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LENDING STRUCTURE AND INSOLVENCY RISK OF MALAYSIAN BANKS: A SENSITIVITY ANALYSIS

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ABSTRACT

This study provides empirical evidence for the theory of bank's insolvency risk using four lending structure models as in Aisyah et al. (2009). Revisiting similar issue, we conduct a sensitivity analysis to explore whether the previous findings are susceptible towards different time frame and the inclusion of macroeconomic and profitability variables. Consistent to previous findings, we find that insolvency risk is driven by real estate lending and lending concentration even though the magnitudes of the relationship change insignificantly. Surprisingly, the stability of lending structure in the short run shows a contradicting sign of direction. By controlling the macroeconomic and profitability variables, we find that a stable lending structure in the short-run helps to lessen the insolvency risk exposure because as banks maintain their lending portfolio within a one-year period; they can better monitor and manage risk, especially when they are at a transitions of the economic cycle and financial landscape. In summary, real estate and concentrated lending increases bank's insolvency risk, but the impact could be softened by a stable lending structure in the short-run. Our results support the interpretation that the increasing property prices can jeopardize the banking institutions in Malaysia. Thus, the authorities should take immediate action to impede the current amplifying real estate price bubbles while at the same time reinforce the risk management framework for the banking sector concerning real estate lending.

Keywords: Insolvency Risk, Commercial Banks, Lending Structure

1. INTRODUCTION

The global financial crisis has triggered the bank to put more emphasis on the insolvency risk. As lending expansion may expose the bank to credit risk, which shortly increases the insolvency risk, the debatable issue now is not the lending growth per se, but how the composition of the lending is being distributed. Hanson et al. (2008) find that if lending portfolio is allocated to different sectors, credit risk can be trimmed down by altering the weights of the composition. In addition, Blasko and Sinkey Jr. (2006) prove that the U.S banks' interest rate risk exposure is being significantly influenced by lending to real estate sector. Simultaneously, lending structure does not only affects risk but also banks' efficiency and capitalization (Rossi et al.

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(2009)). Against this background, studying bank-lending portfolio from various aspects is critical, be it in terms of risk, efficiency or capitalization. Narrowing down to risk perspective, Aisyah et al. (2009) and Aisyah et al. (2010) show that lending structure significantly influences the bank insolvency risk exposure, with a contradicting relationships for the case of Islamic and conventional banks in Malaysia. Nonetheless, their study only captures the bank-specific variables in exploring the issue, exclusive of the effects of the macroeconomic variables. Considering that Marcucci and Quagliariello (2009) conclude that different level of portfolio riskiness has different effect over different phases of the economic cycles, this study revisits the similar issue by incorporating the macroeconomic indicators. Following Aisyah et al. (2009) and Aisyah et al. (2010), the lending structure models employed in this study are 1) the real estate lending, 2) specialization index, 3) short-term lending portfolio stability, and 4) medium-term lending portfolio stability.

The remainder of this paper is organized as follows: section 2 outlines the literature review on bank risk determinants. Section 3 highlights the research design, section 4 discusses the findings, and finally section 5 concludes.

2. REVIEW OF LITERATURE

While there is a numerous amount of literature on bank risks, studies on bank insolvency risk is still small but growing. Some studies investigate the determinants of various types of risk (Madura et al. (1994), Ahmad and Ahmad (2004a), and Ahmad and Ariff (2004b)), while the others observe a specific issue on a specific type of risk (Saunders et al. (1990), Anderson and Fraser (2000), Konishi and Yasuda (2004), Hassan (1993), Cebeyonan and Strahan (2004), Gallo et al. (1996), Brewer et al (1996), Gonzales (2004), Marco and Fernandez (2008), Lepetit et al. (2008), Laeven and Levine (2009), Angkinand and Wihlborg (2009) and Dinger (2009)). As there is no established theory, this study adopts previous literature on various types of risk in revisiting the influence of lending structure on banks' insolvency risk in a different economic cycle and financial landscape (i.e. bank-lending and financial market condition).

Comparing the determinants of implied risk between the deposit-taking institutions and commercial banks in the U.S., Madura et al. (1994) show that lending to real estate sector, real estate owned, non-interest income and capital buffer are the significant drivers to risk for the deposit-taking institutions. While the significant effects of real estate lending and non-interest income diminishes, the influence of real estate owned and capital buffer holds for the case of commercial banks. This implies the different role and risk-taking behavior between the depository-institutions and commercial banks. For the case of Malaysia, Ahmad and Ariff (2004b) explore the risk behavior of the deposit-taking institutions, but instead of looking at the implied risk, they focus on four types of risk using the single-factor Capital Asset Pricing Model (CAPM).[1] They document that different types of risk are driven by diverse factors. For market risk, the significant factors are loan quality, cost of fund, loan expansion and loan to real estate sector. With respect to unsystematic risk, the first two variables hold together

[1] Deposit-taking institutions in Malaysia comprises the commercial banks, merchant banks, and finance companies

with the short-term interest rate. For total risk, the first three variables for market risk remain significant plus the short-term interest rate. Finally, regulatory capital is the only significant determinant for equity risk. In summary, the different determinants of the depository-institutions between Madura et al. (1994) and Ahmad and Ariff (2004b) can be due to the differences in terms of risk measures, time frame, financial structure or the proxy adopted for the influential factors. Even if the underlying justifications for the factors are similar, the specification is not standard. Appendix A and B offer a bird eye view of the Malaysian financial system and the specification for risk and bank-specific variables, respectively.

