by selected commercial Chinese banks. The main data of this study were obtained through the comprehensive evaluation of mobile banking services. The DEMATEL-ANP method was used to evaluate the main factors influencing the adoption of mobile banking. The results show that there is still big space for the improvement of the mobile banking services for the selected Chinese banks. The management significance and suggestions for these banks are also discussed.

## 1. Introduction

Nowadays, with the development of wireless technology, mobile banking (MB) has become one of the most popular ways of dealing with financial service [1]. According to Laukkanen and Cruz [2], MB can make a client independently access banking services without temporal and spatial restrictions. Thanks to this promotion in MB, telecommunication technology and wireless breakthrough in the mobile have made significant progress in this system. Another major factor behind MB development is identified as the technology to provide people with high quality services over more innovative and cost-effective channels to meet client needs [3].

China is one of the fastest mobile and telecommunication technology growing countries in Asian; and there are three mobile service providers working in the China market. By the end of 2016, more than 900 million clients used MB in the Chinese banking market [4]. China's banks are mainly divided into three major policy banks, five state-owned banks, and other commercial banks. Luarn and Lin [5] investigated whether it is a state-owned bank or a

commercial bank in China which is progressively introducing MB systems to reduce costs and enhance productivity. Meanwhile, both traditional banks' branches and customers benefit from MB. The banks can save operating costs, while for customers, the convenient operating rules and more flexible use of time can save their effort and time through using MB [6]. In addition, the use of MB also provides impetus to economy for the whole country development. For example, the convenience and security of transaction contributes to the improvement of the whole economy [7]. Consequently, MB is an innovative application to handle bank transactions by which customers interact with a bank via a mobile device. In the same vein, MB is an indispensable part in personal financial business and commercial arena.

However, it must be noted that consumer adoption and usage of new technology is significantly influenced and driven by the speed and ease of connecting with service providers [8]. Most customers have less interest in this service of MB and the adoption rates also do not reach the desired level in developing countries [9]. For instance, Alalwan et al. adopted nearly 4000 clients' information of

mobile services around the world, but only 19% of the customers are using MB services. Because MB is still in its infancy stage of development, leaving plenty of room to improve, to increase the adoption rate, banks need to understand customers' needs and find the factors influencing their thoughts to adopt MB services. Meanwhile, Friedman et al. [10] conducted MB research and revealed that the factors of perceived trust or credibility of users, in relation to web systems, play an important role to use MB, in online shopping, and to communicate sensitive personal information. Because of the unexpected disclosure of information, customers refuse to provide sensitive personal information to banks. The lack of trust makes customers more worried that their information will be revealed to the third party without their consent. The prior research has tried to explain the adoption factors, such as technology advances, better understanding of technology, and more tech-savvy consumers [11]. In the meantime, many researchers have given greater emphasis to perceived risk as a precondition of behavioral intention [12, 13]; the extent research is mostly conducted in accordance with eight aspects, such as performance, financial, time, psychological, social, privacy, physical, and overall risk [14], but most articles have inadequately considered the factors; the comprehensiveness and depth of these researches are not enough at the same time. In this paper, we consider nine factors to study the degree of adoption in MB, such as, design, usefulness, popularity, content, security, common services, convenience services, finance, and livelihood. In addition, this related information can help MB service providers to design corresponding systems that are more responsive to customers.

In short, this paper focused on identifying the main factors influencing the adoption of MB. The remainder of this paper is organized as follows. Section 2 introduces the related literature about MB and factors influencing adoptions. Following is a brief introduction about the ANP-DEMATEL (analytic network process-decision-making trial and evaluation laboratory) method used in this research. Section 4 describes an empirical analysis of evaluating the MB in China. The basic data derives from a comprehensive of MB evaluation. In the end, the purpose of this article is to examine and empirically identify the factors that affect the user's adoption and intention of MB in the Chinese banking context.

## 2. Literature Review

As one of the most convenient and serviceable technologies, MB has the potential to offer both banking and transaction services to clients in the development of market [15]. Due to cost-effectiveness and greater reachability, banks prefer the MB channel and encourage customers to adopt m-banking services. In the context of MB, consumers should have access to the required resources. Most consumers visit a bank branch because they do not have access to MB or they are not aware of it [16]. Hence, several efforts were made to explore factors affecting m-banking adoption and usage behavior in the previous literature [17–19]. Changchit et al.

[19] collected 309 subjects and used multiple regression analysis to analyze data in this study. Various studies related to MB adoption have been conducted. For instance, a plethora of prior studies, such as Luo et al. [20] and Lee et al. [21] as well as Laukkanen and Cruz [2] have investigated the key factor of risk perception in the original adoption stage of wireless Internet platform, and the results can be used to better understand and improve the acceptance of this specific case for mobile communication. Moreover, numerous studies indicate that intention, performance expectancy, ease of use, compatibility, and self-efficacy can also be used in the research of MB [22–24]. In the extended domain of MB, previous researches have identified the attitude of clients. For instance, Sahoo and Pillai [23] find that attitudes towards banking mediate and MB service scape may affect the customer participation. In addition, Kuisma et al. [24] as well as Bhatiasevi [25] compared the customer-perceived value in the Internet and mobile bill paying service. In the meantime, satisfaction of the users and experience level have been studied. For example, Lin et al. [26] conceptualized their model and found that there are some similarities and differences between high and low experience groups in terms of the MB quality.

Both internal and external perceived behavioral control factors were first differentiated by Ajzen and Madden [27]. It was then increasingly adopted by analyzing the factors that influence adoption of MB in the world. Various studies have been carried on the control factors of behavior. For instance, Alalwan et al. [9], using the Unified Theory of Acceptance and Use of Technology methods, found that the performance of the behavioral intention and motive of hedonic price are greatly affected by the value and risk perception. Based on survey data and descriptive data analysis, Alalwan et al. [28] examined the factors of bank customer intention and behavior to influence the adoption of MB.

Usefulness is one of the main factors that affect the use of MB [29]. Both Alalwan et al. [9] and Hanafizadeh et al. [15] investigated the importance of usefulness on adoption behavior which can best explain the key factors to the Jordanian customers' intention to use MB. In order to better understand the adoption behavior, Alalwan et al. [9] applied the above research to propose the conceptual model and relevant factors, and the major barriers are unable to capitalize upon the usefulness [30, 31].

Demographic factors, namely, gender and experience, are dominant dimension of the traditional service in MB, such as a study by Riquelme and Rios [30] which examined the gender in the adoption of MB effect and the influence of MB adoption in Singapore. Alalwan et al. [9] also investigated the intention of MB adoption in Jordan. Main statistics (mean and standard deviation) with the intention of adoption show that the fluctuation comes from the difference between the customer demographics and intention of MB adoption.

Several researchers have investigated the MB adoption behavior using both qualitative and quantitative methods [1, 17, 18, 31, 32]. The technology acceptance model (TAM) [16], innovation diffusion theory (IDT) [33], unified theory of acceptance and use of technology (UTAUT I and II) [28],

and theory of planned behavior (TPB) [34] were the models used in previous studies to explore m-banking adoption behavior. Literature suggests that perceived ease of use, perceived usefulness, trust, convenience, risk, perceived behavioral control, compatibility, and facilitating conditions are the major factors affecting MB adoption intention [17].

Trust is considered related to, but different from, other predictors. This refers to the extent to which a person believes in MB. Lin [33] and Zhou [35] as well as Kim et al. [36] verify user's initial reliability in MB. They found that trust has a stronger influence on the adoption behavior compared to other factors. In addition, Luarn and Lin [5] proposed the extension work of MB based on the trust construct and two resource-based constructs, and on this basis, Zhou et al. [37] suggest that structural assurance and information quality are key factors affecting initial confidence. The summary of relevant influencing factors is shown in Table 1.

The overall evaluation of MB both in theory and in practice has proven to be very important and complex. However, the research on MB is not enough and there have been limited researches in the current literature. This paper extends the study of these factors discussed above and strives to contribute to subsequent research.

