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Investigating the Assessment Criteria of Banking Supervision from the Perspective of Financial Supervision Law

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Abstract: Following financial liberalization and internationalization, financial innovation activities have become prevalent, banking has grown increasingly complex, and the risk involved in the financial system has increased. To respond effectively to the rapid changes in the financial environment, the advanced countries in the global financial system have committed themselves to promoting financial reform. They are reviewing their financial supervisory systems and financial regulations, improving financial supervisory technology, and urging banks to strengthen their risk management and corporate governance to improve their financial systems and increase financial competitiveness. Financial supervision refers to the power of financial authorities to supervise and manage financial institutions in accordance with relevant laws. In this study, financial supervision law was used as a foundation to investigate the assessment criteria and functions of banking supervision. The new decision-making trial-and-evaluation laboratory model was used in this study to assess and explore assessment indicators for banking supervision and to examine the causal relationships and mutual influences among the criteria. Finally, methods for improving the functions and benefits of financial supervision were discussed. The method not only contributes to current theory, but can also be practically employed.

Keywords: Assessment Criteria, Banking Supervision, Financial Supervision Laws, Risk Assessment, DEMATEL

1 Introduction

Financial supervision refers to the power of financial authorities to supervise and manage financial institutions in accordance with relevant laws. The primary purpose of exercising this authority is to safeguard the rights and interests of depositors, adapt to the needs of industry development, and ensure fair financial trade within the operations of sound financial services to maintain stable financial order. Thus, financial institutions are similar to other for-profit corporations. Both engage in business transactions, provide service quality, and focus on pursuing profit. However, financial institutions exhibit broader influence than other for-profit businesses do because they attract and use deposits from the public. Therefore, government management of financial institutions must be strict to prevent financial malpractice and to maintain a stable financial system [1,2,3].

Following financial liberalization and internationalization, financial innovation activities have become prevalent, banking has grown increasingly complex, and the risk involved in the financial system has increased. To respond effectively to the rapid changes in the financial environment, the advanced countries in the

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global financial system have committed themselves to promoting financial reform. They are reviewing their financial supervisory systems and financial regulations, improving financial supervisory technology, and urging banks to strengthen their risk management and corporate governance to improve their financial systems and increase financial competitiveness [4]. In addition, financial instability exhibits a critical negative effect on the overall economy. In recent years, international financial organizations and central banks around the world have actively developed frameworks for maintaining financial stability. These frameworks are used to conduct systematic analysis and monitoring to adopt relevant response policies and measures in a timely manner and achieve financial stability.

Recently, limited resources for supervision have restricted the world's major financial supervisory agencies. A number of risk-based supervision systems have been adopted to improve supervision effectiveness and efficiency. These systems aim to determine the main risk categories and exposure of inspected institutions before conducting spot checks. Supervision resources are then invested in projects with major risk to determine a bank's risk trends effectively and in a timely manner. Taiwan's financial supervisory agencies began auditing all banks in 2011 and have adopted risk-based auditing methods. The effectiveness of the implementation of various categories of risk management is assessed based on established rating items and breakdowns. During the 2 years in which this system was implemented, auditors selected rating items based on subjective judgments. As a result, auditors' results of assessing the same banks varied or lacked rationality [5,6].

In this study, financial supervisory law was used as a foundation to explore the assessment criteria and functions of banking supervision. The new decision-making trial-and-evaluation laboratory (DEMATEL) was used in this study. First, assessment criteria for banking supervision were addressed. Second, the causal relationships and mutual influences among the criteria were investigated. Finally, methods of improving the functions and effectiveness of banking supervision were discussed.

2 Literature Review

2.1 Functions of Financial and Banking Supervision

Financial supervision refers to the power of financial authorities to supervise and manage financial institutions in accordance with relevant laws. The primary purpose of exercising this authority is to safeguard the rights and interests of depositors, adapt to the needs of industry development, and ensure fair financial trade within the operations of sound financial services to maintain stable financial order [7,8,9]. The functions of financial supervision are described as follows:

(1) Improving Banking Operations
The Banking Act of the Republic of China is the basis for financial business operations. It is the enabling statute of financial services. The banking laws of all countries clearly express from the beginning that the purpose of formulating banking laws is to improve banking operations and to harmonize bank credit with national financial policy. Therefore, improving banking operations is the main purpose of financial supervision.

