Binary choice models for external auditors decisions in Asian banks

Chrysovalantis Gaganis[1], Fotios Pasiouras[2], Sailesh Tanna[3], Constantin Zopounidis[1*]

[1]Financial Engineering Laboratory, Department of Production Engineering and Management, Technical University of Crete, University Campus, Chania, P.O 73100, Greece

[2]School of Management, University of Bath, BA2 7AY, Bath, UK

[3] Department of Economics, Finance and Accounting, Faculty of Business, Environment and Society, Coventry University, Priory Street, CV1 5FB, Coventry UK

Abstract

The present study investigates the efficiency of four classification techniques, namely discriminant analysis, logit analysis, UTADIS multicriteria decision aid, and nearest neighbours, in the development of classification models that could assist auditors during the examination of Asian commercial banks. To develop the auditing models and examine their classification ability, the dataset is split into two distinct samples. The training sample consists of 1,701 unqualified financial statements and 146 ones that received a qualified opinion over the period 1996-2001. The models are tested in a holdout sample of 527 unqualified financial statements and 52 ones that received a qualified opinion over the period 2002-2004. The results show that the developed auditing models can discriminate between financial statements that should receive qualified opinions from the ones that should receive unqualified opinions with a satisfactory accuracy. Both financial variables and the environment in which banks operate appear to be important. The highest classification accuracy is achieved by UTADIS, followed by logit analysis, nearest neighbours and discriminant analysis.

Keywords: Auditing, Bank, Classification

[*] Author for correspondence: Prof. Constantin Zopounidis, Tel: +30-28210-37236, E-mail: kostas@dpem.tuc.gr

1. Introduction

The recent crises in Asia and Latin America have shown that without effective regulation and supervision by the central banks and financial authorities the banking system might experience serious problems, with adverse consequences for the economy as a whole. As a result, the regulatory and supervisory framework in many countries is currently experiencing significant changes.

In a recent report, focusing on the implications of Basel II on Asian banks, Fitch (2005) points out that a number of Asian supervisors have expressed a clear intent to adopt Basel II as a key part of their bank supervisory regime. However, implementing Basel II and supervising Internal Ratings Based (IRB) banks will present challenges for Asian supervisors as more technical skills and resources will be required (Fitch, 2005). Another challenge will be to improve the quality of accounting and auditing standards. Obviously, accurate financial statements are necessary to all the stakeholders that want to assess the financial condition of banks. Hence, auditing standards are crucial, whatever reforms in the regulatory framework may be introduced, since with poor accounting, and auditing requirements, the quality and disclosure of financial statements can be out-of date or unreliable. However, Asia has been noted for an inadequate reporting, accounting and auditing framework that can partly explain why there was a lack of awareness among market participants and regulators [Shirai (2001)]. Therefore, much work needs to be done to ensure the effective and meaningful disclosure of financial information through improved accounting and auditing standards [Parrenas (2002)].

As Gunter and Moore (2003) point out, the increasing emphasis on the reliability of financial reporting has underlined the need for better understanding of the factors contributing to accounting inaccuracies and the methods by which such misstatements might be detected and corrected. However, despite its importance, research focusing on banks' auditing is limited compared to non-financial enterprises, with a few studies mainly focusing on the U.S and examining issues such as the pricing of audit services for financial institutions [Stein et al. (1994), Fields et al. (2004)], the loss underreporting and the auditing role of bank exams [Berger et al. (1991), Gunther and Moore (2003a)], and the effectiveness of bank audit [Siddiqui and Podder (2002)].

The objective of the present study is to contribute towards the detection of banks' financial statements that should receive qualified audit opinions. To accomplish this task, we employ four classification techniques, namely discriminant analysis, logit analysis, Utilities Additives Discriminantes (UTADIS), and nearest neighbours, for the development of auditing models that could assist auditors during the examination of Asian banks. Most of the previous studies on the field have developed models for non-financial firms. Examples of such studies are: Mutchler (1985), Levitan and

Knoblett (1985), Dopouch et al. (1987), Keasey et al. (1988), Spathis et al. (2002, 2003), Fanning et al. (1995). However, these studies generally exclude banks and other financial firms due to their specific characteristics, differences in the environment in which banks operate, as well as differences in the financial statements of banks which make many of the empirical proxies used in these studies inappropriate for the banking sector. Furthermore, to the best of our knowledge no study investigates the development of such models for Asian banks.

Since the detailed audit of all transactions of a bank would not only be time-consuming and expensive but also impracticable [Bank for International Settlements-BIS (2002)], through the employment of such models auditors can save time and money. For example, classification models can provide the basis for a decision tool for auditors when predicting what opinion other auditors would issue in similar circumstances, when evaluating potential clients, in determining the scope of an audit for existing clients, in peer reviews, to control quality within firms and as a defense in law suits [Laitinen and Laitinen (1998)] as well as to avoid difficulties in analyzing large quantities of data. The analysis is also important to parties other than auditors, such as the managers of the bank, and the financial regulators. The later, rely heavily on the work of external auditors as they make their evaluations of banks' financial condition [Fields et al. (2004)]. As Fernandez and Gonzalez (2005) point out better accounting and auditing systems that provide the regulator with more information about the real risk of bank assets can not only increase the effectiveness of minimum capital requirements but also serve to guide disciplinary action imposed by supervisors on bank management in order to reduce instability. Their empirical results indicate that accounting and auditing systems can be effective devices to counteract tendencies for firm risk-taking associated with bank safety nets. In addition, such systems appear as complements for minimum capital requirements, and substitutes for restrictions on bank activities and official discipline. Credit agencies might also have an interest in such models as they usually take into account auditor's opinion during the rating of banks.

