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A HYBRID FINANCIAL PERFORMANCE EVALUATION MODEL FOR WEALTH MANAGEMENT BANKS FOLLOWING THE GLOBAL FINANCIAL CRISIS

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Abstract. The study constructs a hybrid approach to financial performance evaluation for wealth management (WM) banks affected by the global financial crisis from the middle of 2007 into 2008 utilizing an analytic hierarchy process (AHP) and the VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR). Five aspects of multi-criteria group decision making including service, performance, professionalism, risk control, and consumers' confidence (SPPRC) reveal that consumers' confidence, risk control and service are the top three key factors for Taiwan's seven main WM banks in evaluating the performance of banking managers.

Keywords: wealth management, global financial crisis, performance evaluation, AHP, VIKOR, SPPRC.

JEL Classification: C44, C69, G01, G21, G32, M21.

Introduction

The global financial crisis from the middle of 2007 and into 2008 caused a significant decline in overall international economic activity and is considered by leading economists to be the most serious financial disaster since the Great Depression (Yuan *et al.* 2010). Many studies have analysed the financial and economic circumstances associated with the U.S. sub-prime mortgage crisis and the global financial turmoil that has led to severe crises in many countries (Demyanyk, Hasan 2010; Feldman 2010; Ji, In 2010; Kenc, Dibooglu 2010; Yuan *et al.* 2010; Moshirian 2011; Chor, Manova 2012; Hansen 2012). For instance, Aloui *et al.* (2011) addressed the extent of the extreme interdependences and contagion effects between emerging and U.S. markets, and among emerging markets themselves, in the context of the global

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financial crisis. Chudik and Fratzscher (2011) analysed and compared the role of tightening in-liquidity conditions and the collapse in risk appetite played in the global transmission of the financial crisis. The purpose of the aforementioned studies was that they mainly focused on financial risk and its impact on regulation and the role of national government policies in influencing financial markets.

To evaluate this crisis and arrive at a more comprehensive financial performance evaluation approach for wealth management (WM) banks, the present study assesses the overall framework of the financial markets and their performance criteria and measurement in Taiwan's WM banking industry after the financial crisis. WM is an advanced type of financial planning that provides high-net-worth individuals and families with private financial services, such as asset management, banking, estate planning, investment management, and legal resources (Wu *et al.* 2009a, 2010, 2011a; Yu, Ting 2011). WM banking services typically include portfolio management and rebalancing, investment management and strategies, trust and estate management, private banking and financing, tax consulting, and family-office structuring. Therefore, WM products could contain stocks and stock trading, equity-linked investment, structured savings, structured investments and derivatives, foreign exchange, mutual funds and unit trusts, property management and investments, and alternative investments (e.g., art, wine, precious metals, and property) (Wu *et al.* 2009a, 2010, 2011a).

Some previous studies have used a combination of a balanced scorecard (BSC) and analytic network process (ANP) or analytical hierarchy process (AHP) models (Wu *et al.* 2009a, 2010, 2011a) to evaluate and select WM banks. In their studies, the dimensions of financial services provided by WM banks have been examined from four perspectives including finance, the customer, internal business, and learning and growth derived from the BSC approach. However, risk management and confidence are missing. Some important issues related to product risks such as those pertaining to Lehman's minibonds and the operational risk of the bank have not been considered. In particular, a more complete risk control mechanism (Aebi *et al.* 2011) and how to recover the consumers' confidence in banking wealth management have become very important issues since the global financial crisis (Bernanke 2009; Committee on Capital Markets Regulation 2009; Shiller 2009; Davis 2010; Pratt *et al.* 2011). Studies have obviously been insufficient in number to evaluate the financial services sector influenced by the 2008 global financial crisis. Therefore, based on the SPPRC structure, which consists of five critical factors, namely, service (S) (Meyer, Markiewicz 1997; Wang, Lin 2009a; Yu, Ting 2011; Stankevičienė, Mencaitė 2012), performance (PE) (Meyer, Markiewicz 1997; Seçme *et al.* 2009; Wang, Lin 2009a; Wu *et al.* 2009b; Aebi *et al.* 2011; Stankevičienė, Mencaitė 2012), professionalism (PR) (Wu *et al.* 2009b, 2010, 2011a; Yu, Ting 2011; Wu 2012), risk controls (RC) (Meyer, Markiewicz 1997; Wang, Lin 2009a; Aebi *et al.* 2011; Yu, Ting 2011) and confidence (C) (Radcliffe, Schniederjans 2003; Oest, Franses 2008; Pratt *et al.* 2011; Hansen 2012) (SPPRC), this study constructs a more complete approach to the performance evaluation of the financial services provided by WM banks by utilising a multi-criteria decision making method (MCDM) in an AHP hierarchy (Zavadskas, Turskis 2011).

The remainder of this study is organised as follows. The second section reviews the relevant literature on the banking performance evaluation model. The third section presents the research method to describe the AHP and VIKOR methods as well as the sample and

approach to data collection. The fourth section presents the results and analyses. The fifth section discusses the results and implications. The final section presents the conclusions, limitations, and recommendations.

1. Performance evaluation in the banking and financial service sectors

This section briefly reviews the discussion in previous studies on the performance evaluation of the banking and financial services sectors. Performance evaluation is defined as the potential for the future successful implementation of actions in order to reach the firm's objectives and targets (Lebas 1995; Folan, Browne 2005; Rue, Byars 2005). In this section, a review of the different methods used by previous scholars (i.e., the AHP, BSC (balanced scorecard), and DEA (data envelopment analysis) approaches) in evaluating bank performance is presented (Javalgi *et al.* 1989; Mercan *et al.* 2003; Wu *et al.* 2009b, 2010, 2011a).

The analytic hierarchy process (AHP) is a well-known MCDM technique that was first introduced by Saaty (1980, 1990). AHP is a widely-used decision making tool in banking and financial service performance evaluation (Javalgi *et al.* 1989; Zopounidis 1999; Albayrak, Erensal 2005; Seçme *et al.* 2009; Wang, Lin 2009a, 2009b; Wu *et al.* 2009b, 2010, 2011a; Zavadskas, Turskis 2011; Stankevičienė, Mencaitė 2012). Javalgi *et al.* (1989) pointed out that AHP provides bank managers with the ability to integrate the multi-attribute preferences of consumers using hierarchical models to determine the bank's relative position in the marketplace. Seçme *et al.* (2009) analysed the financial and non-financial performance criteria for the performance evaluation of Turkish banks using fuzzy AHP and TOPSIS. Wu *et al*. (2011a) proposed a model that combined the balanced scorecard (BSC) and AHP sensitivity analysis to evaluate wealth management banks. In this study, the dimensions of financial services for wealth management banks have been taken from four perspectives derived from the BSC approach, viz. finance, customers, internal business and learning and growth.

The concept of the BSC was developed by Kaplan and Norton (1992) in a series of articles published in the *Harvard Business Review*. The BSC is a popular tool that is used by many businesses to evaluate their performance based on diverse aspects of their organisation. A large amount of research related to the banking and financial services industry has employed the BSC approach to evaluate performance (Davis, Albright 2004; Wu *et al.* 2010; Wu 2012). Davis and Albright (2004) proposed an empirical analysis that explores the effect of the BSC on a banking institution's financial performance. Wu *et al.* (2009b) applied the four perspectives of the BSC to construct a performance evaluation model for banking. Wu *et al*. (2010) proposed a combination of the BSC and an AHP-GRA hybrid model to evaluate wealth management banks. Wu (2012) proposed a structural evaluation methodology to link key performance indicators (KPIs) to a strategy map of the BSC for banking institutions.

