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The Impact of Efficiency and Crisison Insolvency Risk: The Caseof East Asian Banks

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ABSTRACT

This paper investigates factors affecting bank insolvency risks in East Asian banks during 2000-2010. It emphasizes on inefficiency, the probability of crises, economic and political instability in a dynamic framework. The results show that bank inefficiencies precede future risk taking behaviors. Therefore, credit supervision, technology,and performance improvement reduce insolvency risks. Financial crisesand insolvencies have common country-specific factors, which help managers predict increasingrisks and adopt appropriate strategies. Country-specific changes are beyond the control of banks and have significant influence on them. Hence, policymakers and regulators have contributions to the safety and soundness of banks by stabilizing political and economic conditions.

Keywords:Insolvency risk, Bank efficiency, Early warning systems, Political stability, Economic performance

JEL ClassificationG32 G21 G01D72

INTRODUCTION

Financial systems have the salient role in managing business relationships and economic activities. Banks are financial institutions that facilitate business relationship by accepting deposits and making loans. The intermediary role of banks always exposes them to non-performing loans, the sudden withdrawals of deposits, and hence, insolvencies. The failure of even one bank can trigger systemic shocks and economic collapse. Therefore, investors, managers, and policymakers frequently monitor the probability of insolvencies. For example, if investors feel that a bank is insolvent, they withdraw deposits and may cause speculative attacks. The recurrent bank insolvency risks and financial instability around the world have drawn attentions to risk determinants.

Several studies have investigated risks with some suggestions to avoid further failures (Agoraki, Delis, & Pasiouras, 2011; Cornand & Gimet, 2012; Haq & Heaney, 2012; Niu, 2012; Rahman, 2010). While studies on risk determinants have widely examined bank- and country-specific conditions, banks still face financial crises and insolvencies. This fact has motivated scholars and policymakers to reconsider the dynamic and changing nature of insolvencies. Bank efficiencies, crises probabilities, regulatory environments, political and economic conditions are factors that help investors, managers, and policymakers assess the probability of bank insolvencies. There are a few studies on the impact of political factors on insolvencies with usually inconclusive or insignificant results (Girard & Omran, 2007; Houston, Lin, Lin, & Ma, 2010; Iqbal, Brooks, & Galagedera, 2010; Kocenda & Poghosyan, 2009; Tam & Lai, 2009).

In addition to country-specific environments, bank-specific conditions and managerial decisions can improve the competitive status of a bank by offering a higher efficiency to investors and customers. Although it is necessary to incorporate bank efficiencies as a determinant of risks, an inappropriate proxy can mislead decisions makers. For example, the recent U.S. crisis of 2007 hit financial companies with the high ratings of AAA/Aaa, which were operating in the most advanced countries of the U.S. and Europe. While companies seemed highly efficient with appropriate risk management systems, the reality turned out to be different. It is this fact that necessitates the use of a more technical tool to analyze the efficiency and performance of banks. However, the risk-related studies have used cost-income ratios, which hardly demonstrate bank inefficiencies (Baele, De Jonghe, & Vander Vennet, 2007; Delis & Kouretas, 2011; Shehzad, de Haan, & Scholtens, 2010; Uhde & Heimeshoff, 2009).

With regard to financial crises, a dummy variable is a common way to incorporate the impact of crises. While dummies can only capture the onset of crises, the Early Warning System (EWS) estimates the probability of crises over time. EWS can even show the increasing probability of crises during tranquillity and declining probabilities during crises, which seems more informative than a dummy. The existing gaps motivate this paper to reconsider bank insolvency risks in East Asia countries using the measured Z-risk index. Therefore, this paper aims to investigate factors affecting insolvency risks for East Asian banks using the dynamic approach of GMM.

In order to examine the impact of bank performance on insolvencies, the Stochastic Frontier Analysis (SFA) provides inefficiency scores. This paper employs a wide range of country-specific variables using two indices of economic performance and political stability. The economic performance index can represent monetary and financial stability as well as economic status. The index of political stability captures the influence of corruption perception, government instability, regulatory environments, and other political related factors. Last but not least, EWS improves the model by estimating the probability of banking crises.

The results show that banks in politically unstable countries with low economic performance are prone to insolvencies. Political instability is a factor that exacerbates the probability of insolvency and can delay making appropriate decisions. The probability of crises influences banks and increases insolvency risks. The increasing probability of banking crises is a signal that warns managers to adopt pre-emptive strategies, such as higher capital. Finally, a more efficient bank can survive better than an inefficient bank. The results show that inefficiencies Granger cause future risk takings and suggest that regulators take into account bank inefficiencies in capital requirement policies.

