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Determinants of Credit Risk in Malaysian Islamic Banks

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Abstract: Credit risk is the oldest form of risk in the financial markets and has been receiving great attention mainly in the banking institutions. Credit risk continues to be the leading source of problems in banking institutions all over the world. It is the largest source of risk for banking institutions in Malaysia due to the fact that a banking institution's financing portfolio is typically the largest asset and the major source of revenue. Financing default will cause cash flow problems and affect banks' liquidity, which then reduce the banks' profitability. Therefore, credit risk mitigation and management is very crucial. It is assumed that the more rigorous risk mitigation and management attached in banks' management, the lower the credit risk, hence the higher profit received by banks. The aim of this study is to examine determinants of credit risk in Malaysian Islamic banks. The study makes use of panel least squares and generalised least squares regression methods based on an unbalanced panel data of 96 observations from 15 Islamic banks for the period of 1999 to 2007. Twelve variables representing internal determinants are tested empirically using panel data estimation. This study reveals that financing extended to risky sectors, ratio of debt over asset, leverage, financing and bank size determine credit risk significantly in Malaysian Islamic banks. Possible implications are addressed based on the findings to enhance risk management culture in Islamic banking institutions.

Keywords : Capital adequacy regulation, credit risk; Islamic banking, risk management
JEL classification : E58, G18, G21, G28

1. Introduction

Credit risk is the oldest form of risk in the financial markets. Though the banks have been exposed to new additional risks due to dramatic changes in the banking industry in the last three decades, mitigating and managing credit risk has received great attention by the banks' management as the banks' ability to minimise credit risk influences their profitability. This is because financing is the principal business activity for most commercial banks. The financing portfolio is typically recognised as the largest asset class and a major source of

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revenue. However, financing activities are also seen as the largest and main source of credit risk. During an economic boom, banks tend to increase and expand their financing activities in order to increase market share. Banks may relax credit standards during good times and are prepared to be more lenient in collateral requirements. However, in the case of borrowers delaying their payment, a high accumulation of unpaid financing implies that these financing losses will result in lower returns to banks and as well as a high probability of losing money (default risk). Indeed, financing portfolio problems have historically been the major cause of bank losses and failures, whether due to lax credit standards, poor portfolio risk management, or weakness in the economy.

Recently, the world witnessed the collapse of giant global financial services' firms such as Lehman Brothers, Goldman Sachs, JP Morgan, Citibank and Bank of America following the economic recession in the US, which consequently affected countries all over the world. Credit crisis is one of the main reasons behind the collapse of these firms, and mostly attributed to subprime mortgage. Interestingly after these global firms proclaimed their bankrupt status to the public, attention has been focused on Islamic banking and finance as an alternative financial solution as it was reported that Islamic banks which operate according to *shariah* laws have been least affected by the global economic crisis. Indeed, Malaysia and most ASEAN countries have already learnt how risk formation seriously affects banks' viability, as was evident from the financial crisis that erupted in Asia in mid-1997. Financial industry experts in ASEAN countries admit that they gained much knowledge in dealing with insolvency resolution as a result of the crisis. As a result, during weak economic growth, banks are unwilling or unable to provide high funding in the sense that many borrowers are unable to repay financing, and fund providers (banks) have to make substantial provisions and write-offs.

By operating side by side with conventional banks, Islamic banks are not spared and are equally vulnerable to risks. Risk management in Islamic banks poses tough challenges today because of their unique characteristics arising from the composition of their assets and liabilities, and their obligations to meet the *shariah* principles under which they operate. Islamic banks are not only exposed to credit risk; both market risk and credit risk are strongly bundled together at different stages of the contract. Uniquely, credit risk and market risk are risks that cannot be eliminated or transferred, but must be absorbed by the banks due to the complexity of the risk and difficulty of separating it from an asset. Indeed, banks are increasingly facing credit risk in various financial instruments other than financing, including acceptance, interbank transactions, trade financing, foreign exchange transactions, financial futures, swaps, bonds, equities, options, and in extension of commitments and guarantees, and the settlement of transactions. Hence, it is crucial for the banks' management to manage risk in a suitable manner.

Credit risk in the area of Islamic banks has not been widely studied compared to conventional banks. Given the unique nature of Islamic banking and rapid changes in the global financial landscape which pose additional new risks to the banks, there is a need to identify empirically, key factors influencing risk formation in Islamic banks. Hence, this study attempts to prove empirically that Islamic banks are not spared but are equally vulnerable to such risks. The aim of this study is to identify the underlying internal determinants of credit risk in Malaysian Islamic banks. The results are important to ensure

necessary precautions and preventions are taken so that better returns to shareholders can be achieved and/or retained.

This paper is organised as follows. The next section of the paper provides an overview of credit risk in Islamic banks and hypothetical balance sheet features of Islamic banks. Section 3 contains the theoretical framework of credit risk. Section 4 explains the empirical model and variables used in the study. Section 5 presents the results of the research and the final section presents the conclusion and recommendation of the study.

