

Bank Risk Exposures in the East Asian Region

(Pendedahan Risiko Bank di Wilayah Asia Timur)

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ABSTRACT

Risk management is a pivotal factor for managing financial institutions. Efficient and sustainable banking activity requires managers to take all sources of instability into account and to adopt strategies against risks. The objective of the present paper is to investigate the sources of bank risks with a straightforward and comprehensive risk measurement for the East Asian region. The Z-risk index and a three-factor Capital Asset Pricing Model (CAPM) are adopted to estimate the probability of insolvency, systematic bank risks and unsystematic bank risks. The results demonstrate that banks in East Asian countries are exposed to a variety of risk exposures. Also, the findings show that banks with lower unsystematic risks do not necessarily have lower insolvency risks, indicating that the sources of insolvency risk are complicated and need further research. Finally, a regional cooperation strategy among banks is suggested so that exchange rate and interest rate risks can be reduced.

Keywords: East Asian banks; insolvency risk; three-factor CAPM; stock market; debt market; foreign exchange market

ABSTRAK

Pengurusan risiko merupakan faktor penting bagi pengurusan institusi kewangan. Institusi perbankan yang efisien dan mampan memerlukan pengurus mengambil kira semua sumber yang menyumbang kepada ketidakstabilan ekonomi. Di samping itu, kecekapan dan kelestarian bank juga bergantung kepada sejauh mana bank melaksanakan strategi untuk mengurangkan risiko. Objektif kajian ini adalah untuk melihat sumber-sumber risiko bank melalui pengukuran yang mudah dan komprehensif bagi wilayah Asia Timur. Khususnya, kajian ini menggunakan keadah indeks risiko-Z dan Model Penetapan Harga Aset Modal (CAPM) tiga faktor (CAPM) bagi menganggar kebarangkalian bank untuk menjadi tidak solven serta risiko sistematik dan tidak sistematik yang dihadapi oleh bank. Hasil kajian menunjukkan bahawa institusi perbankan di wilayah Asia Timur terdedah kepada pelbagai jenis risiko. Hasil kajian juga menunjukkan bahawa bank yang mempunyai tahap risiko tidak sistematik yang rendah tidak semestinya mempunyai tahap risiko tidak solven yang rendah, seterusnya menggambarkan bahawa punca kepada risiko tidak solven adalah cangkih dan rumit serta memerlukan kajian lanjut. Di samping itu, kajian ini menyarankan strategi kerjasama bank di peringkat serantau agar pendedahan risiko terhadap turun-naik kadar tukaran wang asing dan kadar faedah dapat dikurangkan.

Kata kunci: Bank di wilayah Asia timur; risiko bank tidak solven; CAPM tiga-faktor; pasaran saham; pasaran hutang; pasaran tukaran asing

INTRODUCTION

Risk identification and quantification are critical issues in risk management because excessive risk exposures may result in insolvencies, bankruptcies and crises. Using the issue of insolvency as an example, it is important to detect whether insolvency risks originate in bank-specific conditions (unsystematic risk) or macroeconomic conditions (systematic risks). The determination of the nature of the risk is of paramount importance because while managers can completely diversify and eliminate unsystematic sources of insolvencies, systematic risks are beyond their control. The problem becomes more serious when a country experiences a financial crisis that significantly exacerbates systematic or macroeconomic risks; and may lead to bank failures and bankruptcies.

While identifying the source of insolvency risks is the focal point of many discussions, insolvencies and bankruptcies continue to be experienced in economies and financial industries around the world. Researchers need to investigate unsystematic, systematic and insolvency risks simultaneously to more precisely determine the sources of frequent insolvencies. Nevertheless, the dearth of empirical studies that consider the aforementioned risks simultaneously stands in contrast to the importance of such risks in practical and policy implications.