The remainder of this paper is organized as follows. Section 2 reviews the literature related to the factors affecting bank risk followed by a description of the methodology in Section 3. Section 4 presents the sample data and empirical specification of the factors affecting bank insolvency risk. Section 5 reports the results, and Section 6 concludes this paper.

LITERATURE REVIEW

Risk management is the salient part of every financial institution to prevent failures. The bank- and country-specific decisions and environments expose banks to various unsystematic and systematic risks. Different regulatory and structural conditions can change the critical point of insolvencies. An insolvent bank lacks resources to meet financial obligations and may trigger speculative attacks. Although some countries have high exposure to systematic and unsystematic risks, they have a low probability of insolvency and bankruptcy. This section reviews the determinants of bank insolvency risks to develop a monitoring system which helps policymakers adopt effective strategies.

Five general categories can explain factors affecting bank risks, namely, ownership structures, off-balance sheet activities, macroeconomic environments, the Basel Accord principles, and bank-specific conditions. Saunders, Strock, and Travlos (1990), Anderson and Fraser (2000), Konishi and Yasuda (2004), Iannotta, Nocera, and Sironi (2007), Dinger (2009), and Shehzad, et al. (2010) investigated ownership structures. The authors analyzed alternate ownership variables for government- or private-owned, managerial- or stockholders-controlled, and international banks. In summary, the findings are subject to sample selection criteria, such as periods and countries. Particularly, environmental conditions can significantly change results and lead to contradictory findings. The following paragraph reviews some previous studies to find existing gaps.

In a study on the impact of managerial shareholdings on risks, Anderson and Fraser (2000) drew the attention on the influence of legislation and regulation. The results demonstrated a positive relationship during less regulated periods and a negative during regulated periods. Konishi and Yasuda (2004) found a nonlinear relationship between stable ownership (investors retain stocks for a long-term) and risks. Finally, Dinger (2009) highlighted the stabilizing role of transnational banks during crises rather than normal periods by providing liquidity. As discussed, the ownership structure is a key factor affecting risks, which influences bank performance. While there are different variables representing ownership and management structures, SFA evaluates the whole bank-specific conditions, such as management by estimating technical efficiencies.

With regard to the off-balance sheet (OBS), Angbazo (1997), Stiroh (2004, 2006), Baele, et al. (2007), Lepetit, Nys, Rous, and Tarazi (2008), Au Yong, Faff, and Chalmers (2009), and Demirgüç-Kunt and Huizinga (2010) investigated the various types of non-interest activities. In general, the results show that diversification using non-traditional and non-interest activities exacerbate risk taking behaviors. However, the findings are still subject to risk measures, bank activities, and functional forms. The following paragraph reviews previous studies to find existing gaps for OBS activities.

While Stiroh (2004) suggested a linear significant impact of non-interest income ratio on insolvency risks measured by Z-score, Baele, et al. (2007) found a non-linear impact of non-interest revenue share on risks. The findings of Lepetit, et al. (2008) show that diversification into non-interest income increases risks and insolvencies. However, the positive relationship was mostly for commission income in small banks. In another study, Au Yong, et al. (2009) found that derivative activities increase long-run interest rate risk in Asia-Pacific banks. However, derivative activities reduced short-run interest rate risk and had no significant impacts on exchange rate risk exposure. Consistent with the previous papers, Demirgüç-Kunt and Huizinga (2010) found a positive relationship between non-interest income and insolvency risks.

Based on the bad management hypothesis, bank inefficiencies Granger cause future risk taking behaviors. Diversification policies are managerial decisions to improve bank efficiencies. If off-balance sheet and non-traditional activities improve bank technical efficiencies, they will reduce risks. The SFA is a technical efficiency measurement which takes into account different inputs, outputs, and environmental factors. Moreover, it can use the flexible functional form of translog to deal with unknown structures and different functional forms. Hence, the efficiency level of a bank can be a proxy to investigate the overall impact of managerial-related issues on insolvency risks.

With regard to the macroeconomic and regulatory conditions, González (2005), Uhde and Heimeshoff (2009), Laeven and Levine (2009), Koopman, Kräussl, Lucas, and Monteiro (2009), Delis and Kouretas (2011), and Houston, et al. (2010) examined the relationship between country-specific conditions and risk taking behaviors. The results support the argument that good economic and regulatory environments reduce risks. In general, previous studies have emphasized on economic and regulatory conditions as country-specific factors affecting risks. The following paragraph reviews some studies to find existing gaps on country-specific variables.