While research on risk determinants provides inconclusive evidence, studies on specific issues adopt different bank-specific indicators as control variables. Studying how ownership structure affects U.S. banks' risk exposure, Saunders et al. (1990) incorporate equity capital, fixed asset, and size as control variables. In another study, Anderson and Fraser (2000) apply a slightly different specification for the equity capital. As oppose to Saunders et al. (1990) who employ the ratio of total equity to total asset (TE/TA), they introduce, '*frequency*', which is the ratio of an average daily share volume traded to number of shares outstanding as an alternative proxy for capital buffer.[2] While the aforementioned studies analyze for the case of the U.S., Konishi and Yasuda (2004) examine the same issue but for the case of Japan. Other than size, they also incorporate three microeconomic variables (hereafter, MIV) related to capital. Besides (TE/TA) and '*frequency*', they add a dummy variable that caters for capital constraint. For the case of Spanish banks, Marco and Fernandez (2008) employ three MIV (size, profitability and types of business). While Saunders at al. (1990), Anderson and Fraser (2000), Konishi and Yasuda (2004), and Marco and Fernandez (2008) study a single country, Laeven and Levine (2009) and Angkinand and Wihlborg (2009) examine the same issue across countries. Research on ownership structure across countries includes both MIV and macroeconomic variables (hereafter, MAV) as control variables.[3] The MAV are per capita income, rights, capital requirements, capital stringency, restrict, deposit insurance, enforcement of contracts, merger and acquisition, and GDP volatility. The MIV employed are size, credit quality, capital buffer, and liquidity ratio.

Studies on off-balance sheet (OBS, here after) activities and bank risk-taking behavior show different significant determinants. Focusing on loan sales and market risk, Hassan (1993) tests variables related to credit, interest rate, and business activities.[4] The credit-related variables comprise loan specialization, loan expansion, and loan default; while the interest rate-related variable is the ratio of absolute GAP to total asset.[5] For the business-related variables, he examines the impact of size and dividend payout ratio. In another study on loan sales, but

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[2] This is due to the fact that *frequency* denotes the speed of which new info is captured in stock price and correlated to variances in bank balance sheet and off-balance sheet portfolio.

[3] Even though most single country research do not include MAV, Drehmann et al. (2010) show that MAV have significant impacts on bank risk exposures via simulation of their hypothetical bank, suggesting that the inclusion of MAV also important for a single country research.

[4] Five market risk measures in Hassan (1993) are 1) systematic risk based on single-CAPM, 2) unsystematic risk based on error term of single-CAPM, 3) default risk premium of subordinated debt, 4) implied asset risk based on Ronn-Verma Option prcing model, and 5) implied asset risk based on Gorton-Santomero debt pricing model.

[5] GAP is RSA-RSL. RSA is rate sensitive asset and RSL is rate sensitive liability.

looking at insolvency risk (from income volatility perspective) and credit risk exposure, Cebenoyan and Strahan (2004) include MIV related to capital, liquidity, and credit. While a standard specification applies for capital and credit-related variables, the liquidity related variable is proxied by short-term investment. Still under the umbrella of OBS activities and bank risk-taking behavior, Yong et al. (2009) focus on derivative instruments with a special attention on interest rate and exchange rate risk exposure for the case of Asia Pacific banks. They employ seven MIV that reflects business, capital, liquidity, interest rate, and credit-related variables.[6] To summarize, studies on off-balance sheet activities shows that credit, interest rate, liquidity, capital, and business-related variables are the significant risk determinants, regardless of the types of risk exposures.

Looking at the effect of income structure of the European banks on various types of risk, Lepetit et al. (2008) employ five MIV that reflect business, credit, and capital-related variables.[7] As they adopt the standard measures for capital and credit-related variables, they build a thorough exploration on the business-related variables, namely size, profitability indicators and business differences (in terms of liability and cost structure). Studying five accounting ratios associated to insolvency risk (standard deviation of ROA, standard deviation of ROE, Zrisk index, and Z-score) and credit risk exposure (loan loss provisions to total loans) and five market measures (three risks based on single-factor CAPM and two insolvency risk based on market data), they find that increasing income from non-lending activities (non-interest income, fee income and trading income) could increase all types of risk exposures. For the MIV, they conclude that size is positively related to market, but inversely related insolvency and credit risk exposures. While business differences and credit-related variables are not significant for all risk measures, capital buffer produce mix results. A closure investigation on profitability shows inconclusive findings; it is negatively related to accounting data-insolvency risk, but positively related to market data-insolvency risk.

With respect to the inclusion of MAV, it goes without saying that studies across countries adopt MAV as control variables (Angkinand and Wihlborg (2009), Dinger (2009), Agoraki et al. (2009), Krainer (2009) and Laeven and Levine (2009)). Nevertheless, recent studies on a single country also adopt some MAV as control variables (Liao et al. (2009) and Saha et al. (2009) who research on the U.S and Indian economy, respectively. This study follows the latest research in revisiting the issue of lending structure and insolvency risk exposure by conducting a sensitivity analysis for MAV and compare whether the findings that do not capture the influence of MAV remain consistent.[8]

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6 Business variables: size and non-interest income/TA; capital variable: TE/TA, Liquidity variable: liquid asset/TA; credit variable: PLL/TA and total loan/TA; Interest variable: net interest income/TA

7 Business variables: 1) size, 2) profitability differences (ROA and ROE), 3) business differences (deposit to total asset) and 4) personnel expenses to total assets. Credit variable is total loan to total asset, and capital variable is total equity to total asset.

8 A bank's insolvency risk exposure may be influenced by the Gross Domestic Product and inflation for MAV (Aisyah and Shahida (2010) and the volume of loan loss provision to total asset, the volume of non-interest income to total asset and the volume of earning asset to total asset for the MIV (Aisyah et al. (2009).However, in all regression specifications those variables turn out to be insignificant. Therefore, we report the results from the regressions omitting those variables.

3. RESEARCH DESIGN

The unbalanced panel regression random effect model is estimated using the generalized least squares (GLS) technique. Twenty-three commercial banks' annual reports are collected for year 2000-2009. Year 2000 is chosen as the starting date because prior to that the Malaysian commercial banks have gone through several steps of mergers and acquisitions. Our regression model is as follows:

$$z_{it} = \alpha_i + \beta LS_{it} + \gamma x_{it} + \delta y_{it} + \varepsilon_{it}$$

Where Z is a measure of insolvency risk of banks, LS is a measure of lending structure, X is a vector of MIV, Y is a vector of MAV, α_i is an individual-specific intercept, and β, γ and δ are slope coefficients to be estimated.