According to extant studies, bank return sensitivities are investigated and categorized into three macroeconomic sources of risks: stock markets, debt markets and foreign exchange markets (Aggarwal & Harper 2010; Black et al. 1972; Bredin & Hyde 2011; Chamberlain et al. 1997; Flannery & James 1984; Jorion 1990; Lintner

1965; Muller & Verschoor 2008; Saunders et al. 1990; Sharpe 1964; Stone 1974). In addition, several studies measure insolvency risks using the Z-risk index (Beck et al. 2010; Boyd & Graham 1986; Boyd et al. 1993; Demirgüç-Kunt & Detragiache 2011; Hannan & Hanweck 1988; Houston et al. 2010; Laeven & Levine 2009; Uhde & Heimeshoff 2009). However, extant studies do not estimate all systematic, unsystematic and insolvency risks simultaneously.

While it is beneficial to have a comprehensive risk-return evaluation, it is empirically impossible to estimate every possible risk. Therefore, the present study adopts a three-factor capital asset pricing model (CAPM) and the Z-risk index to estimate six types of risks for East Asian banks between 2000 and 2010. The use of the three-factor CAPM and the Z-risk index contribute to risk measurement studies because the models estimate total risks, systematic market risks, systematic exchange rate risks, systematic interest rate risks, unsystematic risks and insolvency risks. The estimates can show the exposure of East Asian banks to bank and country specific risks.

The results demonstrate the significant exposure of bank stock price fluctuations to stock market index changes implying systematic market risks. Moreover, interest rate changes and exchange rate changes influence banks and result in systematic risks. However, the mixed findings regarding interest rate and exchange rate risk suggest different net foreign exchange rate and interest rate positions in East Asian banks. Particularly, bank stock market prices have both positive and negative relationships with debt markets and foreign exchange markets.

The Z-risk index reports various levels of insolvencies for the countries under study. A comparison between insolvency risks and other risks indicates that both bank and country specific conditions are the underlying causes of insolvencies. The findings provide a straightforward and comprehensive risk measurement to evaluate banks continuously. A deeper understanding of risk-return performance helps managers and policy makers to determine and monitor appropriate factors affecting banks and adopt appropriate strategies against insolvencies.

The remainder of the present paper is organized as follows. Section 2 reviews the literature related to the measurement of risk exposures. Section 3 presents the methodology related to the CAPM and Z-risk index. Section 4 presents the sample data and empirical specification of the six types of risks. Section 5 presents the findings regarding bank exposure to different sources of risks in each country. Finally, Section 6 concludes the present study.

LITERATURE REVIEW

Risk measurement techniques have three general categories: CAPM, financial ratios and market information.

This section briefly reviews the risk measurement techniques utilized in the present study to estimate six types of risk exposures using the three-factor CAPM and Z-risk index. Different types of CAPM estimate the sensitivity of bank returns and prices to macroeconomic variables. The coefficient of a macroeconomic variable is a systematic risk, whereas the remaining part of the estimated model (residuals) encompasses bank-specific risks. For instance, the single-factor CAPM associates excess firm returns with excess market returns to estimate systematic market risks and unsystematic risks. The present study adopts a three-factor CAPM that estimates bank exposures to macroeconomic and bank-specific risks. This section also reviews historical studies, such as the modern portfolio theory (MPT) of Markowitz (1952, 1956, 1959); and the contributions of Sharpe (1964), Lintner (1965), Treynor (1965), Stone (1974), and Jorion (1990) to CAPM.

Financial ratios can be calculated using either banks' balance-sheet data (e.g., loan loss provision, leverage ratios, capital-asset ratios (CAR) and return on assets (ROA) or bank market information data, such as the market value of return on equity. ROA, CAR and the standard deviation of ROA (σ_{ROA}) can be used to calculate Z-risk index as a measure of a bank's safety and soundness with higher values representing lower insolvency risks. The current study adopts the Z-risk index, which was conceptually introduced by Roy (1952) and then empirically developed by Boyd and Graham (1986) and Hannan and Hanweck (1988).