The findings of Laeven and Levine (2009) show that capital stringency, GDP per capita, capital requirements, activity restriction, and deposit insurance coverage are the determinants of insolvency risks measured by Z-score. Houston, et al. (2010) found that GDP per capita, GDP, capital stringency, regulatory conditions, deposit coverage, creditor rights, inflation, and the Herfindahl–Hirschman Index influence the probability of insolvency risks. Delis and Kouretas (2011) highlighted domestic credit expansions, economic growth, regulatory conditions, and interest rates as factors affecting risks.

Economic variables and regulatory conditions seek to explain the underlying causes of an insolvent bank. However, government instability, corruption perception, monetary and currency instability are the features of politically unstable countries. Political instability affects markets, investments, resources, and hence, exposes banks to unexpected events, crises, and insolvencies. For example, Iqbal, et al. (2010) discussed that the low performance of asset pricing models might be due to economic and political volatility. Girard and Omran (2007) determined that political instability is a restriction on investment. The results of Houston, et al. (2010) show that the control of corruption reduces the probability of insolvency. Having discussed the importance of political stability, studies on risk determinants need to take into account factors that reflect the status of political and economic stability. However, there are a few empirical studies that use political factors, and the results are usually insignificant.

Despite good political and economic conditions for banking activities, some banks still face insolvencies and bankruptcies. Studies, such as Demirgüç-Kunt and Detragiache (2011) sought to explain risk taking behaviors by looking at bank performance and the compliance with Basel Core Principles (BCP). The results of Demirgüç-Kunt and Detragiache (2011) and Festic, Kavkler, and Repina (2011) show that the BCP compliance significantly reduces non-performing loans to total loans ratio. However, the findings hardly support the significant impact of the BCP compliance on systemic risks and soundness measured by Z-scores.

BCP tries to regulate bank-specific environment to reduce risk taking behaviors. In order to investigate the impact of bank-specific characteristics on risks, there are many variables which can demonstrate the different aspects of bank performance and efficiency. The variables reflect the financial status of banks related to credit and capital, interest rate, business, and diversification. However, a technical efficiency analysis using the sophisticated method of SFA can improve results and provide a better picture of overall bank performance.

Given previously discussed issues, this paper attempts to reduce the existing gaps of factors affecting bank insolvency risks by using various bank- and country-specific variables in a dynamic framework[1]. Past inefficiencies and insolvencies explain a part of current insolvency risks. Therefore, this paper employs past efficiency performance using SFA and past insolvencies using the dynamic approach of GMM. This paper uses economic performance index and political stability index to take into account economic and political conditions. Finally, it employs the probability of systemic banking crises using EWS. The following two sections discuss the dynamic model and empirical specification of insolvency risk determinants.

METHODOLOGY

This paper conducts a two-stage procedure to identify the nature and determinants of insolvencies. The first-stage regresses the Z-risk index on unsystematic risk, systematic market risk, systematic interest rate risk, and systematic exchange rate risk to investigate the nature of insolvencies. The unsystematic risk reflects internal or bank-specific problems, whereas systematic risks reflect external or country-specific problems. The first-stage findings provide information about insolvency risk determinants. For example, if the coefficient of unsystematic risk is significant, bank-specific conditions can explain a part of insolvency risks. The significant coefficient of systematic risks shows bank' risk exposure to stock market, debt market, and foreign exchange market, hence, country-specific conditions.

The second-stage investigates factors affecting bank insolvency risks using internal and external factors. Bank insolvencies could be due to internal factors, such as bank inefficiencies or external factors, such as crises, political instability, and economic performance. In addition, past risk taking behaviors can explain current insolvency risks (Agoraki, et al., 2011; Cornand & Gimet, 2012; Niu, 2012). Banking crises are endogenous variables because political and economic factors influence both banking crises and insolvencies. Therefore, it is necessary to adopt a methodology which can deal with endogenous and predetermined variables, such as GMM.

A general model specification which includes a lagged dependent variable (as a predetermined explanatory variable), endogenous and strictly exogenous explanatory variables is as in Equation 1.

$$\mathrm{Y_{it}} = \delta \mathrm{Y_{i,t-1}} + \mathbf{x}'_{1,\mathrm{it}}\boldsymbol{\beta}_{\mathbf{1}} + \mathbf{x}'_{2,\mathrm{it}}\boldsymbol{\beta}_{\mathbf{2}} + \eta_{\mathrm{i}} + \nu_{\mathrm{it}} \quad (1)$$