Following Aisyah et al. (2009) and Aisyah et al. (2010), the insolvency risk is measured by the Zrisk index and the four lending structure variables are: real estate lending (BPS), specialization index (SPEC), short-term lending structure stability index (LCC) and medium-term lending structure stability index (VART). The detail specification for this is discussed in Appendix C.[9]

A number of MIV and MAV are employed as control variables to improve the fit of our model. In compliment to Aisyah et al. (2009), we include the significant MIV plus additional profitability indicator as there are studies showing the significant influence of profitability, though the justification are double sided. While some argue that higher return is associated to higher risk, the others rationalize that a high profit bank is less likely to become insolvent. The list of MIV is as follows: ratio of total equity to total asset (TE), logarithm of total asset (LTA), ratio of non-interest income to total asset (NONII), and ratio of return on asset (ROA), representing the capital buffer, size, deviation from traditional banking activity, and profitability, respectively. The use of profitability indicator measured by ROA follows Marco and Fernandez (2008), Ramlall (2009); Kosmidou (2008); Sufian & Habibullah, (2009); Sayilgan & Yildirim (2009). For the MAV, three variables are adopted, namely, yield of 10 year-Malaysian government securities minus 3 month treasury bills (SPRD), broad money (M3), Kuala Lumpur Composite index (KLCI). SPRD, M3, and KLCI represent the business cycle, bank lending condition, and the stock market condition, respectively. These variables have been used by Bangia et al. (2002), Kavvathas (2001), Nickell et al. (2000), Blank et al. (2009) Mannasoo & Mayes (2009), Koopman et al. (2009), Patro et al. (2000), Baele et al. (2007), Dinger (2009), Uhde & Heimeshoff (2009), Delis & Kouretas (2010), Demirgüç-Kunt & Huizinga (2010), Hadad et al. (forthcoming), Houston et al. (2010), and Demirgüç-Kunt & Detragiache (forthcoming).[10]

9 The lending structure variables are adopted with modification from Amin Gutierrez de Pineres & Ferrantino (1997;1999) and Ibrahim and Amin (2004).

10 Bangia et al. (2002), Kavvathas (2001), Nickell et al. (2000),Blank et al. (2009) Mannasoo & Mayes (2009), andKoopman et al. (2009) study the impact of economic activities on bank credit cycles, which indirectly affects the bank insolvency risk exposure.

For the case of lending structure, the empirical studies show mixed results. Madura et al. (1994), Cebeyonan and Strahan (2004), and Blasko and Sinkey Jr. (2006) show that real estate lending increases various types of risks; namely the implied risk, credit risk, income risk and insolvency risk. For the Malaysian context, Aisyah et al. (2009) find that real estate lending increases the insolvency risk, but Ahmad and Ariff (2004b) discover that real estate lending reduces the market risk exposure while there is no significant impact on equity risk, unsystematic risk and total risk exposure. For the diversification effect, Hassan (1993) shows that loan portfolio diversification reduces the U.S. banks' systematic risk as well as total risk, but Aisyah et al. (2009) fail to show significant effect of diversification for the Malaysian context. For the lending stability variable, Aisyah et al. (2009) show that increasing lending stability in the short-run increases the bank's insolvency risk, but not for the lending stability in the medium-term period. All of the aforementioned studies ignore the effects of country–specific variables, but some argue that macroeconomic variables may alter the findings (Koopman et al. (2009), Blank et al. (2009) and Mannasoo & Mayes (2009)). Hence, this study reconfirms and complements the earlier findings by conducting a sensitivity analysis of some relevant macroeconomic variables.

For the case of financial leverage, total equity is perceived to provide buffer against loss. Hence, we believe an inverse relationship exists between financial leverage and risk. With respect to size, majority authors argue that the greater the size, the greater will be the potential to diversify business risk from various perspectives. For instance, Saunders et al. (1990) mention that the larger the bank, the more information is likely to be gathered, thus reducing information risk. They also mention that regulators are unwilling to let big banks fail; making big banks is synonymous with low risk. In a similar vein, Hassan (1993) justifies that banks with larger assets are more able to diversify; but instead of looking at information risk, he focuses on operating risk that is associated with product or market lines. He believes that larger banks are more able to utilize personnel skill, particularly when engaging in off-balance sheet activities. From a different point of view, Anderson and Fraser (2000) believe that bigger banks are more flexible to adjust unexpected liquidity and capital shortfall. Thus if lending structure is the same but differ only in term of asset size, bigger banks should have lower risk as compared to smaller banks, conjecturing an inverse relationship. However, if lending structure is different, the big banks' overall risk might be higher than the smaller ones. According to them, this is due to the fact that big banks have a tendency to hold riskier loan or to embark in off-balance sheet activities, thus leading to a higher overall risk. Similarly, Gonzales (2004) points out that with the existence of the economy of scale, increase market power, and the 'too big to fail' policy for big banks, big banks tend to enter into risky activities, suggesting a positive relationship between size and risk. Against this background, size can be seen as a double-edged blade; larger banks may be superior at diversification, but bigger banks also denote the concern of the managers' capability to handle more complex and less focused operation. Taken together, it is expected that size can be either positive or negatively related to insolvency risk exposure.

For the case of non-interest income, many believe that one way to reduce the banking business risk is by diversifying from its intermediation role. The degree of banks' involvement in non-traditional activities can be measured by non-interest income as it incorporates income from fee-based transaction, investment in financial assets, and income other than lending facilities.

Previous research points out that the higher the non-interest income, the more diversified the bank is, the lesser the business risk, implying an inverse relationship between non-interest income and insolvency risk. For the case of profitability, it may be a two-sided coin; profit-maximizing policies would go with higher levels of risk, but higher profit would also associated to a sound banking system, suggesting a lower insolvency risk (Marco and Fernandez (2008)).

