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THE DETERMINANTS OF FINANCIAL HEALTH OF ASIAN INSURANCE COMPANIES

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ABSTRACT

Previous studies of financial health of insurance companies are mainly focused on insurers operating in the United States and developed economies. This article focuses on the solvency of general (property-liability) and life insurance companies in Asia using firm data and macro data separately. It uses different classification methods to classify the financial status of both general and life insurance companies. With the exception of Japan, failures of insurers in Singapore, Malaysia, and Taiwan are nonexistent. We find that, first, the factors that significantly affect general insurers' financial health in Asian economies are firm size, investment performance, liquidity ratio, surplus growth, combined ratio, and operating margin. Second, the factors that significantly affect life insurers' financial health are firm size, change in asset mix, investment performance, and change in product mix, but the last three factors are more applicable to Japan. Third, the financial health of insurance companies in Singapore seems to be significantly weakened by the Asian Financial Crisis. As the insurance industry in different Asian economies is at different stages of development, they require different regulatory guidelines.

INTRODUCTION

The major emerging insurance markets in Asia have attracted a great deal of attention (Goenka and Mony, 1997). Indeed, increasing liberalization in the insurance industry together with the 1997 Asian Financial Crisis[1] has posed a great deal of challenges for insurance regulatory authorities in monitoring the financial well-being of insurance companies. For the regulatory authorities to design a system that can identify

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[1] The Monetary Authority of Singapore (MAS) has directed Cosmic Insurance Corporation Ltd. ("Cosmic"), a general insurer, to cease accepting new business, including policy renewals, with effect from September 20, 2002 due to serious operational difficulties (MAS, 2002).

insurers which are in or heading toward a hazardous condition is one of the great challenges.

Previous studies of insolvency of insurance companies focus mainly on insurers (both life and general) operating in the United States and developed economies. Unlike the previous studies, this article uses firm data (for life and general insurers) and market factors separately in analyzing an insurer's financial strength in Japan as well as Malaysia, Singapore, and Taiwan where no insurer has failed before 1999 (Foo, 1997; OECD and MAS, 1999).[2]

The objectives of this article are: first, to compare and contrast to previous research the variables that predict an insurer's financial strength, so that regulators can better monitor the solvency status of insurers and take prompt actions; second, to apply the HHM model[3] together with financial ratios to test the solvency status of individual insurers in the four Asian economies; and third, to assess the effect of Asian Financial Crisis on the financial health of the insurance companies concerned, especially for the companies operated in Singapore and Malaysia whose economies were seriously affected by the crisis. The remainder of this article is organized as follows: "Literature Review" reviews previous studies on the insurers' insolvency. "Data, Hypotheses, and Methods" presents data and methods employed for testing the hypotheses developed followed by "Findings." The article concludes with a discussion on regulatory implications.

LITERATURE REVIEW

Factors Affecting Insurers' Insolvency

McDonald (1992) summarized the factors affecting insurer insolvency, which provide useful guidelines on an insurer's financial health, but without classifying them into different types of insurers. In the following, we will review firm-specific factors that affect property-liability (general) and life/health insurers separately, and market factors that affect both types of insurers. This is because life/health insurers differ greatly in terms of operations, investment activities, vulnerabilities, and duration of liabilities from general insurers (Brockett et al., 1994). Life insurers are said to function as "financial intermediaries" while general insurers as "risk takers."

Firm-Specific Factors on Property-Liability Insurers' Insolvency. Many previous studies focused on general insurers used financial characteristics as insolvency predictors (Ambrose and Seward, 1988; BarNiv, 1990; BarNiv and McDonald, 1992; BarNiv and Smith, 1987; Barrese, 1990; Harrington and Nelson, 1986; Hershbarger and Miller, 1986; Willenborg, 1992; Pinches and Trieschmann, 1974; Trieschmann and Pinches,

[2] Nissan Mutual Life failed in 1997 (Skipper, 1998, p. 267). In December 2000, two more life insurance companies in Japan, Chiyoda and Kyoei went bankrupt, largely caused by the bubble in the real estate market during the late 1980s. In November 2001, another nonlife company, Taisei Fire & Marine, bankrupted due to the reinsurance liability exposure from the September 11, 2001 terrorist attack in New York.

[3] HHM model is an easy-to-use model for predicting the financial strength of a life insurer survival capability (with a 2-year combined accuracy ratio of 78.8 percent). It was developed by Hollman, Hayes, and Murrey (1992).

1973). The factors that are significant for assessing general insurers' insolvency include firm size, investment performance, underwriting result, liquidity, operating margin, premium growth, and growth rate of surplus.

Firm Size: The financial health of any organization is influenced by, among other factors, the size or total assets of the firm. As regulators are less likely to liquidate large insurers, it is expected that small insurers are more vulnerable to insolvency (BarNiv and Hershbarger, 1990; Cummins, Harrington, and Klein, 1995). Variables used to measure firm size include total premium, total admitted assets, and capital and surplus.

Investment Performance: Investment performance discloses the effectiveness and efficiency of investment decisions. As such, investment performance becomes critical to the financial solidity of an insurer. Kim et al. (1995) and Kramer (1996) find that investment performance is negatively correlated to insolvency rate.

Underwriting Result: There are two key components of an insurer's total operating income: investment income and underwriting income. We have discussed the effect of investment performance. As for underwriting income, we use combined ratio[4] to measure its performance. According to Browne and Hoyt (1995), the combined ratio is positively correlated to insolvency rate.

Liquidity Ratio: Liquidity is the capability of an insurer to pay liabilities, which include operating expenses and payment for losses/benefits under insurance policies, when due. For an insurer, cash flow (mainly premiums and investment income) and liquidation of assets are the two sources of liquidity (Hampton, 1993). Lee and Urrutia (1996) found that the current liquidity ratio is a significant indicator of solvency. The stability of the liquidity ratio is a necessary measure of corporate solvency (Dambolena and Khoury, 1980).

Operating Margin: Intuitively, being profitable means that insurers are earning more revenues than being disbursed as expenses. Kramer (1996) found a positive relationship between operating margin[5] and financial solidity, that is, operating margin is negatively correlated to the rate of insolvency.

Premium Growth: Premium growth measures the rate of market penetration. Empirical results show that rapid growth of premium volume is one of the causal factors in insurers' insolvency (Kim et al., 1995). Being too obsessed with growth can lead to self-destruction as other important objectives might be neglected. This is especially true during an economic downturn, such as the Asian Financial Crisis.

Growth Rate of Surplus: Closely related to operating margin is the growth rate of surplus. An insurer who is profitable should be reporting increases in surplus over the years. However, the increases in surplus should not be dramatic as such increases could indicate the increase in the risk level of operation. Being operating with growth

[4] Combined ratio is the ratio of incurred losses to earned premiums plus incurred expenses to written premiums (see Rejda, 2001).

[5] Operating margin is defined as the ratio of net operating income to premiums earned (Lee and Urrutia, 1996).

at higher risk level could produce negative impact on the insurer's financial health (Lee and Urrutia, 1996).

Firm-Specific Factors on Life/Health Insurers' Insolvency. Unlike general insurers' insolvency, Kim et al. (1995) found that the correlation coefficients of identified variables in life insurers' insolvency are not high. Nevertheless, they are important in predicting life insurers' insolvency and thus are discussed here.

Firm Size, Investment Performance, and Operating Margin: Consistent with the findings for general insurers, firm size (Kim et al., 1995) and age (Grace, Harrington, and Klein, 1998) are negatively correlated with life insurers' rate of insolvency. Ambrose and Carroll (1994) got a better classification when ratio of net investment income to total income was included in their analyses. BarNiv and Hershbarger (1990) found that operating margin is the best single variable associated with life insurers' solvency.

Change in Asset Mix:[6] Life insurers' assets can be partitioned into various categories like bonds, common and preferred stocks, mortgage loans, and policy loans. Life insurers offer a variety of life insurance policies, annuities, and other investment sensitive contracts with different risk-return features (Klein, 1995). Hence, any changes in the asset mix will definitely have implications on the insurer's financial solidity to varying degrees. Empirical findings have confirmed that there is a positive relationship between this variable and life insurers' insolvency (Ambrose and Carroll, 1994; BarNiv and Hershbarger, 1990; Carson and Hoyt, 1995).