Another important method used in the measurement of bank performances is DEA (Dekker, Post 2001; Lin, Zhang 2009; Che *et al.* 2010). The DEA methodology developed by Charnes *et al.* (1978, 1979) reveals the envelope of the best-practice production possibility set. Dekker and Post (2001) presented a new DEA model that circumvents the dilemma of choosing between the evils of specification error and finite sample error. Che *et al*. (2010) proposed a fuzzy analytic hierarchy process and data envelopment analysis (FAHP-DEA) to

solve bank loan decision problems. The FAHP is applied to collect related performance data, and the DEA is used to solve the loan decision problem by considering all criteria performance data leading to the identification of performance frontiers. Holod and Lewis (2011) developed a DEA model of bank efficiency that treats deposits as an intermediate product in the bank production process.

In sum, it can be proposed that the literature review based on the performance measurement of the banking and financial services sector clearly shows that different methods can be applied in this field. The main purpose of this study is to construct a performance evaluation model based on the SPPRC framework for the banks in the financial services sector. Depending on this, AHP is proposed as it aims at making performance evaluation more flexible and informative than the traditional methods. The performances of the top seven Taiwan wealth management banks are evaluated with the help of the AHP and VIKOR method and ranked accordingly.

2. Evaluation model and analytical methods

Following a review of the relevant literature and based on discussions with experts in the field of WM from banks, government, and academia, some of the most important selection criteria for the conduct of WM banks can be identified. For the purpose of illustration regarding our model, this study analyses seven distinct alternatives. The seven categories of alternatives are Bank A, Bank B, Bank C, Bank D, Bank E, Bank F, and Bank G. These criteria have been used in the proposed framework for the development of an AHP model. Appendix Table A1 provides a brief description of these seven main WM banks in Taiwan.

The evaluation procedure of this study consists of several steps, as shown in Figure 1. This first step is to identify the multiple criteria that are considered so that decision makers can make an objective and unbiased decision. The modified Delphi method (Murry, Hammons 1995) is adopted here to not only include expert opinions but also identify the antecedents of the integrated marketing communication-based model. After constructing a criteria framework, the criteria weights can be calculated by using AHP (Seçme *et al.* 2009; Wu *et al.* 2010; Stankevičienė, Mencaitė 2012; Zolfani *et al.* 2012). Finally, we will conduct a VIKOR approach to achieve the final ranking results (Wu *et al.* 2009b; Tsai *et al.* 2010a; Kuo, Liang 2011). Each of the following subsections provides a detailed description of each step.

2.1. Designation of the group of experts for the WM banks

Eighteen experts were selected from the banking sector, government, and academia. Since important weights for both types of experts are considered to be equal, to avoid the occurrence of bias, all experts that took part in this study had both academic and industry- related experience and also met the following conditions: (a) the experts from the banking sector had to hold a managerial position in either a WM bank or a financial holding company; (b) the experts from government had to have responsibilities related to the financial sector; and (c) the experts from academia had to analyse research topics related to WM banking.

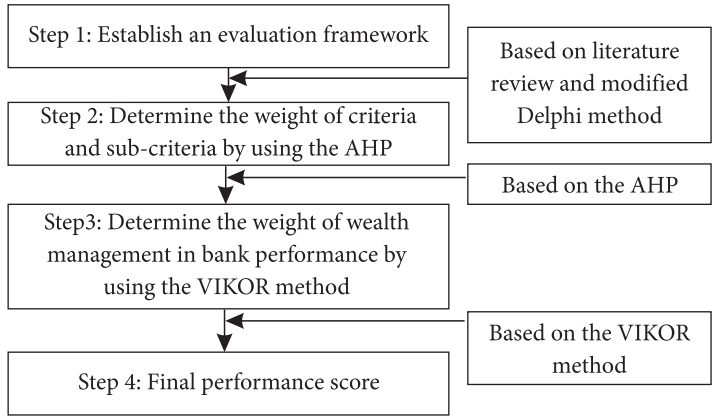

Fig. 1. Performance evaluation framework of the research

Experts selected in this study included twelve managers (i.e., managers who were working in the banking and financial services sector), three governmental officials (i.e., employees of the Financial Supervisory Commission, Executive Yuan), and three academicians (i.e., scholars whose principal research area was finance and banking).

2.2. Establishing an evaluation model and defining the evaluative criteria

The Delphi method accumulates and analyses the opinions of anonymous experts that communicate in written, discussion, and feedback formats on a particular topic (Stewart *et al.* 1999). Anonymous experts in this context share knowledge skills, expertise, and opinions until a mutual consensus is achieved (Stewart *et al.* 1999; Wu *et al.* 2007; Tsai *et al.* 2010b). The Delphi method consists of five procedures: (1) selecting anonymous experts, (2) conducting the first round of a questionnaire survey, (3) conducting the second round of the survey, (4) conducting the third round of the survey, and (5) integrating expert opinions in order to achieve a consensus. If a consensus cannot be reached after the first iteration, Steps (3) and (4) are normally repeated until a consensus is achieved. The results of a literature review and expert interviews can be used to identify and synthesise all common views expressed in the survey. In the modified Delphi method adopted here, Step (2) is simplified by replacing the conventional open-style survey.

To illustrate the use of this modified Delphi method, the present study develops quality evaluation criteria for wealth management banks by conducting interviews and surveys with anonymous experts that focus directly on the outcomes for the wealth management sector of interest (Stewart *et al.* 1999; Tsai *et al.* 2010b). Our study used nine experts to make up the modified Delphi method decision group, consistent with the recommendations of Delbecq *et al.* (1975) for the Delphi method group. To ensure non-interference among the contributing experts, the opinions of the selected experts were first gathered independently. These opinions were then synthesised by bank experts to identify the critical factors that need to be considered when examining bank performance.

From the five SPPRC perspectives, and based on a review of the literature, 45 evaluation indexes related to banking performance were summarised. We then introduced the experts to the modified Delphi method used in the questionnaires (Murry, Hammons 1995; Stewart *et al.* 1999) for screening the indexes' fit for the banking performance evaluation, and a consensus among experts was to be established regarding model reach. The descriptions of the criteria for the selection evaluation of a WM bank's performance are listed in Table 1 and Appendix Table A2 provides each supporting reference for the performance evaluation criteria and sub-criteria. For the purpose of illustrating the subject approach, this study analyses the following seven WM Banks, A, B, C, D, E, F, and G. Figure 2 illustrates the hierarchical framework of the SPPRC performance evaluation criteria (i.e., five dimensions and 25 indices) for WM banks. The five dimensions are "S: service (S_1–S_4)", "PE: performance (PE_1–PE_6)", "PR: professionalism (PR_1–PR_6)", "RC: risk controls (RC_1–RC_5)", and "C: confidence (C_1–C_4)".