2. Overview of Credit Risk in Islamic Banks

Risks unique to Islamic banks arise from the different nature of the intermediation, products and constitution of the balance sheet, and also their obligation to meet *shariah* principles. A different nature of intermediation has two major implications that distinguish Islamic financial intermediaries from conventional banks: first, the relationship between the depositors and the banks are based on profit and loss sharing (PLS) principles; and second, the asset side of the banks includes risky assets (*mudharabah* and *musharakah*) that conventional banks may not carry.

Conventional banks face credit risk in almost all of their operations, because the relationship between the banks and those who transact with them is that of a debtor with a creditor in all cases. Uniquely, Islamic banks also face this form of risk in most of the modes of financing that they use. Islamic modes of financing such as *murabahah, istisna,* and instalment sale are sales with delayed payment thus generating debts in the accounts of the banks. The fundamental form of risk in all these contracts is credit risk.

Credit risk management for Islamic banks is more complicated compared to conventional banks. In the case of default by the counterparty, Islamic banks are prohibited from charging any accrued interest or imposing any penalty, except in the case of deliberate procrastination, that is, delay for no reason. Since they know the banks will not charge any extra payment or penalty, this can be misused by clients who may delay the payment. The banks then may face difficulties as during this period of delay, the banks' capital is not productive and investors or depositors of the banks are not earning any income. Hence, credit risk management seems to play a pivotal role in affecting banks' viability, that is, whether banks are able to remain competitive or not in the banking business over the long term.

2.1 *Hypothetical Balance Sheet Features of Islamic Banks*

Credit risk is the risk that most financial institutions deal with. This is due to the fact that credit risk covers more than 70 per cent of risks in an average bank's banking book asset portfolio. Uniquely, Islamic banks possess more challenges since market risk and credit risk are strongly bundled together in the banking book compared to traditional banks. In traditional banks, market risk is mostly in the trading book, while in Islamic banks, market risk is concentrated in the banking book due to *murabahah, ijarah, salam, musharakah* and *mudharabah* modes of financing in the banking book asset portfolio. Thus, for financing that involves assets such as *murabahah, salam, istisna* and *ijarah,* the risks of financing may transform from credit to market and vice versa at different stages of the contract. Thus, it is important for any bank to pay serious attention to identify, measure, monitor and control credit risk as well as to ensure that they hold adequate capital against these risks.