(2) Safeguarding the Rights and Interests of Depositors
The basic operating model of banks is to attract deposits and create credit. The creation of credit relies on the trust of all depositors in the bank. The majority of depositors remain unable to fully understand a bank's process of credit creation, and thus cannot assess the quality of a bank's operations. Therefore, to safeguard the rights and interests of depositors, financial supervisory authorities establish deposit insurance systems in accordance with the law. These systems establish confidence in bank payments among depositors and further safeguard their rights and interests.

(3) Adapting to the Needs of Industry Development
Industry is the foundation of the economy. Banks create credit primarily in cooperation with business development and adjust the funding requirements of businesses adequately to support and improve the industrial base, thus promoting stable growth in the economy.

(4) Ensuring Fair Financial Trade
Banks attract deposits and create credit. These deposits come from the general public. Therefore, banks must pay particular attention to security and public welfare in the use of funds. To prevent banks from using public funds for a small number of specific people, the Banking Act prohibits banks from providing unsecured loans or guarantees to bank heads or staff. This is intended to prevent bank employees from taking advantage of their authority for profit, causing excessive risk for the banks themselves and affecting operations. If secured lending is provided to employees, the conditions must not be more favorable than are those offered to other borrowers, to ensure the fairness of financial transactions and to protect the deserved rights and interests of the majority of depositing customers in society.

(5) Maintaining the Stability of Financial Order
When banks engage in business operations and create credit, they use the influence of the multiplier theory to maximize the overall money supply. Therefore, to control the money supply appropriately and effectively, bank deposit and loan business must be standardized appropriately, avoiding abnormal

expansion that could affect the execution of monetary policy. Abnormal expansion could also affect the liquidity of banks themselves, preventing the normal operation of payment behavior and leading to financial panic that would exert a negative influence on the economy. Therefore, financial supervision is necessary to control financial order and maintain stability.

2.2 Systems and Criteria for Financial Supervision

When governments respond to the rapidly changing international financial situation, in addition to effectively adjusting supervision policies, the governments especially emphasize the auditing operations of financial supervisory authorities and the financial early warning system. The Basel Committee on Banking Supervision of the Bank for International Settlements published the Core Principles for Effective Banking Supervision in September of 1997. These principles provided financial supervisory authorities around the world with inspection criteria to assess the quality of financial supervisory systems and to help formulate future directions to improve supervisory practices [1,10].

In recent years, financial authorities in numerous countries have moved toward establishing criteria ratings to increase the universality and effectiveness of supervision methods [1,10,8,3].

(1) United States

The Federal Financial Institution Examination Council (FFIEC) of the United States announced the establishment of the Uniform Financial Institutions Rating System in 1979, expressly stipulating that all financial supervisory authorities should adopt the CAMELS rating system (comprising capital adequacy, asset quality, management capability, earnings, liquidity, and sensitivity to market risk as assessment items) to assess bank credit on a scale from 1 to 5 (1 representing sound credit and 5 indicating extreme instability). In a study on the effectiveness of the CAMELS rating system for assisting supervisory authorities in monitoring financial institutions, Aebi et al. (2012) concluded that ratings results effectively grasped the overall conditions of financial institutes within 1.5 to 3 years. Additionally, the FFIEC adopted the ROCA (risk management, operational controls) rating method to monitor the branches of foreign banks in the United States. The rating items are risk management, operational controls, legal compliance, and asset quality. The purpose of ROCA is to assess the operating conditions of the branches of foreign banks in the United States and to identify matters that should be noted during supervision.

(2) United Kingdom

The Financial Services Authority (FSA) of the United Kingdom has adopted the advanced risk response operating framework (ARROW) risk assessment model to audit banks. Swami (2014) indicated that this risk assessment model examines the policy development and implementation, internal controls, risk management, accounting policies, and account and money laundering controls of financial institutions. The FSA began implementing a new bank risk assessment system in 2003. This risk assessment model comprised four groups of business risks (strategic risks; market, credit, and operational risks; financial soundness; and customer nature and services) and six control groups (customer treatment; organization; internal systems and controls; board of directors; management and staff; and culture of business and regulatory compliance)[3].