The remainder of the paper is as follows: Section 2 describes the methodology (sample, variables, classification techniques) of the study. Section 3 presents the empirical results of the analysis, while the last section discusses the concluding remarks.

2. Methodology

2.1 Sample

The sample of this study consists of an unbalanced panel dataset of 2,426 financial statements from 258 commercial banks operating in the main South and Southeastern

Asian countries of China, Hong Kong, India, Korea, Malaysia, Singapore, Taiwan, Thailand, over the period 1996-2004. These banks were included in the sample after fulfilling the requirement of data availability in terms of financial statements and auditor's opinion (i.e. qualified or unqualified) in Bankscope database of Bureau van Dijk's company.

We should mention at this point that the auditor considers how the financial statements might be materially misstated and considers whether fraud risk factors are present that indicate the possibility of fraudulent financial reporting or misappropriation of assets [BIS (2002)]. At the end of the examination, the auditor must prepare a report that contains a clear expression of opinion on the financial statements. An unqualified opinion means that the auditor does not disagree with the financial statements presented by the management implying that they meet at least the minimum acceptable standards of presentation. When the auditor discovers a misstatement material to the financial statements taken as a whole he/she asks management to adjust the financial statements. If the management refuses to make the adjustment, the auditor issues a qualified opinion on the financial statements. Alternatively, a qualified opinion can be expressed in cases that management has not provided the auditor with all the information or explanations he/she requires (BIS, 2002). In our case, some of the banks received qualified opinions for more than one year, while others were not included in the sample for all years, due to missing information (in terms of financial data and/or auditor's opinion). Furthermore, for some banks both consolidated and unconsolidated financial statements were available and considered. Consequently, the final sample consists of an unbalanced dataset of 198 qualified financial statements and 2,228 unqualified ones. The geographical coverage is as follows: China (289), Hong Kong (365), India (488), Korea (252), Malaysia (397), Singapore (152), Taiwan (339), Thailand (144).

To ensure the proper evaluation and comparison of the four auditing models we split the sample into two distinct sub-samples, one used for training and one used for testing. The former one consists of 1,701 unqualified financial statements and 146 ones that received a qualified opinion over the period 1996-2001, and is used to develop the models. The later one, consists of 527 unqualified financial statements and 52 ones that received a qualified audit opinion between 2002 and 2004, and is used to validate the models.

2.2. Variables selection

Fields et al. (2004) point out that since the managers of banks are eventually answerable to their regulators it seems reasonable to assume that the audit function should be driven by financial variables and ratios that these regulators consider important. Although there are many ratios that can be employed to assess the financial condition of banks, these are in general classified under the main categories of Capital strength, Asset quality, Management, Earnings and Liquidity, known as the CAMEL model that is being used by U.S. regulators since the 1970s. In a similar manner, the International Auditing Practices Committee (2000) mentions that: "*The auditor considers the ratios obtained by one bank in the context of similar ratios achieved by other banks for which the auditor has, or may obtain sufficient information. These ratios generally fall into the following categories: Asset quality, Liquidity, Earnings, and Capital Adequacy*". Potential reasons for which variables from these categories can have an impact on the audit decision are discussed below.

Starting with asset quality, a low quality portfolio may have a negative impact on bank profitability, by reducing interest income and by increasing the provisioning costs, thus decreasing net profits. As a result, banks may set provisions outside the range commensurate with their credit quality. Thus, they can reduce the variability of reported income by making higher provisions than necessary when credit quality and net income are high and keeping provisions low once credit quality deteriorates. Obviously, this approach makes the financial condition of a bank less transparent to shareholders, investors and authorities [Gunther and Moore (2000)] and it is expected that inadequate provisions would increase the likelihood of disagreements and the issuance of a qualified audit opinion.

The influence of liquidity on auditor's decision is not so clear. For instance, Ireland (2003) mentions that high liquidity may increase disagreement type modifications because assets may have been overstated. In contrast, Spathis (2003) points out that the possibility of a qualified audit report is higher when the financial health of a company deteriorates (i.e. low liquidity).

Numerous studies that examine non-financial sectors indicate that the firms which receive qualified opinions are the less profitable ones [Loebbecke et al. (1989), Summers and Sweeney (1998), Beasley et al. (1999), Spathis (2002, 2003), Spathis et al. (2003)]. As Spathis (2002) points out "*the profitability orientation is tempered by manager's own utility maximization defined (partially) by job security*" (p. 185).

With respect to capital, the capital adequacy requirements imposed by the 1988 Accord (Basel I) as well as the new capital framework (Basel II) require from banks to hold capital on the basis of their assets' risk. The reason is that capital serves as the last line of defense against the risk of bank failure since any losses a bank suffers could be finally written off against capital. Therefore, an adequate supply would seem to obviate the need for more specific controls over risk [Golin (2001)]. However, banks are highly geared enterprises that do not usually maintain much capital relative to their liabilities, unless constrained by regulations. Consequently, bank management may manipulate financial statements, given the need to meet certain requirements. Obviously, the later could increase the likelihood of disagreements and the issuance of a qualified audit opinion. Furthermore, poor capital strength could increase qualified opinions as financially distressed banks are more likely to attempt to overstate their financial position.

