THE FINANCIAL SURVEILLANCE MODEL FOR RISK MANAGEMENT MECHANISM: AN EARLY WARNING SYSTEM

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Abstract

The present study undertakes a quantitative research of a relative Stock Exchange of a new emerging country, of the Stock Exchange of Thailand (SET) while its subsidiary serve as a clearing house; Thailand Securities Depository (TSD). The major issues investigated in the measurement of variables that aimed to monitor its clearing house's members and its relation to Surveillance Model and its extensions. The financial ratios measured in this study are 27 variables from five categories (profitability, leverage, liquidity, performance, and asset quality). This methodology used in this study utilized the Logit Model to apply the information and to test significance by using t-test significance. Finally, research findings showed that only 6 financial variables were significant and served as the early warning system of financial problem for securities firms monitoring.

INTRODUCTION

The trading on organized exchanges of derivative financial instruments, that is futures and options on interest rates, exchange rates and equities and equity indices, has grown enormously over the past decade. These markets are now a critical component of the financial infrastructure of the G-10 countries and a growing number of other developing countries. In particular, when they measure the market risk associated with their activities, many market participants, including the major banks and securities firms that serve as market-makers for securities and over the counter (OTC) derivatives, assume that markets for exchange traded derivatives will provide sufficient liquidity to allow them to offset their market risk exposures.

Both liquidity of exchange-traded derivatives markets and the timely completion of payments and deliveries associated with these markets are critically dependent on the financial integrity of an exchange's clearing house, in which are concentrated the credit and liquidity risks of exchange trading and the responsibility of managing those risks.

LITERATURE REVIEW

Klein, J.H. (1996) attempted to characterize a set of models of cognition, which may be of value as conceptual tools for risk analysts and managers. Hallbach, W. & Menkveld, B. (1999) utilized the Value at Risk (VaR) concept for measuring downside risk among financial institutions, regulators, and corporates and developed a methodology to decompose the overall VaR into components that are attributable to underlying external risk factors and a residual idiosyncratic component. In addition, Alberto, Suarez & Santiago, Carrillo (2000) designed and implemented a series of computational tools to incorporate into MatRisk, an integrated environment risk assessment developed in MatLab while Diebold, Francis X. & Santomero, Anthony M. (1999) investigated the collapse of several Asian markets and a series of aftershocks in the global financial markets and proposed the new risk management tools motivated by those events. Duffee, Gregory R. & Zhou, Chunsheng (1997) model the effects on banks of the introduction of a market for credit derivatives; in particular, credit default swaps to transfer credit risks. Finally, Elmer,

Funke Kupper (1999) described the key basic elements; a clear understanding of the relationship between risk and shareholder value, using economic value added (EVA) as the key measure; stress-testing regime to assess the financial impact of potential extreme events, and a breakdown in risk models.

SOURCES AND TYPES OF RISK TO AN EXCHANGE CLEARING HOUSE

Replacement cost risk occurs when a clearing member was to default, the clearing house would face replacement cost exposure because the member's default does not relieve the clearing house of its obligation to the clearing member on the other side of the contract. The clearing house would generally replace the contracts by going into the market and purchasing or selling the contracts identical to those on which the clearing member defaulted while the nature of replacement cost risk that the clearing house faces varies from product to product (IFCI, 1999).

Liquidity risk is another problem that clearing house exposes. By substituting itself as counterparty to its clearing members, the clearinghouse exposes itself to liquidity risk; it must fulfill its payment obligations to non-defaulting members on schedule, even if one or more members default. Indeed, it is particularly critical that a clearinghouse performs its obligations without delay so that questions about its solvency do not arise. Depending upon the design of the clearing arrangements and the functions it performs, the clearing house may obligate itself to make a wide variety of payments. In the event of a default, a clearinghouse would look to assets of the defaulting member and its own financial resources to raise the necessary funds (Technical Committee of the International Organization of Securities Commissions, 1994).