### 3. Research Methodology

The research on causal analysis has become more and more popular in recent years. AHP method, BP neural network, fuzzy evaluation theory of application, and the establishment of mathematical model can make causal analysis results more objective and fair. Along with fuzzy AHP and Internet banking, "customer service" is an important factor affecting MB efficiency[26]. As with other types of technology acceptance models (TAM), Luarn and Lin [5] added the trust construct (perceived credibility) and two resource-based constructs (perceived self-efficacy and perceived financial cost) of determining factors of the MB user authorization model, and on this basis, Kim et al. [36] integrated TAMs and initial trust to research the adopted information. With the method of unified theory of acceptance and use of technology (UTAUT), Martins et al. [43] described the risk of internet banking based on perception and action. However, Zhou et al. [42] focused on explaining user adoption of technology perceptions. In the meantime, Gu et al. [38] used structural equation modeling (SEM) to test the causal relationship and verify the behavioral intention of MB. However, these methods ignore an influence or feedback relationship between evaluation indicators.

Bayazit and Karpak [44] as well as Karpak and Topcu [45] proposed the selection of evaluation indexes and evaluation methods of appropriateness, and the choice of the characteristics of the evaluation index and evaluation method has a certain relevance. The DEMATEL method, also known as the decision-making trial and evaluation laboratory, is the logical relationship between elements by direct effect on the matrix structure, suitable for the study of complex systems of the interaction relationship

between factors [46, 47]. ANP is an extension of AHP (analytic hierarchy process), which allows for quantifiable or unquantifiable coexistence of multiple indicators, which is suitable for a system with internal dependency and feedback relationship [48]. Using the DEMATEL method to evaluate the influence factors of MB, although it can handle the causal relationship between the indexes, the calculation of the index weight is the same and does not take into account the weight of high and low points [49]. As a result, the DEMATEL method is used to obtain impact factors evaluation matrix, and the overall impact of the ANP method calculated the index weight; it is concluded that the mixed weight of indicators, which reflects the relationship between the factors of size and considering the factor weight, make up for the deficiency of the single-use DEMATEL method. An overview of the integrated DEMATEL and ANP approach is given in Figure 1.

Briefly, the values are gathered with questionnaires. In cases of inner dependency, DEMATEL is employed. This method can effectively identify the causal relationship and the degree of interaction between the criteria or elements. Further calculations are carried out with ANP. ANP is to demonstrate the complexity of the system network structure; network of each element may influence each other constraints; the characteristics of the network structure happen to be a reasonable description of the interaction relationship between real things. The integrated DEMATEL and ANP methodology can be summarized in the following steps [50–53]:

Step 1: define the element and judge the relationship: analyze and define the elements in the system and judge the relationship between the two elements according to the expert discussion and questionnaire.

Step 2: construct direct relation matrix: first, the relationship between elements is expressed in the following three influences [50]: no influence (0), low influence (1), medium influence (2), high influence (3), and very high influence (4). DMs require experts to identify the degree of comparison. If there are  $n$  elements, then we can get an  $n \times n$  matrix based on comparison results, which is called the direct relationship between the matrix. Here,  $a_{ij}$  stands for the degree to which the criteria  $i$  affects the criteria  $j$ .

Step 3: normalize the direct relation matrix: by multiplying the elements of the direct relationship matrix by  $\lambda$ , the normalized direct relation matrix can be obtained, using the following formulas:

$$M = \lambda * A, \quad (1)$$

$$\lambda = \min \left( \frac{1}{\max \sum_{1 \leq i \leq n} j = 1 |\alpha_{ij}|}, \frac{1}{\max \sum_{1 \leq i \leq n} i = 1 |\alpha_{ij}|} \right), \quad i, j \in \{1, 2, 3, \dots, n\}. \quad (2)$$

TABLE 1: Influencing factors of customer satisfaction.

Factor Authors	Influencing factors of customer satisfaction									
	Trust	Cost-effective	Self-efficacy	Risk perception	Behavioral intention	Ease of use	Performance expectation	Compatibility	Value	Usefulness
[3]		√								
[5]		√					√			
[5]	√	√	√						√	
[36]	√	√		√					√	
[38]	√				√	√				√
[26]	√				√	√		√		
[2]				√					√	√
[39]					√		√			
[2]			√						√	
[25]	√					√	√			
[21]				√	√				√	
[40]	√			√	√		√			
[41]			√	√		√				√
[20]	√			√						
[15]	√	√		√		√		√		√
[42]	√									
[36]	√						√			

Step 4: calculate the total-relation matrix: after obtaining the normalized direct relation matrix  $X$ , because of  $\lim_{k \rightarrow \infty} X^k = 0$ , the comprehensive relational matrix  $T$  can be obtained from the following formula, where  $0$  is the zero matrix and  $I$  is the identity matrix. Calculation formula (3) of the integrated influence matrix is as follows:

$$T = N + N^2 + N^3 + \dots = \sum_{i=1}^{\infty} N^i = N(I - N)^{-1}. \quad (3)$$

Step 5: calculate the influence degree and the influence degree of the calculation elements, such as  $ask_{ij}$  ( $i, j = 1, 2, \dots, n$ );  $j$  is affected by  $i$ , as indicated in formulas (4)–(6). The sum of the rows ( $D_i$ ) is denoted as the comprehensive influence value of the corresponding elements which is called the influence degree, and the corresponding elements of each column ( $R_j$ ) are affected by the comprehensive influence of other elements, which is called the influenced degree.

$$K = [K_{ij}]_{n \times n}, \quad i, j \in \{1, 2, 3, \dots, n\}, \quad (4)$$

$$D_i = \sum_{j=1}^n K_{ij}, \quad (i = 1, 2, \dots, n), \quad (5)$$

$$R_j = \sum_{i=1}^n K_{ij}, \quad (j = 1, 2, \dots, n). \quad (6)$$

Step 6: calculate a threshold value ( $D+R, D-R$ ).  $D+R$  are the elements in the evaluation index system of the size, and the higher the degree, the more the important it is.  $D-R$  is the reason factor, and the element is greater than 0, which indicates that this factor has influence on other indexes. If less than 0, this factor means a lot of room to improve.

Step 7: draw a causal diagram. By mapping the dataset of the ( $D+R, D-R$ ) and using the horizontal axis indicating  $D+R$  and the vertical axis indicating  $D-R$ , the impact-diagraph map is obtained. Results analysis can clearly identify the relationship between indicators and its importance. In the meantime, the result can find out the main factors that influence the adoption of MB.

Step 8: construct the network of the considered problem and evaluate the remaining nodes and alternatives using the ANP [54].

Step 9: construct the network structure and two comparison judgment matrices. As the correlation index of the degree is smaller, when calculating the relative weight, the impact is not large; so, by setting the threshold value (threshold) to remove the smaller correlation connections, using the DEMATEL questionnaire safety evaluation index of comprehensive influence relation matrix  $T$ , we can remove less than the threshold value of the element. Then, we can draw the system network architecture according to the remaining relation. According to the expert discussion results and ANP evaluation scale table (as shown in Table 2), the two comparison judgment matrices between each element can be formed. Therefore, the transpose judgment consist of the reciprocal of these values.

Step 10: calculate the eigenvalues and eigenvectors of the comparison matrix. Supposing that the general goal of the control layer is  $A$ , its control criteria are ( $C_1, \dots, C_i, \dots, C_n$ ) and the pairwise comparison matrix  $A = a_{ij}$ . The column vectors in this matrix represent the influence of all the elements in  $C_i$  on each element in  $C_j$ . Saty introduced the row vector average method and normalized the results with formula (7) as follows:

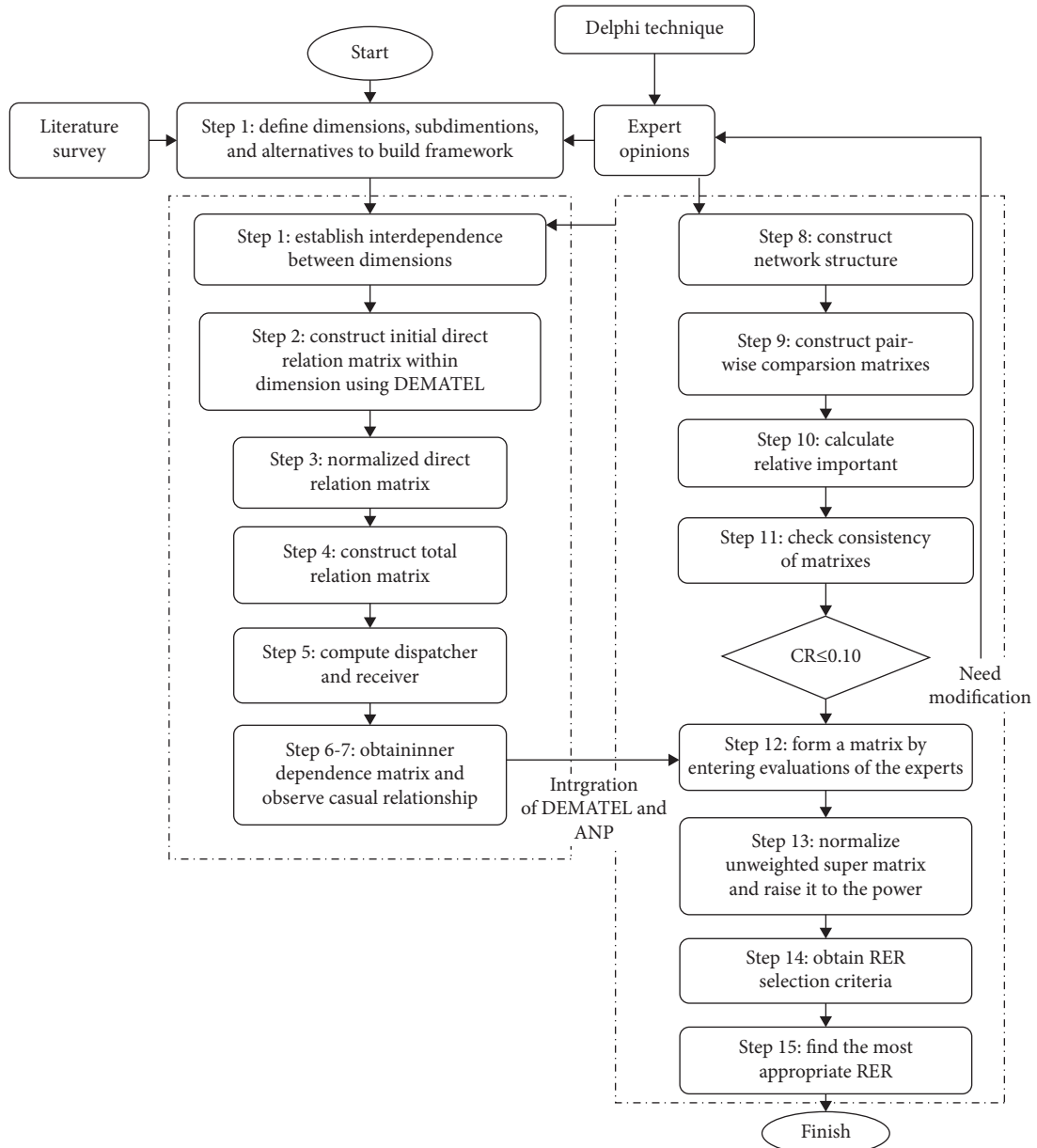


FIGURE 1: Overview of the integrated DEMATEL and ANP approach.

$$W_i = \frac{\sum_{j=1}^n (a_{ij} / \sum_{i=1}^n a_{ij})}{n}, \quad \forall i, j = 1, 2, \dots, n. \quad (7)$$

$$C.I = \frac{\lambda_{\max} - n}{n - 1}, \quad (9)$$

Here, the comparison matrix  $A$  completely responds to  $a_{ik} = a_{ij} \cdot a_{jk}, \forall i, j, k$ . The largest eigenvalue  $\lambda_{\max}$  can be concluded in the following formula:

$$C.R = \frac{C.I}{R.I}. \quad (10)$$

$$AW = \lambda W \lambda_{\max} = \frac{1}{n} \sum_{i=1}^n \frac{(AW)_i}{W_i}. \quad (8)$$

Step 11: check consistency test: based on formulas (9) and (10), the consistency test was performed. CR represents the consistency ratio; CI represents the consistency index, and RI is a random indicator.

If the CR is less than 0.1, the pairwise comparisons are acceptable; otherwise, they are not acceptable. RI's control index is shown in Table 3.

Step 12: after complete consistency check, we can get the unweighted supermatrix by integrating the index of characteristic vector into the supermatrix, and unweighted supermatrix is multiplied by  $\lambda_{\max}$  to determine the weighted supermatrix. Then, calculate the "limit supermatrix" of the matrix, the matrix of each

TABLE 2: ANP evaluation scale table.

Important degree	Definition	Explanation
1	Equal importance	The contribution of the two indicators is of equal importance
3	Moderate importance	Experience judgment shows a slight approval of an indicator
5	Strong importance	Empirical judgment strongly endorses an indicator
7	Very strong importance	The facts show that they strongly agree with an indicator
9	Extreme importance	There is enough evidence to support a certain indicator
2, 4, 6, 8	Intermediate values	Between the above evaluation criteria

TABLE 3: RI's control index.

Matrix order	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.4	1.45	1.49

element is the various elements of the weights in the network, so as to get the relative order of all elements in the system [55].

Step 13: determine the most suitable alternative: the weights are calculated for ranking the alternatives. Using the supermatrix, the alternative that has the highest overall priority value is selected.

#### 4. Data Collection and Results Analysis

Due to the rapid growth of China's macro economy and the stable monetary policy, the financial deleveraging has achieved remarkable results. China's banking sector has picked up and the nonperforming loan ratio has fallen (2017 China banking development trend report). According to the latest CBRC official report, the number of commercial banks has reached thirty thousand, and the number is gradually expanding. The details are as follows: banks in China, including three policy banks, five large commercial banks, one postal savings banks, twelve share-holding commercial banks, one hundred and thirty three urban commercial banks, five private banks, eight hundred and fifty nine rural commercial banks, seventy one rural cooperative banks, one thousand three hundred and seventy three rural credit cooperatives, one home DE housing savings banks, one thousand three hundred and eleven rural banks, and forty eight rural capital supports, a total of three thousand eight hundred and twenty two, as shown in Table 4. Considering the differences between large commercial banks and small rural credit cooperatives in terms of business resources and building MB capabilities, ten commercial banks (five state-owned commercial banks and five national joint-stock commercial banks) were selected for this study.

Four raters are participated to make an appropriate rating and each of them needs to evaluate all selected ten banks in China. Based on a pretest with selected criteria for consistency consideration, the selected items from all types of mobile banking are rated with the commonly used Little Scale, i.e., from a scale of 1 (being the worst possible scenario) to 5 (meaning excellent) accordingly. The average value is taken as the final evaluation result.

Most of the banks in China can achieve customers' satisfaction in terms of visual effect. For example, considering the visual effect, only 10% of observed banks scored

less than three points; 20% of observed banks need to improve their structure classification; 20% of the Chinese banks are lacking visual appeal, as shown in Table 5. Regarding to the visual effect of the MB, we evaluate the color assortment, site aesthetic, and visual attraction. All of the Chinese banks that were observed used texts and pictures to introduce their product information, but none of the banks had video clips, but the video was more convincing to customers. In short, more than 80% of the banks can meet the needs of customers in the MB design, but there is still a lot of room for improvement.

The size of the MB, number of downloads, convenience of the research, version, and replacement of the page are all important factors that affect the users' adoption of MB. The convenience of use is a very important thing for customers, if the steps are too complex, it will be possible to forgo the use directly. Since the user's mobile phone memory is limited, the size of the software becomes the primary factor affecting the user's installation of MB. According to the results of the investigation, the memory of the 60% of observed banks is concentrated in 30 M–60 M, and the other 40% banks have two less than 30 M and two more than 60 M, with the largest memory footprint of 87.9 M, as shown in Table 6. Similarly, the number of downloads that MB needs is also a key factor affecting the user's use. Research shows that 80% of selected banks only need to download one software to make it all work. All banks can meet the needs of customers in their search for convenience. At the same time, MB also includes both IOS and Android versions. In addition, only one bank needs to relog on the page when changing to another interface, and the other nine selected banks can switch pages more easily.