Change in Product Mix: Change in product mix is the ratio representing the average change in the percentage of total premium from each product line during the year. BarNiv and Hershbarger (1990) found that change in product mix affects smaller life insurers adversely.

Insurance Leverage: Insurance leverage is defined as reserves to surplus. The risk of an insurer may increase when it increases its insurance leverage and/or financial leverage (Carson and Hoyt, 1995). Literature on capital structure confirms that a firm's value will increase up to an optimum point as leverage increases, and then decline if leverage is further increased beyond the optimum level. Thus, leveraging beyond this optimum level could result in high risk of insolvency and low value of the firm.

Market/Economic Factors on Property-Liability Insurers' Insolvency. A good understanding of economic conditions under which an insurance company operates is valuable for three reasons (Browne and Hoyt, 1995). First, the potential and probability of insolvencies can be greatly reduced, to the extent that the regulator can influence these market conditions. Second, any effective and efficient regulatory action taken with respect to an insurer's financial distress is a function of the prevailing economic conditions. Third, depending on the economic environment in which insurers operate, the optimal need of resources devoted to solvency surveillance will change. As such,

[6] Change in asset mix variable is the average of the percentage change in assets accounts.

more resources will be needed during difficult economic periods, such as the Asian Financial Crisis.

Browne and Hoyt (1995) tested six hypotheses in relation to general insurers' insolvency, which include the number of insurers (competition), underwriting cycle and combined ratio, first quarter of year (which has to do with the timing of regulatory action taken), unanticipated inflation, interest rate level, and interest rate change. The hypothesized relationships for all these variables are positive, except the interest rate level. It was found that only the first three hypotheses were significant in their study. Their conclusions are to some content supported by the studies done by Munch and Smallwood (1980), Chen, Wong, and Lee (1999), Winter (1991), and Staking and Babbel (1991).

Market/Economic Factors Related to Life/Health Insurers' Insolvency. In a study examining the relationship between insurance market conditions and life/health insurers' insolvency, A. M. Best Company (1992) found that the number of insolvencies is correlated with the accident and health underwriting cycle (lagged by 1–3 years). The increased number of insolvencies is correlated with increases in interest rates and life/health insurers' focus on investment-related products. The study, however, did not examine the economic factors in a multivariate framework to determine their relative significance.

Browne, Carson, and Hoyt (1999) attempted to identify factors that are exogenous to individual life/health insurers, and that increase their susceptibility to insolvency. This is because conditions that are exogenous to the firm may increase the likelihood of its financial distress. They find that life/health insurers' insolvencies are positively related to increases in long-term interest rates and personal income, and negatively related to real estate returns. These findings support the argument that economic and market factors are important in the prediction of life/health insurers' financial health.

Methods Used in Insurers' Insolvency Studies

Various statistical methods (see Table 1) have been employed to study insurers' financial conditions and their likelihood to fail. Altman (1984) provided a comprehensive review of many of these models and empirical results. BarNiv and McDonald (1992) also gave a good review on the literature of statistical methods and results on rating and monitoring insolvency risk of insurers (also see Brockett et al., 1994; Carson and Hoyt, 1995; Kim et al., 1995).

Most previous studies used samples of solvent and insolvent insurers. Using such an approach will prevent the study of potential insolvency of insurers' in economies such as Malaysia, Singapore, and Taiwan where no insurer has failed so far. Kramer (1996) resorted to subjective criteria to classify insurance companies into three categories: strong, moderate, and weak, since bankruptcies of Dutch nonlife insurance companies are very rare. The HHM model, developed by Hollman, Hayes, and Murrey (1992), uses ratio-based methodology to provide an early warning of life/health insurers in possible financial trouble. This model will be discussed further in the following section.

TABLE 1
Limited Dependent Variable Models for Classification of Solvent and Insolvent Insurers

Model or Technique	Research That Employed the Category Models
Univariate analysis	Beaver (1966), Pinches and Trieschmann (1974), BarNiv and Smith (1987), A. M. Best Company (1992), Cummins, Harrington, and Klein (1995)
Multiple discriminant analysis (MDA)	Trieschmann and Pinches (1973), Ambrose and Seward (1988), Hershbarger and Miller (1986), Carson and Hoyt (1995)
Recursive partitioning	Frydman, Altman, and Kao (1985), Scrinivasan and Kim (1987), Carson and Hoyt (1995)
Nonparametric discriminant	BarNiv and Raveh (1989)
Exponential generalized beta	BarNiv and McDonald (1992)
Neural network	Duett and Hershbarger (1990), Huang, Dorsey, and Boose (1994), Brockett, Cooper, Golden, and Pitaktong (1994)
Logit and probit analyses	BarNiv (1990), BarNiv and Hershbarger (1990), Carson and Hoyt (1995), Lee and Urrutia (1996), Ambrose and Carroll (1994), Browne, Carson, and Hoyt (1999), Cummins, Harrington, and Klein (1995)
Cascaded logistic regressions	Baranoff, Sager, and Witt (1999)
Ruin approach	Barth (2000)
Expected policyholder deficit ratio approach	Barth (2000)
Cash flow simulation	Cummins, Martin, and Phillips (1999)

DATA, HYPOTHESES, AND METHODS

Data

The data for general insurance companies in Singapore covered from 1966 to 1999 are collected (data period for life insurers is shorter) from the *Annual Report of the Singapore Insurance Commissioner* (MAS, 1965–2002). Other economic data for Singapore are gathered from the *Singapore Yearbook of Statistics* (The Department of Statistics of Singapore Government, various years) and the Datastream database. For economies other than Singapore, all the data are from 1994 to 1999 (1994–1998 for Taiwan) and are gathered from the relevant insurance yearbooks (Bank Negara Malaysia, 1993–1999; Insurance Institute of the Republic of China, Taipei, 1993–1998; and Insurance Research Institute (Japan), 1993–1999). Table 2 gives the number of insurers used in this study each year from 1994 to 1999 by each economy. Table 3 lists the actual number of insurers that were in operation in each economy. By comparing Tables 2 and 3, we are confident that most of the insurance companies in operation in these economies from 1994 to 1999 are included in our study.

The data from 1994 to 1999 (1994–1998 for Taiwan) for each economy are then pooled together for macro analysis. Table 4 gives the total number of insurers included in this study. For deriving the figures in Table 4, each company is only counted once even though it may have stayed in operation for the whole period. The number in Table 4 is different from that in Table 2 or Table 3. This is because some of the companies have

TABLE 2
Number of Insurers Used in the Study: By Year and Economy

	1994	1995	1996	1997	1998	1999
General Insurance						
Malaysia	55	53	53	53	53	53
Singapore	81	74	79	84	91	85
Taiwan	22	22	25	26	25	n.a.
Life/Health Insurance						
Japan	30	30	30	43	43	42
Malaysia	15	17	18	17	18	18
Singapore	20	21	22	20	20	19
Taiwan	27	28	29	29	31	n.a.

Source: For Malaysia (1999 data): http://www.bnm.gov.my/en/Documents/Periodicals/DGI/2001/04.Charts.pdf. For Japan (1999 data): http://www.seiho.or.jp/english/index.html. For Singapore (2001 data): http://www.mas.gov.sg/directory/index.html. For Taiwan: (1998 data): http://sg.biz.yahoo.com/ifc/tw/news/122099-1.html.

TABLE 3
Number of Actual Insurers Operated in Each Economy

	Malaysia	Singapore	Taiwan	Japan
Direct Insurers	56	59		
Life Insurers	7	7		
General Insurers	38	45	28	–
Composite Insurers	11	7		
Professional Reinsurers	11	40		
Life Insurers	1	1	31	46
General Insurers	10	30		
Composite Insurers	–	9		
Captives	–	54		

Source: For Malaysia (1999 data): http://www.bnm.gov.my/en/Documents/Periodicals/DGI/2001/04.Charts.pdf. For Japan (1999 data): http://www.seiho.or.jp/english/index.html. For Singapore (2001 data): http://www.mas.gov.sg/directory/index.html. For Taiwan: (1998 data): http://sg.biz.yahoo.com/ifc/tw/news/122099-1.html.

ceased in operation, or merged with others, or new companies may have formed between 1994 and 1999.

Hypotheses

There are 16 hypotheses (see Table 5) to be tested in this study, which include the effects of firm-specific factors and market factors on the financial stability of general insurers and life insurers.