Where, i = 1 ,…, N and t = 1 ,…, T. $\mathrm{Y_{i,t}}$ is the dependent variable representing bank insolvency risks. $\mathrm{Y_{i,t-1}}$is the lagged dependent variable as a predetermined explanatory variable, which captures past insolvency risks. $\mathbf{x}'_{\mathbf{1},\mathbf{it}}$is a vector of strictly exogenous explanatory variables, and $\mathbf{x}'_{\mathbf{2},\mathbf{it}}$ is a vector of endogenous explanatory variables.$\mathbf{x}'_{\mathbf{1},\mathbf{it}}and\mathbf{x}'_{\mathbf{2},\mathbf{it}}$ capture the influence of bank- and country-specific conditions on bank insolvencies. δ, $\boldsymbol{\beta}_{\mathbf{1}}$,and$\boldsymbol{\beta}_{\mathbf{2}}$ are unknown parameters, η_{i} is a time invariant fixed effect included in the error term $(\varepsilon_{\mathrm{it}} = \eta_{\mathrm{i}} + \nu_{\mathrm{it}})$, and $\nu_{\mathrm{it}} \sim \mathrm{IID}(0, \sigma_\nu^2)$ is a stochastic error term.

[1] The dynamic model investigates whether past insolvency risks can influence current insolvency risks.

The inclusion of lagged dependent variable (Y_{t-1}) causes a correlation between an explanatory variable (Y_{t-1})and error terms (ε_{it}). In order to estimate a model with consistent estimates, Arellano and Bond (1991) proposed the difference GMM approach. This approach is for samples with small time dimensions (T) and large number of cross-sections (N). The use of a small time dimension has the benefit of avoiding structural breaks and crises. This approach can estimate unbalanced panel data, which also takes into account heterogeneity in the means of $Y_{i,t}$ across banks. Finally, Arellano and Bond (1991) demonstrated that this method would provide more efficient estimates than Ordinary Least Squares (OLS), Generalized Least Squares (GLS), and Two-Stage Least Squares (2SLS).

Arellano – Bond's (1991) approach uses the first difference version of Equation 1, which converts $Y_{i,t-1}$ and ε_{it} to $\Delta Y_{i,t-1}(Y_{i,t-1} - Y_{i,t-2})$ and $\Delta\nu_{it}(\nu_{it} - \nu_{it-1})$. Although this process removes fixed effects (η_i) from the model, it causes a correlation between $Y_{i,t-1}$ and ν_{it-1}. Therefore, the authors suggested using Instrumental Variables (IV) to deal with endogenous and predetermined variables.

The consistency of Arellano and Bond's (1991) GMM estimators depends on the lack of correlation between error terms and IV. If stochastic error terms (ν_{it}) are serially uncorrelated, the lagged values of $Y_{i,t-1}$ and $\mathbf{x}'_{2,it}$can provide valid IV for first differenced variables. Particularly, a set of moment conditions shows the validity of IV as in Equations 2-4:

$$E\left[Y_{i,t-s}(\Delta\nu_{it})\right] = 0 \text{ for } t = 3,\ldots T \text{ ; } s \geq 2 \quad (2)$$
$$E\left[\mathbf{x}'_{2,it-s}(\Delta\nu_{it})\right] = 0 \text{ for } t = 3,\ldots T \text{ ; } s \geq 2 \quad (3)$$
$$E\left[\mathbf{x}'_{1,it-s}(\Delta\nu_{it})\right] = 0 \text{ for } t = 1,\ldots T \text{ ; } s = 0 \quad (4)$$

In order to test whether the lagged values of a variable are valid instruments, Arellano and Bond (1991) developed autocorrelation tests for residuals. The first-order correlation in differences (AR1) examines the serial correlation between, for example, $\Delta\nu_{it}$ and $\Delta\nu_{it-1}$ with the expected significant correlation due to ν_{it-1}. However, the second-order correlation in differences (AR2) seeks to test the existence of a correlation between ν_{it-1} in $\Delta\nu_{it}$ and ν_{it-2} in $\Delta\nu_{it-2}$ with the expected insignificant correlation. In addition to AR1 and AR2 tests, we can use Sargan and Hansen tests of over-identifying restrictions to examine the overall validity of IV.

The first difference GMM approach assumes that the lagged values of endogenous and predetermined variables (for example, ($Y_{i,t-2}, Y_{i,t-3}, \ldots$)) have information about transformed variables (for example, $\Delta Y_{i,t-1}$). However, Blundell and Bond (1998) discussed that if Y is close to a random walk process which represents a unit root, lagged level IV in first difference GMM approach can perform poorly and lack sufficient information to explain future changes. Hence, this paper conducts panel unit root tests to ensure that instruments have sufficient information about future changes.