In the present study, on the basis of data availability we initially consider a set of 18 ratios, from the ones that are pre-calculated in Bankscope, and cover the above-mentioned categories. We also consider the natural logarithm of total assets to examine the relationship between size and auditors opinion. At one hand, large companies are more likely to have good accounting systems and internal controls, thus reducing disagreements and limitations on scope [Ireland (2003)]. On the other hand, assets overstating or misappropriation is among the typical financial statement fraud techniques [Ziegenfuss (1996), Beasley et al. (1999)]. Table 1 presents the 19 variables.

Table 1 – List of available financial variables

Formula	Definition
Log of Total Assets (LOGAS)	The natural logarithm of bank's total assets expressed in million US dollars.
Equity / Total Assets (EQAS)	This ratio measures the amount of protection afforded to the bank by the Equity they invested in it. The higher this figure the more protection there is.
Equity / Net Loans (EQLOAN)	Similarly to equity/total assets this ratio measures the Equity cushion available to absorb losses on the loan book.
Equity / Customer & ST Funding (EQCUST)	This ratio measures the amount of permanent funding relative to short term potentially volatile funding. The higher this figure the better.
Equity/Liabilities (EQLIAB)	This leverage ratio is simply another way of looking at the Equity funding of the balance sheet and is another of looking at capital adequacy.
Cap Funds / Liabilities (CAPLIAB)	This ratio is similar to equity/liabilities but adds hybrid capital and subordinated debt to shareholders' equity in the numerator.
Net Interest Margin (NIM)	This ratio is the net interest income expressed as a percentage of earning assets. The higher this figure the cheaper the funding or the higher the margin the bank is commanding. Higher margins and profitability are desirable

	as long as the asset quality is being maintained.
Net Interest Revenue / Average total Assets (NIRAS)	This ratio is similar to net interest margin but expressed as a percentage of the total balance sheet.
Other Operating Income / Average Assets (OPIAS)	This ratio indicates to what extent fees and other income represent a greater percentage of earnings of the bank. As long as this is not volatile trading income it can be seen as a lower risk form of income. In general, the higher this figure is the better.
Non interest expenses/ Average Assets (EXPAS)	Non interest expenses or overheads plus provisions give a measure of the cost side of the banks performance relative to the assets invested.
Return On Average Assets (ROAA)	This is perhaps the most important single ratio in comparing the efficiency and operational performance of banks as it looks at the returns generated from the assets financed by the bank.
Return on Avg. Equity (ROAE)	The return on average equity is similar to ROAA but indicates the return on shareholder funds.
Cost To Income Ratio (COST)	This ratio measures the overheads or costs of running the bank, the major element of which is normally salaries, as percentage of income generated before provisions.
Recurring Earning Power (RECUR)	This ratio is a measure of before tax profits adding back provisions for bad debts as a percentage of Total Assets. Effectively this is a return on assets performance measurement without deducting provisions.
Net Loans / Total Assets (LOANAS)	This liquidity ratio indicates what percentage of the assets of the bank are tied up in loans. The higher this ratio the less liquid the bank will be.
Net Loans / Customer & ST Funding (LOANCUST)	This loans to deposit ratio is a measure of liquidity in as much as high figures denotes lower liquidity.
Net Loans / Tot Deposits & Borrowings (LOANDEP)	This ratio is similar to net loans/customer &

	shot term funding has as its denominator deposits and borrowings with the exception of capital instruments.
Liquid Assets / Customer & ST Funding (LIQCUST)	This is a deposit run off ratio and looks at what percentage of customer and short term funds could be met if they were withdrawn suddenly, the higher this percentage the more liquid the bank is and less vulnerable to a classic run on the bank.
Liquid Assets / Total Deposits & Borrowings (LIQDEP)	This ratio is similar to Liquid Assets / Customer & ST Funding but looks at the amount of liquid assets available to borrower as well as depositors

From a practical point of view, developing a model that considers such a large number of variables introduce problems to the applicability of the model on a daily basis since it will require collection of various data leading to increased time and cost for data preparation and management [Spathis et al. (2003)]. In addition, in a multivariate analysis, multicollinearity among the variables is another issue that should be kept in mind. Therefore, reducing the set of variables to an easily manageable number is essential. In the present study, this is achieved through a combination of a univariate test of significance, correlation analysis and human judgment as in Doumpos and Zopounidis (2002a), Spathis et al. (2003), Doumpos et al. (2004), Gaganis et al. (2005), Pasiouras et al. (2005), among others.

Obviously, in order to classify the qualified and unqualified financial statements effectively, the variables should be able to discriminate between the two groups. In this case, the rule of thumb is to keep the number of variables small and exclude a variable unless its discriminating power is statistically significant [Kocagil et al. (2002]. Therefore, in selecting the appropriate variables to be included in the auditing models, we focus on their statistical significance at the univariate level using a Kruskal Wallis test of means' differences. Table 2 presents descriptive statistics (mean and standard deviation) and the results of the Kruskal Wallis test.