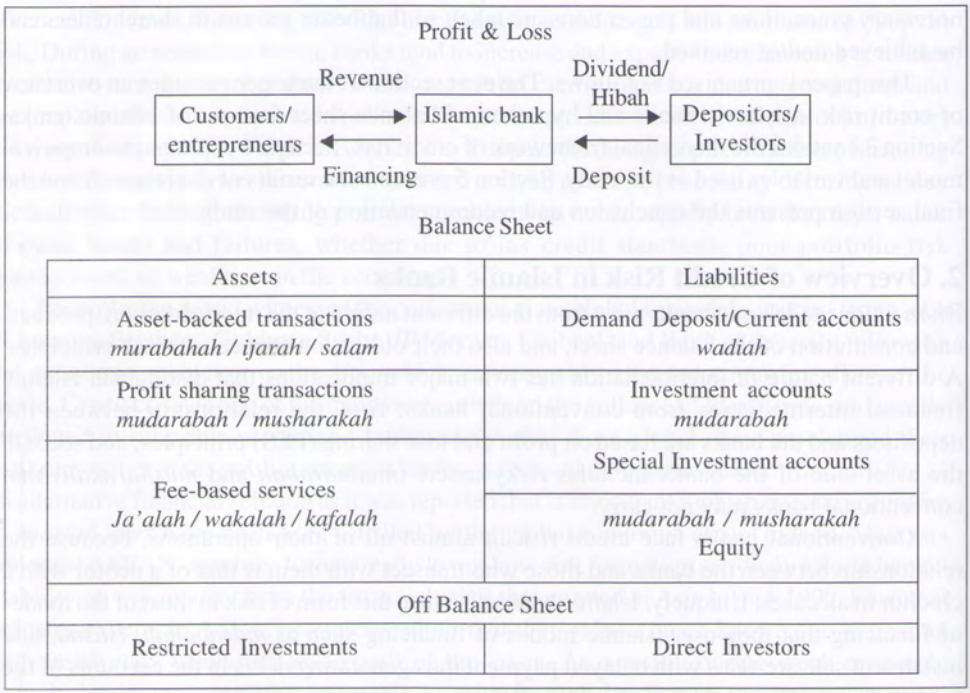

Figure 1. Hypothetical balance sheet of Islamic bank

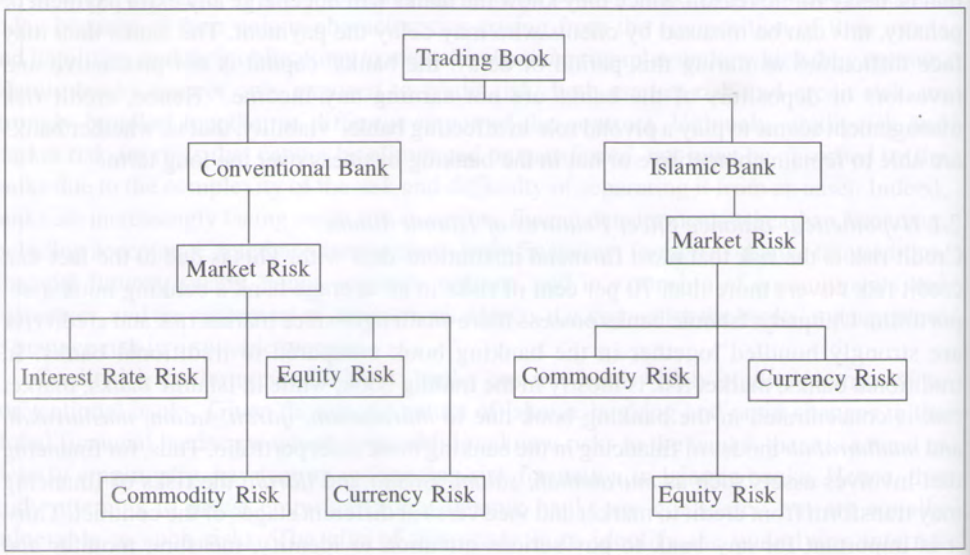

Figure 2. Trading book: Islamic vs Conventional bank

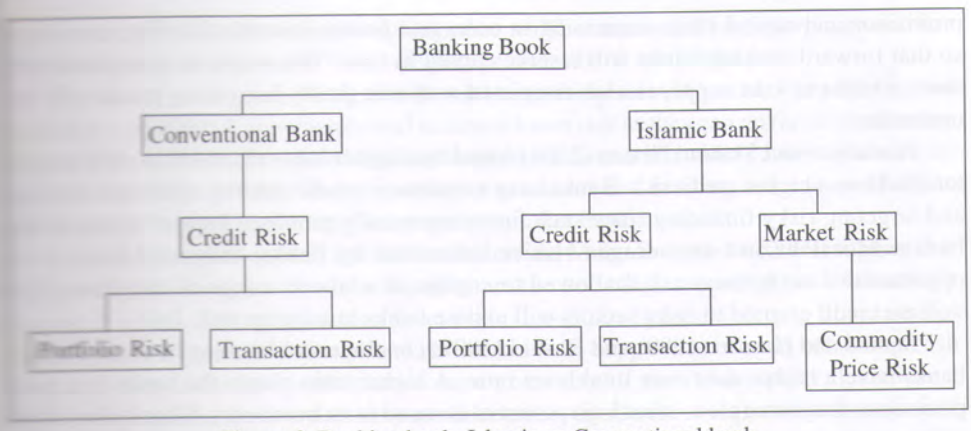

Figure 3. Banking book: Islamic vs Conventional bank

Then, they are able to sufficiently compensate for risks incurred. The hypothetical balance sheet features of Islamic banks are shown in Figure 1. Figures 2 and 3 illustrate the risk exposure of conventional and Islamic banks in relation to their trading book and banking book.

3. Theory of Bank's Credit Risk

Generally, banking institutions are considered efficient when they are able to effectively utilise their assets as well as able to manage their liabilities. Islamic banks, however, are exposed to higher risk since the assets under PLS mode are uncollaterised. This is due to the unique features of the balance sheet of an Islamic bank where the *mudharabah* and *musharakah* modes of financing are placed on the sides of both assets and liabilities, and collateral is not allowed in these modes. Since collateral is not allowed in the PLS mode as security for the banks against credit risk, this can be misused by clients who tend to default as they know the banks will not charge any extra payment or penalty. During the delay, the banks' capital is not productive and the banks' investors or depositors do not earn any income. Hence, it is vital for Islamic banks to manage their riskier assets. It is expected that lower efficiency in managing earning assets would probably lead to higher credit risk to the banks.

There is a relationship between non performing financing (NPF) and default rates respectively. Hassan (1992, 1993) and Fischer *et al.* (2000) opine that as credit risk increases, a larger loan loss provision is required to cover higher non performing loans and indicates deterioration in loan quality. However, Bikker and Metzemakers (2004) argue how a bank's provisioning behaviour is related to a business cycle. They argue that provisioning is substantially higher when GDP growth is lower, reflecting increased riskiness of the credit portfolio when the business cycle turns downwards, which also increases the risk of a credit crunch. This effect is mitigated somewhat as provisions rise in times when earnings are higher, suggesting income smoothing, and higher loan growth, indicating increased risk to the banks. Consistent with the view of Borio *et al.* (2001), they opine that credit risk is build during economic growth. They argue that financial stability would be enhanced by

provisions and capital ratios increasing in economic booms instead of during recessions, so that forward-looking banks will reserve capital in time. This might be considered true since a boost in loan supply is also associated with non thrifty borrowing practice by the customer.