(3) Japan

Japans Financial Services Agency began adopting the new financial inspection rating system in 2006. The inspection operations manual from the Inspection Bureau of the Financial Services Agency indicates that the rating items comprise legal compliance, customer protection and other management, aggregate risk management, capital management, credit risk management, asset quality management, market risk management, liquidity risk management, and operational risk management. Assessors assign each item a rating of A, B, C, or D. A indicates that a management system is extremely sound, B indicates that a management system is not entirely adequate, C indicates that a management system is inadequate, and D indicates that a management system possesses serious deficiencies [8].

2.3 Banking Supervision System and Laws in Taiwan

An integrated financial supervision model is used for financial supervision in Taiwan. The Financial Supervisory Commission (FSC), an independent agency, is responsible for financial supervision. The FSC comprises a commission, the Banking Bureau, the Securities and Futures Bureau, the Insurance Bureau, and the Financial Examination Bureau. The FSC is responsible for the development, supervision, management, and inspection of the financial market and the financial services industry. The financial market comprises the banking market, the money market, the stock market, the commodity futures and financial derivatives market, the insurance market, and the clearing system. The financial services industry comprises the Taiwan Financial Holdings Group, the Resolution Trust Corporation, the Central Deposit Insurance Corporation, the banking industry, the securities industry, the futures

industry, the insurance industry, the electronic financial transactions industry, and other financial service industries.

Based on literature collected and analysis, the organizational functions of the FSC can be classified as follows [11,6]:

(1) Managing the financial system and supervision policies.
(2) Formulating, amending, and repealing financial laws.
(3) Supervising and managing financial institutions, including establishment, revocation, repeal, change, merge, closure, dissolution, and approval of business scope.
(4) Supervising and managing the development of the financial market.
(5) Inspecting financial institutions.
(6) Inspecting matters related to public companies and the stock market.
(7) Managing international financial matters.
(8) Protecting financial consumers.
(9) Banning, punishing, and handling violations of finance-related laws.
(10) Collecting, compiling, and analyzing statistics on financial supervision, management, and inspection.
(11) Other matters related to financial supervision, management, and inspection.

The financial inspection laws involved include the Organic Act Governing the Establishment of the FSC, the Banking Act, the Financial Holding Company Act, the Act Governing Bills Finance Business, the Securities and Exchange Act, and the Insurance Act [11].

3 Methodology

After reviewing the bank rating and auditing systems used by government supervisory authorities in numerous countries, a criteria system for the assessment of banking supervision was established. The criteria comprised 12 evaluation criteria with four dimensions: financial soundness, legal compliance, consumer protection, and risk management. The criteria are detailed as follows:

(1) Financial Soundness: Capital adequacy, asset quality, profitability, and liquidity.
(2) Legal Compliance: Supervision of the board of directors and management, compliance with major laws, and deficiency improvement management.
(3) Consumer Protection: Soundness of operational controls and handling of consumer complaints.
(4) Risk Management: Credit risk management, market risk management, and operational risk management.

Earlier studies on criteria for financial supervision possessed two deficiencies. First, the majority of studies assumed that competing criteria were independent of each other without any mutual influence or causal relationship. Second, a number of studies assumed that the weights of the assessment criteria were identical. To remedy these deficiencies, the new DEMATEL was used in this study. First, assessment indicators for banking supervision were investigated. Second, the causal relationships and mutual influences among the criteria were explored. Finally, methods for improving the functions and benefits of banking supervision were discussed.

3.1 Decision Making Trial and Evaluation Laboratory

The DEMATEL originated in 1971 in the Science and Human Affairs Program of the Geneva Research Center of the Battelle Memorial Institute. In the early stages of development, the DEMATEL focused primarily on complex world problems, such as race, hunger, the environment, and energy. The DEMATEL was used in three main fields of research at the time: (1) studying the structural problems of the world; (2) responding to complex world problems and analyzing and developing adaptation methods; and (3) reviewing research, models, and data on world problems [16,15,13,18,22,14].

Chiu et al. (2006) stated that the DEMATELs method of using direct relationship graph to reveal the structures of complex causal relationships is extremely practical. Directed relation graphs can be used to explain the influences between and the directions of the elements within a system and to divide all guidelines into two categories: a cause group and an effect group. Lee et al. (2008) also indicated that a feature of the DEMATEL method is that it uses matrix operations to calculate the causal relationships and influences among factors. It also uses cause-and-effect diagrams to structure complex problems and clarify the root of the problem, thus identifying the core problems and methods for improvement.