Principal (delivery) risk can incur large credit exposures on settlement days, when the full principal value of transactions may be at risk. This can occur if upon maturity (futures) or exercise or expiration (options) contracts are settled through delivery and delivery versus payment (DVP) is not achieved. If a commodity or underlying instrument is delivered prior to receipt of payment, the deliverer risks losing its full value. If payment is made prior to delivery, the payer risks lose the full value of the payment (Technical Committee of the International Organization of Securities Commissions, 1996).

NEW EMERGING MARKET: A CASE ON THAI SECURITIES FIRMS

The issue of risks and the effects on the settlement system are major concerns to the clearinghouse and the guarantor of the system. Foreseeing that there are ways to prevent risks, which the clearing house established the clearing fund, offers securities lending to cover the risks resulting from members inability to settle the trades, and executes buy-in of securities in the stock market. Following the Asian financial crisis, many securities and finance companies were ordered closed, so the regulators enforced more stringent rules on the remaining companies. The clearinghouse (TSD) can in no way neglect its duties in maintaining a stable settlement environment, therefore enforced its clearing members to comply with the 5% maintenance of net capital level mandated by the Securities and Exchange Commission. In addition, the clearing house imposed settlement cap on members at 8 times the net capital level, as well as monitored settlement activities of each clearing member by evaluating the value of risks associated with pending settlement at each period as a result of the volatility of securities prices (Basle Committee on Banking Supervision, 1994). However, the above risk management tools are still inappropriate to prevent and encompass risk due to the new implementing of new financial products such as index options and derivative warrants in Thai securities markets, which is highly volatility. Therefore, to cope

with these risks, the new early warning system or new risk management tools are necessary to implement.

This report therefore briefly describes the steps used to construct the statistical model known as "Logit Model". The model is especially useful in epidemiological and demographic research in the assessment of the effects of explanatory factors on the relative risk of outcomes (Power & Xie, 1999). The purpose of constructing the model is to predict the possibility of clearing member facing financial problems in the future of time. The details of which shall be mentioned later in the content.

OBJECTIVE

- To create an early warning system to monitor clearinghouse's members.
- To study the factors affecting the clearing members settlement capacity
- To adapt the tool to revise/draft appropriate measures and operational rules

CONCEPTUAL FRAMEWORK

The financial surveillance model is constructed based on the assumption that past information can be used to predict future occurrences as to whether members are likely to confront financial troubles or not. The financial information used as input date to predict the next 3 months (3- month lag model). By using the information of the previous month, the outcome of the next month is predictable, and the same applies to 2 and 3 months. The model, as mentioned earlier, is constructed using a statistical technique, known as Logit Model, and is used to assist in analyzing the financial ratios of the clearinghouse's members. The financial information is derived from the Net Capital Report, Balance Sheet and Income and Loss statements of the clearing members under test. The financial information is used to calculate the financial ratios of each clearing member. The financial ratios are then grouped according to their similarities as shown later in this report. The financial ratios that are found significant after being tested statistically will be substituted in the Logit equation to obtain the predictable values. The model will be applicable upon the condition that the predictable values lie between the benchmarks of 50-70% of the probability to fail or default.

More specifically, the primary objective of this study is to develop the model technique that is utilized to manage those risks by the clearinghouse's members as an early warning system for financial crisis.

APPLICATION MODEL

Normally, in a statistical term, when a decision to be made is dichotomous, that is either "fail" (1) or "not fail" (0), one requires a statistical tool to assist in making decision, such as Linear Regression, Probit or Logit Model. In this case, the most practical is Logit technique since the variables were non-linear.

On the other hand, Logit Model can be used to solve problems where information is not normally distributed. The information under test falls under this category.

Theoretically speaking, a Logit model is a logistics function that reflects the relationship between a dependent and an independent variable. Logistics function is empirically tested by neural network to replicate an unknown relationship between variables.