The collected data in terms of information content and the security of MB are summarized in Table 3. According to the observation, all the Chinese banks under investigation are required to verify their online payments, for example, the five methods of verification and two approaches of testing each account for 10%; 20% of the observed banks have four ways and a large portion (60%) of Chinese banks have three methods to verify it, as shown in Table 7. However, most observed banks are unsatisfactory in ensuring safe innovation, such as facial and fingerprint unlocking, with only 30% of banks doing so. It can be assumed that protecting customer's information security is the premise of gaining users' trust, and 90% of the banks can do better to protect customer information. For example, in the page operation of some MBs, it is necessary to have corresponding permission to carry out; on the basis of no security measures, private client information is not allowed on the Internet and so on.

TABLE 4: The list of the selected commercial banks in China.

Country	No.	Commercial bank	Type of the bank
China	B1	Industrial and Commercial Bank of China	State-owned commercial bank
	B2	Construction Bank of China	State-owned commercial bank
	B3	Bank of China	State-owned commercial bank
	B4	Agricultural Bank of China	State-owned commercial bank
	B5	Bank of Communications	State-owned commercial bank
	B6	China Postal Savings Bank	National joint-stock commercial bank
	B7	China Everbright Bank	National joint-stock commercial bank
	B8	China Merchants Bank	National joint-stock commercial bank
	B9	China Minsheng Bank	National joint-stock commercial bank
	B10	Bank of Beijing	National joint-stock commercial bank

TABLE 5: Summary of the visual effect of the MB.

Category	Visual effect of the MB		
	Ranking	Number	%
Color assortment	Need improvement ( $\leq 3$ )	1	10
	Satisfied ( $> 3$ )	9	90
Total		10	100
Site aesthetic	Need improvement ( $\leq 3$ )	2	20
	Satisfied ( $> 3$ )	8	80
Total		10	100
Visual attraction	Need improvement ( $\leq 3$ )	2	20
	Satisfied ( $> 3$ )	8	80
Total		10	100

TABLE 6: Summary of the ease of use.

Category	Ease of use		
	Ranking	Number	%
File size	(0, 30 M]	2	20
	(30 M, 60 M]	6	60
	(60 M, 100 M]	2	20
Total		10	100
Number of APPs to download	Number (=1)	8	80
	Number (=2)	2	20
Total		10	100
Finding convenience	Need improvement ( $\leq 3$ )	0	0
	Satisfied ( $> 3$ )	10	100
Total		10	100
Version	IOS	10	100
	Android	10	100
Problems with replacing the page	Replace the page (1)	1	10
	Do not replace the page (0)	9	90
Total		10	100

The information of common services is very important for banks, especially for the MB. In this research, all the banks under investigation can meet customers' requirement about account management. Over half (8 out of 10) of the observed banks can apply for credit card through MB, which implies that this method eliminates the need to handle long waits at the counter and reduce banking business. Surprisingly, 60% of the Chinese banks need to improve the management of deposit and loan. However, this server can not only make customers more convenient to handle deposit business but also can increase the bank's business performance. With the improvement of the living standard in our country, the annual number of tourists traveling abroad

increases year by year, and the demand for foreign currency is gradually increasing. Nevertheless, half of the MB do not have this business, and only 20% of observed banks manage well in foreign currency management, as shown in Table 8. Since most banks need to apply for foreign currency in advance, clients have to wait a certain amount of time to get the corresponding foreign currency, especially the small currency. Therefore, it is necessary for banks to increase this business, not only to improve the work efficiency of the outlets but also to some extent to attract potential users.

Most of the convenience services, such as mobile payment, no card withdrawals, foreign currency cash reservation, cross-border payments, and network reservation, can

TABLE 7: Summary of security.

Category	Security		Number	%
	Ranking			
Online payment or remittance security method	Method (=5)		1	10
	Method (=4)		2	20
	Method (=3)		6	60
	Method (=2)		1	10
	Method (=1)		0	0
Total			10	100
Client confidentiality	Need improvement ( $\leq 3$ )		1	10
	Satisfied ( $> 3$ )		9	90
Total			10	100
Ensure safe innovation (fingerprint, face)	Yes (1)		3	30
	No (0)		7	70
Total			10	100

TABLE 8: Summary of the available common services.

Category	Ease of available common services		Number	%
	Ranking			
Account management (balances, details)	Need improvement ( $\leq 3$ )		0	0
	Satisfied ( $> 3$ )		10	100
Total			10	100
Transfer money	Need improvement ( $\leq 3$ )		0	0
	Satisfied ( $> 3$ )		10	100
Total			10	100
Apply for a credit card	Need improvement ( $\leq 3$ )		2	20
	Satisfied ( $> 3$ )		8	80
Total			10	100
Deposit and loan management	Need improvement ( $\leq 3$ )		6	60
	Satisfied ( $> 3$ )		4	40
Total			10	100
Foreign currency management	Need improvement ( $\leq 3$ )		8	80
	Satisfied ( $> 3$ )		2	20
Total			10	100

bring convenience to customers. Mobile payment is widely used in both large and corner stores in China. According to our observation, 30% of the observed banks need to improve their mobile payment method. Similarly, a large portion of MB needs to improve the no card withdrawals as well as the foreign currency cash reservation services, and even more surprisingly, only 10% of the selected banks provide the cross-border payments services on their MB, as shown in Table 9. In addition, due to the limited bank outlets, queuing users will take a long time to do their business, this is not only a waste of time for the user but also reflects that the bank efficiency is low from the side, and cannot satisfy the needs of customers.

Except the convenience services, more and more customers start concentrating on the investment/finance management, so we collect the data in this research which are summarized in Table 10. According to our survey, all the observed banks offer the investment/finance management services. However, 10% of the selected banks need to improve the extensive products and 20% of the banks need to improve the detailed introduction to customers. Otherwise, these imperfect services may cost a long time for clients to find useful information.

The livelihood payment is the addition items to help people settle the cost of living, so in large majority literatures the livelihood payment is identified as the significant index for evaluating the payment method. In this research, among the 10 banks surveyed, there are options for people's livelihood, but the details of the content and information are different. For example, as shown in Table 11, 90% of observed banks have the functions of charging, Internet, and electricity; 60% of the banks can offer food coupons and movie tickets and 70% of the banks have the option of paying a fine or purchase a ticket on MB. In addition, 100% of mobile phone banks can be registered by the corresponding option, but 70% of the banks have fewer than 10 hospitals to choose from, and the largest number of hospitals have 30. However, most banks do not provide the corresponding service of health management, only 10% of the bank provide this service, but the content is not so detailed.

The number of downloads and user comments are key factors that affect the popularity of MB. As can be seen from Table 8, half of the MB have been downloaded from 0–50 million times, and 30% of the banks are concentrated in 50–100 million times, with the maximum number of



TABLE 9: Summary of the available convenience services.

Ease of available common services			
Category	Ranking	Number	%
Mobile payment (collection, payment)	Need improvement ( $\leq 3$ )	3	30
	Satisfied ( $>3$ )	7	70
Total		10	100
No card withdrawals	Need improvement ( $\leq 3$ )	7	70
	Satisfied ( $>3$ )	3	30
Total		10	100
Foreign currency cash reservation	Need improvement ( $\leq 3$ )	9	90
	Satisfied ( $>3$ )	1	10
Total		10	100
Cross-border payments	Need improvement ( $\leq 3$ )	9	90
	Satisfied ( $>3$ )	1	10
Total		10	100
Network reservation	Need improvement ( $\leq 3$ )	6	60
	Satisfied ( $>3$ )	4	40
Total		10	100

TABLE 10: Summary of the investment/finance management.

Ease of investment/finance management			
Category	Ranking	Number	%
Investment/finance management services	Yes (1)	10	100
	No (0)	0	0
Total		10	100
Extensive m-banking products	Need improvement ( $\leq 3$ )	1	10
	Satisfied ( $>3$ )	9	90
Total		10	100
Detailed introduction	Need improvement ( $\leq 3$ )	2	20
	Satisfied ( $>3$ )	8	80
Total		10	100

TABLE 11: Summary of Livelihood payment.