DEMATEL model is suitable for expert questionnaire, and is not suitable for the public questionnaire. The number of experts may be less, but they should very specialize in the study issue. When applying the DEMATEL method, the analytical elements involved must satisfy several assumptions [24,19,23]:

(a) The nature of problems must be explicit: During the problem forming and planning stage, the nature of problems must be clearly defined to correctly establish the direction of the solution to the problem.
(b) Correlations between problems must be clearly expressed: The degree of correlation between each problem element is represented by 0, 1, 2, 3, and 4.
(c) The intrinsic properties of each problem element must be understood: Additional descriptions (including agreements and disagreements) are provided for each problem element and related problems.

In recent years, numerous scholars have noted the practicality of the DEMATEL method. Scholars have

applied this method extensively in a variety of studies to help improve the quality and effectiveness of decision analysis. These studies have covered various systems of assessment and selection [26,17], service quality in various industries [19,25], assessment of competitive strategies in manufacturing companies [23], and assessment of green production [20].

The operation steps of the DEMATEL are explained as follows:

Step 1: Establish a measurement scale and determine the strength of the causal relationships among the factors.

Literature reviews, brainstorming, and expert opinions are used to list and define the factors influencing a complex system. Next, a scale of degree of influence is designed. The factors are compared to understand the degree of the causal relationships among the factors.

Step 2: Establish a direct-relation matrix.

When the meanings represented by the measurement scale are understood, questionnaires can be used to invite experts to compare the mutual relationships among the factors and their degrees. A direct-relation matrix can ultimately be formed. Each value in the matrix represents the degree of mutual influence between factors. The diagonal value in the direct-relation matrix is set to 0.

$$X = \begin{bmatrix} 0 & x_{12} & \cdots & x_{1n} \\ x_{21} & 0 & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & 0 \end{bmatrix} \tag{1}$$

Step 3: Calculate the regularized direct-relation matrix. Use column vectors and maximums as normalization references.

$$\lambda = \frac{1}{\max\limits_{1\le i\le n}\left(\sum\limits_{j=1}^{n} x_{ij}\right)} \tag{2}$$

$$N = \lambda X \tag{3}$$

Step 4: Calculate the direct-indirect-relation matrix T. This is also called the total-relation matrix.

$$T = \lim_{k\to\infty}(N + N^2 + \cdots + N^k) = N(I-N)^{-1} \tag{4}$$

Step 5: Calculate the sum of each column and row.
Sum every column and row in the total-relation matrix T. Use D_i as the sum of column i and R_j as the sum of row j to obtain values D_i and R_i. These values encompass the indirect and direct influences.

$$D_i = \sum_{j=1}^{n} t_{ij} \qquad (i = 1,2,\cdots,n) \tag{5}$$

$$R_j = \sum_{i=1}^{n} t_{ij} \qquad (j = 1,2,\cdots,n) \tag{6}$$

Step 6: Draw the DEMATEL cause-and-effect diagram.
Define $(D+R)$ as prominence and $k = i = j = 1,2,\cdots,n$, representing the total relationships that influence and are influenced by these criteria. This shows the core degree of criterion k in the problem. $(D-R)$ is defined as the relation, which indicates the degree of difference to which a criterion influences and is influenced by other criteria. This value indicates the degree of cause and effect of criterion k in the problem. If the value is positive, the criterion is likely to be in the cause class. If the value is negative, the criterion is likely to be in the effect class. $(D+R)$ is the horizontal axis and $(D-R)$ the negative axis of the cause-and-effect diagram. The figure simplifies complex causal relationships into visual structures that are easy to understand. Decision makers can understand the categorization of each factor based on the locations of the factors and plan appropriate decisions to solve problems based on their degrees of influence. When $(D_k - R_k)$ is positive, property k belongs to the cause class. If $(D_k - R_k)$ is negative, property k belongs to the effect class. When $(D_k + R_k)$ increases, this indicates that the extent to which the property influences and is influenced by other properties is increasing. Properties can be divided into the following four classes based on the coordinate positions of $(D_k + R_k)$ and $(D_k - R_k)$.