The impacts of the condition of stock markets, debt markets, and foreign exchange markets on the value of firms are an imperative issue for risk management. Risk assessments of firms trace back to the seminal paper of Markowitz in 1952. Markowitz (1952) developed the MPT to conceptualize an efficient portfolio. The author defines efficient portfolios as the locus of either the maximum feasible expected returns for given risks or the minimum risks for given expected returns. MPT shows that efficient portfolios provide diversification opportunities and eliminate unsystematic or firm-specific risks. Extant studies argue that stock markets, debt markets and foreign exchange markets are the systematic sources of spreading risk and crisis towards firms, (e.g., Sharpe 1964; Lintner 1965; Treynor 1965; Stone 1974; and Jorion 1990). In order to separate systematic risks from unsystematic risks, Sharpe (1964), Lintner (1965) and Treynor (1965) developed CAPMs.

Several different versions of CAPM exist, including single-factor including stock markets; two-factor including stock markets with either debt markets or foreign exchange markets; and three-factor CAPM. Sharpe (1964), Lintner (1965) and Treynor (1965) individually developed a single-factor CAPM to deal with uncertainties in stock markets. For instance, Sharpe (1964) uses a single-factor CAPM to separate systematic stock market risks from unsystematic risks. Sharpe's (1964) The single-factor CAPM of Sharpe (1964) is similar to Markowitz's MPT (also known as the

‘market model’) because both of them illustrate a linear relationship between the returns of individual securities and market portfolios (Pettit & Westerfield 1974). While the single-factor CAPM assumes stock markets are the only source of systematic risks, Black et al. (1972), Stone (1974) and Jorion (1990) include further factors. As an illustration, Black et al. (1972) examine the single-factor CAPM of Sharpe (1964) and show that stock markets do not fully explain all systematic sources of risks. However, Black et al. (1972) do not show which factor can improve the CAPM for estimating systematic risks. In order to improve the original CAPM, Stone (1974) and Jorion (1990) identify two further sources of systematic risks: debt markets and foreign exchange markets.

Stone (1974) develops a two-factor CAPM to estimate systematic market risk and systematic interest rate risk exposure, which demonstrate bank risk exposures to stock market and debt market fluctuations. In another study, Jorion (1990) draws attention to the high volatility of exchange rates, which highlights foreign exchange markets as another source of systematic risks. Jorion (1990) suggests estimating a two-factor CAPM using systematic market risk and exchange rate risk. Following the identification of the three factors, studies apply different versions of CAPMs to investigate the exposure of equities to risks.

Several studies adopt the CAPM to estimate different systematic and unsystematic risks. Saunders et al. (1990) adopt a two-factor CAPM to estimate systematic market risk exposure; systematic short-run interest rate risk exposures; and systematic long-run interest rate risk exposures. In another study, Chamberlain et al. (1997) construct a CAPM for the U.S. Bank Holding Companies (BHC). An international study by Muller and Verschoor (2008) shows the significant exposure of US multinational corporations to exchange rates changes. Following this further, Aggarwal and Harper (2010) demonstrate the significant exposure of US domestic firms to foreign exchange rate risks. Pozzi and Wolswijk (2012) investigate the financial integration of five European countries and find a co-movement towards a common risk. In a study on Malaysia, Rahman (2010) uses a three-factor CAPM to examine the exposure of commercial banks to systematic and unsystematic risks.

While a CAPM separates different systematic and unsystematic risks, the Z-risk index demonstrates the exposure of banks to insolvencies. Insolvencies include extreme cases of risks originating from systematic and unsystematic sources, which have drawn considerable attention due to the vast repercussions, such as bankruptcies. Studies concerning insolvency risks can be traced back to Roy’s safety-first criterion in 1952. Roy (1952) develops a formula with returns, disastrous levels and the standard deviation of returns, which helps decision makers minimize the probability of shortfalls in returns to remain below the disastrous levels. However, Roy (1952) uses a general concept for disastrous levels without defining an exact variable.

Boyd and Graham (1986) and Hannan and Hanweck (1988) develop the Z-risk index to compute the probability of insolvency where returns fall below the disastrous levels of equity capital to asset ratio. Hence, the index declares a bank as insolvent when return shortfalls or losses exhaust equity capital. The Z-risk index and insolvency risks have several applications in studies concerning financial stability and risk determinants. For example, Rahman et al. (2009) employ the Z-risk index to examine the lending structure in Malaysia. Furthermore, Houston et al. (2010), Beck et al. (2010), and Demirgüç-Kunt and Detragiache (2011) employ the insolvency risk to study financial stability and systemic soundness for panels of countries.