For the macroeconomic variables, we distinguish three blocks of macroeconomic variables that represent economic cycle, bank-lending condition, and financial market condition.[11] According to Koopman et al. (2009), Bangia et al. (2002), Kavvathas (2001), and Nickell et al. (2000), SPRD can forecast the default rate variation over stages of the business cycle. As a signal of current economic condition, SPRD is expected to be inversely related to insolvency risk exposure. For the bank-lending condition, we adopt money supply (M3). According to Koopman et al. (2009), Blank et al. (2009) and Mannasoo & Mayes (2009), aggregate money supply can either directly or indirectly affect monetary policy and private demand for credit. They hypothesize that lower money supply reduces credit supply by banks, and leads to higher default intensities. Hence, we expect M3 to be negatively related to insolvency risk. For the financial market condition, Koopman et al. (2009) opine that stock market return is a good predictor for output growth, thus, we expect KLCI is negatively related to insolvency risk exposure.

4. DISCUSSION OF FINDINGS

The descriptive statistics that reports the mean, median, standard deviation, sknewness, kurtosis, and Jarque-bera of the variables is shown in Table 1. The value of mean ≠ median, sknewness ≠ 0, kurtosis ≠ 3 and all variables have significant Jarque-bera values, indicating the data is not normally distributed; thus, Generalized Least Square (GLS) estimation is more appropriate than Ordinary Least square (OLS) estimation.

Table 2 presents the correlation matrix. Since all variables have correlation values less than 0.8, including all independent variables simultaneously may not cause a serious multicollinerity problem.[12] However, for robustness check we conduct sensitivity analysis by testing lending structure models with MIV (column 2), lending structure models with MIV and money supply (column 3), lending structure models with MIV and stock market (column 4), lending structure models with MIV and interest rate spread (column 5), and finally lending structure models with MIV and all MAV.

[11] Our three blocks of MAV follows the work of Koopman et al. (2009).
[12] Gujarati (2003) sets a maximum cut of point of 0.8 for severely correlated variables.

Table 1: Descriptive Statistics

Variables	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Obs
BPS	0.337477	0.360584	0.16442	-0.07955	2.648651	1.258261***	203
LCC	0.857105	0.912575	0.150397	-2.61988	11.7748	883.4913***	203
SPEC	0.289047	0.263656	0.116711	2.581637	11.51187	838.3169***	203
VART	0.044061	0.032502	0.032467	1.174555	3.8418	52.66956***	203
TE	0.125083	0.089264	0.120158	4.776818	35.98612	9975.388***	203
LTA	7.07679	7.270324	0.655622	-0.34822	2.136114	10.41496***	203
ROA	0.014869	0.011177	0.047944	11.34417	148.55	183542.1***	203
NONII	0.013166	0.009495	0.020554	10.2464	129.1349	138124.3***	203
SPRD	1.091395	0.81	0.652578	0.52479	2.172212	15.11377***	203
M3G	0.085242	0.082526	0.036931	0.312516	3.444623	4.97649***	203
KLCIG	3.063433	2.82	0.885917	2.317628	9.357752	523.6266***	203
ZRISK	14.52995	14.82943	9.574145	0.572538	3.600128	14.13685***	203

Notes: 1. All variables except GDP have significant Jarque-Bera value.
2. *** denotes 1% significant level of confidence.

Table 2: The Results of Correlation Matrix

	ZRISK	BPS	LCC	SPEC	VART	TE	LTA	ROA	NONII	SPRD	M3G	KLCIG
ZRISK	1											
BPS	-0.08019	1										
LCC	0.137517	0.304354	1									
SPEC	-0.16979	-0.03575	-0.42718	1								
VART	0.068014	-0.49925	-0.24676	0.321041	1							
TE	0.389104	-0.43755	-0.13739	0.185145	0.495857	1						
LTA	-0.06456	0.621129	0.263349	-0.20322	-0.62771	-0.62387	1					
ROA	-0.02544	-0.05784	-0.08847	0.008054	-0.01819	0.131855	-0.02649	1				
NONII	0.11383	-0.13404	-0.10049	0.033167	0.218142	0.594847	-0.23776	0.248953	1			
SPRD	0.054404	-0.03475	0.065753	-0.2813	0.040064	-0.036	-0.09512	-0.10836	-0.00763	1		
M3G	-0.07541	0.039118	-0.01416	0.264876	0.044554	0.021535	0.13237	0.038846	-0.09622	-0.16356	1	
KLCIG	-0.14007	-0.03221	-0.19048	0.212853	-0.22984	-0.07253	0.114036	0.082081	-0.01001	-0.49837	-0.01475	1

Notes: 1. Correlation Matrix is based on common sample.
2. Number of observation is 203 for each variable.

Table 3 (a) to 3(d) report the results of random effect panel regression analysis for real estate lending, specialization index, short-term lending structure stability, and medium-term lending structure stability, respectively. As the Zrisk index is a safety index and lower value means "lower safety" or higher insolvency risk exposure; the intuition on the insolvency risk exposure is opposite to the coefficient signs in Table 3(a) to 3(d).

Table 3(a): Model 1 (Real Estate Lending - Sensitivity Analysis)

MIV	MIV	MIV & M3	MIV & KLCI	MIV & SPRD	MIV & MAV
C	12.56094	7.474402	7.456064	8.319805	-9.241
	(1.232152)	(0.696184)	(0.652092)	(0.724441)	(-0.81993)
BPS	-4.474**	-4.37443**	-6.22803***	-4.0903**	-5.57385***
	(-2.26744)	(-2.29372)	(-4.965)	(-2.29562)	(-3.96596)
TE	68.15385***	69.10389***	68.55899***	68.79801***	70.7013***
	(10.76079)	(11.18884)	(10.74134)	(10.74967)	(11.99263)
LTA	-0.55196	0.333589	0.933974	-0.11617	3.253208**
	(-0.37576)	(0.205545)	(0.656751)	(-0.07221)	(2.151182)
ROA	8.682686*	9.060118*	9.665741**	9.850687**	10.44746**
	(1.665637)	(1.766421)	(1.996914)	(2.070703)	(2.171122)
NONII	-148.818***	-149.486***	-146.794***	-148.322***	-145.331***
	(-5.00272)	(-5.27804)	(-4.89821)	(-4.98148)	(-5.37049)
M3		-16.0607**			-22.3227***
		(-2.09177)			(-2.88442)
KLCI			-1.70217*		-1.39287**
			(-1.79701)		(-2.19701)
SPRD				0.864788*	0.749404**
				(1.737678)	(2.396341)
R-squared	0.768325	0.77383	0.786008	0.774167	0.798575
Adjusted R-squared	0.76306	0.767633	0.779491	0.76798	0.790312
S.E. of regression	3.846949	3.806701	3.787157	3.804825	3.687717
F-statistic	145.9213	124.883	120.5995	125.1237	96.63784
Prob(F-statistic)	0	0	0	0	0