Table 2 – Descriptive statistics and Kruskal-Wallis test

	Qualified		Unqualified		Kruskal Wallis
	Mean	St. Dev.	Mean	St. Dev.	p-value
LOGAS	3.499	0.559	3.300	1.115	0.517
EQAS	4.718	3.770	10.260	10.214	0.000

EQLOAN	9.541	6.118	22.873	42.579	0.000
EQCUST	5.609	5.744	14.574	23.707	0.000
EQLIAB	4.894	3.369	13.340	23.060	0.000
CAPLIAB	7.039	4.519	13.995	23.080	0.000
NIM	2.350	1.477	2.771	1.052	0.081
NIRAS	2.169	1.362	2.526	0.932	0.111
OPIAS	1.115	0.496	0.910	0.999	0.000
EXPAS	4.711	3.636	2.645	1.668	0.000
ROAA	-1.481	5.111	0.645	1.627	0.000
ROAE	-23.752	78.687	4.825	28.372	0.040
COST	89.679	51.277	54.738	26.452	0.000
RECUR	0.430	1.942	1.619	1.168	0.000
LOANAS	50.136	17.027	56.737	16.228	0.000
LOANCUST	59.441	25.947	73.304	28.211	0.000
LOANDEP	57.124	19.901	68.514	19.654	0.000
LIQCUST	36.519	17.217	30.912	24.890	0.000
LIQDEP	36.150	17.323	28.904	21.263	0.000

The univariate test suggests that the mean values of the independent variables for the qualified versus the unqualified financial statements are significantly different in a number of cases. The variables that measure capital strength are all significant indicating that banks with qualified financial statements are not as well capitalized as the ones with unqualified financial statements. Bank with qualified financial statements are in general less profit (ROAA, ROAE, OPIAS, RECUR) and less cost efficient (EXPAS, COST) than the ones with unqualified financial statements. Finally, the variables measuring liquidity indicate that banks with qualified financial statements appear to be more liquid on average than the ones with unqualified statements.

The next step in the analysis was to examine the correlations among the aforementioned significant variables and exclude variables that were highly correlated (among 0.75 in absolute terms).

Table 3-Correlation analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) EQAS	1.000							
(2) EQLOAN	0.612	1.000						
(3) EQCUST	0.743	0.595	1.000					
(4) EQLIAB	**0.884**	0.556	**0.777**	1.000				
(5) CAPLIAB	**0.875**	0.551	**0.773**	**0.994**	1.000			
(6) OPIAS	0.109	0.186	0.071	0.128	0.135	1.000		
(7) EXPAS	-0.064	-0.045	-0.039	0.001	0.022	0.344	1.000	
(8) ROAA	0.298	0.184	0.186	0.203	0.181	0.149	-0.708	1.000
(9) ROAE	0.099	0.059	0.055	0.055	0.031	0.081	-0.599	**0.764**
(10) COST	-0.163	-0.038	-0.100	-0.085	-0.070	0.011	0.453	-0.482
(11) RECUR	0.249	0.093	0.167	0.169	0.162	0.317	-0.336	0.654
(12) LOANAS	-0.115	-0.428	-0.087	-0.100	-0.095	-0.263	0.045	-0.163
(13)LOANCUST	0.341	-0.054	0.402	0.335	0.338	-0.151	-0.010	-0.003
(14) LOANDEP	0.305	-0.139	0.254	0.290	0.299	-0.194	0.022	-0.029
(15) LIQCUST	0.353	0.502	0.400	0.303	0.306	0.130	-0.108	0.191
(16) LIQDEP	0.340	0.463	0.313	0.291	0.293	0.140	-0.114	0.212

Note: Correlations above 0.75 (in absolute values) are denoted with bold

Table 3-Correlation analysis (continue)

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(9) ROAE	1.000							
(10) COST	-0.471	1.000						
(11) RECUR	0.506	-0.708	1.000					
(12) LOANAS	-0.135	0.013	-0.048	1.000				
(13) LOANCUST	-0.068	-0.041	0.052	0.650	1.000			
(14) LOANDEP	-0.093	-0.056	0.077	**0.827**	**0.832**	1.000		
(15) LIQCUST	0.144	-0.138	0.193	-0.576	-0.212	-0.375	1.000	
(16) LIQDEP	0.162	-0.168	0.221	-0.608	-0.331	-0.426	**0.947**	1.000

Note: Correlations above 0.75 (in absolute values) are denoted with bold

The results in Table 3 indicate that both EQAS and EQCUST are highly correlated with EQLIAB and CAPLIAB which are also correlated to each other. From these correlated variables, we select EQAS that is considered one of the basic ratios whose use dates back to the early 1900s [Golin (2001)] and has been employed in numerous studies in banking [e.g. Kocagil et al. (2002), Gunther and Moore (2003a,b)]. We also include EQLOAN and EQCUST that are not highly correlated with EQAS. Between the two profitability ratios that are correlated (0.764), we select ROAE rather than ROAA because it is more likely that managers will manipulate the former to keep shareholders pleased. Finally, we observe that among the liquidity ratios, LOANAS and LOANCUST are correlated with LOANDEP, as are the ratios LIQDEP and LIQCUST. From these ratios we select LOANCUST and LIQDEP that are both considered basic measures of liquidity.

In addition to the 10 financial variables selected above, we consider a non-financial variable to control for the banking environment in which banks operate. Obviously, banking supervision will have an impact on almost every scheme of bank's governance, through prudential regulation (e.g. capital requirements), disclosure requirements and constraints on their business activities. We therefore employ the Heritage Banking and Finance Factor that measures the relative openness of a country's banking and financial system. The score for this factor, is estimated by determining: (1) whether foreign banks and financial services firms are able to operate freely, (2) how difficult it is to open domestic banks and other financial services firms, (3) how heavily regulated the financial system is, (4) the presence of state-owned banks, (5) whether the government influences the allocation of credit, and (6) whether banks are free to provide customers with insurance and invest in securities. In general, the factor may take the values of 1 (very low restrictions on banks), 2 (low restrictions on banks), 3 (moderate restrictions on banks), 4 (high restrictions on banks) or 5 (very high restrictions on banks).