To conclude, literature regarding risk-return relationships and risk measurements has improved considerably since 1952. Markowitz (1952) uses the concept of portfolios and introduces efficient portfolios. Sharpe (1964) develops a CAPM in which firm returns are a function of an efficient stock market portfolio. The author separates systematic risks beyond the control of firms from diversifiable unsystematic risks. While efficient portfolios help banks eliminate unsystematic risks, systematic risks can still expose banks to insolvencies. Therefore, Roy (1952), Boyd and Graham (1986) and Hannan and Hanweck (1988) develop the Z-risk index, which measures the probability of insolvencies. The present study contributes further to risk measurement by using a three-factor CAPM and the Z-risk index, which is discussed in greater detail in the methodology section.

METHODOLOGY

CAPITAL ASSET PRICING MODEL (CAPM)

The present study employs a three-factor CAPM and the Z-risk index to measure six types of risks. The CAPM employed in the present study uses market information to estimate the sensitivity of banks to the fluctuations of equity markets, debt markets and foreign exchange markets. Sharpe (1964), Lintner (1965) and Treynor (1965) develop a single-factor CAPM to estimate systematic market risk. The single-factor CAPM highlights stock markets as the only non-diversifiable source of systematic risks, whereas Stone (1974) and Jorion (1990) highlight interest rate and exchange rate fluctuations as other types of non-diversifiable systematic risks.

The functional form in Equation 1 estimates five types of risks using a CAPM. The model regresses the stock price index fluctuations of each bank (R) on market portfolios (r_m), interest rates (I) and exchange rates (EXH). The estimated coefficients of this model (β_m , β_I , and β_{EXH}) represent systematic risks. The standard deviation of R (σ_R) and error terms (σ_e) shows total risk and unsystematic risk exposure for each bank, respectively.

$$\Delta R_{it} = \beta_0 + \beta_m \Delta r_{mt} + \beta_1 \Delta I_t + \beta_{EXH} \Delta EXH_t + \varepsilon_{it} \quad (1)$$

here:

R_{it} = The stock price index of bank i during period t .

r_{mt} = The price index of market portfolio during period t (country level).

I_t = Interest rates during period t (country level).

EXH_t = Foreign exchange rates during period t (country level).

ε_{it} = The error term captures bank's specific effects.

β_0 = The intercept of the characteristic line of bank i for period t .

β_m = The systematic market risk exposure of bank i for period t .

β_1 = The systematic interest rate risk exposure of bank i for period t .

β_{EXH} = The systematic foreign exchange rate risk exposure of bank i for period t .

The standard deviation of R_{it} (σ_{Rit}) is the total risk exposure of bank i for period t (bank level). The standard deviation of ε_{it} ($\sigma_{\varepsilon_{it}}$) is the unsystematic risk exposure of bank i for period t .

Z-RISK INDEX

In order to estimate the probability of bank insolvencies, extant studies widely utilize the Z-risk index (Boyd & Graham 1986; Boyd et al. 1993; Hannan & Hanweck 1988; Roy 1952). Based upon the Z-risk index, a bank becomes insolvent if $ROA \leq -CAR$. ROA is a random variable representing returns on total assets. CAR denotes the ratio of equity capital to total assets. Using the Bienaymé-Tchebycheff inequality, $P(ROA \leq -CAR)$ can be estimated as follows (Hannan & Hanweck 1988; Roy 1952):

$$P(|ROA - E(ROA)| \geq (E(ROA) + CAR)) \leq \frac{\sigma_{ROA}^2}{(E(ROA) + CAR)^2}$$

$$P(E(ROA) - ROA \geq E(ROA) + CAR) = P(ROA \leq -CAR)$$

$$P(ROA \leq -CAR) \leq \frac{\sigma_{ROA}^2}{(E(ROA) + CAR)^2} = \frac{1}{Z^2}$$