Norhayati and Shahrul Nizam (2004) found that higher loans extended to risky sectors tend to have a higher credit risk. Banks have a tendency to take risks by offering financing, and targeting risky financing since such financing usually promises highest returns to the banks. Moral hazard encourages riskier behaviour by banks; they will have more opportunities to increase risk if allowed to engage in a broader range of activities. High volume credit granted to risky sectors will expose banks to a higher risk.

Samad and Hassan (1999) and Rashid (2007) conclude that banking becomes risky if banks have a higher debt over total asset ratio. A higher ratio places the banks in a risky position as they struggle to meet high potential demand from borrowers. If banks have high debts, it indicates that banks may face difficulties in paying their debtors and may require to back them with capital allocation to cover unexpected loss.

Financial risk increases with leverage. Thus, theoretically, a positive relation between risks and leverage is expected. The banks may use borrowed capital to increase the potential return of an investment. However, while the banks use leverage to try to generate shareholder wealth, should they fail to do so, the interest expense and credit risk of default destroys shareholder value.

Well-capitalised banks can better absorb temporary financial difficulties on the part of their borrowers and preserve long term financing relationships. Indeed, excess capital is a direct measure of banks' capacity to expand credit because it takes into consideration prudential regulation constraints. However, Nor Hayati and Shahrul Nizam (2004) suggest that Islamic banks are not in dire need to have a big capital base to cushion against losses since investment depositors or equity holders absorb the risks and losses are shared between entrepreneur and bank. However, their deductive intuition is that credit risk has a negative relationship with regulatory capital. Furthermore, in order to compete in the challenges posed by globalisation and take into consideration the rapid changes in the global financial landscape, excessive capital is vital to reduce unexpected losses.

A higher debt equity ratio and equity multiplier indicate that banks are involved in risky business (Samad and Hassan 1999; Rashid 2007). Should banks experience a higher customer default rate, they may face difficulties as they uneasily turn over their funds to finance their assets, which then require banks to borrow more funds from external sources.

Ahmad Azam and Mohd Sollehudin (2009) opine that lending to a customer involves both operational cost and credit loss. Indeed, it is a known fact that the probability of losing money in funding someone who is a bankrupt is higher compared to a debtor with a good standing. Financing portfolio problems have historically been the major cause of bank losses and failures whether due to laxed credit standards, poor portfolio risk management, or weakness in the economy.

Nor Hayati and Shahrul Nizam (2004) find that risk-weighted asset has a significant influence on credit risk of conventional and Islamic banks. Banks are required to carry a certain amount of capital to protect against unexpected losses. The amount of capital required changes, or is 'weighted,' depending on the level of asset risk. The more risky the

assets owned by banks, the more weightage that will be imposed. Thus, a larger proportion of risk-weighted assets tend to have a higher probability of credit risk.

The size of total assets is significant and negatively related to risk (Nor Hayati and Shahrul Nizam 2004). Larger banks tend to have a lower risk as they can go for diversification compared to smaller banks. Moreover, large banks have access to a wider variety of borrowers and a broader deposit base. Their financing originations and funding sources are likely to span larger geographical markets compared to smaller banks.

Athanasoglou *et al.* (2005) and Ahmad Azam and Mohd Sollehudin (2009) suggest that poor asset quality and low levels of liquidity are the two major causes of bank failures. In the case of a bank having a position in an illiquid asset, its limited ability to liquidate that position at short notice will compound its market risk. Suppose a firm has offsetting cash flows with two different counterparties on a given day. If the counterparty that owes it defaults on payment, the firm will have to raise cash from other sources to make its payment. In the case that it is unable to do so, it will also default on payment. In this matter, liquidity risk compounds credit risk. Some research outcomes suggest that poor asset-quality, credit risk and low level of liquidity have a considerable negative impact on banks' profitability (Molyneux and Thornton 1992; Miller and Noulas 1997) and are considered as key factors of bank failure. Indeed, in today's challenging period, borrowers tend to default which subsequently may cause cash flow problems and affect a bank's liquidity.

The high accumulation of unpaid financing implies that these financing losses produce lower returns to banks and result in a high probability of loss of money (default risk). Hence, a high credit risk will result in impacts on the bank's performance and efficiency.