Table 1 presents the specification of panel unit root tests employed to find the order of integration in panel data. The Levin, Lin, and Chu (LLC) panel unit root test assumes that there is a common unit root across cross-sections (banks). IPS (Im, Pesaran, and Shin), Fisher-ADF (Augmented Dickey–Fuller) and Fisher-PP (Phillips-Perron) of panel unit root tests assume that there are individual unit roots across cross sections. All unit root tests use the null hypothesis of unit root or the stationary of order one (I(1)). That implies that if we fail to reject the null hypothesis, lagged level instrumental variables are poor without sufficient information. A significant p-value less than 5 per cent implies the integration of order zero (I(0)) or stationary panel data. On the other hand, it shows that lagged level IV contains information for future changes of that variable.

THE DATA AND EMPIRICAL SPECIFICATIONS

This paper uses unbalanced panel data of 1182 annual observations from a sample of 118 commercial banks in 10 countries of East Asia during 2000-2010, namely, Cambodia, China, Indonesia, Malaysia, South Korea, Thailand, the Philippines, Singapore, Hong Kong and Vietnam. The Z-risk index is the dependent variable (Y_{it}), which is a measure for insolvency risks. The three-factor Capital Asset Pricing Model (CAPM) provides data on systematic market risk, systematic interest rate risk, and systematic exchange rate risk, as well as unsystematic risk exposure. The first-stage regresses the Z-risk index on CAPM estimates as in Equation 5.

$$Y_{it} = \hat{\delta} Y_{i,t-1} + \mathbf{x}'_{1,it}\widehat{\boldsymbol{\beta}}_{\mathbf{1}} + \hat{\varepsilon}_{it} (5)$$

Where, i = 1 ,…, 118 and t = 2000 ,…, 2010. $Y_{i,t}$is the Z-risk index as a measure of insolvency risks, and $Y_{i,t-1}$ is lagged insolvency risks. $\mathbf{x}'_{\mathbf{1},\mathbf{it}}$is a vector of strictly exogenous explanatory variables including CAPM estimates.

The second-stage regresses the Z-risk index on efficiency scores, banking crises probabilities, political stability index, and economic performance index with the empirical specification as in Equation 6.

$$Y_{it} = \hat{\delta} Y_{i,t-1} + \mathbf{x}'_{1,it}\widehat{\boldsymbol{\beta}}_{\mathbf{1}} + \mathbf{x}'_{2,it}\widehat{\boldsymbol{\beta}}_{\mathbf{2}} + \hat{\varepsilon}_{it} (6)$$

Where, $\mathbf{x}'_{\mathbf{1},\mathbf{it}}$ includes efficiency (efficiency scores with two lags), economic performance index, and political stability index. $\mathbf{x}'_{\mathbf{2},\mathbf{it}}$includes EWS (banking crises probabilities) which is an endogenous variable. The paper also estimates another model using inflation, money growth, and GDP growth instead of economic performance index to ensure the specified model of Equation 6 is robust to variable selection.

The estimated efficiency scores from SFA provide information about the performance of banks. SFA is a sophisticated tool, which emphasizes on the intermediary role of banks in efficient use of inputs in producing outputs. Thus, it can also evaluate managerial decisions, ownership structures, and internal environments. There are two hypotheses for the relationship between bank inefficiency and risks; namely, cost skimping hypothesis and bad management hypothesis. In cost skimping hypothesis, laxer supervision and credit monitoring may increase bank efficiency in the short-run. However, they cause higher risk-taking in the long-run. In bad management hypothesis, inefficient credit and operating cost monitoring coupled with market problems Granger cause risk-taking behaviors in the future. Hence, both positive and negative signs can explain the influence of the estimated efficiency scores on bank insolvency risks.

The economic performance describes bank and monetary stability, budget deficit or surplus, unemployment and economic growth. The index spans from 0 to 25, with 25 representing the best economic performance taken from EUROMONEY. The database of EUROMONEY publishes data on economic performance index which takes into account various economic conditions. The economic performance captures economic and financial conditions which are beyond the control of banks. In addition to the discussed database, World Bank's World Development Indicators (WDI) publishes data on inflation rate, money growth, and GDP growth.

Studies, such as Laeven and Majnoni (2003), Dinger (2009), Koopman, et al. (2009), Uhde and Heimeshoff (2009), Laeven and Levine (2009), Rahman (2010), Ali and Daly (2010), Houston, et al. (2010), Delis and Kouretas (2011), Demirgüç-Kunt and Detragiache (2011) investigated the influence of economic growth, unemployment, fiscal and monetary policies on risks. Slow economic growth, unemployment, and budget deficit can increase the probability of crises and insolvencies. In addition, lower money supply and higher inflation increase interest rates and make funding more expensive, hence, increase bank insolvency risks and crises. As a result, a higher value of the economic performance index as an exogenous explanatory variable reduces insolvency risks.