RESEARCH DESIGN

The sample uses to test the practicality of the model is obtained from 19 securities companies that are clearing members of the clearing house of the Stock Exchange of Thailand. The time frame used under the test ranged from October 1997-December 1998, which was the period of after the Asian financial crisis. Thailand served as a good representative of new emerging market for stock exchange and financial risk management area.

RESEARCH PROCEDURE

This study finds coefficients of each financial ratio using t-test significance level by running the information in the Logit model for all 3 lags.

The factors used to calculate the given 27 financial ratios (X1,..., X27) based on the financial information obtained in net capital report, balance sheets and profits and loss statements. All 27 financial ratios are grouped under the following 5 categories (Description of the ratios is in Table 1 to 5):

1. Profitability Ratio, such as Net Profit/Total Revenue, Profits (Loss)/Excess Net Capital

2. Leverage Ratio, such as Total Debt/Total Equity, Long-term Debt/Total Debt

3. Liquidity Ratio, such as Net Capital Ratio, EBIT/Interest, Current Ratio

4. Performance Ratio, such as Net Profit/Employee salary

5. Asset Quality Ratio, such as Total account receivable/Equity, Total risks/Market value

RESEARCH FINDINGS

Lag 1 (Next Month)

Model 1	$Z = -1.059758444 - 0.183523954 * X_3$
Model 2	$Z = -1.05978146 + 0.063739136 * X_6 - 0.19013169 * X_8$
Model 3	$Z = 0.532360452 - 1.943602993 * X_{13}$
Model 4	$Z = -0.921074939 - 0.004033988 * X_{15}$
Model 5	$Z = -1.461331372 + 4.937782688 * X_{20}$
Model 6	$Z = 0.256312976 - 0.126952463 * X_3 - 0.001132095 * X_8 - 2.263215582 * X_{13} + 0.025454676 * X_{15} + 4.724819023 * X_{20}$

Lag 2 (Next Two Months)

Model 1	$Z = -1.026724258 - 0.220816341 * X_3$
Model 2	$Z = -1.044225269 + 0.058490079 * X_6 - 0.178341228 * X_8$
Model 3	$Z = 0.278824095 - 1.425428522 * X_{13}$
Model 4	$Z = -0.907598681 - 0.002013929 * X_{15}$
Model 5	$Z = -1.511104006 + 5.332540924 * X_{20}$
Model 6	$Z = -0.067141907 - 0.131212426 * X_3 - 0.00114231 * X_8 - 1.845256166 * X_{13} + 0.028141964 * X_{15} + 6.193440883 * X_{20}$

Lag 3 (Next Three Months)

Model 1	$Z = -1.030373441 - 0.222780487 * X_3$
Model 2	$Z = -1.0413877 + 0.048531078 * X_6 - 0.15391935 * X_8$
Model 3	$Z = 0.125849234 - 1.11455304 * X_{13}$
Model 4	$Z = - 0.932208918 - 0.005179246 * X_{15}$
Model 5	$Z = - 1.66304174 + 6.275232856 * X_{20}$
Model 6	$Z = - 0.334814588 - 0.0885977 * X_3 - 0.001219028 * X_8 - 1.551688844 * X_{13} + 0.017892595 * X_{15} + 7.227686932 * X_{20}$

The coefficients of 27 variables showed that there are 6 variables that are significant (X_3, X_6, X_8, X_{13}, X_{15}, X_{20}) according to the group of ratios. Ratios under the leverage group showed higher statistical significance values and contain the right sign (+/-) (see table 1) for 2 variables (X_6, X_8). The six variables chosen are:

X_3 Net Profit/Excess Net Capital

X_6 Total Debt/Equity

X_8 Long-term Debt/Total Debt

X_{13} Net Capital Ratio

X_{15} Net Profit/Employee Salary

X_{20} Total Risks/Market Value

The six predicted variables can be written (all three lags) as six models as follows:

Model 1: Profitability Ratio

$$Z = a_0 + a_3 X_3$$

Model 2: Leverage Ratio

$$Z = a_0 + a_6 X_6 + a_8 X_8$$

Model 3: Liquidity Ratio

$$Z = a_0 + a_{13} X_{13}$$

Model 4: Performance Ratio

$$Z = a_0 + a_{15} X_{15}$$

Model 5: Asset Quality Ratio

$$Z = a_0 + a_{20} X_{20}$$

Model 6: Full Model

$$Z = a_0 + a_3 X_3 + a_6 X_6 + a_8 X_8 + a_{13} X_{13} + a_{15} X_{15} + a_{20} X_{20}$$

The models derived will be substituted in the Logit equation to obtain exponential values between 0 and 1. Information used in the test ranged from October 1998 - May 1999. The information from such period will be substituted in all the six models for all the six models for all 3 lags to obtain Z value. The Z value is then substituted in the equation to get Y value.

$$\hat{Y}_{it} = \frac{Exp(\hat{Z}_{it})}{1+Exp(\hat{Z}_{it})} + V_{it}$$

where, Y value lies between 0 and 1

Then, compare the Y values obtained with the benchmark at 3 levels (A%), 50%, 60% and 70%.

If Y value > (A%) signifies that the company has financial problems.

And If, Y value < (A%) signifies that the company has no financial problems.

VALIDILITY AND RELIABILITY OF THE MODEL

After running the model, The backed stress test has been performed to recheck the reliability and validity of the model. From Table below, stress test showed the accuracy of the model and matching cases between the results computed by the forecasting system ad the results obtained from Member's Supervision Department for all 3 models and 3 lags, and for 50%, 60%, and 70% conditions.

		Model 1								
		50%			60%			70%		
	Result 1/ Result 2	Yes	No	Total	Yes	No	Total	Yes	No	Total
Lag 1	Yes	0	12	12	0	12	12	0	12	12
	No	0	83	83	0	83	83	0	83	83
	Total	0	95	95	0	95	95	0	95	95
Lag 2	Yes	0	12	12	0	12	12	0	12	12
	No	0	83	83	0	83	83	0	83	83
	Total	0	95	95	0	95	95	0	95	95
Lag 3	Yes	0	12	12	0	12	12	0	12	12
	No	0	83	83	0	83	83	0	83	83
	Total	0	95	95	0	95	95	0	95	95

		Model 2								
		50%			60%			70%		
	Result 1/ Result 2	Yes	No	Total	Yes	No	Total	Yes	No	Total
Lag 1	Yes	2	10	12	2	10	12	2	10	12
	No	2	81	83	1	82	83	1	82	83
	Total	4	91	95	3	92	95	3	92	95
Lag 2	Yes	2	10	12	2	10	12	2	10	12
	No	3	80	83	1	82	83	1	82	83
	Total	5	90	95	3	92	95	3	92	95
Lag 3	Yes	1	11	12	1	11	12	1	11	12
	No	4	79	83	3	80	83	1	82	83
	Total	5	90	95	4	91	95	2	93	95

		Model 3								
		50%			60%			70%		
	Result 1/ Result 2	Yes	No	Total	Yes	No	Total	Yes	No	Total
Lag 1	Yes	3	9	12	0	12	12	0	12	12
	No	7	76	83	1	82	83	1	82	83
	Total	10	85	95	1	94	95	1	94	95
Lag 2	Yes	1	11	12	0	12	12	0	12	12
	No	0	83	83	0	83	83	0	83	83
	Total	1	94	95	0	95	95	0	95	95
Lag 3	Yes	1	11	12	0	12	12	0	12	12
	No	1	82	83	0	83	83	0	83	83
	Total	2	93	95	0	95	95	0	95	95