Table 1. Descriptions of the selection evaluation indices for WM banking performance

Evaluation criteria	Evaluation sub-criteria	Description
Service (S)	VIP-certified financial service (S_1)	The provision to customers of complete VIP-certified financial services.
	Wealth managers' service attitude (S_2)	Wealth managers provide a good-service attitude to each customer.
	Customer service quality (S_3)	WM bank provides good-service quality for each customer.
	Consultancy convenience (S_4)	WM bank provides consultancy convenience for each customer.
Performance (PE)	Operational quality of customer groups' segmentation (PE1)	WM bank provides good operational quality to each customer group.
	Capacity for profitability (PE_2)	The various products and projects created by WM banks that serve to increase their capacity for profitability.
	Operational performance satisfaction (PE_3)	Sales revenue.
	Handling charge/ revenue (PE_4)	WM bank's revenue is earned by selling the customer's product.
	Customer market share ratio (PE_5)	Reflects the proportion of business that a business unit sells in a given market.
	Customer satisfaction (PE_6)	Customer satisfaction with products and services.
Professionalism (PR)	Education and training of wealth managers (PR_1)	Includes wealth management knowledge, the use of teleconferencing, and the attainment of basic professional certificates.
	Financial products' innovation capacity (PR_2)	WM bank creates new financial products capacity.
	Integration IT and customer data (PR_3)	WM bank can integrate IT and customer data.

End of Table 1

Evaluation criteria	Evaluation sub-criteria	Description
	Professional information support capacity (PR_4)	WM bank develops their professional information support capacity.
	Certified financial integration platform for professionals (PR_5)	WM bank provides the certified financial integration platform for professional VIP customers.
	Taking the lead in innovation system programming (PR_6)	WM bank measures how well a WM bank accedes to innovation system programming in accordance with the wealth manager's professional knowledge and ability.
Risk Controls (RC)	Market risks (RC_1)	WM bank faces all wealth management market risks.
	Financial risks (RC_2)	How global financial risks affect the WM bank.
	Industries' business cycle movement (RC_3)	How industries' business cycle movements affect the WM bank.
	Customer risk control mechanism (RC_4)	WM bank provides a customer risk control mechanism.
	Secrecy of financial and customer data (RC_5)	WM bank provides secrecy on all customers' data and financial records.
Confidence (C)	Customer retention (C_1)	WM bank tracks, in absolute or relative terms, the rate at which a business unit retains, or maintains, ongoing relationships with its customers.
	Customers have confidence in the wealth managers (C_2)	Wealth managers improve the VIP services for customers and assure customers of confidentiality.
	Customer equity (C_3)	Customers' equity in WM bank.
	Brand reliability (C_4)	Customers' trust when they choose their WM bank.

2.3. Utilising AHP to determine the weight of criteria

The AHP is a well known MCDM technique that is still widely used in business, economics, and industry (Saaty 1980, 1990; Chou *et al.* 2004; Zavadskas *et al.* 2008; Wang, Lin 2009b; Sipahi, Timor 2010; Zavadskas, Turskis 2011; Stankevičienė, Mencaitė 2012; Tsai, Chang 2013). This section of the study focuses on the financial services of Taiwan's WM banking industry and on how the AHP technique for organising and analysing complex decisions can be applied to this industry (Zopounidis 1999; Wu *et al.* 2009b; Zavadskas, Turskis 2011).

As a decision method, AHP not only dissects a complex multi-criteria group decision problem into a hierarchy of more easily comprehended sub-problems (Saaty 1980; Tung, Tang 1998; Macharis *et al.* 2004; Zavadskas, Turskis 2011), but it is also a measurement theory that prioritises the hierarchy and consistency of judgmental data provided by a group of decision makers (Arbel, Orgler 1990; Javalgi *et al.* 1989; Lin *et al.* 2012). The AHP framework (Dong *et al.* 2008) was constructed in the form of a matrix, and, by solving the following equation, a local priority vector can be derived as an estimate of the relative importance associated

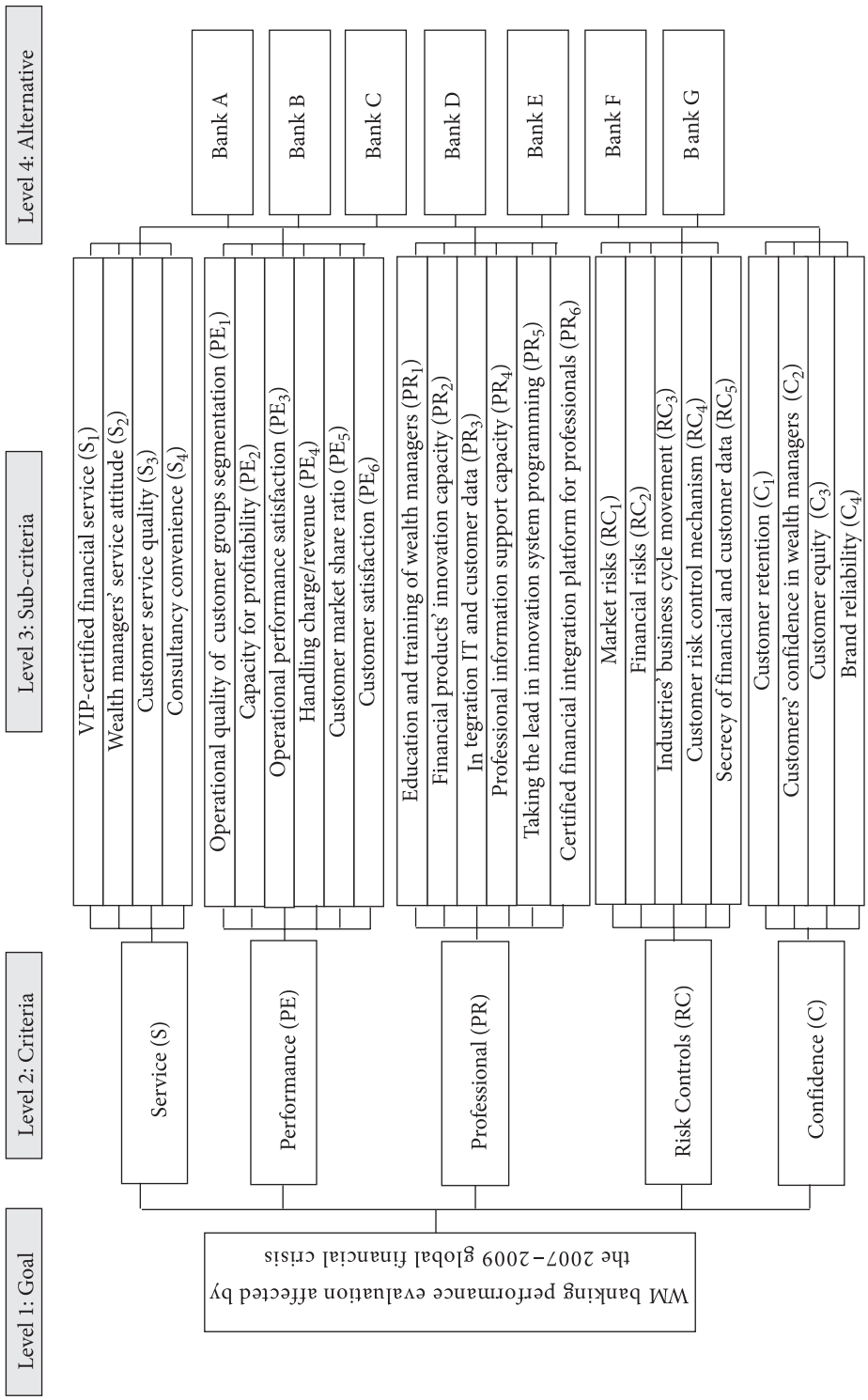

Fig. 2. Hierarchical framework of SPPRC performance evaluation criteria for WM banking as a result of the global financial crisis

with the elements (or components) being compared: $A \cdot w = \lambda_{\max} \cdot w$, where A is the matrix of pair-wise comparison, w is the eigenvector, and $\lambda_{\max}$ is the largest eigenvalue of A. Saaty (1980) proposed utilising a consistency index ($C.I. = \lambda_{\max} - n/n-1$) and consistency ratio ($C.R. = C.I./R.I.$) to verify the consistency of the comparison matrix, where *R.I.* represents the average consistency index over numerous random entries of the same order reciprocal matrices. If $C.R. \leq 0.1$, the estimate is accepted; otherwise, a new comparison matrix is solicited until $C.R. \leq 0.1$.