Classification Methods

General Insurers (Financial Ratios). Most previous studies focused on general insurers used financial characteristics as solvency predictors. Table 6 lists the ratios that are found significant in previous studies in predicting general insurers' insolvency.

TABLE 4
Total Number of Insurers Used by Economy

Economy	Total Number of Insurers Used
General Insurance	
Malaysia	63
Singapore	127
Taiwan	28
Life/Health Insurance	
Japan	46
Malaysia	19
Singapore	26
Taiwan	32

TABLE 5
Hypotheses of the Effects of Various Factors on the Financial Stability of Asian Insurers

Hypothesis	Factors	Expected Effect
Company's Factors on General Insurers		
H1	Firm size	+
H2	Investment performance	+
H3	Operating margin	+
H4	Premium growth	−
H5	Surplus growth	−
H6	Combined ratio	−
H7	Liquidity ratio	+
Company's Factors on Life/Health Insurers		
H8	Firm size	+
H9	Investment performance	+
H10	Operating margin	+
H11	Change in asset mix	−
H12	Change in product mix	−
H13	Insurance leverage	−
Market/Economic Factors on both General and Life/Health Insurers		
H14	Number of insurers (competition)	−
H15a	Interest rate changes	−
H15b	Absolute level of interest rate	+
H16	Inflation rate change	−

The National Association of Insurance Commissioners (NAIC) of the United States employed three systems to prioritize insurers for further regulatory action. The Insurance Regulatory Information System (IRIS) has served as the baseline solvency screening system for the NAIC and state regulators from the mid 1970s until the development of the Financial Analysis and Surveillance Tracking (FAST) system in 1993 and the property-liability insurance risk-based capital (RBC) system in 1994.

The computational phase of the IRIS involves calculating 11 financial ratios for an insurer and comparing each ratio to its specified "usual range." In the analytical phase, insurers are then selected for a more detailed assessment of their financial results based

TABLE 6
List of Financial Ratios Employed for Predicting General Insurers' Insolvency and Sources of Reference

Ratios	Mathematical Expressions	Sources
Liquidity		
Liquidity ratio	$\frac{\text{Liquid Assets at Market Value}}{\text{Total Reserves}}$	Lee and Urrutia (1996), Hampton (1993)
Liabilities to liquid assets ratio	$\frac{\text{Stated Liabilities}}{\text{Liquid Assets (Accounting Value)}}$	Brockett et al. (1994), Ambrose and Seward (1988), NAIC
Profitability		
Loss ratio	$\frac{\text{Losses Incurred} \pm \text{Adjusting Expenses}}{\text{Premiums Earned}}$	Hampton (1993)
Expense ratio (trade basis)	$\frac{\text{Acquisition Expenses} \pm \text{Administrative Expenses}}{\text{Premiums Written}}$	Ambrose and Seward (1988)
Expense ratio (financial basis)	$\frac{\text{Acquisition Expenses} \pm \text{Administrative Expenses}}{\text{Premiums Earned}}$	Hampton (1993)
Combined ratio (trade basis)	$\frac{\text{Losses Incurred}}{\text{Premiums Earned}} + \frac{\text{Adjusting Expenses}}{\text{Premiums Written}}$ = Loss ratio + Expense ratio (Trade Basis)	Hampton (1993)
Combined ratio (financial basis)	$\frac{\text{Losses Incurred} \pm \text{Underwriting Expenses}}{\text{Premiums Earned}}$ = Loss ratio + Expense ratio (Financial Basis)	Ambrose and Seward (1988), Pinches and Trieschmann (1974)

(Continued)

TABLE 6
(Continued)

Ratios	Mathematical Expressions	Sources
Investment yield ratio	$\frac{\text{Investment Income}}{\text{Average Invested Assets}}$	Ambrose and Seward (1988), Brockett et al. (1994), NAIC
Investment income ratio	$\frac{\text{Investment Income}}{\text{Premiums Earned}}$	Hampton (1993)
Change in surplus ratio	$\frac{\text{Ending Surplus} - \text{Starting Surplus}}{\text{Starting Surplus}}$	Lee and Urrutia (1996), Hampton (1993), NAIC
Capacity		
Assets to premiums ratio	$\frac{\text{Starting Admitted Assets}}{\text{Premiums Earned}}$	Hampton (1993)
Premiums to surplus ratio	$\frac{\text{Premiums Written}}{\text{Surplus}}$	Lee and Urrutia (1996), Ambrose and Seward (1988), Pinches and Trieschmann (1974), NAIC
Change in writings ratio	$\frac{\text{Premiums (Current Yr)} - \text{Premiums (Prior Yr)}}{\text{Premiums (Prior Year)}}$	Lee and Urrutia (1996), Ambrose and Seward (1988), Hampton (1993), NAIC
Surplus aid to surplus	$\frac{\text{Commissions on Reinsurance Ceded}}{\text{Surplus}}$	Ambrose and Seward (1988), Brockett et al. (1994), NAIC

Note: See the Appendix for the guidelines for financial ratios.

on a number of criteria, including whether an insurer has four or more ratios outside the designed usual ranges. Following this detailed analysis, each insurer is placed into one of the five categories—first, second, third, no priority, and no synopsis required (Grace, Harrington, and Klein, 1998).

FAST encompasses nearly all the information conveyed by IRIS. The overall FAST score, a univariate summary statistic compiled by the NAIC is based on the 29 financial ratios constituting the FAST system. The NAIC assigns scores corresponding to a company's ratios based on a subjective evaluation of the importance of the ratios and their relationship to solvency, and the scores are summed to obtain the company's overall FAST score. In contrast to the IRIS system, the FAST scores are not revealed by the NAIC, and both the ratios and the scores could change over time as new information becomes available (Grace, Harrington, and Klein, 1995).

According to the NAIC, the RBC requirements are to provide a standard of capital adequacy that (1) is related to risk, (2) raises the safety net for insurers, (3) is uniform among states, and (4) provides authority for and in some cases requires regulatory action when capital falls below the standard. The NAIC's property-liability RBC formula encompasses four major risk categories: (1) asset risk (default and market value declines), (2) credit risk (uncollectible reinsurance and other receivables), (3) underwriting risk (pricing and reserve errors), and (4) off-balance sheet risk (e.g., guarantees of parent obligations, excessive growth). The RBC formulas apply factors to various amounts reported in (or related to) the annual statement to determine RBC charges for each type of risk. A covariance adjustment is made to the accumulated RBC charges to account for diversification between major risk categories (Grace, Harrington, and Klein, 1998).

The IRIS rule classifies an insurer as a priority company when the insurer failed to meet the standard in 4 (36.36%) or more of their 11 financial ratios. In this article, we classify insurers in Taiwan that failed 5 (35.7%) or more of the 14 financial ratios listed in Table 6 as financially unstable, while those failed less than 5 of the 14 ratios as financially stable. As for the insurers in Singapore and Malaysia, we consider only 13 ratios, as the data on "Commissions on Reinsurance Ceded" is not available for analysis. We will classify companies that failed 5 (38.5%) or more of the 13 ratios as financially unstable, while those failed less than 5 of the 13 ratios as financially stable.

We must stress that in this article we use the financial ratios to classify general insurers into two categories (financially stable and unstable) and not to predict their failure because there is no insolvency case so far in Singapore, Malaysia, and Taiwan (Foo, 1997; OECD and MAS, 1999). It is also important to note that we use "financial solvency," "financial solidity," "financial strength," and "financial health" interchangeably. They are essentially measures of financial strength of insurers, and do not imply failure or possible failure.

Life/Health Insurers (The HHM Model): The HHM model (Hollman, Hayes, and Murrey, 1992) uses a ratio-based methodology to provide an early warning of insurers in possible financial trouble. As such, it reflects the relative changes of balance sheet items as a distinctive measure, represented by an index of stability (I). The value of I_k therefore disregards the size factor of the company. Greater instability is represented by a larger value of I_k, and this should prompt regulator for immediate attention.

The mathematical expression of the HHM model given below, which is in a weighted natural logarithmic form, will help explain the implication:

$$I_k = \sum_{i=1}^{n} x_i[\ln x_i / y_i], \tag{1}$$

where I_k is a summary measure of instability of the kth section of financial data series; $i = 1, 2, \ldots, n$ is the order of appearance of n financial statement items; x_i represents a specific item from specific financial statement; and y_i represents the corresponding (prior period) reference component.