		Model 4								
		50%			60%			70%		
	Result 1/ Result 2	Yes	No	Total	Yes	No	Total	Yes	No	Total
Lag 1	Yes	0	12	12	0	12	12	0	12	12
	No	0	83	83	0	83	83	0	83	83
	Total	0	95	95	0	95	95	0	95	95
Lag 2	Yes	0	12	12	0	12	12	0	12	12
	No	0	83	83	0	83	83	0	83	83
	Total	0	95	95	0	95	95	0	95	95
Lag 3	Yes	0	12	12	0	12	12	0	12	12
	No	0	83	83	0	83	83	0	83	83
	Total	0	95	95	0	95	95	0	95	95

		Model 5								
		50%			60%			70%		
	Result1/ Result 2	Yes	No	Total	Yes	No	Total	Yes	No	Total
Lag 1	Yes	2	10	12	1	11	12	0	12	12
	No	5	78	83	2	81	83	0	83	83
	Total	7	88	95	3	92	95	0	95	95
Lag 2	Yes	3	9	12	1	11	12	0	12	12
	No	7	76	83	2	81	83	0	83	83
	Total	10	85	95	3	92	95	0	95	95
Lag 3	Yes	2	10	12	1	11	12	1	11	12
	No	7	76	83	1	82	83	0	83	83
	Total	9	86	95	2	93	95	1	94	95

		Model 6								
		50%			60%			70%		
	Result1/ Result 2	Yes	No	Total	Yes	No	Total	Yes	No	Total
Lag 1	Yes	3	9	12	0	12	12	0	12	12
	No	15	68	83	6	77	83	2	81	83
	Total	18	77	95	6	89	95	2	93	95
Lag 2	Yes	4	8	12	0	12	12	0	12	12
	No	15	68	83	9	74	83	3	80	83
	Total	19	76	95	9	86	95	3	92	95
Lag 3	Yes	3	9	12	0	12	12	0	12	12
	No	12	71	83	9	74	83	7	76	83
	Total	15	80	95	9	86	95	7	88	95

CONCLUSION

By comparing the results derived from Logit model and the results of the financial surveillance model on the clearinghouse of SET for same companies and same period, the results showed more than 80% matching cases for all models.

Predicted values for the benchmark level of 50% showed the most reliable results for all 3 lags since the predicted values showed signs that the securities companies were likely to face financial problems when predicted values were not high. On the other hand, 60% and 70% conditions predicted the status of the companies only when the predictable values are high enough.

TABLE 1

MEANING OF THE SIGNS POSTED TO THE FINANCIAL RATIOS

Type of Financial Ratios	Financial Ratios	IV	S	Meanings of the sign
Profitability	Net Profit/ Total Revenue	X1	-	If the company has high net profit over total revenue, the chances that the company will face financial problems is also reduced, therefore, the relationship is inverse (-).
	Net Profit/ Equity	X2	-	There is an inverse relationship (-) between facing financial problem and making good net profits over equity.
	Net profit/ENC	X3	-	There is an inverse relationship (-) between facing financial problem and making good net profits over excess net capital.
	Net Profit (Loss)	X4	-	There is an inverse relationship (-) between facing financial problem and making good net profits.
	Total Debt/ Equity X5	X5	-	There is an inverse relationship (-) between facing financial problem and making good net profits over revenue from core business.

TABLE 2

Type of Financial Ratios	Financial Ratios	IV	S	Meanings of the sign
Leverage	Total Debt/ Equity	X6	+	There is a direct relationship (+) between facing financial problems and having high foreign debt over total debt.
	Foreign Debt/ Total Debt	X7	+	There is an inverse relationship (-) between facing financial problems and having a higher foreign debt over total debt.

	Long-term Debt/ Total Debt	X8 X9	- +	There is an inverse relationship (-) between facing financial problems and having a higher long-term debt over total debt.
	Obligations/ Equity			There is a direct relationship (-) between facing financial problems and having high obligations over equity.