2.4. Utilising VIKOR to determine the WM banks' performance

The VIKOR method was proposed by Opricovic and Tzeng (2004). The basic concept of the VIKOR method is based on the compromise programming utilised in MCDM by comparing the measure of "closeness" to the "ideal" alternative (Opricovic, Tzeng 2004; Zavadskas, Turskis 2011). The various alternatives are denoted by $a_1, a_2 \ldots, a_m$. For an alternative a_i , the merit of the *j*th aspect is denoted by f_{ij} , that is, f_{ij} is the value of the *j*th criterion function for the alternative a_i .

The compromise ranking algorithm is summarised as follows (Opricovic, Tzeng 2004; Wu *et al.* 2009b; Kuo, Liang 2011; Wu *et al.* 2011b):

Step 1: Determine the best f_j^* and the worst f_j^- values of all criterion functions. Assume that the *j*th criterion function represents a benefit:

$$f_j^* = \max_i f_{ij}, \quad i = 1,2,3,\ldots,m, \quad f_j^- = \min_i f_{ij}, \quad i = 1,2,3,\ldots,m, \tag{1}$$

Step 2: Compute the values S_i and $R_i, i = 1,2,3\ldots,m,$ by the relations:

$$S_i = \sum_{j=1}^{n} w_j \left(f_j^* - f_{ij}\right) \Big/ \left(f_j^* - f_j^-\right); \tag{2}$$

$$R_i = \max_j \left[w_j \left(f_j^* - f_{ij}\right) \Big/ \left(f_j^* - f_j^-\right) \right], \tag{3}$$

where w_j is the weight of the *j*th criterion, expressing the DM's preference in terms of the relative importance of the criterion.

Step 3: Compute the values Q_i for $i = 1,2,3,\ldots,m,$ which are defined as:

$$Q_i = v\left[\frac{S_i - S^*}{S^- - S^*}\right] + (1-v)\left[\frac{R_i - R^*}{R^- - R^*}\right], \tag{4}$$

where $S^* = \min_i S_i$, $S^- = \max_i S_i$, $R^* = \min_i R_i$, $R^- = \max_i R_i$, and v is a weighting reference, v is introduced as the weight of the strategy of the maximum group utility, whereas $(1-v)$ is the weight of the individual regret. Thus, when the v reference is larger (>0.5), the index of Q_i will tend toward majority rule.

Step 4: Compute a compromise solution in which the alternative (a') is ranked the best by the measure Q (minimum) if it satisfies the following two conditions:

$Q(a'') - Q(a') \geq DQ$, which is called an "acceptable advantage".

In this equation, a'' is the alternative with the second position in the ranking list according to $DQ = 1/(J-1)$. J is the number of alternatives.

The decision-making process demonstrates acceptable stability. Alternative d must also be ranked the best by S and/or R. This solution is stable in a decision-making process, which could consist of "voting by majority rule" (when $v > 0.5$ is needed), "by consensus" $v \approx 0.5$, or "with veto" ($v < 0.5$). Here, v is the weight of the decision-making strategy with the max group utility.

If conditions are not fully satisfied, then a set of compromise solutions is proposed, as shown by the following two alternatives:

- Alternatives a' and a'' are used only if condition 2 is not satisfied.
- Alternatives a'; $a'', \ldots, a^{(M)}$ are used if condition 1 is not satisfied. $a^{(M)}$ is determined by the relation $Q\left(a^{(M)}\right) - Q(a') < DQ$ for maximum M.

The best alternative, ranked by Q, is the one with the minimum value of Q; the main ranking result is the compromise ranking list of alternatives and the compromise solution with the advantage rate (Tzeng *et al.* 2002; Opricovic, Tzeng 2004).

Ranking obtained by the VIKOR method requires the use of different values of the criteria weights and an analysis of the impact of the criteria weights on the proposed compromise solution. We determine the weight stability intervals by using the methodology presented in Opricovic (1998). The compromise solution gained with the initial weights ($w_i, i = 1, \ldots, n$) will be replaced if the value of a weight is missing from the stability interval. The analysis of the weight stability intervals for a single criterion is utilised for all criterion functions with the initial values of the weights. By doing so, the stability of the preferences in a gained compromise solution may be analysed utilising the VIKOR program (Opricovic, Tzeng 2004).

VIKOR is a tool that benefits MCDM in situations where the decision maker is unstable at the beginning of the system's design. In addition, decision makers accept the compromise solution because it provides a maximum group utility, which is represented by Min Q and a minimum individual regret, which is represented by Min R (Tzeng *et al.* 2002).

3. Empirical results for WM banking performance

The study uses the five perspectives, SPPRC, as the framework for establishing performance evaluation indices while AHP is introduced within this framework to obtain the weights of the indices. In addition, we utilise the MCDM analytical tool, VIKOR, to evaluate the respective financial performance of each WM bank. The comprehensive analysis is illustrated in the following steps:

Step 1: Establishing an evaluation framework.

Using the literature review and modified Delphi method (Wu *et al.* 2007), an evaluation framework is established; the evaluation framework is depicted in Figure 2.

Step 2: Application of AHP in determining the weights of the criteria and sub-criteria.

Based on the hierarchical framework of the SPPRC evaluation criteria and sub-criteria, the AHP questionnaire using the geometric mean method (GMM) was distributed among

the 18 experts for soliciting their professional opinions. Table 2 describes the aggregate pairwise comparison matrix for the criteria; the sub-criteria are listed in Appendix Table A3. The relative importance scores of each evaluation index analysed by the AHP are listed in Table 3.

Table 2. Aggregate pairwise comparison matrix for criteria of level 2

Criteria	S	PE	PR	RC	C
S	1.000	1.235	1.333	0.917	0.759
PE	0.810	1.000	1.067	0.739	0.607
PR	0.750	0.937	1.000	0.682	0.556
RC	1.091	1.353	1.467	1.000	0.828
C	1.318	1.647	1.800	1.208	1.000

Note: $\lambda_{max} = 5.072$; CI = 0.018; RI = 1.120; CR = 0.016 ≤ 0.1.