Table 4 presents the number of qualified and unqualified financial statements and the relative banking environment for the banks in sample. Two conclusions can be drawn. First, all banks operate in banking environments that received values between 1 and 4, while none has received a value of 5. Second, most of the qualified opinions were assigned in an environment with high restrictions on banks (i.e. banking environment 4) while none operates in an environment with very low restrictions on banks (i.e. banking environment 1). On the other hand, most unqualified opinions (44%) were assigned in an environment with moderate restrictions (banking environment 3), followed by high restrictions (banking environment 4) and very low restrictions (i.e. banking environment 1).

Table 4 - Auditors' opinion and banking environment

	Auditor's opinion		
Banking environment	Qualified	Unqualified	Total
Very low restrictions (=1)	0	365	365
Low restrictions (=2)	11	301	312
Moderate restrictions (=3)	57	977	1,034
High restrictions (=4)	130	585	715
Very high restrictions (=5)	0	0	0
Total	198	2,228	2,426

To introduce this variable in the analysis three dummy 0-1 variables are used. The first dummy variable (BANKING 1) indicates whether a bank operates in a market with very low restrictions (very low restrictions=1) or not (very low restrictions=0). Similarly, the second variable (BANKING 2) indicates whether the bank operates in a market with low restrictions (low restrictions = 1) or not (low restrictions = 0). Finally, the third variable (BANKING 3) indicates whether the bank operates in a market with moderate restrictions (moderate restrictions = 1) or not (moderate restrictions = 0). Banks operating in markets with high restrictions (BANKING 4) are represented with zero values in all these dummy variables.

2.3 Classification techniques

The problem considered in this study is a classification one that in general involves the assignment of a finite set A = {a_1,a_2,…,a_m) of m alternatives, along a set g = {g_1, g_2, …, g_n) of *n* criteria into a set of q groups {C_1,C_2,…,C_3). In this study the alternatives involve the financial statements in the sample, the variables correspond to the 11 independent variables and there are two classes, the qualified financial statements and the unqualified ones. This paper employs four classification techniques namely Discriminant Analysis (DA), Logit Analysis (LA), k-Nearest Neighbours (k-NN) and UTilités Additives DIScriminantes (UTADIS) that are briefly discussed below.

2.3.1 Discriminant Analysis

DA seeks to obtain a linear combination of the independent variables whose objective is to classify observations into mutually exclusive groups as accurately as possible by maximizing the ratio of among-groups to within-groups variance. The DA method therefore estimates a discriminant function of the following form:

$$Da = w_0 + w_1 g_1 + w_2 g_2 + ... + w_m g_m \qquad (1)$$

where D_a is the score (for a financial statement *i*), w_0 is the intercept term and w_j (*j*=1,…,m) represent the slope coefficients associated with the independent variables g_j (*j*=1, …, *m*) for each firm.

A cut-off point is calculated according to the a-priori probabilities of group membership and the costs of misclassification. In the final step, each financial statement is classified into the qualified or the unqualified group, depending on its score and the cut-off point. Financial statements with discriminant scores greater than the cut-off point are classified into the one group, while financial statements with discriminant scores less than the cut-off point are classified into the other group. Alternatively, firms can be classified on the basis of the probability of belonging to one of the groups and a cut-off probability point.

2.3.2. Logit Analysis

In logit analysis the probability of a financial statement to be qualified is based on a set of independent variables is given by the following function:

$$P_i = \left(\frac{1}{1 + e^{-Z_i}} \right) \tag{2}$$

where

$$Z_i = \ln\left(\frac{P_i}{1 - P_i} \right) = w_0 + w_1 g_1 + w_2 g_2 + ... + w_m g_{m,} + \varepsilon_i \tag{3}$$

is the probability that firm *i* will receive a qualified auditor's opinion, w_0 is the intercept term and w_j (*j* = 1,…,*m*) represents the coefficients associated with the corresponding independent variables g_j (j= 1,…,*m*) for each financial statement. The coefficient estimates are obtained by regression which involves maximising a log-likelihood function. The model is then used to estimate the group-membership probabilities for all financial statements under consideration. The financial statement is classified as qualified or unqualified using an optimal cut-off point, attempting to minimise type I and type II errors.

2.3.3 Nearest Neighbours

Nearest Neighbours is a non-parametric density estimation method that classifies an object (i.e. financial statement) to the class of its nearest neighbour in the measurement space using some kind of distance measure like the local metrics [Short and Fucunaga (1980)], the global metrics [Fukunaga and Flick (1984)], the

Mahalanobis or the Euclidean distance. The later is the most commonly used one and is also employed in the present study.

The modification of the nearest neighbour rule, the k-nearest neighbour (k-NN) method that is employed in the present study, classifies an object (i.e. financial statement) to the class (i.e. qualified or unqualified) more heavily represented among its k nearest neighbours.

Assuming a financial statement x described by the feature vector $< g_1(x), g_2(x), ..., g_m(x) >$ where $g_r(x)$ is used to denote the values of the r^{th} characteristic of firm x, the distance between two instances x_i and x_j is estimated as follows:

$$d(x_i, x_j) = \sqrt{\sum_{r=1}^{m} (g_r(x_i) - g_r(x_j))^2} \tag{4}$$

Then, the algorithm for approximating a discrete-valued function of the form $f : \Re^n \rightarrow C$, where C is a finite set of classes $\{C_1, C_2, ..., C_q\}$ proceeds as follows:

Step 1: For each training example (i.e. financial statement) $< x, f(x) >$, add the firm to the list of training examples.