(1) $(D_k - R_k)$ is positive and $(D_k + R_k)$ is high: This indicates that the property belongs to the cause class and is a driving factor in solving problems.
(2) $(D_k - R_k)$ is positive and $(D_k + R_k)$ is low: This indicates that the property is independent and can influence only a small number of other properties.
(3) $(D_k - R_k)$ is negative and $(D_k + R_k)$ is high: This indicates that the property is a core problem to be resolved. However, because it belongs to the effect class, it cannot be improved directly.
(4) $(D_k - R_k)$ is negative and $(D_k + R_k)$ is low: This indicates that the property is independent and is influenced by only a small number of other properties.

4 Results and Discussion

4.1 Questionnaires

The questionnaire on assessment criteria for financial supervision covered four dimensions and 12 criteria. The four dimensions were financial soundness, legal compliance, consumer protection, and risk management. The 12 assessment criteria were capital adequacy (a1), asset quality (a2), profitability (a3), and liquidity (a4); supervision of the board of directors and management (b1), compliance with major laws (b2), and deficiency improvement management (b3); soundness of operational controls (c1) and handling of consumer complaints (c2); and credit risk management (d1), market risk management (d2), and operational risk management (d3). The DEMATEL questionnaires were distributed between July 16, 2014, and July 30, 2014. The measurement scale was a 10-point scale, with 9 representing maximal influence and 0 representing no influence. The scores between these two values were sequential ratings based on value. A group of Taiwanese experts provided personal opinions on assessment criteria for banking supervision in Taiwan. The recipients of the questionnaires were 14 experts, comprising five professors of finance, five general managers of banks, and four officials from government regulatory units. The authors personally interviewed each expert. The experts completed the questionnaires after the questionnaire content was explained to them. A total of 14 formal questionnaires were distributed and 14 valid questionnaires were collected, for a valid response rate of 100%.

4.2 Results

This study used Matlab software to calculate. The scores from the 14 experts were averaged and rounded to one decimal place to create a table of 12 criteria, as shown in Table 1.

Next, the normalized direct-relation matrix was calculated using column vectors and maximums as benchmarks for normalization. The reciprocal of the maximum value 65.4 within the sum of each column was the λ value. Using Equation (2), the direct-relation matrix X was multiplied by the λ value to obtain the normalized direct-relation matrix N. The influence coefficient was rounded to two decimal places (Table 2).

Equations (3) and (4) were then used to calculate the total-relation matrix T, as shown in Table 3.

Equations (5) and (6) were used to calculate value D_i of each column and value R_j of each row to obtain prominence $(D+R)$ and relation (DR), as shown in Table 4. In addition, the 12 criteria were drawn into a figure with prominence as the horizontal axis and relation as the vertical axis, as shown in Fig. 1.

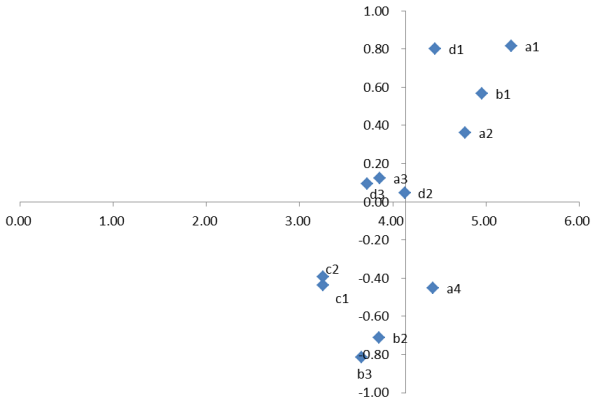

Fig. 1: Mutual influences among the 12 criteria

4.3 Discussion

Based on the analysis results from Table 4 and Fig. 1, the causality and mutual influence of the 12 assessment criteria for financial supervision are explained as follows:

(1) High relation and high prominence: This category contained a1, a2, b1, and d1. These four criteria were properties in the cause category and were core influences on the other criteria. This indicates that these were driving factors and critical problem-solving factors.
(2) High relation and low prominence: This category contained a3, d2, and d3. These three criteria influenced only a small number of the other properties, and their influence was extremely weak. This indicates that these properties were relatively independent.
(3) Low relation and high prominence: This category contained only a4. This criterion was in the effect category and was influenced by the other properties. Although a4 was a property that required improvement, it could not be directly improved because it was in the effect class. Therefore, a4 was relatively irrelevant.
(4) Low relation and low prominence: This category contained b2, b3, c1, and c2. These four criteria were influenced by other properties. However, the influences were small. This indicates that these properties were relatively independent.