Table 3(b): Model 2 (Specialization Index - Sensitivity Analysis)

MIV	MIV	MIV & M3	MIV & KLCI	MIV & SPRD	MIV & MAV
C	9.199928	5.130536	4.764227	5.610452	-10.4794
	(0.956048)	(0.513428)	(0.456685)	(0.541897)	(-1.03558)
SPEC	-3.67449***	-3.05791***	-3.84897***	-3.01491***	-1.26308
	(-3.81706)	(-5.633)	(-5.71847)	(-4.64403)	(-1.42381)
TE	68.46542***	69.15344***	68.55186***	68.96198***	70.30443***
	(11.30813)	(11.86491)	(11.41487)	(11.38751)	(13.08752)
LTA	-0.1393	0.559954	1.029747	0.202055	3.08889**
	(-0.09819)	(0.372722)	(0.764301)	(0.137483)	(2.22005)
ROA	8.895879*	9.263278*	9.795924**	10.01426**	10.75651**
	(1.782121)	(1.876378)	(2.072227)	(2.206924)	(2.276746
NONII	-148.539***	-148.944***	-145.761***	-147.94***	-144.51***
	(-5.25453)	(-5.44948)	(-5.06258)	(-5.16851)	(-5.3536)
M3		-14.0678**			-21.4668**
		(-2.20109)			(-2.50371)
KLCI			-1.34811		-1.15535*
			(-1.58598)		(-1.8778)
SPRD				0.822929*	0.863514***
				(1.746808)	(2.850131)
R-squared	0.768862	0.772348	0.782318	0.77342	0.79231
Adjusted R-squared	0.763609	0.766111	0.775688	0.767213	0.783789
S.E. of regression	3.841499	3.819465	3.820088	3.811006	3.746818
F-statistic	146.3624	123.8324	117.9985	124.5913	92.98743
Prob(F-statistic)	0	0	0	0	0

Table 3(c): Model 3 (Short-term Lending Structure-Sensitivity Analysis)

MIV	MIV	MIV & M3	MIV & KLCI	MIV & SPRD	MIV & MAV
C	8.524883	0.968713	6.367881	4.048102	-16.9312*
	(0.92653)	(0.124075)	(0.548996)	(0.422651)	(-1.77169)
LCC	4.996413***	5.003191***	3.547888***	4.788687***	3.336875***
	(3.763611)	(4.082479)	(2.681987)	(3.511722)	(2.70589)
TE	68.0544***	69.51938***	68.48277***	68.76015***	71.53735***
	(11.05254)	(11.70212)	(11.60302)	(11.07759)	(14.04354)
LTA	-0.7923	0.521788	0.202179	-0.28678	3.523952**
	(-0.56823)	(0.386079)	(0.128183)	(-0.20407)	(2.340558)
ROA	11.12158**	11.706**	11.43892**	12.2372**	12.41909**
	(1.995051)	(2.07468)	(2.227986)	(2.297435)	(2.365809)
NONII	-148.995***	-150.253***	-149.495***	-148.521***	-147.395***
	(-4.94391)	(-5.45704)	(-4.9571)	(-5.00739)	(-5.80498)
M3		-23.0878***			-29.8513***
		(-3.15037)			(-4.4943)
KLCI			-1.28979		-0.91722*
			(-1.5779)		(-1.69397)
SPRD				0.907445*	1.01755***
				(1.880412)	(4.457426)
R-squared	0.784761	0.793384	0.792619	0.790708	0.811437
Adjusted R-squared	0.779755	0.787591	0.786138	0.78484	0.803498
S.E. of regression	3.723171	3.653125	3.75206	3.678144	3.590385
F-statistic	156.7778	136.9561	122.3051	134.7488	102.2029
Prob(F-statistic)	0	0	0	0	0

Table 3(d): Model 4 (Medium-term Lending Structure – sensitivity Analysis)

MIV	MIV	MIV & M3	MIV & KLCI	MIV & SPRD	MIV & MAV
C	24.1831*	11.09197	25.46162**	16.86135	5.377108
	(1.78208)	(1.13371)	(1.984903)	(1.29207)	(0.530169)
VART	-7.22518	2.989056	-22.1665	-7.32507	-9.72478
	(-0.27189)	(0.106017)	(-0.85965)	(-0.32164)	(-0.35738)
TE	59.54722***	62.64147***	59.86548***	61.05595***	64.26778***
	(25.88378)	(23.01501)	(20.67022)	(17.39708)	(25.8259)
LTA	-2.20621	-0.23923	-1.63106	-1.33148	1.19992
	(-1.05406)	(-0.14628)	(-0.92196)	(-0.75478)	(0.854617)
ROA	8.867584**	9.480379**	9.770602**	9.971368**	10.91507**
	(1.967584)	(2.051721)	(2.175805)	(2.377844)	(2.334443)
NONII	-126.66***	-133.661***	-124.326***	-128.354***	-133.015***
	(-3.83346)	(-4.04427)	(-3.86501)	(-3.92096)	(-4.33501)
M3		-20.1964***			-1.51586**
		(-2.93355)			(-2.33467)
KLCI			-1.6431*		0.467004
			(-1.86093)		(1.143709)
SPRD			0.888193*		-23.2726***
			(1.666884)		(-2.944)
R-squared	0.685208	0.696589	0.699839	0.695156	0.71482
Adjusted R-squared	0.676003	0.685881	0.689245	0.684396	0.70124
S.E. of regression	3.460964	3.40266	3.384378	3.411743	3.312771
F-statistic	74.44301	65.04948	66.06033	64.61029	52.63765
Prob(F-statistic)	0	0	0	0	0