The model captures the relative changes of balance sheet items over the years for individual company to standardize the financial statement amounts. Any negative value is hence taken as positive before summation. Also, any zero value of x_i and/or y_i in $[\ln x_i/y_i]$ is substituted with the value 0.0000001, prior to finding the logarithm. Thus, the weight, x_i, still retains its original value of zero in any case.

The dichotomous classification rule rests on the value of individual I_k score relative to the sample mean I_{av} score. An insurance company whose I_k score is greater than the sample mean I_{av} score in either the asset or liability section is identified as financially unstable. This model of classification for life insurers is employed in this study because it has an excellent 1-year lead-time accuracy of 85.7 percent, and a high combined accuracy ratio of 78.8 percent in the United States (Hollman, Hayes, and Murrey, 1992).

The HHM model provides an easy-to-use method for analyzing the solvency of life/health insurers over the years. Moreover, there are other advantages of using the model. First, it removes the difficulty of insufficient data from new and small insurance companies, and hence can be applied to a given firm over time or at a point in time. Second, it makes the financial assessment of individual insurer more feasible. Third, it allows scrutiny of financial statement items at different composite levels, allowing more sensitive search after initial screening. Fourth, the model overcomes some of the application deficiencies of regression analysis (e.g., MDA, logit, and probit). Finally, it is also "scale free" as it captures the relative changes and not the change in absolute values.

However, the HHM model is not a foolproof method; its main limitation is the problem of possible window dressing of financial statements. Hence, this method should only serve as a screening device to uncover any abnormal instability of financial statement items, so that those items which warrant detailed examination can be identified.

Regression Analysis

Apart from the violation of assumption of normally distributed errors and constant variance, the linear specification does not confine the probability for the response to the unit (1 or 0) interval. A cumulative probability distribution function $P(\cdot)$ can solve this fundamental problem by transforming the linear predictor smoothly to the unit interval. Both the probit and logit models have such specification, which uses the normal and logistic cumulative probability distribution functions, respectively. Despite their similarity, the logit model is simpler to interpret as the model can be

written as a linear model for the log odds. In addition, the diagnostics[7] for linear models can be extended to the logit model. Therefore, logit model (see Fox, 1997) is used to estimate the following two test equations on firm-specific factors based on our hypotheses listed in Table 5.

Property-Liability Insurers

$$\log_e \frac{\pi_i}{1-\pi_i} = \beta_0 + \beta_1 \text{SIZ} + \beta_2 \text{IP} + \beta_3 \text{OM} + \beta_4 \text{PG} + \beta_5 \text{SG} + \beta_6 \text{CR} + \beta_7 \text{LQ} + e_t. \quad (2)$$

Life/Health Insurers

$$\log_e \frac{\pi_i}{1-\pi_i} = \beta_0 + \beta_1 \text{SIZ} + \beta_2 \text{IP} + \beta_3 \text{OM} + \beta_4 \Delta\text{AM} + \beta_5 \Delta\text{PM} + \beta_6 \text{IL} + e_t \quad (3)$$

where $\log_e(\pi_i/1-\pi_i)$ is the logit (dependent variable takes on two values 1 and 0 with probabilities π_i and $1-\pi_i$, respectively); SIZ, the firm size measured by total admitted assets; IP, the investment performance measured by ratio of net investment income to total income; OM, the operating margin measured by ratio of net operating income to premium earned; PG, the premium growth between current and prior year; SG, the surplus growth between current and prior year; CR, the combined ratio (trade basis); LQ, the liquidity measured by ratio of liquid assets to total reserves; ΔAM, the change in asset mix between current and prior year; ΔPM, the change in product mix between current and prior year; IL is the insurance leverage measured by ratio of reserves to surplus.

Multiple regression is used to estimate the following equation on market/economic factors for both life/health and general insurers' solvency. Since the time series of data for Japan, Malaysia, and Taiwan insurers are very short, we will only conduct an analysis for Singapore general insurers, which have a total of 34 years and sufficient number of insurers over the period for study. We will not conduct a similar analysis for Singapore life insurers, since the sample sizes for earlier years are small and financial data are not complete.

$$Y = \beta_0 + \beta_1 \text{TI} + \beta_2 \Delta\text{IR} + \beta_3 \text{IR} + \beta_4 \text{IF} + e_t, \quad (4)$$

where Y is the percentage of financially unstable (weak) insurers; TI, the total number of insurers in that industry; ΔIR, the average change in interest rate (prime rate) level over the four quarters per year; IR, the interest rate level (year-end prime rate); IF is the yearly inflation rate change (year end).

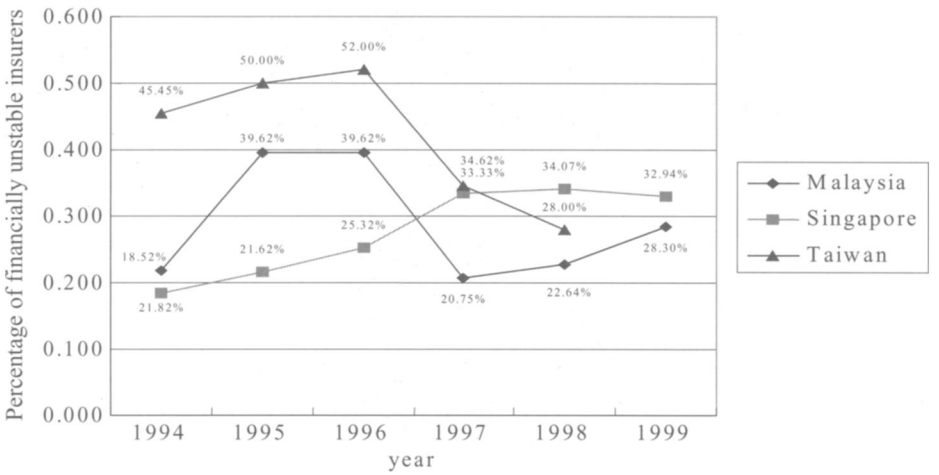
FINDINGS

Property-Liability Insurers

Trends in Financially Unstable Property-Liability Insurers. Figure 1 reveals that Singapore scored the lowest percentage (below 30 percent) of financially unstable property-liability insurers as compared to Malaysia and Taiwan before 1996. However, the

[7] Diagnostics include studentized residuals, hat values, influence diagnostics partial-residual plots, partial-regression plots, and constructed-variable plots.

FIGURE 1
Property-Liability Insurers' Financial Health by Economy: 1994–1999



Note: The average percentage for Singapore, Malaysia, and Taiwan is 27.63, 28.79, and 42.01 percent, respectively. The average percentage for all these three economies over the 6 years is 32.81 percent.

financial solidity of Singapore general insurers seems to devastate over the sampling period and there seems to be a clear sign of convergence among insurers in the three economies. The financially unstable insurers are about 30 percent for all the three economies. Here we have to keep in mind that as discussed earlier, the criterion we used to classify insurers in Taiwan is somewhat more stringent than that used for Singapore and Malaysia.

The trend reveals that there is a need for concern in the increased proportion of financially weak insurers in Singapore in 1997, which was the year when the Asian Financial Crisis broke out in Thailand. It seems that the Asian Financial Crisis has weakened general insurers' financial conditions in Singapore.

Firm-Specific Determinants of Property-Liability Insurers' Financial Health. Firm Size: The impact of firm size (as measured by the total admitted assets) on property-liability insurers' financial health is statistically significant for Singapore and Malaysia (Tables 7 and 8). In fact, the coefficients of firm size in all six regressions are in the expected direction and three of them are statistically significant at 1 percent level. This positive relationship is congruent with the findings by BarNiv and Hershbarger (1990) and Cummins, Harrington, and Robert (1995). Hence, firm size is an important determinant of the financial strength of general insurers, both in developed and developing economies. The *R*-statistic, 0.2273 (*R*-statistic is the partial correlation and "+" means that the likelihood of being classified as healthy insurer is increased) of firm size variable for Malaysia for the 2-year prior prediction (Table 8) is highest among the three economies.

Investment Performance: The investment performance of Taiwan's general insurers is positively significant at 5 percent level for both the 1- and 2-year prior prediction.