Step 2: Given a query firm x to be classified, let $x_1, x_2, ..., x_k$ denote the k instances from the training examples that are nearest to *x*.

Step 3: Return $\hat{f}(x) \leftarrow \arg\max_{c \in C} \sum_{i=1}^{k} \delta(c, f(x_i))$, where $\delta(a, b) = 1$ if $a = b$ and where $\delta(a, b) = 0$ otherwise.

Thus, the algorithm returns the value $\hat{f}(x)$ as an estimate of $f(x)$, which is the most common value of f among the k training examples nearest to *x*.

2.3.4 UTADIS

UTADIS leads to the development of an additive utility function that is used to score the financial statements and decide upon their classification. The developed additive utility function has the following general form:

$$U(a) = \sum_{i=1}^{n} w_i u_i'(g_i) \in [0,1] \tag{5}$$

where $\underline{g} = \{g_1, g_2, ..., g_n\}$ is the set of the evaluation criteria, which in this case correspond to the 11 variables, w_i is the weight of criterion g_i (the criteria weights sum up to 1) and $u'_i(g_i)$ is the corresponding marginal utility function normalized between 0 and 1. The marginal utility functions provide a mechanism for decomposing the aggregate result (global utility) in terms of individual assessment to the criterion level. To avoid the estimation of both the criteria weights and the marginal utility functions, it is possible to use the transformation $u_i(g_i) = w_i u'_i(g_i)$. Since $u'_i(g_i)$ is normalized between 0 and 1, it becomes obvious that $u_i(g_i)$ ranges in the interval [0, w_i]. In this way, the additive utility function is simplified to the following form:

$$U(\text{a}) = \sum_{i=1}^{n} u_i(g_i) \in [0,1] \tag{6}$$

The developed utility function provides an aggregate score $U(\text{a})$ for each financial statement along all criteria. In the case of auditing decisions, this score provides the basis for determining whether the financial statement could be classified in either the group of qualified or unqualified financial statements. The classification rule in this case is the following (C_1 and C_2 denote the group of unqualified and qualified financial statements respectively, while u_1 is a cut-off utility point defined on the global utility scale, i.e. between 0 and 1):

$$\left.\begin{array}{ll} U(\text{a}) \geq u_1 & \Rightarrow a \in C_1 \\ U(\text{a}) < u_1 & \Rightarrow a \in C_2 \end{array}\right\} \tag{7}$$

The estimation of the additive value function and the cut-off threshold is performed through linear programming techniques so that the sum of all violations of the classification rule (7) for all the financial statements in the training sample is minimized. Detailed description of the mathematical programming formulation used in the UTADIS method can be found in the works of Zopounidis and Doumpos (1999) and Doumpos and Zopounidis (2002b).

3. Empirical Results

After selecting an appropriate set of variables the classification models are developed using the training data and tested on the future holdout sample. Summary statistics, the significance of the variables in discriminating between qualified and unqualified financial statements and classification accuracies are presented in Tables 5 and 6.

Table 5 – Variables significance and models' summary

Variables	LA	DA	UTADIS
EQAS	0.041	-0.002	
	(3.223)	(-0.017)	4.42%
EQLOAN	-0.102	-0.008	
	(30.003)**	(-0.233)	9.62%
EQCUST	0.01	-0.003	
	(0.632)	(-0.06)	1.50%
OPIAS	0.439	0.151	
	(10.225)**	(0.119)	62.67%
EXPAS	0.189	0.054	
	(9.132)**	(0.151)	0.34%
ROAE	-0.005	-0.004	
	(3.25)	(-0.259)	8.42%
COST	0.014	0.009	
	(17.418)**	(0.372)	0.10%
RECUR	-0.64	-0.233	
	(30.215)**	(-0.373)	7.37%
LOANDEP	-0.017	-0.002	
	(5.179)*	(-0.039)	3.02%
LIQCUST	0.037	0.015	
	(30.229)**	(0.326)	2.53%
	-14.398	-2.493	
BANKING 1+	(2.245)	(-0.667)	0.01%
	-4.077	-2.384	
BANKING 2	(95.523)**	(-0.645)	
	-1.933	-1.658	
BANKING 3	(81.086)**	(-0.802)	
	0.662		
Constant	(1.022)	0.082	
Models' Summary Statistics			
Chi-square	1378.178**	-	
Nagelkerke R Square	0.701	-	
Wilks' Lambda	-	0.46	
Chi-square	-	1426.658	

Notes: * Statistically significant at the 5% level

** Statistically significant at the 1% level

+ In the case of UTADIS, "banking" enters the analysis as a single variable that takes the values of 1, 2, 3 and 4 for very low restrictions, low restrictions, moderate restrictions and high restrictions respectively.

Among the capital strength ratios only EQLOAN appears to be statistically significant at the LA model, while similar results are observed both in the case of DA model (as indicated by the standardized coefficients) and the UTADIS model (as indicated by the weights of the criteria). OPIAS is also important in all the models and is actually the most important one in the case of UTADIS. From the remaining profit and cost efficiency ratios that are statistically significant in the LA model, EXPAS and COST are positively related to the probability of receiving a qualified auditor's opinion, while RECUR is negatively related. The results in the DA model for these ratios are quite similar however in the case of UTADIS only ROAE and RECUR appear to have some importance. The liquidity ratios are both statistically significant in the LA model. LOANDEP is negatively related to the probability of a qualified auditor's opinion while, as expected, the opposite occurs in the case of LIQCUST, indicating that, consistent with the univariate results, the more liquid a bank appears to be the higher the probability of receiving a qualified opinion. The importance of these two ratios is similar and moderate in the UTADIS model, while only LIQCUST is important in the DA model.