From Table 3(a), the significant inverse relationship infers that lending to real estate sector (model 1) increases the banks' insolvency risk exposure. This is because most of real estate loan are speculative in nature. It means that borrowers purchase real estate properties with the hope that the selling price is higher than the purchase price in a short-term period so that they can obtain huge capital gain. On the other hand, if the situation is reverse, they would default the loan; causing an increase in the banks' insolvency risk exposure. This finding is consistent to Aisyah et al. (2009), Blasko and Sinkey Jr. (2006), Cebeyonan and Strahan (2004), Madura et al. (1994) and Pais and Stork (2011) despite a various types of risk measures. For model 2, our specialization index (Table 3(b)) shows an inverse relationship, implying that increasing lending specialization would increase the banks' insolvency risk exposure. This finding supports our earlier evidence on the positive relationship of the real estate lending as well as the finding by Hassan (1993). For the short-term lending stability (model 3), our results indicate that increasing stability would reduce the banks' insolvency risk exposure. Surprisingly, although it contradicts to the one by Aisyah et al. (2009), it is applicable because when banks preserve their lending portfolio strategy within a one-year period; they can better manage their risk exposures as compared to keep on changing strategies. As the market players such as the regulatory bodies, market structure, and customers take time to adjust to the equilibrium, sustaining lending portfolio in the short-run seems beneficial. In addition, the GAP analysis to measure interest rate risk caters the interest rate movement in a one-year period. Perhaps the inclusion of profitability and MAV can be one of the reasons for the contradicting results. However, we strongly believe incorporating those variables would generate more precise findings rather than the MIV alone since banks' insolvency risk somehow depends on systematic risk, be it in either a direct or tortuous manner. For the case of medium-term lending portfolio stability (model 4) in Table 3(d), our findings show insignificant effect and support the ones of Aisyah et al. (2009).

For the MIV, our findings show that capital buffer (TE), profitability (ROA) and deviation of lending transaction (NONII) are significant. While TE and ROA are inversely related, NONII is positively related. Consistent to prior findings (Madura et al (1994); Brewer et al (1996); Angbazo (1997); Cebeyonan and Strahan (2004)), the higher the capital buffer, the lower will be the banks' insolvency risk exposure. For ROA, lowering interest rate with intense competition for deposits would squeeze bank profit (Steinberg, 2008). This scenario when coupled with controlled mortgage rates by the government will boost interest rate risk substantially which indirectly increase banks' insolvency risk exposure; hence resulting an inverse relationship between bank's profit and risk. For the NONII, the positive relationship implies that increasing the deviation from the traditional role of banks (lending activities) by moving towards fee-based and OBS activities increases the bank insolvency risk. Although this finding contradicts Hassan (1993) who studies for the case of U.S., it is relevant for Malaysia since most of the Malaysian commercial banks embark in interest rate and foreign exchange transactions for their OBS activities. Banking theory suggests that OBS activities can either reduce or increase risk, depending on how the banks strategize it. The purpose of OBS can be for hedging or speculative and providing bank guarantee to obligate its clients' payment in future (if he or she defaulted). In Malaysia, it shows that the second function dominates as increasing NONII increasing the banks insolvency risk exposures.

With respect to the MAV, the economic condition (SPRD), the bank-lending condition (M3), and the stock market condition (KLCI) are significant in determining the banks' insolvency risk exposure. M3 and KLCI are positively related whereas SPRD is inversely related. Consistent to Koopman et al (2009), Bangia et al. (2002), Kavvathas (2001), and Nickell et al. (2000), our finding of the inverse relationship of SPRD indicates that good economic condition reduces the banks' insolvency risk exposure. Meanwhile, the expansionary monetary policy (M3) as well as good stock market condition (KLCI) encourages the banks to engage in risky business activities; hence, increasing their insolvency risk exposure. Our finding support the earlier findings from Koopman et al. (2009), Blank et al. (2009) and Mannasoo& Mayes (2009)

5. CONCLUDING REMARKS

As our findings show that lending structure to some extent affects the banks' insolvency risk exposure, policy makers and practitioners should take note of this empirical evidence when designing the economic master plan, investment portfolio and risk management framework. For the policy makers, as real estate lending and increasing concentration on this sector increases the banks' insolvency risk exposure, the central bank of Malaysia should introduce prudent guidelines for capital adequacy standard of the banking institutions, particularly for the property sector. However, please be caution that investing heavily on the real estate sector may not the only reason of the increase in risk. Perhaps the change in banking behavior can also be triggered by the exogeneous factor such as the influence of the government. For example, if the government wishes to promote agricultural sector, several incentives such as a lower lending rate is given in that particular sector. This could encourage banks to change their lending structure by moving towards higher risk lending portfolio as a reaction to the erosion of bank profit resulted from a low return policy for the desired sector.