TABLE 7
Results From Logistic Regression by Economy: 1-Year Prior Prediction for Property-Liability Insurers

Variables	Expected Sign	Singapore	Malaysia	Taiwan
Firm size (SIZ)	+	5.06E-6 (0.1092) $R = 0.0785$	4.53E-06*** (0.0027) $R = 0.1786$	8.00E-08 (0.2132)
Investment performance (IP)	+	−3.7258*** (0.0077) $R = -0.1063$	0.0085 (0.1251)	32.723** (0.0203) $R = 0.3068$
Liquidity ratio (LQ)	+	1.2835*** (0.0000) $R = 0.2234$	0.1098 (0.3114)	−0.0049 (0.9289)
Premium growth (PG)	−	0.0197 (0.8940)	−0.2574 (0.3734)	0.0115 (0.9458)
Surplus growth (SG)	−	−0.0688* (0.0539)	−0.0003 (0.9853)	−0.0956 (0.5696)
Combined ratio (CR)	−	−1.1166*** (0.0004) $R = -0.1806$	−3.5462** (0.0111) $R = -0.1633$	−0.8192 (0.3968)
Operating margin (OM)	+	0.3319 (0.1730)	1.4545 (0.2950)	2.5406* (0.0988) $R = 0.2491$
LR statistic (7df)	n.a.	66.680	39.911	38.099
McFadden R^2	n.a.	0.150	0.125	0.279

Note: The shaded cells denote correlation coefficients in the hypothesized direction. *P*-values are in parentheses below each coefficient. *R*-statistic is the partial correlation, which is zero unless otherwise specified under each coefficient. *Significant level at 10%, **significant at 5%, and ***significant at 1%.

This evidence supports that the better the investment performance of Taiwan's insurers, the stronger their financial solidity (Chen and Lee, 1998). A weaker relationship is found for general insurers in Malaysia (Table 7). Kim et al. (1995) and Kramer (1996) drew the same conclusions for developed countries. Thus, it appears that investment performance is positively affecting the financial solidity of general insurers in both developed and developing economies. Furthermore, the coefficient of investment performance is large, which means that investment performance has a great impact on general insurers' financial health. Our results, therefore, support the distinction made by Brockett et al. (1994) that general insurers function as "risk takers."

Liquidity Ratio: Liquidity ratio is positively related to general insurers' financial health in Singapore (Tables 7 and 8). These results are consistent with the findings by Lee and Urrutia (1996). In addition, the liquidity ratio is consistent with the expected sign in four of the six regressions. Therefore, liquidity ratio is a significant factor affecting general insurers' financial health in developing economies.

TABLE 8
Results From Logistic Regression by Economy: 2-Year Prior Prediction for Property-Liability Insurers

Variables	Expected Sign	Singapore	Malaysia	Taiwan
Firm size (SIZ)	+	1.41E-05*** (0.0044) $R = 0.1377$	7.93E-06*** (0.0004) $R = 0.2273$	1.15E-07 (0.1777)
Investment performance (IP)	+	−0.8756 (0.5665)	0.0038 (0.6844)	37.1328** (0.0229) $R = 0.3325$
Liquidity ratio (LQ)	+	2.6592*** (0.0000) $R = 0.3321$	−0.1131 (0.3796)	0.0220 (0.8537)
Premium growth (PG)	−	0.0154 (0.9474)	−0.1337 (0.6807)	−0.2050 (0.7225)
Surplus growth (SG)	−	−0.1016 (0.2784)	−0.0201 (0.1451)	−0.1564 (0.7292)
Combined ratio (CR)	−	−1.9940*** (0.0000) $R = -0.2603$	−0.5499 (0.8216)	−0.7735 (0.5056)
Operating margin (OM)	+	0.6759** (0.0249)	5.1307** (0.0419) $R = 0.1496$	2.8877 (0.1323) $R = 0.2831$
LR statistic (7 df)	n.a.	78.312	44.307	28.991
McFadden R^2	n.a.	0.246	0.174	0.374

Note: The shaded cells denote correlation coefficients in the hypothesized direction. *P*-values are in parentheses below each coefficient. *R*-statistic is the partial correlation, which is zero unless otherwise specified under each coefficient. *Significant level at 10%, **significant at 5%, and ***significant at 1%.

Premium Growth: Premium growth is insignificant in all six regressions. Our results, therefore, did not support the findings of Kim et al. (1995).

Surplus Growth: Surplus growth, which is another growth ratio, is negatively significant for Singapore insurers for the 1-year prior prediction (Table 7). This is consistent with the findings by Lee and Urrutia (1996). However, surplus growth is not significant for general insurers in Malaysia and Taiwan.

Combined Ratio: The combined ratio is found to be negatively related to general insurers' financial health in all the economies although only Singapore is significant for both types of prediction (Tables 7 and 8), and Malaysia is significant for the 1-year prior prediction (Table 7). As reported by Browne and Hoyt (1995), a high combined ratio could indicate unfavorable underwriting results, and thus lower the profitability. Doherty and Garven (1995) also provided theoretical evidence to the hypothesized negative relationship between the combined ratio and solvency rate.

Operating Margin: Operating margin is a profitability ratio. Our results show that operating margin is positively significant for general insurers in all three economies either in the 1-year or 2-year prior prediction and have the expected sign in all six regressions. Our finding is consistent with Kramer's (1996).

There are other interesting issues worthy of being noted. First, the model for each economy in Tables 7 and 8 gives different combination of significant predictors of general insurers' financial health. This could be largely due to different economies that have different economic, social, legal, and political environments, which result in different determinants for general insurers' financial solidity with different magnitudes. Thus, regulatory authorities in different economies may give different weights in measuring the financial health of their general insurers. Moreover, different time-lag effects could also affect the prediction of the general insurers' financial solidity, an interesting finding from our cross-country study. Second, the impact of firm size on general insurers' financial health is marginal as evident by the small coefficients in all the economies (Tables 7 and 8). Third, in order to explain the hypotheses and results in terms of statistical power to identify weak insurers, following Cummins, Harrington, and Klein (1995), we use the underlying null hypothesis that a given insurer is weak; the alternative hypothesis is that the insurer is financially strong. Given this convention, the type I error probability (rate) is the probability that a weak insurer is incorrectly classified as strong. The type II error probability (rate) is the probability that a strong insurer is incorrectly classified as weak.[8] The results are shown in Table 9. We find that the classification ranks Taiwan the first, Singapore the second, and Malaysia the last. The prediction will become reliable at least at 20% of type II error. Fourth, the 2-year prior prediction seems to be more useful than the 1-year prior prediction as measured by the number of significant coefficients and the McFadden R^2 (Tables 7 and 8). This shows that factors studied gave lagged impact on general insurers' financial health in Asian economies.

Macro Trends and Determinants of Financially Unstable Property-Liability Insurers

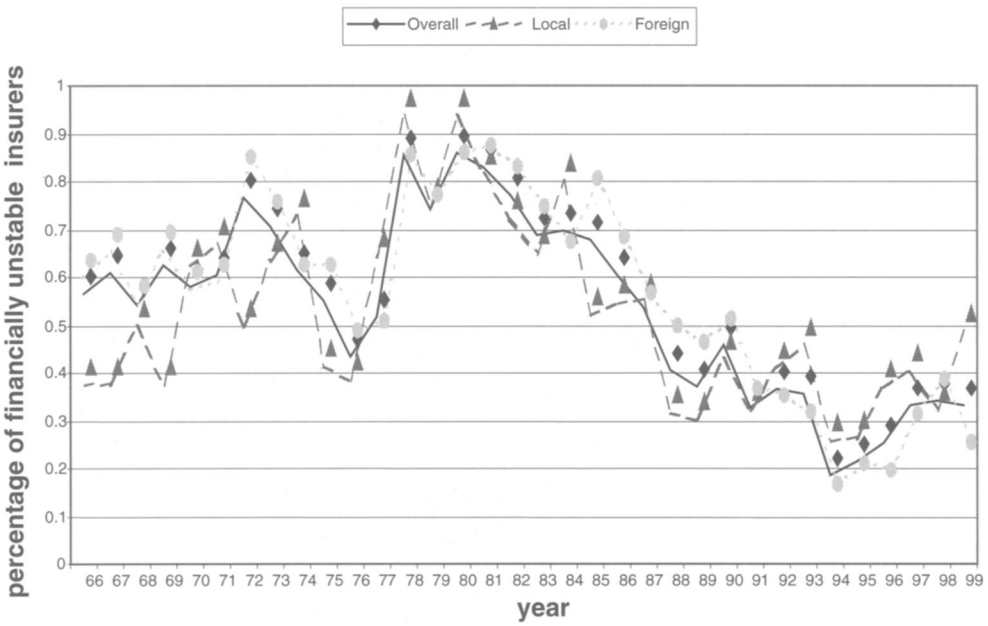
Macro Trends. Figure 2 shows the overall trend as well as the trends of both local and foreign constituted general insurers in Singapore over the period 1966–1999. As all the three plotted trends follow a similar pattern, our discussion will be based mainly on the overall trend of financially unstable general insurers. The annual percentage of unstable general insurers is quite erratic up to 1980. The erratic movement of general insurers' financial health during the second half of the 1960s might be caused by the result of confusion and uncertainty, when the new Singapore Insurance Act 1966 was enacted after the separation of Singapore from Malaysia in 1965. In 1978, the local general insurers were at their poorest financial conditions with 93.75 percent