4. Empirical Model and Data

The aim of the empirical analysis in this paper is to identify internal determinants of credit risk in Islamic banks based on the theory of credit risk in banks. In this study, the estimation equation for the model is[1]

$$CR_{it} = \lambda_0 + \lambda_1 MGT_{it} + \lambda_2 FQUAL_{it} + \lambda_3 RSEC_{it} + \lambda_4 DTAR_{it} + \lambda_5 LEV_{it} + \lambda_6 REGCAP_{it} + \lambda_7 DER_{it} + \lambda_8 EM_{it} + \lambda_9 FINANCING_{it} + \lambda_{10} RWA_{it} + + \lambda_{11} SIZE_{it} \lambda_{12} LIQUID_{it} + \varepsilon_{it}$$

where the variable definitions and expected signs for variables are as follows:

CR_{it} = non performing financing for the current year to total financing of bank i in year t

MGT_{it} = earning assets to total assets of bank i in year t (-ve) earning asset = total asset – (cash + fixed asset + non earning deposit)

$FQUAL_{it}$ = financing loss provisions to total financing of bank i in year t (-ve)

$RSEC_{it}$ = risky sector financing to total financing bank i in year t (+ve) risky sector financing = property financing (residential properties financing + non-residential property financing + real estate financing + construction

[1] The estimation equation for the model is taken from various previous studies (Samad and Hassan 1999; Nor Hayati and Shahrul Nizam 2004; Athanasoglou *et al.* 2005; Rashid 2007; Ahmad Azam and Mohd Sollehudin 2009).

financing) + purchase of securities financing + consumption credit financing

$DTAR_{it}$ = total debt to total assets of bank *i* in year *t* (+ve)

LEV_{it} = tier-2 capital to tier-1 capital of bank *i* in year *t* (+ve)

$REGCAP_{it}$ = tier-1 capital to total assets of bank *i* in year *t* (-ve)

DER_{it} = total debt to total equity of bank *i* in year *t* (+ve)

EM_{it} = total assets to share capital of bank *i* in year *t* (+ve)

$FINANCING_{it}$ = total financing to total asset of bank *i* in year *t* (+ve)

RWA_{it} = risk-weighted assets to total assets of bank *i* in year *t* (+ve)

$SIZE_{it}$ = natural log of total assets of bank *i* in year t (-ve)

$LIQUID_{it}$ = ratio of cash plus short term marketable securities to total assets of bank *i* in year *t* (-ve)

ε_{it} = white-noise error terms

Non performing financing (NPF) to total financing is taken as a proxy for credit risk (CR). Bank financing requires borrowers to repay monthly instalments according to a schedule of payment dates and amounts. When borrowers do not repay their financing according to a schedule, banks may declare the financing to be non performing. For most banks, financing is considered non performing if a due principal is unpaid for 90 days or more. A high NPF indicates deterioration of asset quality which results in banks inclining towards more cautious behaviour in their financing policies.

The data is drawn from 15 Islamic banks operating in Malaysia. A list of the sample of banks employed in this study is shown in Table A (Appendix). Based on unbalanced panel data, 96 observations were used for the model estimation giving a total combination of 15 cross-sections and 9 time-series.

5. The Results

First, the basic statistics of the variables are presented in this section. Table 1 reports the descriptive statistics based on a common sample. Based on the common sample correlation matrix in Table 2, none of the variables were found to have collinearity problem; hence all the independent variables were used for the subsequent regression.

Second, to estimate model equation, this study employed two approaches, that is, ordinary least square (OLS) model and generalised least square (GLS) model. In the first approach, OLS specification model for panel data was estimated: (i) OLS; (ii) cross-section fixed effect (FE); and (iii) cross-section random effect (RE). In the second approach, cross-section weights were assigned to the OLS model. This exercise transformed the OLS to GLS model.

The random effect model was selected as best representing the model of credit risk for this study due to several reasons:

i. Inconsistency of test of panel data model selection between FE and RE
ii. Higher adjusted *R*-square value compared to the first approach
iii. Use of a higher level of RE (GLS) by assigning weights to control for heteroscedasticity.

Table 1. Descriptive statistics

Variables	Mean	Standard Deviation	Skewness	Kurtosis	Jarque-Bera
CR	0.0831	0.1271	5.6926	44.3130	7345.5370*
MGT	0.8190	0.1461	-1.0338	3.6880	18.9941*
PROFIT	0.0150	0.0228	4.2581	24.0954	2070.1690*
RSEC	0.5321	0.2524	-0.0203	2.4250	1.3291
DTAR	0.9147	0.0586	-2.2079	8.2184	186.9264*
LEV	0.2578	0.3003	1.7692	4.7118	61.8015*
REGCAP	0.0890	0.0728	2.5214	9.9944	297.4075*
DEP	13.6159	11.2233	-0.5657	22.1609	1473.6840*
SIZE	14.7382	11.3022	-0.5650	21.6059	1389.8180*
FINANCING	0.5182	0.2124	-0.0203	2.4172	1.3654
RWA	0.6783	0.2688	-0.1202	2.6486	0.7252
DEF	15.0020	1.1808	-0.7096	3.4278	8.7877**
LIQUID	0.1555	0.1400	1.1316	4.1438	25.7219*

Note: Jarque-Bera statistics for all variables are significant at 1% except $RSEC_{it}$, $FINANCING_{it}$ and RWA_{it}.