Table 3. Weights of the SPPRC evaluation indicators by AHP

Criteria	Weights for level 2	Sub-criteria	Weights for level 3	Weights of the overall
S	0.201	S_1	0.308	0.062 (3)
		S_2	0.198	0.040 (12)
		S_3	0.229	0.046 (8)
		S_4	0.265	0.053 (6)
PE	0.162	PE_1	0.158	0.026 (18)
		PE_2	0.115	0.019 (23)
		PE_3	0.105	0.017 (25)
		PE_4	0.196	0.032 (15)
		PE_5	0.144	0.023 (20)
		PE_6	0.281	0.045 (10)
PR	0.150	PR_1	0.256	0.039 (14)
		PR_2	0.131	0.020 (22)
		PR_3	0.195	0.029 (17)
		PR_4	0.159	0.024 (19)
		PR_5	0.139	0.021 (21)
		PR_6	0.119	0.018 (24)
RC	0.220	RC_1	0.139	0.030 (16)
		RC_2	0.168	0.037 (13)
		RC_3	0.200	0.044 (9)
		RC_4	0.237	0.052 (7)
		RC_5	0.256	0.056 (4-5)
C	0.267	C_1	0.159	0.042 (11)
		C_2	0.332	0.089 (1)
		C_3	0.299	0.080 (2)
		C_4	0.211	0.056 (4-5)

The results show that the critical order of the five SPPRC dimensions for the evaluation of WM banks is "S: Service (0.201)", "PE: Performance (0.162)", "PR: Professionalism (0.150)", "RC: Risk controls (0.220)", and "C: Confidence (0.267)". Table 2 presents the respective weights of the four indexes for the "Service perspective, S_1 (0.308), S_2 (0.198), S_3 (0.229), and S_4 (0.265)". The respective weights of the six indexes for the "Performance perspective are PE_1 (0.158), PE_2 (0.115), PE_3 (0.105), PE_4 (0.196), PE_5 (0.144), and PE_6 (0.281)". The respective weights of the six indexes for the "Professionalism perspective are PR_1 (0.256), PR_2 (0.131), PR_3 (0.195), PR_4 (0.159), PR_5 (0.139), and PR_6 (0.119)". The respective weights of the five indexes for the "Risk controls perspective are RC_1 (0.139), RC_2 (0.168), RC_3 (0.200), RC_4 (0.237), and RC_5 (0.256)". The respective weights of the four indexes for the "Confidence perspective are C_1 (0.159), C_2 (0.332), C_3 (0.299), and C_4 (0.211)".

The following are the synthesis values (overall weights) of the seven WM banks under the twenty-five sub-criteria: S_1 (0.062), S_2 (0.040), S_3 (0.046), S_4 (0.053), PE_1 (0.026), PE_2 (0.019), PE_3 (0.017), PE_4 (0.032), PE_5 (0.023), PE_6 (0.045), PR_1 (0.039), PR_2 (0.020), PR_3 (0.029), PR_4 (0.024), PR_5 (0.021), PR_6 (0.018), RC_1 (0.030), RC_2 (0.037), RC_3 (0.044), RC_4 (0.052), RC_5 (0.056), C_1 (0.042), C_2 (0.089), C_3 (0.080), and C_4 (0.056). As indicated in Table 2, the six most important evaluation indexes are "C_2: Customers have confidence in the wealth managers (0.089)", "C_3: Customer equity (0.080)", "S_1: VIP-certified financial service (0.062)", "RC_5: Secrecy of financial and customer data (0.056)", "C_4: Brand reliability (0.056)", and "S_4: Consultancy convenience (0.053)".

Step 3: Application of VIKOR in ranking alternatives.

The VIKOR approach ranks the performance of the seven WM banks based on the weights of the SPPRC performance evaluation indexes by AHP as shown in Table 4. Table 4 shows the performance matrix given by Eq. (1) with the best value f_j^* and the worst value f_j^-. The values of S_i and R_i obtained by Eqs (2) and (3) are shown in Table 5, while the computed value Q_i (with $v = 0, 0.5, 1$) using Eq. (4) and the preference order WM banks ranking are given in Table 6.

Table 4. Performance matrix with the best value and the worst value by VIKOR

Indices	Bank A	Bank B	Bank C	Bank D	Bank E	Bank F	Bank G	f_j^*	f_j^-
S_1	0.132	0.163	0.193	0.238	0.092	0.111	0.071	0.238	0.071
S_2	0.136	0.155	0.183	0.223	0.098	0.118	0.087	0.223	0.087
S_3	0.120	0.160	0.186	0.225	0.108	0.114	0.087	0.225	0.087
S_4	0.130	0.153	0.172	0.201	0.106	0.124	0.116	0.201	0.106
PE_1	0.161	0.130	0.244	0.192	0.071	0.111	0.091	0.244	0.071
PE_2	0.158	0.142	0.218	0.195	0.113	0.093	0.082	0.218	0.082
PE_3	0.156	0.130	0.221	0.175	0.106	0.092	0.119	0.221	0.092
PE_4	0.141	0.113	0.205	0.173	0.144	0.133	0.092	0.205	0.092
PE_5	0.157	0.125	0.235	0.167	0.106	0.097	0.113	0.235	0.097

End of Table 4

Indices	Bank A	Bank B	Bank C	Bank D	Bank E	Bank F	Bank G	f_j^*	f_j^-
PE_6	0.150	0.133	0.196	0.174	0.103	0.116	0.128	0.196	0.103
PR_1	0.168	0.126	0.184	0.220	0.101	0.120	0.081	0.220	0.081
PR_2	0.154	0.126	0.182	0.210	0.107	0.135	0.087	0.210	0.087
PR_3	0.159	0.129	0.199	0.245	0.089	0.102	0.077	0.245	0.077
PR_4	0.171	0.128	0.185	0.218	0.075	0.101	0.121	0.218	0.075
PR_5	0.146	0.118	0.177	0.211	0.108	0.113	0.127	0.211	0.108
PR_6	0.164	0.132	0.178	0.203	0.116	0.098	0.110	0.203	0.098
RC_1	0.237	0.107	0.149	0.208	0.087	0.121	0.092	0.237	0.087
RC_2	0.246	0.107	0.172	0.221	0.078	0.109	0.066	0.246	0.066
RC_3	0.232	0.111	0.150	0.195	0.101	0.120	0.091	0.232	0.091
RC_4	0.243	0.126	0.165	0.184	0.097	0.107	0.078	0.243	0.078
RC_5	0.198	0.110	0.154	0.170	0.127	0.139	0.102	0.198	0.102
C_1	0.155	0.139	0.227	0.187	0.081	0.101	0.110	0.227	0.081
C_2	0.154	0.128	0.237	0.177	0.081	0.117	0.107	0.237	0.081
C_3	0.172	0.128	0.234	0.189	0.071	0.111	0.096	0.234	0.071
C_4	0.158	0.151	0.220	0.181	0.071	0.103	0.117	0.220	0.071

Table 5. The values S_i and R_i by VIKOR

WM banks evaluation	S_i	R_i
Bank A	2.102 (3)	0.198 (3)
Bank B	3.334 (4)	0.234 (4)
Bank C	1.044 (2)	0.157 (2)
Bank D	0.669 (1)	0.128 (1)
Bank E	4.561 (7)	0.332 (7)
Bank F	3.972 (5)	0.255 (5)
Bank G	4.547 (6)	0.308 (6)

Note: () denotes ranking order.

Table 6. The preference order ranking by VIKOR for sensitivity analysis

WM banks evaluation	$Q_i[v=0]$	$Q_i[v=0.5]$	$Q_i[v=1]$
Bank A	0.378 (3)	0.373 (3)	0.368 (3)
Bank B	0.545 (4)	0.615 (4)	0.685 (4)
Bank C	0.000 (1)	0.197 (2)	0.096 (2)

End of Table 6

WM banks evaluation	$Q_i[v=0]$	$Q_i[v=0.5]$	$Q_i[v=1]$
Bank D	0.049 (2)	0.025 (1)	0.000 (1)
Bank E	1.000 (7)	1.000 (7)	1.000 (7)
Bank F	0.644 (5)	0.746 (5)	0.849 (5)
Bank G	0.890 (6)	0.943 (6)	0.996 (6)

Note: () denotes ranking order.