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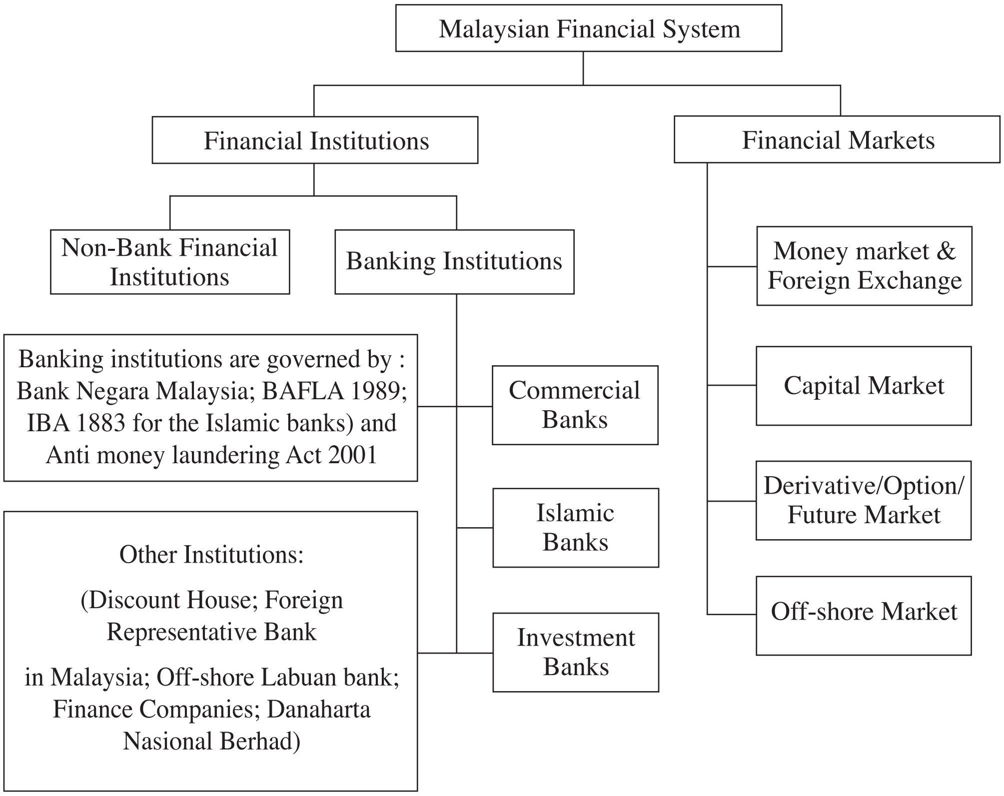
APPENDIX A


Malaysian Financial System
Financial Institutions
Financial Markets
Non-Bank Financial Institutions
Banking Institutions
Banking institutions are governed by : Bank Negara Malaysia; BAFLA 1989; IBA 1883 for the Islamic banks) and Anti money laundering Act 2001
Other Institutions:
(Discount House; Foreign Representative Bank
in Malaysia; Off-shore Labuan bank; Finance Companies; Danaharta Nasional Berhad)
Commercial Banks
Islamic Banks
Investment Banks
Money market & Foreign Exchange
Capital Market
Derivative/Option/ Future Market
Off-shore Market

APPENDIX B: MEASUREMENT OF RISK AND BANK-SPECIFIC VARIABLES

Author(s)	Risk Measures		Control Variables	
	Risk	**Specification**	**Influential factors**	**Specification**
Ahmad & Ariff (2004b) (single-factor CAPM)	➢ market risk ➢ unsystematic risk ➢ Total risk ➢ Equity risk.	➢ β of KLCI for Malaysia ➢ Standard deviation of the error term of the regression equation for single-factor CAPM ➢ Standard deviation of bank return ➢ Ratio of Book Value to Market Value of equity	➢ Loan Quality ➢ Loan Quality in lagged form ➢ Management Efficiency ➢ Financial leverage ➢ Real Estate Lending ➢ Regulatory Capital ➢ Cost of Fund ➢ Credit Risk ➢ Risk Weighted Asset ➢ Interest rate risk 1 ➢ Interest rate risk 2 ➢ Interest rate risk 3 ➢ Loan growth ➢ Size	➢ Non-performing loan/Total Loan ➢ Non-performing loan of previous year / current Total Loan ➢ Total Earning Asset/ Total Asset ➢ Tier 2 Capital/ Total Capital ➢ (lending to BPS + Purchase of securities loan + consumption credit) ➢ Tier 1 Capital / Total Loan ➢ Cost of Fund ➢ Loan Loss Provision ➢ Risk Weighted Asset ➢ KLIBOR ➢ SPREAD ➢ GAP ➢ Total Loan/ Total Deposit ➢ Log of TA
Madura et al.(1994)	➢ Bank implied risk	➢ The ex-ante risk: using average daily implied standard deviation (ISD) of the jth bank in year t. (followed Latane & Rendleman (1976) ➢ ISD = based on call option price. ➢ Disadvantage of ISD: since it is implied, it may be different to the actual risk of the firm.	Credit Risk: ➢ Loan growth ➢ Real estate lending ➢ Exposure of Less Dev Country debt /TA ➢ Real Estate owned Capital Risk: ➢ Capital buffer 1 ➢ Capital buffer 2 Interest Rate Risk: ➢ GAP analysis ➢ Interest expense Business Risk: ➢ Off-balance sheet activities	 ➢ Total Loan/Total Asset ➢ RE loan/Total Asset ➢ Exposure of Less Dev Country debt / Total Asset ➢ RE owned/Total Asset ➢ Total Equity/Total Asset ➢ Loan Loss Provision/ Total Asset ➢ Rate Sensitive Asset/ Rate sensitive Liability ➢ Interest expense/ Total Asset ➢ Non-interest income/ Total Asset
Saunders et al. (1990) (2-factor CAPM)	➢ total risk ➢ unsystematic risk 1 ➢ unsystematic risk 2 ➢ Market risk 1 ➢ Market Risk 2 ➢ Interest rate risk 1 ➢ Interest rate risk 2	➢ σs Standard deviation of bank return ➢ σes =unsys for s/t ➢ σel= unsys for l/t ➢ βms = sys for s/t ➢ βml= sys for l/t ➢ βis=sys for s/t ➢ βil= sys for l/t	➢ Ownership structure ➢ Financial Leverage ➢ Operating leverage ➢ Size	➢ proportion of stock held by managers ➢ Total Equity/Total asset ➢ Fixed Asset/ Total asset ➢ Logarithm of Total asset