$$P(ROA \leq -CAR) \leq \frac{1}{Z^2}$$

$$P(ROA \leq -CAR) = P\left(\frac{(ROA) - E(ROA)}{\sigma_{ROA}} \leq -Z\right) = \Phi(-Z)$$

where, Φ , for a standard normal distribution, is $\Phi(\cdot) \sim N(0, 1)$. The above relationship necessitates a cumulative distribution function (CDF) to be performed for ROA to measure the probability of insolvency risks. Nevertheless, it is possible to measure the Z-risk index without a CDF as follows:

$$Z - \text{risk index} = \frac{E(ROA) + CAR}{\sigma_{ROA}} \quad (2)$$

As equity capital is a buffer against losses, a higher CAR indicates better capitalization. Better capitalized banks will, *ceteris paribus*, be able to better survive unexpected withdrawals, loan losses and lower income. In summary, the higher values of the Z-risk index show lower insolvency risks. (Beck et al. 2010; Boyd & Graham 1986; Boyd et al. 1993; Hannan & Hanweck 1988; Houston et al. 2010; Laeven & Levine 2009; Nash & Sinkey 1997; Sinkey Jr & Nash 1993; Uhde & Heimeshoff 2009).

DATA AND MODEL SPECIFICATION

In order to estimate the three-factor CAPM employed in the present study, the market information of commercial banks in East Asia is required. The process of data acquisition limits the sample to listed banks with available stock prices for eight stock markets between 2000 and 2010, including China, Indonesia, Malaysia, South Korea, Thailand, the Philippines, Singapore and Hong Kong. The CAPM employed in the present study uses weekly data over a one-year period to estimate the yearly systematic and unsystematic risks for each bank. Datastream provides weekly stock price indices for the dependent variable of Equation 1 (R_{it}).

Systematic market and interest rate risks are the estimated coefficients of market portfolio indices and interest rates, respectively. Moreover, the nominal effective exchange rate (NEER) of each country is utilized as a proxy for exchange rates; and estimated coefficients represent systematic exchange rate risks. Datastream provides country-level data for the three aforementioned variables. Equation 3, below, represents an empirical specification for the three-factor CAPM:

$$\Delta R_{it} = \hat{\beta}_0 + \hat{\beta}_m \Delta r_{mt} + \hat{\beta}_1 \Delta I_t + \hat{\beta}_{EXH} \Delta EXH_t + \hat{\varepsilon}_{it} \quad (3)$$

Equation 3 provides yearly systematic market risks ($\hat{\beta}_m$), systematic interest rate risks ($\hat{\beta}_1$), systematic exchange rate risks ($\hat{\beta}_{EXH}$), unsystematic risks ($\hat{\varepsilon}_{it}$) and total risks ($\hat{\sigma}_R$). Based upon extant studies (Chamberlain et al. 1997; Jorion 1990; Sharpe 1964; Stone 1974), the present study expects a positive sign for systematic market risk; and either positive or negative signs for both systematic interest rate and exchange rate risks. The capital market line, which illustrates a linear combination of stock market returns and firm returns, can explain the positive sign of systematic market risk. The sign of interest rates and exchange rates demonstrate the position of a bank and whether the bank can benefit from rising interest rates and exchange rates or from declining interest rates and exchange rates.

Since several extant studies find that multi-factor CAPMs are associated with problems of data snooping or data mining, the present study takes several steps to overcome the issue. First, a CAPM is estimated for each listed bank in each year for East Asian banks to ensure that the findings are robust to the sample selection.

Second, diagnostic tests are conducted on the ARCH-GARCH estimations to ensure that the models do not suffer from volatilities (e.g., ARCH effect test; and estimating GARCH to determine whether volatility clustering and persistence exist). The results show that the direction of influence is consistent regardless of the methodology adopted. Third, the selection of explanatory variables follows previous works which highlight three sources of systematic risk: stock markets, debt markets and foreign exchange markets.