[8] The model produces a fitted value of $y^*_{j,t,}$ and $y^f_{j,t}$ for each firm. Assume that we are interested in a type II error rate of z percent, i.e., an error rate such that z percent of the financially healthy firms are classified as financially unhealthy. We find the cutoff value of $y^*_{j,t}$, $y^c_{j,t}$, such that $y^f_{j,t} < y^c_{j,t}$ for z percent of the healthy firms in the sample. The proportion of unhealthy firms with that $y^f_{j,t} > y^c_{j,t}$ then equals the type I error rate. Here, $y^*_{j,t}$ is the propensity for the insurer to become unhealthy subsequent to year t. We do not observe $y^*_{j,t}$ but instead observe $y_{j,t} = 0$ if the insurer becomes unhealthy and $y_{j,t} = 1$ if it remains healthy. $y^f_{j,t}$ is the fitted value of $y^*_{j,t}$ and $y^c_{j,t}$ is the cutoff value of $y^*_{j,t}$.

TABLE 9
Prediction Evaluation for Property-Liability Insurers (Type I Error for Given Different Levels of Type II Error)

		Type II Error					
Economy	Prediction Period	5%	10%	15%	20%	25%	30%
Malaysia	1-year prediction	72.15%	67.09%	60.76%	53.16%	44.30%	37.97%
	2-year prediction	67.19%	57.81%	53.13%	40.63%	29.69%	29.69%
Singapore	1-year prediction	70.10%	54.64%	44.33%	37.11%	30.93%	27.84%
	2-year prediction	56.52%	46.38%	40.58%	37.68%	24.64%	18.84%
Taiwan	1-year prediction	43.59%	30.77%	23.08%	23.08%	20.51%	15.38%
	2-year prediction	48.39%	29.03%	25.81%	22.58%	19.35%	19.35%

FIGURE 2
Financially Unstable Property-Liability Insurers in Singapore: 1966–1999



classified as financially weak, while the corresponding percentage of overall general insurers was 82.05 percent. The percentages of financially unstable local and foreign incorporated general insurers show the steepest rise in 1977 and 1978. This could be due to many new insurers (mainly from the United States, Japan, and Europe) joined the industry after 1975, which intensified competition and threatened the incumbents' profitability during the period. The intense competition alongside with negative underwriting income and low investment return might have caused the poor financial health of general insurers.

From 1980 to 1994, there was a clear trend of decreasing percentage of financially unstable general insurers. The improvement is likely to be due to higher investment

return, which was above 10% in each of these years as reported by Chen and Lee (1998). This observation is consistent with our earlier findings that investment performance is positively related to general insurers' financial solidity.

However, the percentage of unstable insurers began to increase again from 1995 onwards. The increase in 1997 (by 8.01 percentage points) was particularly significant. This could be attributed to the effect of the Asian Financial Crisis, which broke out in July 1997. In 1998, most Asian countries had poor economic performance. Malaysia, Indonesia, and Thailand had negative economic growth rate, while Singapore recorded a low positive growth rate of 1.5 percent. The percentage of financially unstable insurers remained at about the same level even after the crisis. This should prompt the regulatory authorities to step up their supervisory role in the subsequent years.[9]

Macro Determinants. First of all the stationarity of economic data series is examined by using augmented Dickey–Fuller test. We found that the number of insurers has a unit root. The prime lending rate also has a unit root. The change on the 3-month bank deposit rate is stationary. Following Browne and Hoyt (1995), the unanticipated inflation is calculated by the difference between the predicted and realized rates of inflation. They fitted a distributed lag model to the consumer price index (CPI) monthly inflation series to get the predicted inflation. As our quarterly CPI has a unit root, we use the naïve model that next period expected inflation equals the realized inflation of last period. Next, we get the unanticipated inflation by taking the difference between the realized and expected value. The unanticipated inflation itself is stationary.

We run the regression on competition, interest rate level, unpredicted inflation, and change in interest rate using percentage of financially unstable general insurers as dependent variable. We tested the stationarity of residual using augmented Dickey–Fuller test. The result shows that the five variables are cointegrated. Thus the spurious regression problem does not exist in our analysis.

Competition: Table 10 indicates that competition is statistically significant at the 5 percent level, but it carries a negative sign instead of the expected positive sign. This finding is inconsistent with our discussion above and the finding by Browne and Hoyt (1995). A careful checking of our sample, we find that the number of insurers has a clear upward trend until 1996. But the percentage of unstable insurers decreases over the period resulting in the negative relationship. It is possible that the trend of improvement in management performance had overtaken the effect of competition over the period, which leads to the decline in percentage of unstable insurers.

Interest Rate: We find that the absolute interest rate is positively related to the financially unhealthy rate, which is inconsistent with our hypothesis (H15b). Browne, Carson,

[9] On September 20, 2002, the MAS has directed Cosmic Insurance Corporation Ltd. ("Cosmic"), a general insurer, to cease accepting new business, including policy renewals, with effect from September 20, 2002 due to serious operating difficulties. These difficulties include continued losses arising from higher claims, large uncollected premium balances, and inadequate reserves (MAS, 2002). This measure adopted by MAS, which is the first in such kind in Singapore insurance history, is a preemptive move to protect the interests of the policyholders of Cosmic.

TABLE 10
Results of Regression on Economic Factors for Singapore Property-Liability Insurers

Variables	Coefficients[a]	Standard Deviation	*t*-Statistic	Sig.
Competition	−0.003969	0.000856	−4.634361	0.0001
Interest rate level (absolute)	0.049286	0.012446	3.959984	0.0004
Unpredicted inflation	0.009563	0.028204	0.339077	0.7370
Change in interest rate	−0.007912	0.012424	−0.636795	0.5293

[a]Dependent variable: Percentage of *financially unstable* general insurers. Notice that Table 4 hypothesizes the relationship between the independent variable and financial stability of the insurer.
Model summary: $R^2 = 0.763$; adjusted $R^2 = 0.731$; F-statistic = 23.390.

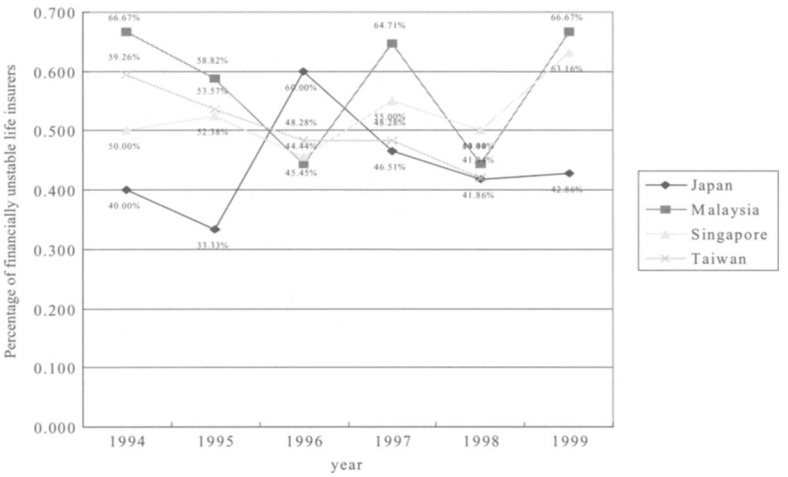
Hoyt (1999) also find that insurers are more likely to face disintermediation and to become insolvent during periods of increases in long-term interest rates. Our finding could be attributed to two reasons. First, for the prime rate we used the minimum lending rate, it could well reflect the cost of doing business. The higher the cost of borrowing is, the larger the burden of interest servicing, and thus resulting in poorer financial solidity. With this reasoning, the variable should be renamed as interest rate cost, and thus accepting the statistically positive relationship with the percentage of financially unstable insurers that failed 5 or more of the 14 financial ratios test. Second, interest income is one form of investment income for insurers. Thus, interest rate is an important variable for investment decisions, which affects the investment strategies of insurers. As such, the effect of investment performance becomes more prominent. This is true since the chance for mismanagement, excessive risk taking, and fraud increases with the complexity of investment strategies (Klein, 1995). This may lead to costly financial instability. The other two factors (unpredicted inflation and change in interest rate) are statistically insignificant.