In the unweighted OLS, each residual receives the same weight in minimising the residual sum of squared (RSS). But in GLS, the weight assigned to each observation is inversely proportional to its residual, that is, observations coming from a population with a larger residual will get a relatively smaller weight and vice versa in minimising the RSS. Hence, the different explicit data in the GLS method of estimation that produces BLUE estimators (Gujarati, 2003) will be used for analysis purposes. Table 3 reports the panel regression results.

The results and analysis based on the OLS model is discussed in Appendix. The estimation analysis based on OLS, FE and RE models will not be used for further analysis as the OLS method does not take into consideration the different weightage for each residual.

The finding of this study reveals that $RSEC_{it}$, $DTAR_{it}$, LEV_{it}, $FINANCING_{it}$ and $SIZE_{it}$ are significant in determining credit risk in Islamic banks while other variables are not significant. The coefficient for $RSEC_{it}$ is positive and significant in its association with credit risk. An increase of 1 unit in $RSEC_{it}$ would lead to a 0.19 increase in CR_{it}. This finding gives the impression that conventional banks and Islamic banks are not significantly different in terms of risk exposure in relation to financing extended to risky sectors. This analysis postulates that banks have a tendency to take risks by making funding, and targeting risky financing since such financing usually promises high returns to the banks. Moral hazard encourages riskier behaviour by banks so they will have more opportunities to increase risk if allowed to engage in a broader range of activities. A high volume of credit granted to these sectors will expose banks to a higher risk. Conflict of interest may arise when banks engage in diverse activities such as securities underwriting and real estate investment. Banks, for example may attempt to get rid of securities or shift the risk to ill-informed investors so as to assist firms with outstanding financing, which then would result in higher risk to the banks due to difficulty in monitoring them (since banks are involved in a broad range of financial activities).

Table 2: Correlation matrix

	CR_{it}	MGT_{it}	$FQUAL_{it}$	$RSEC_{it}$	$DTAR_{it}$	LEV_{it}	$REG\ CAP_{it}$	DER_{it}	EM_{it}	$FINAN\text{-}CING_{it}$	RWA_{it}	$SIZE_{it}$	$LIQUID_{it}$
CR_{it}	1.0000												
MGT_{it}	-0.1138	1.0000											
$FQUAL_{it}$	-0.0528	0.0432	1.0000										
$RSEC_{it}$	0.2997	-0.1544	0.0645	1.0000									
$DTAR_{it}$	0.0659	-0.2632	0.1485	0.1019	1.0000								
LEV_{it}	-0.0964	-0.1602	0.1851	0.1476	0.2280	1.0000							
$REGCAP_{it}$	-0.0618	0.2693	-0.1108	0.0128	-0.7247	-0.0978	1.0000						
DER_{it}	0.0245	-0.2379	-0.4279	0.0262	0.3873	-0.0450	-0.2362	1.0000					
EM_{it}	0.0208	-0.2310	-0.4274	0.0256	0.3927	-0.0505	-0.2418	0.9972	1.0000				
$FINANCING_{it}$	-0.0771	0.3189	0.1523	-0.2820	-0.3350	0.0069	0.3546	-0.2827	-0.2941	1.0000			
RWA_{it}	-0.0816	0.4298	0.0123	-0.0621	-0.3812	-0.0715	0.3659	-0.3102	-0.3073	0.4739	1.0000		
$SIZE_{it}$	-0.1717	-0.2085	0.2124	0.1247	0.3288	0.3309	-0.1468	-0.0676	-0.0657	0.2011	-0.0685	1.0000	
$LIQUID_{it}$	0.1404	-0.9364	-0.0869	0.1072	0.2350	0.1863	-0.2311	0.2506	0.2431	-0.3090	-0.4125	0.1590	1.0000

Note: Correlation matrix based on common sample.

Table 3. GLS estimation results

Variable	GLS	
CONSTANT	0.0342	(0.1847)
NCT	-0.0143	(0.1265)
FIXCAL	-0.3014	(0.3548)
REC	0.1892*	(0.0207)
DTAR	0.4281*	(0.1553)
LEV	-0.0356**	(0.0207)
REGCAP	0.0107	(0.0796)
DEP	-0.0006	(0.0057)
SW	-0.0008	(0.0056)
FINANCING	0.1202*	(0.0346)
ROA	-0.0112	(0.0205)
SIZE	-0.0322*	(0.0049)
LIQUID	0.1257	(0.1301)
No. of observations	96	
Adjusted R-squared	0.5849	
F-statistic	12.1557*	
DW statistic	1.5581	

Notes: Regressions are based on White cross-section standard errors and covariance (d.f. corrected). Values in parentheses are the standard errors. ** and * indicate significance levels of 5% and 1% respectively. Durbin-Watson d-statistic falls in the indecisive zone. By deriving a lower bound (dL) and an upper bound (dU), there is no positive serial correlation first degree at 5% level of significance.