The political stability demonstrates the status of regulation, non-corruption perception, government stability, financial payments (e.g. as loans and dividends), and non-capital repatriation. The index of political stability ranges from 0 to 25, with 25 representing the highest political stability taken from EUROMONEY. The database of EUROMONEY publishes data on political stability index which takes into account various political conditions. The political stability captures political and regulatory conditions which are beyond the control of banks.

With regard to the expected relationship between political conditions and risks- returns, we can refer to the studies done by Girard and Omran (2007), Kocenda and Poghosyan (2009), Tam and Lai (2009), Marshall, Maulana, and Tang (2009), Iqbal, et al. (2010), and Houston, et al. (2010). The authors pointed out to the significant impact of political stability on investments and returns. Nevertheless, the studies hardly found a significant relationship between political conditions and risks. Particularly, the findings of Houston, et al. (2010)demonstrated that political stability (government stability) insignificantly reduced bank insolvency risks. As a result, a higher value of the political stability index (monetary stability as well as government stability) reduces bank insolvency risks.

EWS seeks to predict the probability of systemic banking crises using a logit model. The estimated probabilities capture systemic shocks, the onset and period of crises, and even increasing probabilities during tranquillity. Several studies, such as Bartram, Brown, and Hund (2007), Rahman (2010), Kim, Loretan, and Remolona (2010), Rötheli (2010), and Bordo, Meissner, and Stuckler (2010) investigated the relationship between crises and risks. The authors used a crisis dummy variable as an exogenous variable. Nevertheless, economic and political conditions influence the probability of insolvencies and banking crises. Weak economic performance and political instability expose banks to banking crises, insolvencies, and bankruptcies. As a result, the variable representing the probability of banking crises (EWS) is an endogenous explanatory variable. It is expected that the higher probability of banking crises exacerbates insolvency risks.

Given the previously discussed relationships and expected signs, the next section reports the results of two stages to ensure whether they are in line with expectations.

RESULTS

Table 2 shows the panel unit root tests of LCC, IPS, Fisher-ADF and Fisher-PP. The results point out that all variables are stationary at 5 per cent level of significance which indicates the integration of order zero (I(0)). This implies that the lagged values of endogenous and predetermined variables have information to explain future changes. Hence, Arellano and Bond's (1991) IV can perform well in explaining lagged dependent variable ($Y_{i,t-1}$) as a predetermined explanatory variable and the probability of banking crises (EWS) as an endogenous explanatory variable.

Table 3 reports the estimated coefficients of Equation 5 which is the first-stage. The results demonstrate the significant impact of systematic market risk (-12.363), systematic interest rate risk (-0.005), systematic exchange rate risk (-0.066), and unsystematic risk (-0.120) on Z-risk index which is a measure of insolvency risk. The significant negative coefficients of the first-stage have two empirical implications. Firstly, higher volatility in stock markets, debt markets, and foreign exchange markets increases bank insolvency risks. It implies that economic and political conditions as well as crises can influence insolvency risks measured by Z-risk index. Secondly, bank-specific conditions can also influence insolvencies, which imply that the efficiency of banks is another factor affecting insolvency risks. Therefore, a monitoring system should observe both internal and external environments of banks.

Table 3 shows a significant coefficient for the lagged dependent variable (0.219), which implies that past risk taking behaviors influence current insolvency risks. Hansen test of over-identifying restrictions (0.3) shows the validity of IV, which validates Equations 2 and4. The p-value of AR1 (0) and AR2 (0.4) are in line with expectations, which implies that residuals are serially uncorrelated. That means a lagged value of a variable can be a valid instrument.

Table 4 reports the estimated coefficients and diagnostic tests of Equation 6 as the second-stage of factors affecting bank insolvency risks in two models. Column 3 reports the results of Model 1 including economic performance index, political stability index, crises probabilities, and efficiency scores. Model 2 in the fourth column replaces economic performance index with inflation, money growth, and GDP growth to examine whether Model 1 is robust to variable selection. All variables significantly influence insolvency risks except money growth (0.002). The lagged dependent variable is positive in both Models 1 (0.559) and 2 (0.587), which implies that past risk taking behaviors influence current insolvency risks.

Model 1 in the third column reports negative coefficients for efficiency- lag 1 (-7.303) and -lag 2 (-9.748). Model 2 also reports negative significant coefficients for lag 1 (-9.451) and lag 2 (-9.743).[2] The negative signs highlight the bad management hypothesis that low bank efficiency Granger causes future insolvency risks. Hence, inefficient use of inputs, such as deposits in producing outputs, such as loans increases the probability of insolvencies in the future (FIordelisi, Molyneux, & Marqués Ibáñez, 2010; Jonathan, 2004; Koutsomanoli-Filippaki & Mamatzakis, 2009; Podpiera & Weill, 2008).