In summary, among the 12 assessment criteria for financial supervision, a1, a2, b1, and d1 exhibited high relation and high prominence. These were core properties that influenced the other properties. Improving and placing particular emphasis on these four properties could resolve core problems and also improve the competitive advantage of other properties. Therefore, by focusing on improving these four properties, financial supervisory authorities can achieve immediate performance improvements.

Table 1: Initial direct-relation matrix *X*

Criteria	a1	a2	a3	a4	b1	b2	b3	c1	c2	d1	d2	d3
a1	0.0	7.3	4.6	8.2	6.3	5.1	5.5	4.6	4.6	7.2	7.3	4.7
a2	6.3	0.0	4.6	6.1	5.3	5.2	4.2	4.5	5.6	4.2	4.6	4.5
a3	4.2	4.2	0.0	6.4	4.2	4.5	3.1	3.2	3.1	3.3	3.4	2.3
a4	6.2	5.1	5.2	0.0	4.4	4.4	3.5	3.2	2.3	2.4	2.1	2.2
b1	5.3	5.3	3.4	4.7	0.0	7.6	8.2	4.5	4.6	5.7	6.2	5.1
b2	2.4	2.5	2.4	3.2	3.4	0.0	5.6	3.2	3.6	2.4	2.6	2.7
b3	2.4	2.4	2.7	3.4	3.1	2.8	0.0	2.4	2.7	2.8	2.5	2.6
c1	2.5	2.3	2.9	3.3	2.7	2.9	3.2	0.0	2.6	2.7	2.5	2.1
c2	2.6	2.4	2.8	3.5	3.1	2.5	3.1	2.5	0.0	2.5	2.8	2.1
d1	6.5	6.8	2.4	7.2	4.5	4.3	4.2	4.2	3.7	0.0	5.6	6.2
d2	4.8	5.2	4.2	3.4	5.4	4.7	3.5	3.3	2.7	2.5	0.0	3.9
d3	4.3	3.5	4.1	3.1	4.4	4.6	3.3	3.4	2.9	2.7	3.9	0.0

Table 2: Normalized direct-relation matrix *T*

Criteria	a1	a2	a3	a4	b1	b2	b3	c1	c2	d1	d2	d3
a1	0.00	0.11	0.07	0.13	0.10	0.08	0.08	0.07	0.07	0.11	0.11	0.07
a2	0.10	0.00	0.07	0.09	0.08	0.08	0.06	0.07	0.09	0.06	0.07	0.07
a3	0.06	0.06	0.00	0.10	0.06	0.07	0.05	0.05	0.05	0.05	0.05	0.04
a4	0.09	0.08	0.08	0.00	0.07	0.07	0.05	0.05	0.04	0.04	0.03	0.03
b1	0.08	0.08	0.05	0.07	0.00	0.12	0.13	0.07	0.07	0.09	0.09	0.08
b2	0.04	0.04	0.04	0.05	0.05	0.00	0.09	0.05	0.06	0.04	0.04	0.04
b3	0.04	0.04	0.04	0.05	0.05	0.04	0.00	0.04	0.04	0.04	0.04	0.04
c1	0.04	0.04	0.04	0.05	0.04	0.04	0.05	0.00	0.04	0.04	0.04	0.03
c2	0.04	0.04	0.04	0.05	0.05	0.04	0.05	0.04	0.00	0.04	0.04	0.03
d1	0.10	0.10	0.04	0.11	0.07	0.07	0.06	0.06	0.06	0.00	0.09	0.09
d2	0.07	0.08	0.06	0.05	0.08	0.07	0.05	0.05	0.04	0.04	0.00	0.06
d3	0.07	0.05	0.06	0.05	0.07	0.07	0.05	0.05	0.04	0.04	0.06	0.00