Step 4: Computing a compromise solution.

The final ranking result is judged and produced according to two cardinal conditions (C1 and C2) stated in Section 3.4 (Wu *et al.* 2011b). The judging methods are as follows:

– C1. "Acceptable advantage":

In this study (which postulates that v = 0.5), the DQ threshold value is 0.167 (DQ = 1/(7–1) = 0.167). According to the Q_i value in Table 6, the gap between the ranked first Bank D (0.025) and ranked second Bank C (0.197) is 0.172. Since 0.172 surpasses the acceptable profit threshold value 0.167, it meets the acceptable profit threshold of condition one (C1). Similarly, the gap of the Q_i value between the ranked second Bank C (0.197) and ranked third Bank A (0.373) is 0.176 greater than 0.167 and fits in condition one. The gap of the Q_i value between the ranked third Bank A (0.373) and the ranked fourth Bank B (0.615) is 0.242 (greater than 0.167), which implies that the acceptable profit threshold of condition one (C1) exists. However, the gap of the Q_i value between the ranked fourth Bank B (0.615) and ranked fifth Bank F (0.746) is 0.131, which does not surpass the acceptable profit threshold value 0.167. The result does not fit in with the acceptable profit threshold of condition one (C1). The gap of the Q_i value between the ranked fifth Bank F (0.746) and ranked sixth Bank G (0.943) is 0.197 (greater than 0.167) which meets the condition one (C1). Finally, the gap of the Q_i value between the ranked sixth Bank G (0.943) and ranked seventh Bank E (1.000) is 0.057, which is less than the acceptable profit threshold value 0.167. That is, the gap does not satisfy the condition one (C1).

– C2. "Acceptable stability in decision making":

As shown in Table 5, the S_i value and the R_i value of the ranked first Bank D in the Q_i value are superior to those of the ranked second Bank C which confirms the reliability of the analysis of the acceptable policy of condition two (C2). We also find that the condition two (C2) exists, while the S_i value and the R_i value of the ranked first Bank C (Bank B) in the Q_i value are superior to those of the ranked second Bank A (Bank F). Similarly, since the S_i value and the R_i value of the ranked first Bank A in the Q_i value are also higher than those for the ranked second Bank B, they confirm condition two (C2). The S_i value and the R_i value of the ranked first Bank F (Bank G) in the Q_i value are greater than those for the ranked second Bank G (Bank B) and they thus confirm the reliability of the analysis of the acceptable policy. Finally, condition two (C2) also exists in which the S_i value and the R_i value of the ranked first Bank G in the Q_i value are superior to those of the ranked second Bank E.

Based on the analysis results of the above two conditions, we have that $D > C > A > B \approx F > G \approx E$. This means that Bank D is superior to the other six banks. Bank D is thus the most successful bank. Consequently, Bank D should be the preferred choice because it has the "best relative weights".

Step 5: Sensitivity analysis using VIKOR.

The VIKOR sensitivity analysis-based decision-making method is used to construct an evaluation method, which can provide bank managers and other decision makers in the financial sector with a valuable reference for evaluating the WM banks' performance. In this study, the value of v is set to equal 0, 0.5, and 1 for the sensitivity analysis. Following the original survey result evaluation (which postulates that $v = 0.5$), the performance ranking order of the seven banks using VIKOR is Bank D > Bank C > Bank A > Bank B > Bank F > Bank G > Bank E. When $v = 0$, the banking performance ranking changes to Bank C > Bank D > Bank A > Bank B > Bank F > Bank G > Bank E, but does not change with that of $v =$ 1 as shown in Table 6. When the value of $v =$ is set to equal 0, Bank C is better than Bank D. This is because Bank C has the greatest weights for performance (0.215) and confidence (0.231) among the seven WM banks (see Table 7). Bank C received the first prize in the "Most Trust-worthy Award" and "Best Teamwork Among Financial Consultants and Best Performance Award" in 2011 (Business Today 2011).

Table 7. Weights of WM banking performance evaluation with respect to criteria

Indices	Bank A	Bank B	Bank C	Bank D	Bank E	Bank F	Bank G
Service (S)	0.129 (4)	0.158 (3)	0.183 (2)	0.221 (1)	0.101 (6)	0.117 (5)	0.091 (7)
Performance (PE)	0.152 (3)	0.128 (4)	0.215 (1)	0.178 (2)	0.109 (6)	0.111 (5)	0.107 (7)
Professionalism (PR)	0.161 (3)	0.127 (4)	0.185 (2)	0.219 (1)	0.099 (6)	0.112 (5)	0.098 (7)
Risk Controls (RC)	0.227 (1)	0.113 (5)	0.158 (3)	0.191 (2)	0.102 (6)	0.121 (4)	0.088 (7)
Confidence (C)	0.160 (3)	0135 (4)	0.231 (1)	0.183 (2)	0.076 (7)	0.109 (5)	0.106 (6)

Note: () denotes ranking order.

4. Discussions and practical management implications

This study conducted a performance analysis for the top seven Taiwan banks using an MCDM approach based on SPPRC perspectives following the global financial crisis. The AHP and VIKOR analytical methods were employed in the performance analysis for computing the weights of the criteria, ranking the banking performance and attempting to explain the differences among the seven banks, respectively.

4.1. Discussions

Based on the empirical results, we find that Bank D has the highest value among the seven banks; Bank E is the last on the list because of its having the lowest weight. Bank D has the highest weight for service (0.221) and professionalism (0.219); Bank C, ranked second, has the biggest weight for performance (0.215) and confidence (0.231); and Bank A, ranked third, has the greatest weight for risk controls (0.227) (see Table 7, the weights summary from Expert Choice Software 2000 2nd Edition).

As shown in Table 8, during the global financial crisis, Bank D is found to have the highest net fees and commissions (NFC) and net income (NI) among the seven banks (BankScope 2011). In 2010, Bank D also has the highest NFC and the NFC/NI ratio (180.84%) among the seven banks after the 2008 global financial crisis. Therefore, the NFC and NI data (during 2007–2010) give great support to our research results. According to the fifth questionnaire survey[1] conducted in Taiwan following the global financial crisis, the 2011 Wealth Management Bank Evaluation (Business Today 2011) indicated that Bank D was the best bank for wealth management in Taiwan, followed by Bank C, Bank A and Bank B among 19 domestic banks. The report further confirmed that Bank D won the prize for the best wealth management, service, professionalism, and products; Bank C won the prize for the best performance, confidence, and wealth management team; and Bank A won the prize for the best risk controls in 2011 (Business Today 2011).

Table 8. Seven banks' net fees and commissions and net income in 2007–2010

Year	2007			2008			2009			2010		
Bank	NFC (USD)	NI (USD)	NFC/ NI (%)	NFC (USD)	NI (USD)	NFC/ NI (%)	NFC (USD)	NI (USD)	NFC/ NI (%)	NFC (USD)	NI (USD)	NFC/ NI (%)
Bank A	248,735	103,519	240.28	192,508	183,459	104.93	184,565	161,983	113.94	261,346	249,949	104.56
Bank B	227,222	90,772	250.32	203,112	–118,924	–170.79	189,342	30,864	613.47	n.a.	n.a.	0
Bank C	100,463	79,969	125.63	82,482	23,827	346.16	98,052	55,059	178.08	154,720	136,663	113.21
Bank D	680,000	342,809	198.36	597,208	383,919	155.56	661,362	37,502	1763.52	88,778	452,763	180.84
Bank E	160,216	202,099	79.2	158,321	141,258	112.08	149,513	275,265	54.32	n.a.	n.a.	0
Bank F	2,438	2,370	102.86	23,258	–22,721	–102.36	142,332	159,135	89.44	371,449	502,750	73.88
Bank G	195,401	433,086	45.12	189,522	104,268	181.77	189,280	330,790	57.22	n.a.	n.a.	0

Note: Net fees and commissions (NFC); Net income (NI).
Source: BankScope Database (BankScope 2011).