With regard to country-specific conditions, the results show the significant effects of political and economic environments as well as crises on banks. The positive coefficient of political stability index in Model 1 (0.419) and Model 2 (0.380) shows that regulations, non-corruption perception, government and financial stability reduce the probability of insolvencies (Houston, et al., 2010; Tchankova, 2002). The negative sign of EWS in Model 1 (-7.806) and Model 2 (-2.792) provides a linkage between the probability of banking crises and insolvencies (Bartram, et al., 2007; Bordo, et al., 2010; Kim, et al., 2010; Rahman,

[2] The higher value of efficiency explanatory variable represents lower bank efficiencies. The Z-risk index is a measure of the insolvency risk dependent variable with the higher value representing lower insolvency risks. Therefore, the negative signs of Efficiency (-1) and Efficiency (-2) show that higher bank inefficiencies Granger cause higher insolvency risks.

2010; Rötheli, 2010). Therefore, the higher probability of banking crises can warn investors on approaching problems, trigger speculative attacks on banks, and hence, exacerbate insolvencies. Inflation (-1.120), money growth (0.002), GDP growth (0.101), and economic performance index (1.987) are economic explanatory variables (Ali & Daly, 2010; Delis & Kouretas, 2011; Demirgüç-Kunt & Detragiache, 2011; Dinger, 2009; Houston, et al., 2010; Koopman, et al., 2009; Laeven & Levine, 2009; Laeven & Majnoni, 2003; Rahman, 2010; Uhde & Heimeshoff, 2009). The findings suggest that banks in a better economic condition face lower insolvency risks than in an unstable financial system.

In order to deal with endogenous EWS and predetermined Insolvency risk (-1), GMM used the lagged values of them as IV. Hansen test of over-identifying restrictions and AR2 are diagnostic tests representing the validity of IV in the fitted models of Table 4. Hansen test of over-identifying restrictions (0.3) shows the validity of IV, which validates Equations 2-4. The p-value of AR1 (0) and AR2 (1, 0.8) are in line with expectations, which implies that residuals are serially uncorrelated.

In summary, the significant coefficient of lagged dependent variable $(\hat{\delta})$ implies that insolvencies persist but decline with an adjustment rate between 0 and 1. Particularly, past insolvency risks influence current insolvency risks with declining values. The significant coefficients of efficiency $(\hat{\beta}_{11},\ \hat{\beta}_{12})$ support the influence of managerial decisions, resource allocation, and past performance on insolvencies. In addition, the findings show the impact of environmental factors, such as political and economic conditions on insolvencies. The results are robust to variable selections, endogeneity problems, fixed effects, autocorrelation, and heteroskedasticity.

CONCLUSION

This paper investigates factors affecting bank insolvency risks measured by Z-risk index in the East Asia region during 2000-2010 using the dynamic approach of GMM. The results show that bank performance and country-specific conditions influence insolvencies. Consistent with expectations, inefficiencies Granger cause future risk taking behaviors especially during financial crises. The higher probability of banking crises significantly exacerbates insolvencies, which may originate in investors' fears. Political and economic conditions significantly influence bank insolvency risks. Therefore, corruption perception, financial non-payments, weak economic environments, financial and government instabilities, inefficient regulations and supervision trigger systemic crises and insolvencies. Last but not least, the findings show that past risk taking behaviors influence current insolvency risks.

Regulatory authorities, bank managers, and policymakers have pivotal roles in the stability of banks. The findings suggest that regulators take into account bank inefficiencies in risk-adjusted capital requirements. Inefficiencies can warn managers of declining returns on assets in the two years prior to insolvencies. Therefore, managers can adopt strategies to improve performance prior to failures. In order to decrease the repercussions of systemic banking crises, early warning systems help managers predict the probability of crises in 12-24 months prior to the onset. Managers can improve bank performance, such as efficiencies and returns, whereas country-specific environments, such as political and financial stability are beyond the control. Therefore, policymakers have crucial roles in stabilizing financial systems and preventing systemic failures and insolvencies.