Life/Health Insurers

Trends in Financially Unstable Life/Health Insurers. Figure 3 shows that among the four Asian economies, Japan has the lowest average percentage (44.09 percent) of financially unstable life/health insurers over the period 1994–1999, while Malaysia has the highest average percentage (57.63 percent). The percentage of financially weak life insurers in Singapore and Malaysia fluctuated wildly from year to year over the same period. It seems to indicate that the life/health insurers in Japan and Taiwan are relatively safer than those in Malaysia and Singapore. Thus, the life insurance industry in Singapore and Malaysia may need more regulatory scrutiny.

Firm-Specific Determinants of Life/Health Insurer's Financial Health. Firm Size: The results of logistic regression (Equation (3)) are presented in Tables 11 and 12. Firm size is significantly positively related to the financial health of life/health insurers in Singapore and Taiwan. This finding is consistent with the findings by Kim et al. (1995) and Grace, Harrington, and Klein (1998). However, the coefficients of firm size are not significant for Japan and Malaysia, but they are in the expected direction. This seems to indicate that the firm size has an impact on life insurers' financial health in both developed and developing economies.

FIGURE 3
Comparison of Life/Health Insurers' Financial Health by Economy: 1994–1999



Note: The average percentage for Singapore, Malaysia, Taiwan, and Japan is 52.67, 57.63, 50.26, and 44.09 percent, respectively. The average percentage for all four economies over the six years is 51.16 percent.

Change in Asset Mix: As expected, change in asset mix is another factor that significantly and negatively affects life/health insurers' financial health in Japan (Table 11 and 12) and Taiwan (Table 11). This is consistent with the findings by Ambrose and Carroll (1994), BarNiv and Hershbarger (1990), and Carson and Hoyt (1995). The negative relationship could be partly attributed to the role of financial intermediaries played by life insurers. Assets in life insurance companies are invested into various products such as bonds, stocks, and loans. Hence, any drastic change in the asset mix will change the risk exposure of the life insurers and therefore affect their financial stability. The decrease in real estate value and stock prices in Japan as a result of the bust of bubble economy in the early 1990s might have resulted in significant changes in asset mix (Wood, 1992).

Investment Performance: The results do not indicate that investment performance is significantly related to the financial stability of Singapore, Malaysia, and Taiwan life insurers. However, the investment performance is significant with expected sign for Japan insurers in both 1-year and 2-year of prediction. The drastic changes in the Japan insurance business law were introduced in 1996. The changes include promotion of deregulation and liberalization, maintenance of sound management, and provision of fair business operations. This sweeping reform might have helped improve investment performance of Japan insurers.

Operating Margin: The impact of operating margin on life/health insurers' stability is found insignificant for all of the four economies. This finding is inconsistent with the results of BarNiv and Hershbarger (1990). They found that operating margin is the best single variable associated with life insurer's solvency.

Change in Product Mix: Change in product mix seems to have negative effects on the financial stability of life insurers in most of the economies. However, it is only

TABLE 11
Results From Logistic Regression, by Economy 1-Year Prior Prediction for Life/Health Insurers

Variables	Expected Sign	Singapore	Japan	Malaysia	Taiwan
Firm size (SIZ)	+	3.59E-07*	1.79E-08	2.96E-08	9.54E-09***
		(0.0883)	(0.5040)	(0.8282)	(0.0023)
		$R = 0.2427$			$R = 0.2480$
Change in asset mix (AM)	−	−1.6308	−20.427*	−11.5238	−9.0283*
		(0.1026)	(0.0761)	(0.3861)	(0.0766)
		$R = -0.1723$	$R = -0.1912$		$R = -0.2035$
Investment performance (IP)	+	−0.0966	15.2147***	−0.6250	−1.3951
		(0.9596)	(0.0015)	(0.1457)	(0.5038)
			$R = 0.2754$	$R = -0.1898$	
Operating margin (OM)	+	0.0084	−0.4960	0.0330	0.1638
		(0.5027)	(0.6279)	(0.2778)	(0.4941)
					$R = 0.1410$
Change in product mix (PM)	−	−1.6308	−43.0870*	−6.5118	−7.1034
		(0.8032)	(0.0559)	(0.2405)	(0.2741)
			$R = -0.1518$		
Insurance leverage (IL)	−	0.0135	−7.34E-05	0.2517	0.0294
		(0.4489)	(0.4625)	(0.5146)	(0.1475)
					$R = 0.1530$
LR statistic (6 df)	n.a.	10.249	57.421	6.260	40.747
McFadden R^2	n.a.	0.597	0.212	0.055	0.231

Note: The shaded cells denote correlation coefficients in the hypothesized direction. *P*-values are in parentheses below each coefficient. *R*-statistic is the partial correlation, which is zero unless otherwise specified under each coefficient. *Significant level at 10%, **significant at 5%, and ***significant at 1%.

TABLE 12
Results From Logistic Regression by Economy: 2-Year Prior Prediction for Life/Health Insurers

Variables	Expected Sign	Singapore	Japan	Malaysia	Taiwan
Firm size (SIZ)	+	6.13E-07**	1.38E-08	1.04E-07	8.85E-09**
		(0.0353)	(0.6387)	(0.5278)	(0.0276)
		$R = 0.2954$			$R = 0.2110$
Change in asset mix (AM)	−	−12.652	−29.1360**	−8.5923	−3.6772
		(0.5905)	(0.0396)	(0.6903)	(0.4184)
			$R = -0.2265$		
Investment performance (IP)	+	−3.0990	10.2649*	−0.0747	−2.3628
		(0.1810)	(0.0758)	(0.8394)	(0.3327)
			$R = 0.1726$		
Operating margin (OM)	+	0.0117	−0.9129	−0.0187	0.1083
		(0.5207)	(0.4061)	(0.5619)	(0.6554)
Change in product mix (PM)	−	−1.4733	−39.5369	5.5282	−8.0875
		(0.8482)	(0.1084)	(0.3668)	(0.2207)
			$R = -0.1470$		
Insurance leverage (IL)	−	−0.0035	−0.0002*	−3.9363	0.0575
		(0.6023)	(0.0672)	(0.2497)	(0.1031)
			$R = -0.1606$		$R = 0.2048$
LR statistic (6 df)	n.a.	13.719	35.461	2.510	28.988
McFadden R^2	n.a.	0.158	0.178	0.029	0.228

Note: The shaded cells denote correlation coefficients in the hypothesized direction. *P*-values are in parentheses below each coefficient. *R*-statistic is the partial correlation, which is zero unless otherwise specified under each coefficient. *Significant level at 10%, **significant at 5%, and ***significant at 1%.

statistically significant for Japan. To a certain extent, our result is consistent with the finding by BarNiv and Hershbarger (1990) that change in product mix affects smaller life insurers adversely.

Insurance Leverage: Insurance leverage is only negatively significant for Japan. The difference in the signs of coefficients among four economies could be largely due to the unique operating environment in each economy and its institutional backgrounds. Orrù, Biggart, and Hamilton (1991) have provided a good comparison of enterprise groups in Asia based on institutionalized organizational analysis. Skipper (1998) has given a detailed discussion on the difference in insurance regulation, market openness, and culture in international arena.

Business corporations in Japan are large and highly interconnected through mutual shareholdings and interlocking directorates. This communitarian culture emphasizes consensus making and risk sharing and ensures the balanced mix of competition and cooperation within their enterprise group. There is a significant role played by the state, who valued the collaborative partnership between the state and business firms.