Author(s)	Risk Measures		Control Variables	
	Risk	**Specification**	**Influential factors**	**Specification**
M. Kabir Hassan (1993) (single-factor CAPM)	➢ Market risk ➢ Total Risk ➢ Implied Risk 1 ➢ Implied Risk 2 ➢ Implied Risk 3	➢ β= systematic risk ➢ σ= standard deviation of equity return ➢ Default Risk Premium of subordinated debt ➢ (Ronn-Verma Option Pricing Model) ➢ Gorton-Santomero debt pricing method	➢ Off-balance sheet activities ➢ Leverage ➢ Loan Diversification ➢ Credit risk ➢ Interest rate risk ➢ Size ➢ Dividend policy	➢ Loan sales/Total Asset ➢ Total Liabilities/ Total Asset ➢ Herfindahl index ➢ Loan Loss Reserve/ Total Asset ➢ Absolute GAP analysis ➢ Logarithm of Total Asset ➢ Div Payout Ratio/ Total Asset
Gallo et al. (1996) (single-factor CAPM)	➢ Market risk ➢ Industry risk ➢ Unsystematic risk	➢ β of Wilshire 5000 Index ➢ β Wilshire finance Index ➢ Standard deviation of the error term of the regression equation	➢Loan growth ➢Liquid Asset 1 ➢Liquid asset 2 ➢ Capital Buffer ➢ Mutual fund Asset ➢ Size	➢ Total Loan/Total Asset ➢ Investment securities/TA ➢ (Sales Fed-purchased Fed)/Total Asset ➢ Total equity/Total Asset ➢ MFA/Total Asset ➢ Logarithm of Total Asset
Brewer et al. (1996)	➢ Total Risk	➢ σbkStockReturnto represent volatility of bank return	➢ Capital Buffer ➢ Real Estate Lending 1 ➢ Real Estate Lending 2	➢ Market value of Total equity/ Total Asset ➢fixed rate mortgage loan / MV of common stock ➢ Adjustable rate Mortgage/ MV of common stock
Anderson & Fraser (2000) (single-factor CAPM)	➢ total risk ➢ unsystematic risk ➢ systematic risk	➢ σs Standard deviation of bank return ➢ Standard deviation of the error term. ➢ Total –unsystematic risk	➢ Size ➢ frequency ➢ Tobin Q	➢ Logarithm of Total Asset ➢ Average daily share volume traded/number of shares outstanding ➢ Σ(CSmv+Liabilitybv/TA)
Cebeyonan & Strahan, (2004)	➢ Income volatility 1 ➢ Income volatility 2 ➢ Credit risk 1 ➢ Credit Risk 2	➢ σROE ➢ σROA ➢ σLLP./TL ➢ σnpl/TL	➢ capital buffer ➢ liquid asset ➢ Real estate lending 1 ➢ Real estate lending 2	➢ Total equity / (total asset - cash - fed funds sold -securities) ➢ cash + net fed fund + securities) / Total Asset ➢ (commercial + industrial loan) /Total Asset ➢commercial Real estate loans/Total Asset
Gonzalez (2004)	➢ Total risk ➢ credit risk	➢ σs Standard deviation of bank return ➢ NPL/TL	➢ Size ➢ Tangible asset ➢ Long term investment in subsidiaries ➢ Financial Leverag	➢ logarithm of Total Asset ➢ (net property+ plant + equipment)/ Total Asset ➢ Investment in unconsolidated subsidiaries/ Total Asset ➢ Total Debt/ Total Asset

Author(s)	**Risk Measures**		**Control Variables**	
	Risk	**Specification**	**Influential factors**	**Specification**
Konishi & Yasuda (2004)	➢ total risk ➢ unsystematic risk ➢ systematic risk ➢ market risk (β1) ➢ interest rate risk ➢ Insolvency risk	➢ σs Standard deviation of bank return ➢ Standard deviation of the error term. ➢ Total risk - unsystematic risk ➢ βof tokyo stock exchange ➢ β2 of interest rate ➢ Z-score developed by Boyd et al. (1993)	➢ Size ➢ Frequency	➢ log of Total Asset ➢ Volume of shares/ number of shares outstanding

APPENDIX C

Mnemonics	Definition
Zrisk Index	Zrisk index is developed by Hannan and Hanweck (1988).[13] According to Hannan them, insolvency occurs when current losses exhaust capital, which is expressed as follows: $Z = \frac{[E(ROA) + CAP]}{\sigma_{ROA}}$ Where *E(ROA)* is the expected return on assets, *CAP* is the ratio of equity capital to total asset, and σ_{ROA} is the standard deviation of *ROA*. *CAP* is often used as an indicator for risk in banks because high levels of capital provide protection against large decline in income. Hence, better capitalized firms will, other things equal, incur less risk of insolvency because of loan losses, lower revenues, or higher cost of funds. Thus, a lower Zrisk index implies a riskier bank while a higher Zrisk implies a safer bank
Specialization index SPEC)	$SPEC = \sum_{i=1}^{12} S^2 \text{ it}$ where, s_i is the lending share of industry *i* in total lending. A score approaching 1 suggest a high degree of concentration while a score approaching 0 indicates a high degree of diversification
Lending composition in the short run (LCC)	$LCC = \sum_{i=1}^{12} min\ (s_{\text{it}}, s_{\text{it-1}}$ wheres_{it} is the share of broad property sectors *i* in total lending in year *t*. For example, if lending shares of all 12 sectors remain exactly the same, *LCC* will have a value of 1. On the other hand, LCC equals 0 if a bank lending sector, none of which were loaned in the previous year VART is the variance of traditionality index across sector based on 5-year rolling window. More specifically, the traditionality index for the year 1995 is computed using lending data from 1993 to 1997; for 1996, using data from 1994-1998, and so on. The TI formula is as follows:
Lending composition in the medium-term period *(VART)*	$TI_{\text{it}} = \frac{\sum_{l=-2}^{l=2} C_{\text{i,t-1}}}{5}$ where $C_{\text{it}} = \frac{\sum_{i=t_o}^{t} \varepsilon_{it}}{\sum_{i=t_0}^{t1} \varepsilon_{it}}$ where t_0 and t_1 are initial and terminal periods of the data and e_{it} is lending of industry *i* in year *t*. Since VART is a variance of *TI*, a high variance indicates an episode of divergent pattern of lending during the 5 year period. Meanwhile a low variance suggests a stability of lending composition.

[13] Hannan & Hanweck (1988) develop the Zrisk index based on the work of Roy (1952) and Boyd & Graham (1986). Afterwards, the Zrisk index has been widely employed by various banking researchers such as Liang & Savage (1990), Eisenbeis & Kwast (1991), Sinkey & Nash (1993), Nash & Sinkey (1997), Blasko & Sinkey Jr. (2006), Ahmad et al. (2006), and Lepetit et al. (2008).