Table 3: Total-relation criteria matrix *T*

Criteria	a1	a2	a3	a4	b1	b2	b3	c1	c2	d1	d2	d3
a1	0.19	0.29	0.23	0.32	0.28	0.27	0.27	0.22	0.22	0.26	0.28	0.22
a2	0.25	0.16	0.20	0.26	0.23	0.24	0.22	0.20	0.21	0.19	0.21	0.19
a3	0.19	0.18	0.11	0.23	0.18	0.19	0.17	0.15	0.15	0.15	0.16	0.14
a4	0.21	0.20	0.18	0.14	0.19	0.19	0.18	0.15	0.14	0.14	0.15	0.13
b1	0.25	0.24	0.19	0.25	0.17	0.28	0.29	0.21	0.21	0.22	0.24	0.21
b2	0.13	0.13	0.12	0.15	0.14	0.10	0.18	0.13	0.13	0.11	0.13	0.12
b3	0.12	0.12	0.11	0.15	0.13	0.13	0.09	0.11	0.11	0.11	0.12	0.11
c1	0.12	0.12	0.12	0.14	0.13	0.13	0.13	0.07	0.11	0.11	0.12	0.10
c2	0.13	0.12	0.12	0.15	0.13	0.13	0.13	0.11	0.07	0.11	0.12	0.10
d1	0.26	0.26	0.18	0.28	0.23	0.23	0.22	0.20	0.19	0.14	0.23	0.22
d2	0.20	0.20	0.17	0.19	0.21	0.20	0.18	0.16	0.15	0.15	0.12	0.16
d3	0.18	0.17	0.16	0.18	0.18	0.19	0.17	0.15	0.14	0.14	0.17	0.10

5 Conclusion

Following financial liberalization and internationalization, financial innovation activities have become prevalent, banking has grown increasingly complex, and the risks in the financial system has increased. To respond to the rapid changes in the financial environment effectively, the leading countries in the global financial system have committed themselves to promoting financial reform. They are reviewing financial supervisory systems and financial regulations, improving financial supervisory technology, and urging banks to strengthen risk management and corporate governance to improve financial systems and increase financial competitiveness. In this study, financial supervision law was used as a foundation to investigate the assessment criteria and functions of banking supervision. The new DEMATEL was used in this study to assess and explore assessment indicators for banking supervision and to

Table 4: Summary table of prominence and relation.

Criteria	D	R	D + R	D - R
a1	3.04	2.23	5.27	0.82
a2	2.57	2.21	4.77	0.36
a3	1.99	1.87	3.86	0.12
a4	1.99	2.44	4.43	-0.45
b1	2.76	2.20	4.96	0.57
b2	1.57	2.28	3.85	-0.71
b3	1.42	2.24	3.66	-0.81
c1	1.41	1.85	3.25	-0.44
c2	1.43	1.82	3.25	-0.39
d1	2.63	1.83	4.46	0.80
d2	2.09	2.04	4.13	0.04
d3	1.91	1.81	3.72	0.09
Average	2.07	2.07	4.14	0.00

examine the causal relationships and mutual influences among the criteria. Finally, methods for improving the functions and benefits of financial supervision were discussed. Among the 12 assessment criteria for financial supervision, capital adequacy (a1), asset quality (a2), supervision of the board of directors and management (b1), and credit risk management (d1) exhibited high relation and high prominence. These were core properties influencing the other properties. By actively improving and placing particular emphasis on these four properties, core problems can be solved and improvements in performance will be seen immediately. Subsequent studies can use the DEMATEL model and select various problems and situations to develop other evaluation systems.

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References

[1] Aebi, V., Sabato, G. & Schmid, M. 2012. Risk management, corporate governance, and bank performance in the financial crisis. Journal of Banking & Finance, **36**(12), 3213-3226.

[2] Benjamin, C. & Charles, C. 2014. Bank Panics, Government Guarantees, and the Long-Run Size of the Financial Sector: Evidence from Free-Banking America. Journal of Money Credit and Banking, **46**(5), 961-997.

[3] Swami, M. B. 2014. The Impact of liberalization of regulation in Banking Sector: Case Study of Botswana Banking Sector. Open Journal of Finance, **6**, 1-10.

[4] Shipra, Bansal & Yash, P. T. 2014. Comparative Study on Performance Evaluation of Large Cap Equity and Debt Mutual Fund Schemes. Open Journal of Finance, **3**, 1-13.

[5] Hu, D.Q., 2003. Financial Supervision and Financial Inspection Practices. Taipei, Taiwan: Taiwan Academy of Banking and Finance.

[6] Huang, S.R., 2013. Consumer Finance and Risk Management. Taipei, Taiwan: Taiwan Academy of Banking and Finance.

[7] Berger, A. N., Hasan, I. & Zhou, M. 2009. Bank ownership and efficiency in China: What will happen in the world's largest nation? Journal of Banking & Finance, **33**(1), 113-130.