Ease of use			
Category	Ranking	Number	%
Payment recharge (life payment, credit)	Need improvement ( $\leq 3$ )	1	10
	Satisfied ( $>3$ )	9	90
Total		10	100
Food and leisure (ticket, movie tickets)	Need improvement ( $\leq 3$ )	4	40
	Satisfied ( $>3$ )	6	60
Total		10	100
Traffic travel (paid fines, ticket purchases)	Need improvement ( $\leq 3$ )	3	30
	Satisfied ( $>3$ )	7	70
Total		10	100
Medical registration	(0, 10]	7	70
	(10, 20]	0	0
	(20, 30]	3	30
Total		10	100
Health management (health assessment, daily tasks)	Need improvement ( $\leq 3$ )	9	90
	Satisfied ( $>3$ )	1	10
Total		10	100

downloads reaching 320 million times. 50% of MB should improve their user evaluation, as shown in Table 12. According to the survey, user evaluation is the key factor for customers to download MB. Therefore, the bank should pay close attention to the contents of MB in order to improve users' evaluation.

The MB customer service is a very important factor to impact load. As shown in Table 10, all the observed banks have offered some consulting ways. In various ways of user feedback, such as message board, contact phone, online solution banks, and e-mail, can solve customers' needs more quickly. 10% of the banks have five consulting methods; 10%

TABLE 12: Summary of the popularity of the APP.

Category	Website popularity		
	Ranking	Number	%
APP downloads	(0, 5000]	5	50
	(5000, 10000]	3	30
	(10000, 15000]	2	20
Total		10	100
User reviews	Need improvement ( $\leq 3$ )	5	50
	Satisfied ( $> 3$ )	5	50
Total		10	100

TABLE 13: Summary of the customer service.

Category	Ease of available common services		
	Ranking	Number	%
Consultation (message board, contact phone number, online answer, e-mail, etc.)	Method (=5)	1	10
	Method (=4)	0	0
	Method (=3)	1	10
	Method (=2)	4	40
	Method (=1)	4	40
Total		10	100
Feedback speed	Need improvement ( $\leq 3$ )	4	40
	Satisfied ( $> 3$ )	6	60
Total		10	100
Feedback accuracy	Need improvement ( $\leq 3$ )	7	70
	Satisfied ( $> 3$ )	3	30
Total		10	100

of the selected have three types of consulting; and most banks have one or two types of consulting, as shown in Table 13. According to the actual survey, 50% of MB need to speed up their feedback to improve customer satisfaction. In addition, 70% of banks need to improve the accuracy of their feedback; although most banks can answer it quickly, the feedback is irrelevant to the client's problem. Therefore, these are urgent problems for banks to settle which can improve the customers' satisfaction.

## 5. Solutions from DEMATEL-ANP Analysis

To further determine the factors which influence the adoption rate of MB, the DEMATEL-ANP is employed in this research. This approach relies on a team of experts to measure data. In the study, three experts were selected to discuss the motivations, decisions, and considerations that influence the adoption rate of MB. The three experts selected in this case are the company manager, technical engineer, and sales manager. The questionnaire is mainly used to evaluate the importance of the factors, and in the decision-making process, the evaluation criteria are sorted to obtain the direct relation matrix.

Step 1: the influencing factors, decision goals, standards, subcriteria, and alternatives of decision-making are shown in Table 14. In summary, nine criteria and 34 subcriteria are identified.

Step 2: in the process of choosing whether to download the MB, customers will be compared according to the 4-leveled scale of DEMATEL.

Step 3: internal dependencies are found in each index of the direct relationship matrix, as shown in Table 15. The columns sum  $\{0, 3.67, 5.34, 8.33, 8, 3.68, 8, 26.66, 9.66\}$  are derived from the above direct relationship matrix. Also, we can have the rows sum  $\{11.34, 13.67, 12, 6.33, 6, 5, 5, 5.67, 8.33\}$ . From this, we can get a maximum of the popularity of the columns 26.66. Then, according to formulas (1) and (2), the direct relation matrix is standardized, and the normalized direct relation matrix of Table 16 is obtained.

Step 4: finally, through formula (3), and using MATLAB tools to carry out operation, the comprehensive influence matrix is given in Table 17.

Step 5: with the help of formulas (4)–(6), computing center factors and reason factors are shown in Table 18.

Step 6: based on the previous steps, the matrix for influencing aspects is concluded by using the dataset  $(D_i + R_i)$ ,  $(D_i - R_i)$ . The causal diagram for the total influencing factors is given in Figure 2. Due to the limited space, only five indicators are taken as examples. Here, the result indicates that A, B, C, and F are dispatchers and D, E, G, H, and I are receivers. Therefore, the visual effect, ease of use, security, and investment management index will have a great influence on the common services, convenience services, livelihood payment, popularity of the MB, and customer service index. From Table 14, it is seen that the visual effect (A) has the value of  $(D_i - R_i = 0.583)$  and is considered to be an important factor affecting all the other factors with a high importance  $(D_i + R_i = 0.583)$ .

TABLE 14: The measures of the online services of mobile banking.

Goal	Aspects	Criteria
Online services of e-banking	A: visual effect	A <sub>1</sub> color assortment
		A <sub>2</sub> site aesthetic
		A <sub>3</sub> visual attraction
	B: ease of use	B <sub>1</sub> file size
		B <sub>2</sub> number of APPs to download
		B <sub>3</sub> finding convenience
		B <sub>4</sub> version (IOS, Android)
		B <sub>5</sub> problems with replacing the page
	C: security	C <sub>1</sub> online payment or remittance security method
		C <sub>2</sub> client confidentiality
		C <sub>3</sub> ensure safe innovation (fingerprint, face)
		D <sub>1</sub> account management (balances, details)
	D: common services	D <sub>2</sub> transfer money
		D <sub>3</sub> apply for a credit card
		D <sub>4</sub> deposit and loan management
		D <sub>5</sub> foreign currency management
		E <sub>1</sub> mobile payment (collection, payment)
	E: convenience services	E <sub>2</sub> no card withdrawals
E <sub>3</sub> foreign currency cash reservation		
E <sub>4</sub> cross-border payments		
E <sub>5</sub> network reservation		
F <sub>1</sub> investment/finance management services		
F: investment/finance management	F <sub>2</sub> extensive m-banking products	
	F <sub>3</sub> detailed introduction	
	G <sub>1</sub> payment recharge (life payment, credit)	
G: livelihood payment	G <sub>2</sub> food and leisure (ticket, movie tickets)	
	G <sub>3</sub> traffic travel (paid fines, ticket purchases)	
	G <sub>4</sub> medical registration	
	G <sub>5</sub> health management	
	H: popularity of the APP	H <sub>1</sub> APP downloads
I: customer service	H <sub>2</sub> user reviews	
	I <sub>1</sub> consultation (message board, contact phone number, online answer, e-mail, etc.)	
	I <sub>2</sub> feedback speed	
		I <sub>3</sub> feedback accuracy

TABLE 15: The initial direct relation matrix for economic aspects.

	A	B	C	D	E	F	G	H	I
A	—	1.67	0	1.67	1.33	0.67	1.67	2.33	2
B	0	—	1	2	2	0.67	3	3.67	1.33
C	0	2	—	2	1.67	1	1.33	3.33	0.67
D	0	0	0.67	—	0.67	0	0.33	3.33	1.33
E	0	0	0.67	0.33	—	0	0	3.67	1.33
F	0	0	0.67	0	0	—	0	3.33	1
G	0	0	0.33	0	0	0	—	3.67	1
H	0	0	1	1	1.33	0.67	0.67	—	1
I	0	0	1	1.33	1	0.67	1	3.33	—

TABLE 16: The normalized direct relation matrix.

	A	B	C	D	E	F	G	H	I
A	0.000	0.063	0.000	0.063	0.050	0.025	0.063	0.087	0.075
B	0.000	0.000	0.038	0.075	0.075	0.025	0.113	0.138	0.050
C	0.000	0.075	0.000	0.075	0.063	0.038	0.050	0.125	0.025
D	0.000	0.000	0.025	0.000	0.025	0.000	0.012	0.125	0.050
E	0.000	0.000	0.025	0.012	0.000	0.000	0.000	0.138	0.050
F	0.000	0.000	0.025	0.000	0.000	0.000	0.000	0.125	0.038
G	0.000	0.000	0.012	0.000	0.000	0.000	0.000	0.138	0.038
H	0.000	0.000	0.038	0.038	0.050	0.025	0.025	0.000	0.038
I	0.000	0.000	0.038	0.050	0.038	0.025	0.038	0.125	0.000

TABLE 17: The comprehensive influence matrix.