With regard to the Z-risk index, the present study uses balance sheet data instead of market information and, as a result, includes non-listed banks. The sample consists of 118 commercial banks from 10 East Asian financial markets (i.e., Cambodia, China, Indonesia, Malaysia, South Korea, Thailand, the Philippines, Singapore, Hong Kong and Vietnam) between 2000 and 2010, which provides an unbalanced panel of 1182 annual observations. Bankscope (Bureau Van Dijk) provides data concerning the three financial ratios used in the Z-risk index: ROA, CAR and σ_{ROA} . Table 1 provides the descriptive statistics of the variables used to estimate Equation 1 and to measure Equation 2.

The figures show that Cambodian banks have, on average, the largest value of CAR (20.885) and ROA (2.080) over the period. However, the higher value of ROA is accompanied by higher risk, which is captured by σ_{ROA} (1.120). On the other hand, South Korea has the lowest CAR (5.401) and ROA (0.521), which is accompanied by a lower σ_{ROA} (0.630). Banks with higher values of ROA, which represents higher returns, and experiencing higher σ_{ROA} , which represents higher risk, are buffered against insolvency risks by a higher CAR. The risk inherent in banking activities can be further scrutinized by identifying the different sources of systematic risks by reporting changes in interest rates, exchange rates and stock market prices (Table 1). For example, the figures indicate that Malaysia has the lowest exchange rate changes (0.013). Thus, the lowest systematic exchange rate risk is expected to be found in Malaysia.

RESULTS

Table 2 reports the average values of the estimated three-factor CAPM and the Z-risk index for the East Asian countries examined in the present study. The figures are represented by taking the average values of the estimated bank risk of each country over the period between 2000 until 2010. For instance, the estimated systematic exchange rate for Malaysia (-0.005) represents the average systematic exchange rate of all Malaysian banks over the period of 2000-2010. The significance level of each coefficient may differ from one bank to another bank. However, in general, the results show that systematic market risks (i.e., the coefficients of stock market price changes) are significant at 1%, but systematic exchange rate and interest rate risks are significant at 10%.

Column 2 (β_m) represents average systematic market risks, which range between 0.079 in Indonesia and 0.7 in Malaysia. The results show that listed banks in Indonesia, the Philippines and South Korea have the least exposure to market fluctuations. Column 3 (β_I) demonstrates the average systematic interest rate risks with absolute values ranging between 0.309 for the Philippines banks and 16.301 for Singapore. The estimated systematic interest rate risks indicate that debt market fluctuations have the least impact on banks in the Philippines, Hong Kong and South Korea. With regard to the lowest systematic exchange rate risk, column 4 (β_{EXH}) reports Malaysian banks with the average absolute value of 0.005 followed by the Philippines (0.031) and Indonesia (0.259). The estimated systematic exchange rate risks indicate that Malaysia, the Philippines, Indonesia and South Korea have provided an environment for banks with the lowest exposure to the fluctuations of foreign exchange markets.

A comparison between the CAPM coefficients and Z-risk index rankings helps recognize the nature and sources of insolvency risks. Particularly, the results show whether insolvencies are systematic or unsystematic.

TABLE 1. Average values of variables used in the CAPM and the Z-Risk Index by country, 2000-2010

Descriptive Analysis	EXH ¹	r_m^1	I ¹	ROA	CAR	σ_{ROA}
China	0.019	2.430	0.0005	0.766	8.016	0.359
Hong Kong	-0.027	10.990	-0.011	1.006	8.407	0.290
Indonesia	-0.062	5.269	-0.011	1.576	12.866	2.313
South Korea	-0.020	1.769	-0.004	0.521	5.401	0.630
Malaysia	0.013	1.254	-0.0004	1.122	10.215	0.434
The Philippines	-0.036	3.582	-0.012	1.355	11.454	0.400
Singapore	0.021	1.184	-0.004	1.131	10.265	0.225
Thailand	0.014	0.657	-0.005	0.783	10.635	1.555
Cambodia				2.080	20.885	1.120
Vietnam				1.597	15.904	0.665

¹EXH, r_m and I are the first difference of exchange rate, stock price index, and interest rate, respectively.