[8] Nuno, Ferreira & Manuela, M. O. 2014. An Analysis of Equity Markets Cointegration in the European Sovereign Debt Crisis. Open Journal of Finance, **6**, 11-19.

[9] Mora, N. 2014. Reason for Reserve? Reserve Requirements and Credit. Journal of Money Credit and Banking, **46**(2), 469-501.

[10] Jiang, G. J. & Lo, I. 2014. Private information flow and price discovery in the U.S. treasury market. Journal of Banking & Finance, 47(10), 118-133.

[11] Taiwan Academy of Banking and Finance, 2012. Internal Controls and Audits in Banks. Taipei, Taiwan: Taiwan Academy of Banking and Finance.

[12] Chiu, Y. C., Chen, B. S., Shyu, J. Z., & Tzeng, G. H. 2006. An evaluation model of new product launch strategy. Technovation, **26**(11), 1244-1252.

[13] Chuang, H.M., Lin C.K., Chen D.R. & Chen Y.S. 2013. Evolving MCDM applications using hybrid expert-based ISM and DEMATEL models: an example of sustainable ecotourism. Scientific World Journal, Dec 23, 2013: 751728. doi: 10.1155/2013/751728.

[14] Falatoonitoosi, E., Ahmed, S. & Sorooshian, S. 2014. Expanded DEMATEL for determining cause and effect group in bidirectional relations. Scientific World Journal, 2014 Feb 16, 2014: 103846. doi: 10.1155/2014/103846.

[15] Fontela, E., & Gabus, A. 1976. The DEMATEL Observer (DEMATEL 1976 Report). Switzerland, Geneva: Battelle Geneva Research Center.

[16] Gabus, A. and Fontela, E. 1973. Perceptions of the world problematique: Communication procedure, communicating with those bearing collective responsibility, DEMATEL report No. 1. Geneva, Switzerland: Battelle Geneva Research Center.

[17] Ho, L. H., Feng, S. Y., Lee, Y. C., & Yen, T. M. 2012. Using modified IPA to evaluate supplier's performance: Multiple regression analysis and DEMATEL approach. Expert Systems with Applications. **39**(8), 7102-7109.
[18] Lee, C. C., Chen, S. D. & Chen, C. L. 2012. A Computation-Efficient Three-Party Encrypted Key Exchange Protocol. Applied Mathematics & Information Sciences, **6**(9), 573-579.
[19] Lee, Y. C., & Hsieh, Y. F. 2011. Integration of revised simultaneous importance performance analysis and decision making trial and evaluation laboratory: A study of the mobile telecommunication industry in Taiwan. African Journal of Business Management, **5**(6), 2312-2321.
[20] Lee, Y. C., Chen, C. Y., Tsai, S. B. & Wang, C. T. 2014. Discussing Green Environmental Performance and Competitive Strategies. Pensee, **76**(7), 190-198.
[21] Lee, Y. C., Hu, H. Y., Yen, T. M., & Tasi, C. H. 2008. Kano's model and decision making trial and evaluation laboratory apply to order-winners and qualifiers improvement: A study of computer industry. Information Technology Journal, **7**(5), 702-714.
[22] Lei, X., Jin, M. Z., Lin, S. Q. & Ren, P. Y. 2012. Multipath Delay Estimation by Jammed Pilot in OFDM System. Applied Mathematics & Information Sciences, **6**(9), 639- 647.
[23] Tsai, S. B., Lee, Y. C., Wu, C. H. & Guo, J. J. 2013. Examining How Manufacturing Corporations Win Orders. South African Journal of Industrial Engineering, **24**(3), 112-124.
[24] Wu, H. H., Chen, H. K. & Shieh, J. I., 2010. Evaluating performance criteria of employment service outreach program personnel by DEMATEL method. Expert Systems with Applications, **37**(7), 52195223.
[25] Wu, W. W., Lan, L. W., & Lee, Y. T. 2013. Factors hindering acceptance of using cloud services in university: A case study. The Electronic Library, **31**(1), 84-98.
[26] Yang, J. L. & Tzeng, G. H. 2011. An integrated MCDM technique combined with DEMATEL for a novel cluster-weighted with ANP method. Expert Systems with Applications, **38**(3), 1417-27.

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