	A	B	C	D	E	F	G	H	I
A	0.000	0.064	0.017	0.08	0.069	0.033	0.079	0.145	0.096
B	0.000	0.004	0.055	0.092	0.094	0.034	0.125	0.2	0.074
C	0.000	0.076	0.018	0.092	0.083	0.046	0.067	0.182	0.049
D	0.000	0.003	0.035	0.012	0.037	0.007	0.02	0.147	0.06
E	0.000	0.003	0.035	0.024	0.013	0.007	0.008	0.157	0.059
F	0.000	0.002	0.033	0.01	0.011	0.006	0.007	0.14	0.045
G	0.000	0.002	0.021	0.01	0.011	0.006	0.007	0.15	0.045
H	0.000	0.003	0.044	0.045	0.058	0.029	0.031	0.033	0.047
I	0.000	0.004	0.048	0.061	0.051	0.031	0.046	0.158	0.016

TABLE 18: The comprehensive influence matrix after influence.

	A	B	C	D	E	F	G	H	I	Di	Di + Ri	Di - Ri
A	0.000	0.064	0.017	0.08	0.069	0.033	0.079	0.145	0.096	0.583	0.583	0.583
B	0.000	0.004	0.055	0.092	0.094	0.034	0.125	0.2	0.074	0.678	0.839	0.517
C	0.000	0.076	0.018	0.092	0.083	0.046	0.067	0.182	0.049	0.613	0.919	0.307
D	0.000	0.003	0.035	0.012	0.037	0.007	0.02	0.147	0.06	0.321	0.747	-0.105
E	0.000	0.003	0.035	0.024	0.013	0.007	0.008	0.157	0.059	0.306	0.733	-0.121
F	0.000	0.002	0.033	0.01	0.011	0.006	0.007	0.14	0.045	0.254	0.453	0.055
G	0.000	0.002	0.021	0.01	0.011	0.006	0.007	0.15	0.045	0.252	0.642	-0.138
H	0.000	0.003	0.044	0.045	0.058	0.029	0.031	0.033	0.047	0.29	1.359	-1.022
I	0.000	0.004	0.048	0.061	0.051	0.031	0.046	0.158	0.016	0.415	0.906	-0.076
Ri	0.000	0.161	0.306	0.426	0.427	0.199	0.39	1.312	0.491			

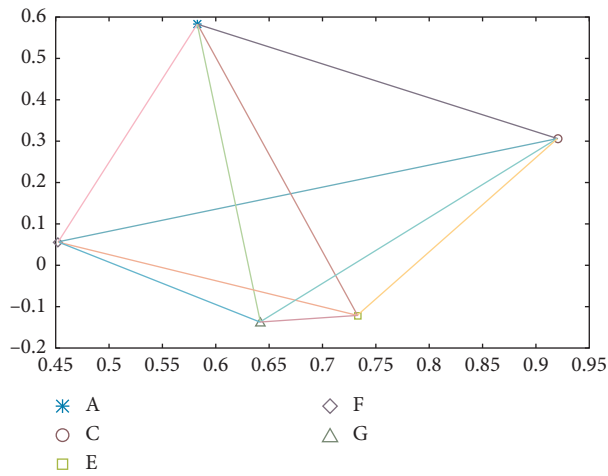


FIGURE 2: The causal diagram for the total influencing factors.

TABLE 19: The comprehensive influence matrix.

	A	B	C	D	E	F	G	H	I
A	0.000	0.064	0.017	0.08	0.069	0.033	0.079	0.145	0.096
B	0.000	0.004	0.055	0.092	0.094	0.034	0.125	0.2	0.074
C	0.000	0.076	0.018	0.092	0.083	0.046	0.067	0.182	0.049
D	0.000	0.000	0.035	0.012	0.037	0.007	0.000	0.147	0.06
E	0.000	0.000	0.035	0.024	0.013	0.007	0.008	0.157	0.059
F	0.000	0.000	0.033	0.000	0.011	0.006	0.007	0.14	0.045
G	0.000	0.000	0.021	0.000	0.011	0.006	0.007	0.15	0.045
H	0.000	0.000	0.044	0.045	0.058	0.029	0.031	0.033	0.047
I	0.000	0.004	0.048	0.061	0.051	0.031	0.046	0.158	0.016

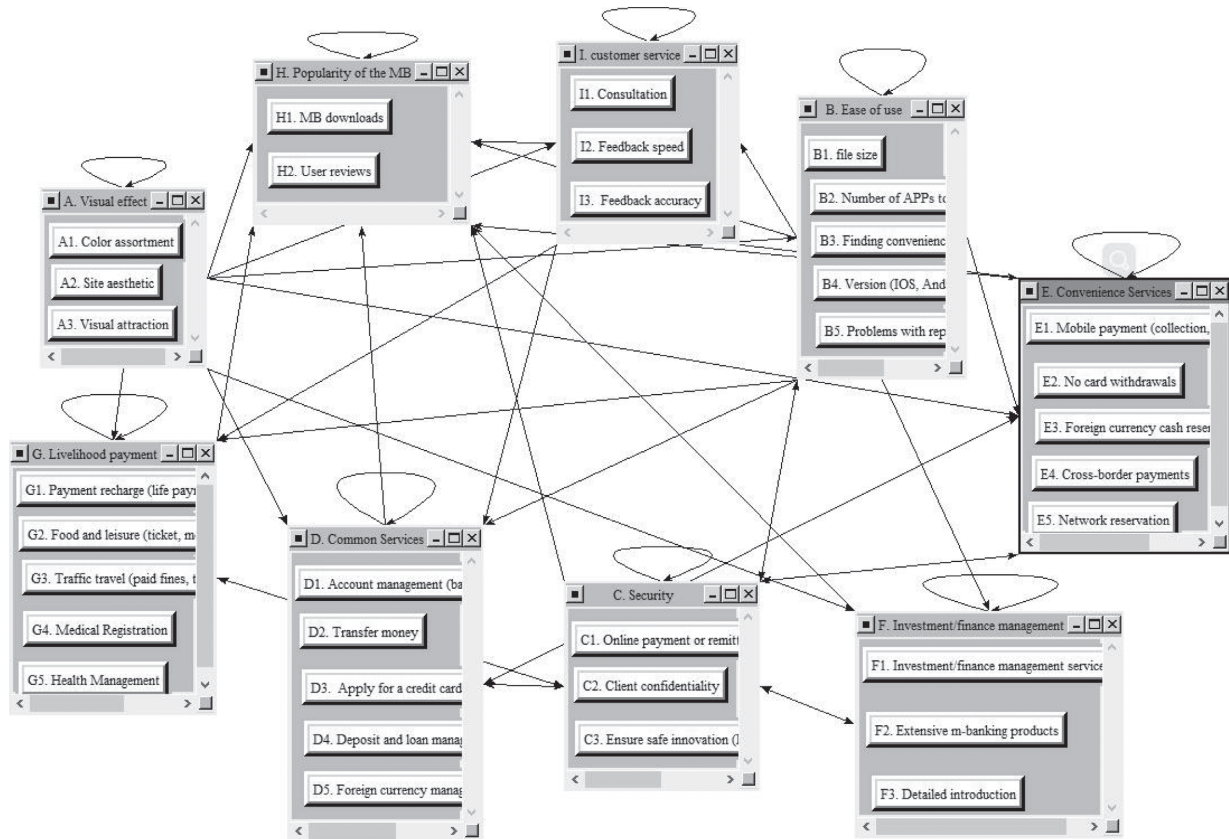


FIGURE 3: Network structure of the evaluation model.

TABLE 20: The pairwise comparison matrix.