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TABLE 1: Unit Root Testing Procedures

Statistic	Test equation	Null hypothesis
LLC	Common unit root process	Unit root
IPS	Individual unit root process	Unit root
Fisher-ADF	Individual unit root process	Unit root
Fisher-PP	Individual unit root process	Unit root

TABLE2: The Results Of The Unit Root Tests

	LLC	IPS	Fisher-ADF	Fisher-PP
Insolvency risk[a]	I(0)[f]	I(0)	I(0)	I(0)
Systematic market risk	I(0)	I(0)	I(0)	I(0)
Systematic interest rate risk	I(0)	I(0)	I(0)	I(0)
Systematic exchange rate risk	I(0)	I(0)	I(0)	I(0)
Unsystematic risk	I(0)	I(0)	I(0)	I(0)
Efficiency[b]	I(0)	I(0)	I(0)	I(0)
EWS[c]	I(0)	I(0)	I(0)	I(0)
Economic Performance[d]	I(0)	I(0)	I(0)	I(0)
Inflation	I(0)	I(0)	I(0)	I(0)
Money growth	I(0)	I(0)	I(0)	I(0)
GDP growth	I(0)	I(0)	I(0)	I(0)
Political Stability[e]	I(0)	I(0)	I(0)	I(0)

Note: a) The insolvency risk is measured by the Z-risk index that lower values show higher insolvency risks. b) Efficiency explanatory variable is measured by SFA that a higher value of the estimated efficiency score represents lower efficiency. c) EWS is an explanatory variable, representing the estimated probability of systemic banking crises by a logit model. d) Economic Performance is an index with higher scores representing better economic conditions. e) Political Stability is an index with higher scores representing higher political stability and better conditions. f) I(0) denotes the integration of order zero (level stationary).

TABLE3: The GMM Estimates (First-Stage) For Parameters Of The Insolvency Risk (The Z-Risk Index) For East Asian Banks, 2000-2010

Coefficient	Parameters	Estimated value[d]	Standard error
Insolvency risk (-1)[a]	$\hat{\delta}$	0.219***	0.005
Systematic market risk	$\hat{\beta}_{11}$	-12.363***	1.322
Systematic interest rate risk	$\hat{\beta}_{12}$	-0.005***	0.001
Systematic exchange rate risk	$\hat{\beta}_{13}$	-0.066***	0.027
Unsystematic risk	$\hat{\beta}_{14}$	-0.120***	0.018
Hansen -p value[b]		0.3	
AR1 -p value[c]		0	
AR2 -p value[c]		0.4	

Note: a)(-1) represents the lagged value of the insolvency risk. b)Hansen test of over-identifying restrictions provides information for the overall validity of Instrumental Variables (IV). c) AR1and AR2 –p values show whether first-order and second-order correlations in differences are significant. d)*** Significant at the 1% level.

TABLE4: the GMM estimates (second-stage) for parameters of the insolvency risk (the Z-risk index) for East Asian banks, 2000-2010

Coefficient	Parameters	Model 1[h]	Model 2	Standard error
Insolvency risk[a] (-1)	$\hat{\delta}$	0.559***	0.587***	0.015[i]/0.017[j]
Efficiency[b] (-1)	$\hat{\beta}_{11}$	-7.303***	-9.451***	2.353[i] /2.484[j]
Efficiency (-2)	$\hat{\beta}_{12}$	-9.748***	-9.743***	1.935[i] /1.965[j]
EWS[c]	$\hat{\beta}_{21}$	-7.806***	-2.792*	1.296[i] /1.678[j]
Economic Performance[d]	$\hat{\beta}_{13}$	1.987***		0.197[i]
Inflation	$\hat{\beta}_{14}$	-0.760***	-1.120***	0.059[i] /0.068[j]
Money growth	$\hat{\beta}_{15}$		0.002	0.025[j]
GDP growth	$\hat{\beta}_{16}$		0.101***	0.024[j]
Political Stability[e]	$\hat{\beta}_{17}$	0.419***	0.380***	0.117[i] /0.150[j]
Hansen test –p value[f]		0.3	0.3	
AR1 -p value[g]		0	0	
AR2 -p value[g]		1	0.8	

Note: a) The insolvency risk is measured by the Z-risk index that a lower value shows higher insolvency risks. b) Efficiency explanatory variable is measured by SFA that a higher value of estimated efficiency score represents lower efficiency. c) EWS is an explanatory endogenous variable, representing the probability of systemic banking crises. d) Economic Performance is an index with higher scores representing better economic conditions. e) Political Stability is an index with higher scores representing less corruption, more stable governments, better political and regulatory environments. f) Hansen test of over-identifying restrictions provides information for the overall validity of the Instrumental Variables (IV). g) AR1and AR2 –p values show whether first-order and second-order correlations in differences are significant. h) * and *** Significant at the 10% and 1% level. i) The standard errors of the model without Money growth and GDP growth. j) The standard errors of the model with Money growth and GDP growth.