TABLE 2. Average Z-risk Index and CAPM Coefficients

Country (1)	$\hat{\beta}_m$ (2)	$\hat{\beta}_I$ (3)	$\hat{\beta}_{EXH}$ (4)	σ_{ε} (5)	σ_R (6)	Z-risk index (7)
China	0.241*** [8.679]	-3.908* [-1.708]	-3.799* [-1.828]	23.295	31.562	40.182
Indonesia	0.079*** [7.678]	3.915* [1.699]	-0.259* [-1.829]	7.803	8.990	36.700
Hong Kong	0.142*** [5.577]	-1.205* [-1.907]	-8.415* [-1.754]	79.783	107.065	76.982
Malaysia	0.700*** [5.633]	-7.793* [-1.835]	-0.005** [-1.985]	16.150	21.174	47.741
Vietnam						42.528
The Philippines	0.104*** [5.913]	-0.309* [-1.773]	0.031* [1.852]	13.711	16.480	46.465
Singapore	0.288*** [6.102]	-16.301** [-1.963]	0.720* [1.847]	12.846	21.156	61.495
Thailand	0.610*** [6.710]	3.396* [1.768]	0.390* [1.714]	7.346	11.080	31.240
Cambodia						25.053
South Korea	0.114*** [3.260]	2.472** [1.906]	0.261* [1.886]	8.653	9.975	24.778

Note: $\hat{\beta}_m$, $\hat{\beta}_I$, and $\hat{\beta}_{EXH}$ are estimated systematic market, interest rate, and exchange rate risk exposure, respectively. σ_{ε} is estimated unsystematic risk exposure. σ_R is total risk exposure. The figures in the bracket show t-values. ***, ** and * denote the coefficients are significant at the 1%, 5%, and 10% levels, respectively.

Columns 5 (σ_{ε}) and 7 (Z-risk index) show the average values of unsystematic risks (σ_{ε}) and Z-risk indices, respectively. Although banks in Thailand (7.346) and Indonesia (7.803) have the lowest unsystematic risks, they are among banks with the highest probability of insolvency risks. Therefore, bank-specific conditions can hardly explain the entirety of underlying causes of insolvencies. Hong Kong banks have the highest unsystematic risks, whereas they have the lowest insolvency risk. The findings highlight that both systematic and unsystematic risk channels can influence insolvency risks.

The results show mixed signs for systematic interest rate and exchange rate risks, which implies that regional cooperation can reduce risk exposures. Consequently, column 6 (σ_R) reports the average value of total bank risks for each country as the standard deviation of stock price indices. The results show that total risks range between 8.99 in Indonesia and 107.065 in Hong Kong.

CONCLUSION

The present study estimates six types of risks using a three-factor CAPM and the Z-risk index for East Asian countries (i.e., Cambodia, China, Indonesia, Malaysia, South Korea, Thailand, the Philippines, Singapore, Hong Kong, and Vietnam) between 2000 and 2010. The CAPM and the Z-risk index use weekly data to estimate yearly unsystematic, total, three systematic and insolvency risks.

The findings of the CAPM utilized in the present study show positive systematic market risk exposure in all East Asian countries for all years, which supports the contribution of stock markets to bank prices and returns as mentioned in the theory of CAPM. The mixed signs of systematic interest rate and exchange rate risks in East Asian countries infer hedging opportunities, diversification strategies and regional cooperation, which may help risk managers to hedge and stabilize their portfolios against interest rate and exchange rate fluctuations. In the case of interest rates, banks may benefit from regional cooperation by extending their operations into other regional countries with different systematic interest rate risk exposures (Tamadonnejad 2013).

The comparison between the CAPM and the Z-risk index findings indicates that banks with lower unsystematic risks do not necessarily have lower insolvency risks, which implies the complexity of insolvency risks (Tamadonnejad 2013). The fact that the findings presented by the present study in East Asian countries with various regulatory, economic and political conditions draws the attention of academic researchers to the complexity of insolvency risks. Both bank-specific and country-specific environments may influence insolvency risks, which implies that low bank performance and high country instability can be environmental factors affecting insolvencies. Therefore, it is necessary that managers and policymakers develop a monitoring system on factors affecting bank insolvency risks to avoid bankruptcies and insolvencies.

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