Super decisions main window: influence factor.sdmod; cluster matrix view

Cluster node labels	A: visual effect	B: ease of use	C: security	D: common services	E: convenience services	F: investment/finance management	G: livelihood payment	H: popularity of the MB
A: visual effect	0.3333	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
B: ease of use	0.2909	0.2364	0.2527	0.0000	0.0000	0.0000	0.0000	0.0000
C: security	0.0000	0.4757	0.4898	0.5579	0.5579	0.4736	0.7085	0.0000
D: common services	0.1285	0.1059	0.1022	0.2772	0.2772	0.0000	0.0000	0.0000
E: convenience services	0.0645	0.0537	0.0396	0.1293	0.1293	0.0000	0.0000	0.0000
F: investment/finance management	0.0542	0.0376	0.0422	0.0000	0.0000	0.4736	0.0000	0.0000
G: livelihood payment	0.0535	0.0458	0.0503	0.0000	0.0000	0.0000	0.2311	0.0000
G: popularity of the MB	0.0148	0.0201	0.0228	0.0354	0.0354	0.0526	0.0603	1.0000

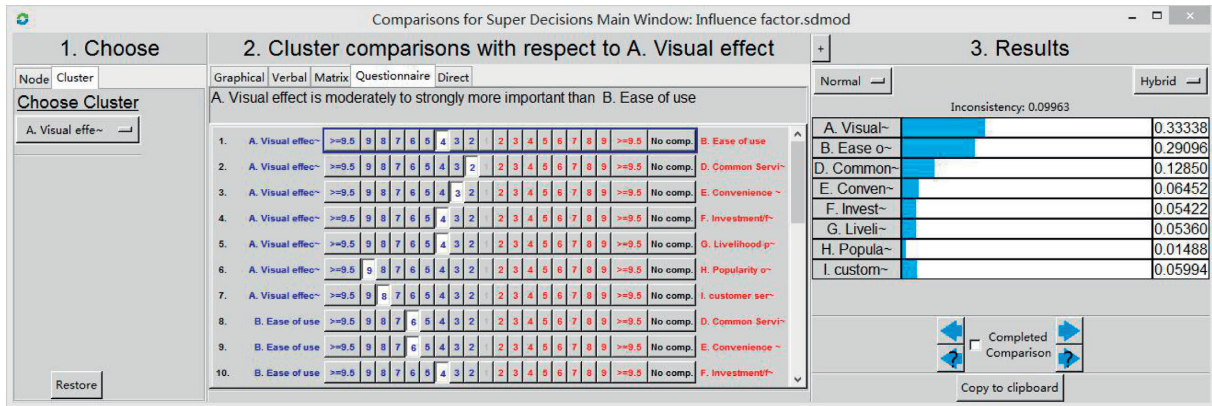


FIGURE 4: Display of the normalized weight vector and consistency index.

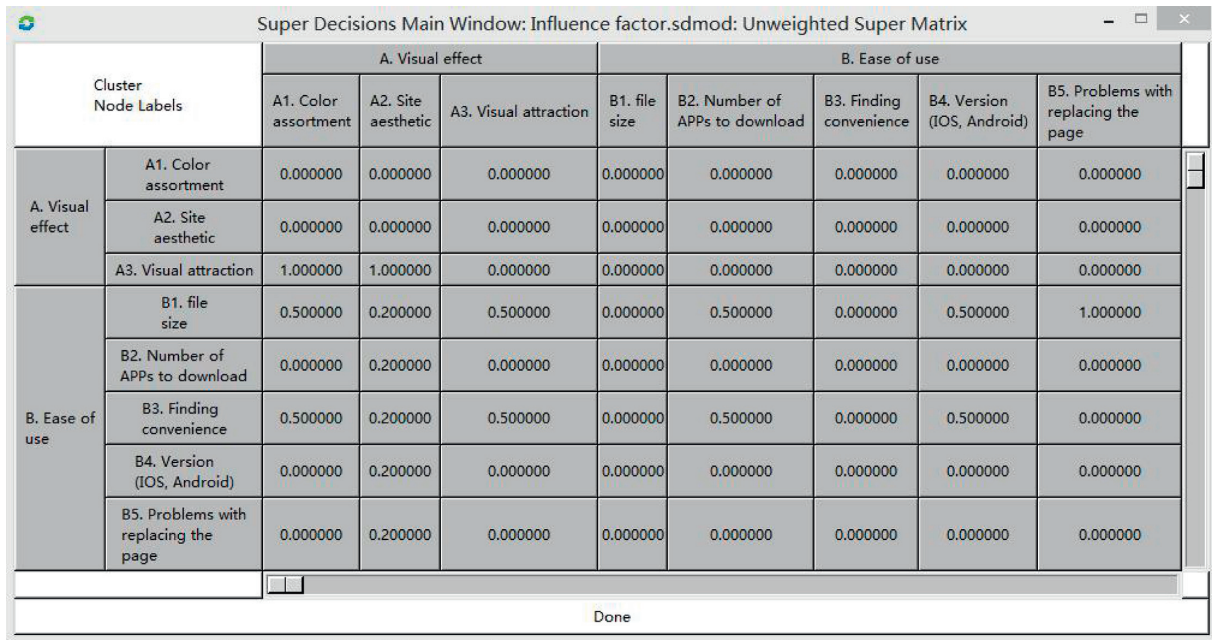


FIGURE 5: Implementation of the unweighted super matrix.

The ease of use (B) has  $(D_i - R_i = 0.517)$  in the cause group, and its  $(D_i + R_i = 0.839)$  is the second important indicator.

### 6. Conclusions and Suggestions for Future Research

This paper focuses on the factors influencing the adoption rate of MB, including the analysis of competition between five state-owned banks and five commercial banks in China’s financial market. The purpose of this study is to (1) investigate the effectiveness of 10 banks in MB services; (2) compare the differences between state-owned banks and commercial banks in various indicators; and (3) provide relevant correction suggestions to relevant banks.

Step 7: according to the above results, it can be seen that there is a strong internal correlation among selected indicators. The internal dependence of other indicators is studied by the same research method. From the expert opinion and repeated tests, the threshold value = 0.03, remove the irrelevant association relationship and obtain the relationship shown in Table 19.

Step 8: relevant data generated by the DEMATEL method above is input into the ANP application software super decision, and the network structure of the evaluation model can be established through the external independence between factors, as shown in Figure 3. The application of the ANP method can better reflect the proportion of each index, while DM only shows the causal relationship between each factor and can give the judgment of the numerical

Cluster Node Labels		A. Visual effect			B. Ease of use				
		A1. Color assortment	A2. Site aesthetic	A3. Visual attraction	B1. file size	B2. Number of APPs to download	B3. Finding convenience	B4. Version (IOS, Android)	B5. Problems with replacing the page
A. Visual effect	A1. Color assortment	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	A2. Site aesthetic	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	A3. Visual attraction	0.333377	0.333377	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
B. Ease of use	B1. file size	0.145478	0.058191	0.218232	0.000000	0.118230	0.000000	0.118230	0.242382
	B2. Number of APPs to download	0.000000	0.058191	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	B3. Finding convenience	0.145478	0.058191	0.218232	0.000000	0.118230	0.000000	0.118230	0.000000
	B4. Version (IOS, Android)	0.000000	0.058191	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	B5. Problems with replacing the page	0.000000	0.058191	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

FIGURE 6: Implementation of the weighted supermatrix.

Cluster Node Labels		A. Visual effect			B. Ease of use				
		A1. Color assortment	A2. Site aesthetic	A3. Visual attraction	B1. file size	B2. Number of APPs to download	B3. Finding convenience	B4. Version (IOS, Android)	B5. Problems with replacing the page
A. Visual effect	A1. Color assortment	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	A2. Site aesthetic	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	A3. Visual attraction	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
B. Ease of use	B1. file size	0.073943	0.073943	0.073943	0.073943	0.073943	0.073943	0.073943	0.073943
	B2. Number of APPs to download	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	B3. Finding convenience	0.038199	0.038199	0.038199	0.038199	0.038199	0.038199	0.038199	0.038199
	B4. Version (IOS, Android)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
	B5. Problems with replacing the page	0.038199	0.038199	0.038199	0.038199	0.038199	0.038199	0.038199	0.038199

FIGURE 7: Implementation of the limit matrix.

model. At the same time, using experts from different fields to grade evaluation indicators will greatly help the impartiality of the decision-making process. The next step is to use the ANP method to calculate the weight of each index.