TABLE 3

Type of Financial Ratios	**Financial Ratios**	**IV**	**S**	**Meanings of the sign**
Liquidity	Current Ratio	X10	-	There is an inverse relationship (-) between facing financial problems and maintaining high current ratio for it means that the company has high liquidity.
	Quick Ratio	X11	-	There is an inverse relationship (-) between facing financial problems and maintaining high quick ratio (excluding inventory) for it means that the company is very liquid.
	EBIT/Interest	X12	-	If earnings before interest and tax (EBIT) over interest is likely to be high, there is lesser tendency that the company will face financial problems, therefore the relationship is inverse (-).
	NCR	X13	-	There is an inverse relationship (-) between maintaining a high net capital level and facing financial problems for the company is in a good position to pay for its debt.

TABLE 4

Type of Financial Ratios	**Financial Ratios**	**IV**	**S**	**Meanings of the sign**
Performance	Revenue/ Employee Salary	X14	-	If the company can maintain high revenue over employee salary, the company is unlikely to face financial problems,
	Net Profit/ Employee Salary	X15	-	therefore the relationship is inverse (-). If the company can maintain a high net profits over employee salary, the company is unlikely to face financial problems, therefore the relationship is inverse (-).

	Employee Salary	X16	+	If employee salary is too high, it is likely that the company will face financial problems, therefore the relationship is direct (+).
	Other operational expenses	X17	+	High other operational expense signals that the company is likely to face financial problems, therefore the relationship is direct.
	Other operational expenses/ Operational expense	X18	+	If other operational expense is higher than the operational expense required to do business, it is likely that the company will face financial problems, therefore the relationship is direct (+).
	Spread	X19	-	If the company receives high spread on the interests, is unlikely that the company will face financial problems, therefore the relationship is inverse (-).

TABLE 5

Type of Financial Ratios	**Financial Ratios**	**IV**	**S**	**Meanings of the sign**
Asset Quality	Total Risks/ Market Value	X20	+	There is direct relationship (+) between high haircut and the company facing financial problem.
	Total account receivable (Securities account receivable + securities loaned/Equity	X21	+	There is a direct relationship (+) between high total accounts receivable over equity and the company facing financial problem.
	Collateral placed by securities account receivable and borrower of securities/total value of margin loan and securities loan.	X22	-	There is an inverse relationship (-) between maintaining collateral with high value over total loan and the company facing financial problem.
	Securities accounts receivable not due/ Total value of securities accounts receivable (Accounts not due + due within 30 days + overdue by 30 days)	X23	+/-	The relationship under this case is either direct (+) or (-) since payment has not been due. In this way, the company faces risks of not receiving payment and may face financial problem, so the relationship is direct. On the other hand, if the company expects to receive full payment, is unlikely that the company will face financial problem, so the relationship is inverse.

	Securities account receivable with payments due within 30 days/Total value of securities account receivable (Accounts not due + due within 30 days + overdue by 30 days)	X24	+	The relationship under this case is either direct (+) or (-) since payment has been due but falls within the allowable period of 30 days. In this way, the company faces risks of not debtor defaulting payment and may face financial problem, so the relationship is direct. On the other hand, if the company can redeem full payment, it is unlikely that the company will face financial problem, so the relationship is inverse.
	Securities account receivable with payments overdue by 30 days/Total value of securities account receivable (Accounts not due + due within 30 days + overdue by 30 days)	X25	+	If undue payments fall pass 30 days, there is a tendency that high bad debts will rise, therefore the relationship of having such accounts and the company facing financial problem is direct (+).
	Uncovered collateral (market value of collateral - market value of borrowed securities) after deducting market risks/total margin accounts (covered collateral for cash loan + uncovered collateral for cash and securities loan)	X26	+/-	If the value of uncovered collateral rises, there is a chance that the company will face financial problem, so the relationship is direct.
	Portfolio Investment/ Equity	X27	+/-	The relationship under this case is either direct (+) or inverse (-) for it depends on the valuation of the securities portfolio. If the portfolio has high value, it is unlikely that the company will face financial problem, so the relationship is inverse. On the other hand, if the portfolio has low value, the company is likely to face financial problem, so the relationship is direct.

IV = Independent variable S = Sign

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