The coefficient for $DTAR_{it}$ proxied by ratio of debt over asset indicates a positive and significant relationship with CR_{it}. An increase of 1 unit in $DTAR_{it}$ would lead to a 0.43 increase in credit risk. This implies that banks are considered insolvent when they have greater debts compared to total value of their assets. A higher debt indicates the banks may face difficulties paying their debtors and may require to be backed up with capital allocation to cover unexpected loss. Hence, it is important for banks to protect customer deposits in order to reduce risks associated with banks' liabilities. If too many depositors attempt to withdraw their funds at one time, there is tendency for banks to be illiquid while solvent banks may fail. Moreover, monitoring banks is expensive as there is an externality associated with monitoring to curtail risk-taking behaviour. Therefore, depositors will have a tendency to free ride, which in turn results in more risks to banks.

Table 3 reports a negative correlation between LEV_{it} and CR_{it}. An increase of 1 unit in LEV_{it} would lead to a 0.04 decrease in CR_{it}. LEV_{it} is measured by the ratio of tier-2 capital to tier-1 capital. Generally, the banks may use borrowed capital, such as margin, to increase the potential return of an investment. However, while the banks use leverage to attempt to generate shareholder wealth, should they fail to do so, interest expense and credit risk of default destroys shareholder value. Basically, tier-1 capital is considered the more reliable form of capital compared to tier-2 capital and tier-1 capital also indicates the banks' ability to sustain future losses. High consumption of supplementary capital in tier-2 capital over their tier-1 capital will result in higher risk for banks. Here, the possible explanation for the negative sign is because though consumption of tier-2 capital by banks steadily increases,

the banks still make greater use of tier-1 than tier-2 capital which results in they being able to reduce credit risk exposure. Hence, this analysis actually supports the theory of credit risk by banks. The REGCAP analysis proves that on average, Islamic banks hold about 8.9 per cent of tier-1 capital, above the minimum capital requirement of 8 per cent of their total capital base (tier-1 + tier-2 capital) under Basel I and Basel II agreements. This implies that capital serves as a cushion for banks to absorb shocks of business losses and maintain solvency, with benefits accruing to depositors and other stakeholders.

$FINANCING_{it}$ has a positive relationship with credit risk. An increase of 1 unit in $FINANCING_{it}$ would lead to a 0.12 increase in CR_{it}. $FINANCING_{it}$ is measured by the ratio of total financing to total assets. Total financing/assets reflect the fact that all financing is more expensive to originate and administer than investment securities, the other major asset of banks. Generally, funding to the customer involves operational cost and credit loss. A high level of financing activities does not exactly indicate that the banks have performed better. Should customers delay their monthly payment stipulated in the contract, the cost and risk that banks have to bear from NPF indicate that financing activities represent unprofitable business to the banks.

Moreover, financing is usually the banks' main source of revenue, and positively related to profits. However, financing by Islamic banks is in the form of profit and loss basis which is interest free. Their financing-profitability might depend on economic conditions. A strong economy will lower the default chances of PLS financing and contribute towards a rise in profits. In contrast, a weak economy could lower profits, because borrowers are more likely to default on their financing.

The coefficient for $SIZE_{it}$ is negative and significant in its association with CR_{it}. An increase of 1 unit in $SIZE_{it}$ would lead to a 0.03 decrease in CR_{it}. $SIZE_{it}$ is measured by the banks total asset. Smaller banks are unable to reap the benefits of economies of scale and scope. Larger sized banks have significant potential for efficiency gains through cost savings due to economies of scale and scope, organisational efficiency, reduced cost of funding, and economising of capital. Compared to small institutions, large banks have access to a wider variety of borrowers and a broader deposit base. Their loan originations and funding sources are likely to span larger geographical markets. Thus, larger-sized banks tend to have a lower credit risk exposure.