Step 9: according to the comprehensive influence matrix, input the 10 mutual influences of the relationship between the indexes; due to space limitations, only capture some indexes between the pairwise comparison matrices, as shown in Table 20.

Step 10: through equations (7) and (8), the relative weight of each indicator can be obtained. Using Super Decisions software, the weight value of the above pairwise comparison matrix was input in the “Show New Priorities under the “Computation menu bar,” and the normalized weight vector and consistency index value as shown in Figure 4 could be obtained. The consistency index value of the judgment matrix is  $0.09963 < 0.1$ , which meets the requirements and the weight is within the acceptable range.

TABLE 21: Implementation of the stable weight vector.

Aspects	Criteria	Local weight	Global weight
A: visual effect	A <sub>1</sub> color assortment	0.40124	0.216694
	A <sub>2</sub> site aesthetic	0.27514	0.148590
	A <sub>3</sub> visual attraction	0.32362	0.174771
B: ease of use	B <sub>1</sub> file size	0.49184	0.073943
	B <sub>2</sub> number of APPs to download	0.47049	0.028617
	B <sub>3</sub> finding convenience	0.25408	0.038199
	B <sub>4</sub> version (IOS, Android)	0.32988	0.014977
	B <sub>5</sub> problems with replacing the page	0.25408	0.381990
C: security	C <sub>1</sub> online payment or remittance security method	0.10124	0.000694
	C <sub>2</sub> client confidentiality	0.27234	0.148059
	C <sub>3</sub> ensure safe innovation (fingerprint, face)	0.12362	0.174771
	D <sub>1</sub> account management (balances, details)	0.34686	0.039817
D: common services	D <sub>2</sub> transfer money	0.19058	0.021877
	D <sub>3</sub> apply for a credit card	0.12685	0.014562
	D <sub>4</sub> deposit and loan management	0.16382	0.018806
	D <sub>5</sub> foreign currency management	0.17189	0.019732
	E <sub>1</sub> mobile payment (collection, payment)	0.29175	0.012195
E: convenience services	E <sub>2</sub> no card withdrawals	0.19667	0.008221
	E <sub>3</sub> foreign currency cash reservation	0.14828	0.006198
	E <sub>4</sub> cross-border payments	0.23017	0.009621
	E <sub>5</sub> network reservation	0.13313	0.005565
	F <sub>1</sub> investment/finance management services	0.37253	0.022659
F: investment/finance management	F <sub>2</sub> extensive m-banking products	0.15698	0.009548
	F <sub>3</sub> detailed introduction	0.47049	0.028617
	G <sub>1</sub> payment recharge (life payment, credit)	0.21616	0.009491
G: livelihood payment	G <sub>2</sub> food and leisure (ticket, movie tickets)	0.18494	0.008120
	G <sub>3</sub> traffic travel (paid fines, ticket purchases)	0.18494	0.008120
	G <sub>4</sub> medical registration	0.18494	0.008120
	G <sub>5</sub> health management	0.22903	0.010056
	H <sub>1</sub> MB downloads	0.67012	0.030424
H: popularity of the MB	H <sub>2</sub> user reviews	0.32988	0.014977
	I <sub>1</sub> consultation (message board, contact phone number, online answer, e-mail, etc.)	0.91307	0.002626
I: customer service	I <sub>2</sub> feedback speed	0.04346	0.000125
	I <sub>3</sub> feedback accuracy	0.04346	0.000125

Step 11: according to equations (9) and (10), all element level judgment matrices are entered in accordance with the above steps. If  $C \cdot R \leq 0.10$ , the consistency test is satisfied and the weight is within an acceptable range. If  $C \cdot R \leq 0.10$ , the result in this case is valid.

Step 12: the consistency of the matrix is tested. The Super Decision software, after passing through the consistency check, through the "Computation of main interface" menu bar under the "Unweighted Super Mater" and "Weighted Super Mater" bar menu command, can get a weighted matrix and weighted hypermatrix, as shown in Figures 5 and 6, respectively; The limit matrix can be obtained through the "Limit Matrix" menu command under the "Computation" menu bar in the main interface, as shown in Figure 7.

Step 13: through the above results, the final ranking of each index weight value can be obtained, as shown in Table 21.

The main data of this study were obtained through the comprehensive evaluation of MB services, which mainly includes the visual effect, ease of use, security, common

service, convenience service, investment/finance management services, livelihood payment, the popularity of the MB, and customer service of the 10 banks which use DEMATEL-ANP evaluation on the MB services. According to the global weight obtained in Table 20, the four indicators for evaluating MB in online services are (1) visual effects, whose weight = (0.22, 0.15, 0.17), (2) ease of use, weight = (0.07, 0.03, 0.04, 0.01, 0.38), (3) security, weight = (0.00, 0.15, 0.17), and (4) common services, weight = (0.04, 0.02, 0.01, 0.02, 0.02). As shown in Table 1, the three factors that foreign scholars pay most attention to in the research on the adoption rate of MB are trust, risk perception, and behavioral intention. As a result, a number of important management influences are obtained: (1) MB in finance and investment service should enrich its product introduction and the related kinds of choices simplified the process of online purchase financial products at the same time. (2) Research shows that when users download MB, they will pay attention to other users' comments and the number of downloads of their software. (3) Banks should also enhance their services on people's livelihood payment so that users can pay their living expenses through MB and other related issues.



By comparing the data of state-owned banks and commercial banks, it can be concluded that the customer satisfaction of commercial banks is higher than that of state-owned banks. Commercial banks score higher on the ease of use, security, and common services than state-owned banks, for example, the file size in the ease of use, the software of state-owned banks size with an average of 53.86 M, and the commercial banks is 36.12. In terms of ensuring safe innovation in security, three of the five commercial banks have introduced fingerprint and facial recognition functions, which can ensure the security of user accounts and the convenience of operation. In the deposits and loans management in common services, the satisfaction rate of commercial banks is 60%, while that of the state-owned banks is only 20%. But in convenience services, significantly higher than the score of state-owned banks to commercial banks, in mobile payment, no card withdrawals, and network reservation of the three functions, the customer satisfaction of state-owned banks were higher than 50%, while in commercial banks, customers' satisfaction was only 40%, 20%, and 0%; in other words, the five commercial banks in the study does not exist in the function of network reservation. In livelihood payment, the popularity of MB, and customer service, three aspects of state-owned banks and commercial banks have their own advantages. For example, five state-owned banks can be fulfilled in this software for traffic travel (paid fines and ticket purchases), only two banks of commercial banks in providing the service. In terms of medical registration, for example, in Beijing, only 27 hospitals can be reserved by state-owned banks, while 57 hospitals can be reserved by commercial banks, more than double that of state-owned banks. Among the popularity of MB, the download volume of state-owned banks is much higher than that of commercial banks, and the user reviews of commercial banks is slightly higher than that of state-owned banks. Customer service in the kinds of consultation and feedback accuracy of the customer satisfaction of commercial banks were significantly higher than that of state-owned banks, and the feedback speed of customer satisfaction in state-owned banks is 80% and the commercial bank is only 20%.

Based on the results of this study, from the perspective of MB, there is still much room for banks to increase their MB adoption rate. We suggest that MB services of banks should be strengthened as follows: (1) banks should enhance their attention to users in terms of the softwares' color, structure, and visual appeal of MB; (2) to ensure that customer's personal information will not leak when participating in online banking, as well as to add the fingerprint and face unlock function, MB in the login, and payment security to further strengthen; (3) the size of the MB users to download the MB will focus on software and looking for convenience; at the same time, the number needed to download the MB software can significantly affect the downloads; banks should make the function of the MB concentration in a software; (4) generally, the management of deposit, loan, and foreign currency should be strengthened in the common services of MB, and the functions of credit card application, deposit and loan management, and foreign currency management

should be increased; (5) enhancing the service quality and service speed of online customers service, reducing the waiting time of users, and improving customer satisfaction.

## Data Availability

The main data of this study were obtained through the observation sheet of mobile banking services from the APP of the following banks: Industrial and Commercial Bank of China, Construction Bank of China, Bank of China, Agricultural Bank of China, Bank of Communications, China Postal Savings Bank, China Everbright Bank, China Merchants Bank, China Minsheng Bank, and Bank of Beijing.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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