[1] Business Today is a top weekly financial magazine in Taiwan. Following Euromoney, the magazine held the first wealth management banks' questionnaire survey, cooperating with Shih Hsin University and the Bankers' Association in 2007. The fifth wealth management banks' questionnaire survey was held in 2011.

Some previous studies have used a combination of a balanced scorecard (BSC), grey relational analysis (GRA), VIKOR, TOPSIS, and AHP models (Seçme *et al.* 2009; Wu *et al.* 2009b, 2010, 2011a; Stankevičienė, Mencaitė 2012) to evaluate bank performance. In Seçme *et al.* (2009), the dimensions of financial services provided by the five largest commercial banks in the Turkish banking sector have been examined from several financial (including capital adequacy, profitability, income expenditure structure, asset quality, liquidity, group share, and sectoral share) and non-financial indicators (including pricing, differentiation, marketing, service delivery, and productivity). In their study, the fuzzy AHP method is utilised to determine the weights of the main criteria and sub-criteria of the performance evaluation hierarchy and the TOPSIS method is used for ranking the banks in terms of their financial, non-financial and overall performance. Wu *et al.* (2009b) proposed a fuzzy multiple criteria decision-making (FMCDM) approach (i.e., SAW, TOPSIS, and VIKOR) for banking performance evaluation with BSC. A similar study, Wu *et al.* (2010, 2011a) applies the BSC method to build a performance evaluation framework for wealth management banks. The paper evaluates the business performance of wealth management banks in Taiwan by applying the AHP and GRA. Stankevičienė and Mencaitė (2012) proposed an analytic hierarchy process and GRA to evaluate the performance of banks' decision problems. In their study, they used three perspectives, namely, the customer perspective, financial perspective, and qualitative evaluation, as the framework for establishing performance evaluation indices while AHP was introduced within this framework to obtain the weights of the indices. In addition, their study utilised the GRA to evaluate the respective performance of each Lithuanian commercial bank.

In brief, it can be proposed that the literature analysis based on the measurement of bank performance clearly shows that different criteria, techniques, and methods can be applied in this field. With this in mind, we develop an SPPRC framework (including service, performance, professionalism, risk controls, and confidence) to consider these factors by combining the VIKOR method with an AHP approach. This method offers a more complete decision-making model especially designed to solve performance evaluation problems for wealth management banks following the global financial crisis.

4.2. Practical management implications

The results of this study offer the following practical management implications and performance evaluation strategies for the bank managers and other decision makers who wish to improve their performance following the global financial crisis. In considering the weights of the criteria and sub-criteria, we found "Service", "Risks controls", and "Confidence" to be the three most important criteria. Six sub-criteria including customers having confidence in the wealth managers, customer equity, VIP-certified financial services, secrecy of financial and customer data, brand reliability, and consultancy convenience are highly important. This indicates that WM banks should expend more efforts on customer service, the risk control mechanism, and customer confidence either simultaneously or subsequently. The banks should also provide more complete VIP service, confidential service, and consultancy convenience service. In addition, the most important confidence features are those that result in customer retention. When customers are trying to choose their WM bank, wealth manag-

ers must improve the VIP services for customers and assure customers that confidentiality, customer equity, and their trust will be maintained.

Hence, this study provides practitioners who manage WM banks with a process involving the use of an algorithm. First, they can choose the truly important criteria and sub-criteria for the evaluation of WM banks based on this concept of SPPRC and 25 indexes, rather than only on their working experiences or a traditional evaluation angle. Finally, they can formulate the best business management strategies especially after the global financial crisis.

Conclusions, limitations and recommendations

We propose an integrated MCDM approach for a financial performance evaluation approach to consumers' confidence have become top priority issues following the global financial crisis (Bernanke 2009; Committee on Capital Markets Regulation 2009; Shiller 2009; Davis 2010; Hansen 2012). This study addresses the parameters within which WM banks may integrate the structured AHP organisational and analytical process with the VIKOR procedure based on a performance measurement approach.

The empirical findings of this study can be summarised as follows. First, by integrating all the relevant literature reviews and experts' opinions, 25 indexes are selected as being suitable for banks' financial performance in terms of five perspectives, i.e., SPPRC, after the global financial crisis. Secondly, the empirical results of the MCDM illustrate the order of relative importance of the SPPRC for banking performance to be: confidence, risk controls, service, performance and professionalism. Consequently, consistent with arguments from Bernanke (2009), Shiller (2009) and Davis (2010) and the report of the Committee on Capital Markets Regulation (2009), confidence, risk controls and service are the most three important factors for WM banks in evaluating the performance of banking managers. Third, the weights of the AHP criteria reveal that the ranking of the banking performance of the seven main WM banks in Taiwan by employing the VIKOR analytical methods is Bank D, C, A, B, F, G, and E, respectively. In the illustrative examples cited in this study, Bank D should be the most effective organisation because it has the largest relative weight and appears to be reaching most of its desired performance measurement results. Thus, Bank D has won four out of 10 major awards in the "2011 Evaluation of Wealth Management Banks" by Business Today magazine, taking first place in terms of the overall evaluation and capturing "the Best Service Award", "the Best Professionalism Award" and "the Best Products Award". This has made Bank D the biggest winner among the 19 domestic banks evaluated for the fifth year by the weekly magazine. In fact, with its outstanding performance, Bank D has been rated as the Best Private Bank in Taiwan in terms of wealth management by Euromoney for the seventh consecutive year in 2011. It has also been evaluated by Private Banker International as the Best Local Private Bank in Taiwan in 2011. The realities of Bank D's performance following the financial crisis confirm our empirical findings.

Although our study contributes to the evaluation of banking performance following the financial crisis, it still has its limitations. Since we only studied risk management, customer service and confidence, and bank performance in Taiwan, and corporate governance has a significant influence on banking performance, our results cannot be generalised widely.

Moreover, although the criteria and features were edited according to suggestions from other academic researchers and high-level bank managers in Taiwan, we may have overlooked other important criteria and features. Practitioners within the financial services sector could, however, adopt our analytic approach to improve WM bank performance.

We hope the banking performance evaluation model in this study can be helpful to bank managers and other decision makers for creating a more complete performance evaluation system following the 2008 financial crisis. In a future study, we could utilise the fuzzy analytic network process (FANP) or decision making trial and evaluation laboratory (DEMATEL) to discuss the interactive and feedback relations among indexes of the SPPRC for enriching the research on the WM banking market.