As it concerns the coefficients of the three dummy variables that correspond to the environmental conditions, they all carry a negative sign. The highest coefficient (in absolute terms) is observed in the case of the banking environment with very low restrictions (-14.398), followed by low restrictions (-4.077) and moderate restrictions (-1.933). Hence, the probability of a qualified report is lower in for banks operating in an environment with very low restrictions, followed by banks operating in environments with low and moderate restrictions. Nevertheless, it should be mentioned that this variable is the less important one in the case of the UTADIS model.

Table 6–Classification accuracies (in %)

	LA	**DA**	**UTADIS**	**k-NN**
		Training		
Unqualified	84.2	81.6	79.8	89.9
Qualified	86.3	89.0	89.0	100.0
Average	85.3	85.3	84.4	95.0
		Testing		
Unqualified	66.8	46.1	74.0	85.4
Qualified	59.6	63.5	55.8	40.4
Average	63.2	54.8	64.9	62.9

The classification results obtained from the application of the four methods in discriminating between qualified and unqualified financial statements are presented in Table 6. With regard to the training sample, the average classification accuracy of k-

NN is 95%, hence higher than that of the other three methods which all obtain average classification accuracies around 85%. Of course, higher model fit does not ensure higher generalizing ability and the results in the future holdout sample become of particular interest towards a more appropriate evaluation of the four methods.

As expected the classification accuracies in the holdout sample are lower than the ones achieved in the training sample. The model developed through UTADIS is now the one that achieves the highest classification accuracy (64.9%), followed by LA (63.2%), k-NN (62.9%) and DA (54.8%). Further inspection of the results indicates that the superiority of UTADIS and LA is due to their ability to classify relatively well both qualified and unqualified financial statements. On the other hand, DA achieves the highest classification in terms of qualified financial statements, but its performance is inferior in terms of unqualified financial statements, while the opposite occurs in the case of k-NN. These differences indicate that the combination of all methods into an integrated model could possibly lead to higher classification accuracies.

4. Conclusions

The regulatory and supervisory framework in many Asian countries is currently experiencing significant changes. However, auditing standards are crucial, whatever reforms in the regulatory framework may be introduced, since with poor accounting and auditing requirements, the quality and disclosure of financial statements can be out-of date or unreliable. Nevertheless, Asia has been noted for an inadequate reporting, accounting and auditing framework.

The objective of the present study was to contribute towards the detection of banks' financial statements that should receive qualified audit opinions. To accomplish this task we investigated the efficiency of four classification techniques, namely discriminant analysis, logit analysis, UTADIS multicriteria decision aid, and nearest neighbours, in the development of auditing models. Since the detailed audit of all transactions of a bank would not only be time-consuming and expensive but also impracticable, the employment of such models could provide the basis for a decision tool for auditors during the examination of Asian commercial banks. The analysis is also important to parties other than auditors, such as the managers of the bank, and the financial regulators.

To develop the auditing models and examine their classification ability, the dataset was split into two distinct samples. The training sample consisted of 1,701 unqualified financial statements and 146 ones that received a qualified opinion over the period 1996-2001. The models were then tested in a holdout sample of 527 unqualified financial statements and 52 ones that received a qualified opinion over the period 2002-2004. The results showed that the developed auditing models can discriminate between financial statements that should receive qualified opinions from the ones that should receive unqualified opinions with a satisfactory accuracy. Both financial variables and the environment in which banks operate appeared to be important. The highest classification accuracy was achieved by UTADIS, followed by logit analysis, nearest neighbours and discriminant analysis.

Future research could be directed towards the analysis of other types of banks (e.g. investment, co-operative), the employment of alternative classification techniques (e.g. neural networks, support vector machines), and the use of additional variables (e.g. audit fess, auditor's independence) that were not included in the present study due to data availability.

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References

Bank for International Settlements. (2002). The relationship between banking supervisors and banks' external auditors. Basel Committee on Banking Supervision, January, available at: http://www.bis.org/publ/bcbs87.htm

Basel Committee on Banking Supervision. (1999). A New Capital Adequacy Framework: Consultative paper. June, Basel.

Basel Committee on Banking Supervision. (2001). The New Basel Capital Accord: an explanatory note. Bank for International Settlements, January.

Basel Committee on Banking Supervision. (2003). Overview of The New Basel Capital Accord: Consultative Document. Bank for International Settlements, April.

Basel Committee on Banking Supervision. (2004). International Convergence of Capital Measurement and Capital Standards: A Revised Framework. Bank for International Settlements, June.

Beasley S.M, Carcello J.V. and Hermanson D.R. (1999). Fraudulent Financial Reporting: 1987-1997: An Analysis of US Public Companies. Research Report, COSO.

Berger A.N., King K.K. and O'Brien J.M. (1991). The limitations of market value accounting and a more realistic alternative. Journal of Banking and Finance vol. 15, 753–783.

Dopouch N., Holthausen R. and Leftwich R. (1987). Predicting audit qualifications with financial and market variables. Accounting Review vol. 62, 431-454.

Doumpos M., Kosmidou K. and Pasiouras F. (2004). Prediction of acquisition targets in the UK: A multicriteria approach. Operational Research An International Journal vol. 4, 191-211.