The Japanese want to prevent insolvencies, although a medium size mutual life insurer (Nissan Mutual) failed in 1997. Market stability is of overriding concern in Japan, volatility is to be minimized, which means strict regulation of policy forms and prices. Like Germany, Japan historically has viewed unfettered competition as unstable and ruinous. Japanese insurance regulation has been characterized as being based on a "convoy" philosophy. The convoy members (insurance companies) move no faster than the slowest ship (weakest or least innovative insurer). Historically, price competition has been severely circumscribed, with insurers generally charging the same rates. This practice—which is changing—ensured that financially weakest insurer would survive. However, due to the rapid decline in Japanese real estate and security values in the early 1990s, the possibility of other failures has not been ruled out (Skipper, 1998, p. 267). For example, two more life insurers failed in 2000 and one nonlife insurer failed in 2001 (see footnote 1). The chronic overcapacity problem in Japan has lowered the return of its capital investments (*Far Eastern Economic Review*, October 1, 1998). Recently, Japan passed law allowing life insurers to cut yield guaranteed to policyholders in a move, which could avert their collapse (*Business Times*, July 18, 2003).[10] With more opening of Japan's insurance market to foreign insurers, the competition in Japan insurance market will become more furious (Skipper, 1998, pp. 490, 513–516), which may result in more financial unstable insurers. All these changes in the economic and insurance market conditions will make Japanese insurance regulators to seriously think about the possible changes in regulatory focuses from price fixing to rely more on market forces.

[10] Japanese life insurers are struggling under negative spreads, where rock-bottom interest rates and returns on investments have fallen below guaranteed yields for policy holders. Yields as high as 6 percent offered to customers at the height of the equity bubble between 1985 and 1990 have proved untenable as the markets collapsed. Today, yields are around 1.5 percent, with the average yield at 3.56 percent in the year to March 2002, according to a parliamentary official, citing government statistics (*Business Times*, July 18, 2003).

Taiwan historically has been following the practices of Japan in doing insurance business due to its long period of occupation by Japan. Thus, similar to Japan, Taiwan imposes restrictive form and rate regulation on nonlife insurers. Standard policy forms are required in all lines except marine cargo, marine hull, commercial general liability, and product liability (export only) insurance. The Ministry of Finance (MOF) must approve all new policy forms, a time-consuming process. The MOF also regulates premium rates and commission rates payable to insurance intermediaries. All insurers, except marine insurers, are restricted in their ability to alter these rates (Skipper, 1998, p. 492).

However, business groups in Taiwan are relatively smaller and are more diversified as compared to Japan. The enterprise groups lack control centrality as their familial culture provided wider ownership among their private extended family. Most importantly and unlike Japan, the role of the government in Taiwan is minimal. The recent Asian Financial Crisis has made this distinction important. For example, the financial crisis has not affected Taiwan as much as other Asian economies (*Asian Wall Street Journal*, October 8, 1998).

The insurance markets in Singapore and Malaysia are more open to foreign insurance companies as compared with Japan and Taiwan. Similar to the United States, Malaysia, and especially Singapore are using similar NAIC warning systems to supervise insurer's daily operations rather than just focusing on premium rate and policy forms. They rely more on market force discipline on insurance company financial behavior.

The above-mentioned unique economic, cultural, and regulatory environments as well as the degree of openness of insurance markets could have affected their life/health insurers as well as general insurers' financial solidity differently.

The result of classification for life/health insurers in different economies is similar to that for general insurers (Table 13). Taiwan ranks first, followed by Japan and Singapore, and then Malaysia. The predictions can be acceptable at 20 percent or more type II error. Most of the time, the 2-year prediction is better than the 1-year

TABLE 13
Prediction Evaluation for Life/Health Insurers (Type I Error for Given Different Levels of Type II Error)

		Type II Error					
Economy	Prediction Period	5%	10%	15%	20%	25%	30%
Japan	1-year prediction	55.00%	38.75%	32.50%	30.00%	30.00%	28.75%
	2-year prediction	64.81%	57.41%	50.00%	37.04%	35.19%	27.78%
Malaysia	1-year prediction	85.42%	77.08%	70.83%	64.58%	64.58%	54.17%
	2-year prediction	83.78%	64.86%	62.16%	59.46%	45.95%	45.95%
Singapore	1-year prediction	66.66%	63.89%	61.11%	52.78%	41.67%	41.67%
	2-year prediction	75.00%	71.43%	53.57%	42.86%	35.71%	35.71%
Taiwan	1-year prediction	65.52%	36.21%	27.59%	25.86%	22.41%	17.24%
	2-year prediction	61.11%	44.44%	44.44%	33.33%	30.56%	22.22%

prediction. Moreover, the impact of firm size on financial solidity is marginal for both life and general insurers.

CONCLUSION AND IMPLICATIONS

We have examined the firm-specific and macro determinants of the financial health (stability) of insurers in four Asian economies. The logistic regressions for the insurers in each economy have generated statistically significant results consistent with majority of the hypotheses formulated on firm-specific factors, which determine an insurer's financial strength. At the macro level, none of the hypotheses about the effects of market/economic factors on the general insurers' financial strength is supported. However, such an analysis was confined to Singapore only as data are limited for other economies. Our results have some important policy implications for monitoring insurers' financial health in Asian economies. For general insurers, *firm size* and *investment performance* significantly affect their financial health, both in the 1- and 2-year prior prediction. Moreover, the coefficient of investment performance is larger, and thus has a greater impact on the insurers' financial health. Therefore, regulators should pay more attention to the investment regulation of general insurance companies. In view of the growth of local capital markets, the removal of exchange controls and the inexorable globalization of financial markets, investment regulations need to be constantly reviewed (Cheng, 1999). The need for insurance supervision on investment regulation is also advocated by Dickinson (1999).

Since general insurers' *liquidity ratio* is one of the most direct measures of their financial health, regulators may consider using it as a first line indicator of possible financial difficulties. For example, regulators may decide to constantly monitor the liquidity ratios, without letting the insurers know the limits being set (so as to avoid window dressing by insurers). In addition, regulators should like to monitor the underwriting results as indicated by the *combined ratio*. As reported by Chen, Wong, and Lee (1999), the most recent trough of underwriting cycle for Singapore was likely to be around year 2000.[11] This is important, as operation performance (underwriting results) is another indicator of insurers' profitability, other than investment performance.

For life/health insurers, *firm size* and *change in asset mix* are the two factors consistently affecting their financial health in all four economies studied. Other factors have different effects on the insurers' financial health in different economies. This together with the different predictors for general insurers in different economies shows that each economy has its own characteristics, which need a different efficient set of predictors of insurers' financial health.

It is also important to have different regulations for life/health and general insurance companies (even for the same economy), as each operates under different constraints and requires more specific management and regulatory structures. Insurance authorities should develop their guiding principles according to the stages of economic development of their own country (along with the historical and cultural context of

[11] The underwriting income of Singapore property/liability business for both direct insurers and reinsurers was negative in 2001 (MAS, 2002), the first time since the last negative underwriting income recorded in 1993, which verifies the underwriting cycle length of 7.78 years for Singapore calculated by Chen and Lee (1998) and Chen et al. (1999).

each economy). Thus, insurance regulation is an evolving process and there is a need to be flexible, as there will be continuing changes in the environment and insurance market.

There are limitations in our study as we focused only on financial statements data at the firm level and did not take into consideration the qualitative information from each insurance company. Qualitative assessment can be an important addition to the process of better assessing an insurer's financial conditions. Window dressing of the financial statements could be a potential problem in our study.

APPENDIX

TABLE A1
The Guidelines for Financial Ratios

Ratios	Guideline
Liquidity	
Liquidity ratio	≥1
Liabilities to liquid assets ratio	≤1
Premiums due to surplus ratio	≤0.4
Profitability	
Loss ratio	≤Industry norm
Expense ratio (trade basis)	≤Industry norm
Expense ratio (financial basis)	≤Industry norm
Combined ratio (trade basis)	<1
Combined ratio (financial basis)	<1
Investment yield ratio	Industry ± 50%
Investment income ratio	5–20%
Change in surplus ratio	−10% to 50%
Capacity	
Assets to premiums ratio	>1.25
Premiums to surplus ratio	<3
Change in writings ratio	−0.33 to 0.33
Surplus aid to surplus	<0.25

Source: These guidelines are mainly from Hampton (1993). Some are from NAIC and other publications.

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