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APPENDIX

Table A1. Brief description of seven alternatives among WM banks

Bank	Description
A	Bank A is the second main financial holding Co. in Taiwan. It now boasts 124 domestic and three overseas branches, with an extensive product line covering corporate and consumer banking, WM, credit cards, financing, trust, and public treasury, which enable the bank to offer one-stop-shopping for financial services.
B	Bank B was established in 1990. The bank's main services and banking options include deposits, loans, bills discounting, remittances, guarantees, short-term bills brokerage and proprietary trading, import and export negotiation, foreign-currency deposits, trusts, agencies, custodianship, credit cards, cash cards, trading in derivative products, factoring, and offshore banking.
C	Bank C was founded in 2002, and eventually expanded into the C Bank Conglomerate, which includes the following financial institutions: Commercial Bank Securities Co.; Insurance Brokers Co. and Venture Capital Co. These institutions have joined together and integrated the following six major resources for consistent professional total quality management (TQM) and service: brand names, corporate culture, human resources, products, information, and customer bases.
D	Bank D was established in 1966 as the China Securities and Investment Co. and has become Taiwan's third main financial holding Co. so far. In order to improve WM services, in 2006. Bank D was the first bank to launch the Financial Advisory Account service in Taiwan in 2006.
E	Bank E is a wholly-owned subsidiary of Taiwan's largest financial holding company. Bank E is a full-service bank serving consumers and businesses with over 100 branches and over 10 overseas offices.
F	Bank F is a major international bank, founded in 1812 as the City Bank of New York; later, it was renamed the First National City Bank of New York (Taiwan Branch). Bank F is now the consumer and corporate banking arm of financial service giant Citigroup, which had the largest holdings of any bank in the United States as of March 2007.
G	Bank G has come into being as a result of the merger of the International Commercial Bank of China and Chiao Tung Bank. Bank G is a leading Chinese financial services institution and a subsidiary of Financial Holding Company G. The bank offers deposits, loans, guarantees, documentary credits, remittances, bill purchases, offshore banking, trust business and foreign exchange trading.

Table A2. Supporting literature of the SPPRC performance evaluation criteria and sub-criteria

Criteria	Supporting literature	Sub-criteria	Supporting literature
S	Meyer, Markiewicz (1997); Wang, Lin (2009a); Stankevičienė, Mencaitė (2012)	S_1	Wu *et al.* (2010, 2011a); Wu (2012)
		S_2	Kuo (2009); Yu, Ting (2011); Wu (2012)
		S_3	Meyer, Markiewicz (1997); Wu (2012)
		S_4	Seçme *et al.* (2009); Yu, Ting (2011)
PE	Meyer, Markiewicz (1997); Seçme *et al.* (2009); Wang, Lin (2009a); Wu *et al.* (2009b); Aebi *et al.* (2011); Stankevičienė, Mencaitė (2012)	PE_1	Experts' suggestion
		PE_2	Meyer, Markiewicz (1997); Seçme *et al.* (2009); Wu *et al.* (2009b); Yu, Ting (2011); Stankevičienė, Mencaitė (2012)
		PE_3	Wu *et al.* (2009b); Stankevičienė, Mencaitė (2012); Wu (2012)
		PE_4	Wu *et al.* (2010, 2011a); Yu, Ting (2011)
		PE_5	Wu *et al.* (2009b); Wu *et al.* (2010, 2011a); Wu (2012)
		PE_6	Kuo (2009); Wu *et al.* (2009b); Wu *et al.* (2010, 2011a); Wong (2012); Wu (2012)

End of Table A2

Criteria	Supporting literature	Sub-criteria	Supporting literature
PR	Wu *et al.* (2009b, 2010, 2011); Büyüközkan *et al.* (2011); Yu, Ting (2011); Wu (2012)	PR_1	Wu *et al.* (2009b); Wu *et al.* (2010, 2011a); Wu (2012)
		PR_2	Wu *et al.* (2009b); Büyüközkan *et al.* (2011); Wu (2012)
		PR_3	Experts' suggestion
		PR_4	Wu *et al.* (2009b); Yu, Ting (2011)
		PR_5	Wu *et al.* (2010, 2011a)
		PR_6	Wu *et al.* (2010, 2011a)
RC	Meyer, Markiewicz (1997); Wang, Lin (2009a); Aebi *et al.* (2011); Yu, Ting (2011)	RC_1	Yu, Ting (2011)
		RC_2	Yu, Ting 2(011)
		RC_3	Experts' suggestion
		RC_4	Experts' suggestion
		RC_5	Experts' suggestion
C	Radcliffe, Schniederjans (2003); Oest, Franses (2008); Pratt *et al.* (2011); Hansen (2012)	C_1	Wu *et al.* (2009b); Benoit, Van den Poel (2012); Wu (2012)
		C_2	Experts' suggestion
		C_3	Hyun (2009); Shao, Chen (2011); Wong (2012)
		C_4	Sweeney, Swait (2008); Nam *et al.* (2011)

Table A3. Criteria for aggregate pairwise comparison matrix for sub-criteria of level 3

Service (S)	S_1	S_2	S_3	S_4		
S_1	1.000	1.550	1.333	1.179		
S_2	0.645	1.000	0.870	0.741		
S_3	0.750	1.150	1.000	0.857		
S_4	0.848	1.350	1.167	1.000		
Performance (PE)	PE_1	PE_2	PE_3	PE_4	PE_5	PE_6
PE_1	1.000	1.417	1.545	0.810	1.063	0.552
PE_2	0.706	1.000	1.091	0.591	0.812	0.414
PE_3	0.647	0.917	1.000	0.524	0.733	0.379
PE_4	1.235	1.692	1.909	1.000	1.375	0.690
PE_5	0.941	1.231	1.364	0.727	1.000	0.517
PE_6	1.813	2.417	2.636	1.450	1.933	1.000
Professionalism (PR)	PR_1	PR_2	PR_3	PR_4	PR_5	PR_6
PR_1	1.000	1.923	1.318	1.611	1.857	2.167
PR_2	0.520	1.000	0.684	0.812	0.929	1.083
PR_3	0.759	1.462	1.000	1.222	1.429	1.667
PR_4	0.621	1.231	0.818	1.000	1.143	1.333
PR_5	0.539	1.077	0.700	0.875	1.000	1.167
PR_6	0.461	0.923	0.600	0.750	0.857	1.000

End of Table A3

Service (S)	S_1	S_2	S_3	S_4	
Risk Controls (RC)	RC_1	RC_2	RC_3	RC_4	RC_5
RC_1	1.000	0.824	0.700	0.583	0.539
RC_2	1.214	1.000	0.850	0.708	0.654
RC_3	1.429	1.176	1.000	0.846	0.786
RC_4	1.714	1.412	1.182	1.000	0.993
RC_5	1.857	1.529	1.273	1.077	1.000
Confidence (C)	C_1	C_2	C_3	C_4	
C_1	1.000	0.514	0.514	0.720	
C_2	1.944	1.000	1.105	1.704	
C_3	1.944	0.905	1.000	1.370	
C_4	1.389	0.587	0.730	1.000	

Note: Service (S): $\lambda_{max} = 4.024$; CI = 0.008; RI = 0.900; CR = 0.009 ≤ 0.1; Performance (PE): $\lambda_{max} = 6.290$; CI = 0.058; RI = 1.240; CR = 0.047 ≤ 0.1; Professionalism (PR): $\lambda_{max} = 6.250$; CI = 0.050; RI = 1.240; CR = 0.040 ≤ 0.1; Risk Controls (RC): $\lambda_{max} = 5.224$; CI = 0.056; RI = 1.120; CR = 0.050 ≤ 0.1; Confidence (C): $\lambda_{max} = 4.054$; CI = 0.018; RI = 0.900; CR = 0.020 ≤ 0.1.

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