Doumpos M. and Zopounidis C. (2000a). Business Failure Prediction: A Comparison of Classification Methods. Operational Research An International Journal vol. 2, 303-319.

Doumpos M. and Zopounidis C. (2002b). *Multicriteria Decision Aid Classification Methods*. Kluwer Academic Publishers: Dordrecht.

Fanning K, Cogger K. and Srivastava R. (1995). Detection of management fraud: a neural network approach. International Journal of Intelligent Systems in Accounting, Finance and Management vol. 4, 113-26.

Fernandez A.I. and Gonzalez F. (2005). How accounting and auditing systems can counteract risk-shifting of safety-nets in banking: Some international evidence. Journal of Financial Stability vol. 1, 466-500.

Fields L.P., Fraser D.R. and Wilkins M.S. (2004). An investigation of the pricing of audit services for financial institutions. Journal of Accounting and Public Policy vol. 23, 53-77.

Fitch. (2005). Asian Banks and Basel II. Special Report. 19 January, www.fitchratings.com

Gaganis Ch., Pasiouras F. and Tzanetoulakos A. (2005). A comparison and integration of classification techniques for the prediction of small UK firms failure. The Journal of Financial Decision Making vol. 1, 55-69.

Golin J. (2001). *The Bank Credit Analysis Handbook: A Guide for Analysts, Bankers and Investors*. John Wiley & Sons Pte Ltd: Asia.

Gunther J.W. and Moore R.R. (2000). Financial Statements and Reality: Do Troubled Banks Tell All?, Federal Reserve Bank of Dallas Economic and Financial Review, Third Quarter, 30-35.

Gunther J.W. and Moore R.R. (2003a). Loss underreporting and the auditing role of bank exams. Journal of Financial Intermediation vol. 12, 153-177.

Gunther J.W. and Moore R.R. (2003b). Early warning models in real time. Journal of Banking & Finance vol. 27, 1979-2001.

International Federation of Accountants. (2000). The Audit of International Commercial Banks: Proposed International Auditing Practice Statement. International Auditing Practices Committee, September.

Ireland J. (2003). An empirical investigation of determinants of audit reports in the UK. Journal of Business Finance & Accounting vol. 30, 975-1015.

Keasey K., Watson R. and Wynarzcyk P. (1988). The small company audit qualification: A preliminary investigation. Accounting and Business Research vol. 18, 323-333.

Kocagil A.E., Reyngold A., Stein R.M. and Ibarra E. (2002). Moody's RiskCalc™ Model for Privately-Held U.S, Banks. Moody's Investor Service Global Credit Research, July.

Laitinen E.K. and Laitinen T. (1998). Qualified audit reports in Finland: evidence from large companies. European Accounting Review vol. 7, 639-653.

Levitan A.S. and Knoblett J.A. (1985). Indicators of exceptions to the going concern opinion decision. Auditing: A Journal of Practice and Theory vol. 5, 26-39.

Loebbecke J., Eining M. and Willingham J. (1989). Auditor's experience with material irregularities: frequency, nature, and detectability. Auditing: A Journal of Practice and Theory vol. 9, 1-28.

Mutchler J.F. (1985). A multivariate analysis of the auditor's going concern opinion decision. Journal of Accounting Research vol. 23, 668-682.

Parrenas J.C. (2002). The New Basle Accord: Challenges for Asia's Banks and Regulators, PECC Finance Forum Conference, Issues and Prospects for Regional Cooperation for Financial Stability and Development, August 11-13, Honolulu.

Pasiouras F., Tanna S. and Zopounidis C. (2005). *Application of Quantitative Techniques for the Prediction of Bank Acquisition Targets*. World Scientific: Singapore.

Shirai S. (2001). Searching for New Regulatory Frameworks for the Intermediate Financial Structure in Post-Crisis Asia. Wharton School, Working Paper Series 01-28, University of Pennsylvania.

Siddiqui J. and Podder J. (2002). Effectiveness of bank audit in Bangladesh, Managerial Auditing Journal vol. 17, 502-510.

Spathis Ch. (2003). Audit Qualification, Firm Litigation, and Financial Information: an Empirical Analysis in Greece. International Journal of Auditing vol. 7, 71-85.

Spathis Ch. (2002). Detecting false financial statements using published data: some evidence from Greece. Managerial Auditing Journal vol. 17, 179-191.

Spathis Ch., Doumpos M. and Zopounidis C. (2003). Using client performance measures to identify pre-engagement factors associated with qualified audit reports in Greece. The International Journal of Accounting vol. 38, 267-284.

Spathis Ch., Doumpos M. and Zopounidis C. (2002). Detecting falsified financial statements: a comparative study using multicriteria analysis and multivariate statistical techniques. The European Accounting Review vol. 11, 509-535.

Stein M., Simunic D. and O'Keefe T. (1994). Industry differences in the production of audit services. Auditing: A Journal of Practice and Theory 13 (Supplement), 129-142.

Summers S.L. and Sweeney J.T. (1998). Fraudulently misstated financial statements and insider trading: an empirical analysis. The Accounting Review vol. 73, 131-146.

Ziegenfuss D.E. (1996). State and local government fraud survey for 1995. Managerial Auditing Journal vol. 9, 50-55.

Zopounidis C. and Doumpos M. (1999). A multicriteria decision aid methodology for sorting decision problems: The case of financial distress. Computational Economics vol. 14, 197-218.