The coefficient for MGT_{it} shows a negative sign which is consistent with the hypothesis of this study, that is, bank efficiency in managing earning assets would result in a lower credit risk. The coefficient for $FQUAL_{it}$ also shows a negative sign, suggesting that the greater the volumes of bad loans the banks have, the greater the corresponding provision will be, depicting that banks have deteriorated in their loan quality. However, these two variables are not significant in determining credit risk in Islamic banks. This analysis also found that $REGCAP_{it}$, DER_{it}, EM_{it}, RWA_{it} and $LIQUID_{it}$ show a different sign, that is, misaligned with the hypothesis in this study. The authors' intuition is that, for the variables $REGCAP_{it}$ and RWA_{it}, the possible explanation for the different sign could be due to different methods in calculating risk between conventional and Islamic banks because of the specific nature of assets of Islamic banks and the related particular risks. The general approach in measuring credit risk employed in this study was similar to the application in conventional banks and this might have resulted in a different coefficient. For instance, in this study, the RWA_{it} calculation method just considers credit risk. Indeed, Islamic banks are quite unique since

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Appendix

Table A. List of participating banks in the Islamic banking scheme in the sample study

No	Bank	Duration of data collection		
		Full-fledged	Window-based	Islamic subsidiaries
1	Bank Islam Malaysia Berhad	1999 - 2007		
2	Bank Muamalat Malaysia Berhad	2000 - 2007		
3	Rashid Husin Bank Berhad	2005 -2007	1999-2004	
4	Malayan Banking Berhad		1999-2007	
5	Citibank Berhad		1999-2007	
6	Standard Chartered BankMalaysia Berhad		1999-2007	
7	Public Bank Berhad		1999-2007	
8	Alliance Bank Malaysia Berhad		1999-2007	
9	Hong Leong Bank Berhad		1999-2004	2005-2007
10	EON Bank Berhad		1999-2005	2006-2007
11	Overseas Chinese Bank Corporation (Malaysia)Berhad		1999-2007	
12	Ambank (Malaysia) Berhad		1999-2006	2007
13	Hong Kong & Shanghai Bank Corporation (Malaysia) Berhad		1999-2007	
14	Affin Bank Berhad		1999-2005	2006-2007
15	Southern Bank Berhad		1999-2005	

Table B. Analysis of the panel least square estimation method

Dependent variable: Credit risk (CR)

Variable	OLS	FE	RE
C_{it}	-0.1651	0.09	-0.1365
	(0.4202)	(0.5889)	(0.4666)
MGT_{it}	0.1853	0.2983	0.2362
	(0.2521)	(0.2669)	(0.2569)
$FQUAL_{it}$	-0.5821	-0.3978	-0.4502
	(0.6605)	(0.6658)	(0.6546)
$RSEC_{it}$	0.2046*	0.2251*	0.2185*
	(0.054)	(0.0814)	(0.0628)
$DTAR_{it}$	0.4953	0.4635	0.5170
	(0.3733)	(0.456)	(0.3931)
LEV_{it}	-0.0594	-0.0036	-0.0451
	(0.0453)	(0.0638)	(0.0519)
$REGCAP_{it}$	-0.0668	0.0712	0.0075
	(0.2588)	(0.2759)	(0.2645)
DER_{it}	-0.0002	0.0012	0.0004
	(0.0152)	(0.0154)	(0.0151)
EM_{it}	-0.0016	-0.0021	-0.0015
	(0.0151)	(0.0154)	(0.0150)
$FINANCING_{it}$	0.1522***	0.0841	0.1404
	(0.0808)	(0.1327)	(0.0972)
RWA_{it}	-0.0420	-0.0166	-0.0299
	(0.0579)	(0.0705)	(0.0616)
$SIZE_{it}$	-0.0342**	-0.0587*	-0.0427*
	(0.0131)	(0.0196)	(0.0155)
$LIQUID_{it}$	0.3464	0.4371	0.3886
	(0.2585)	(0.2739)	(0.2639)
No. of observations	96	96	96
Adjusted R-squared	0.1147	0.1695	0.1128
F-statistic	2.026**	1.7456**	2.0061**
DW statistic	1.9447	2.3333	2.1434

Notes: Values in parentheses are the standard errors. ***, ** and * indicate significance levels of 10%, 5% and 1% respectively. Durbin-Watson d statistic for OLS model lies between the lower and upper limit (or in the indecisive zone); there is inconclusive evidence on the presence or absence of positive first-order serial correlation.

We then conducted Hausman test by comparing Fixed Effect (FE) with Random Effect (RE) Model Fixed Effect versus Random Effect Model. The Hausman test can be used to decide which method is appropriate between FE Model and RE Model. In FE Model, the intercept in the regression

model is allowed to differ among individuals in recognition of the fact that each individual or cross-sectional unit may have some special characteristics of its own. It is interesting to know that the findings of the study show a contradiction in selecting best estimation method. Table C.1 describes the analysis of likelihood ratio test.

Table C.1. Analysis of likelihood ratio test

Effects Test	Statistic	d.f.	Prob.
Cross-section F	1.390822	(14,69)	0.1814
Cross-section Chi-square	23.8631	14	0.0476

Based on the analysis in Fixed Effect Model (FEM) versus OLS, the likelihood ratio test reveals that the Chi-Square statistic rejects the null hypothesis at 5 % significance level. Thus, based on FEM, fixed effect is the better model compared to no effect in the first place. However, analysis in Fixed Effect versus Random Effect Model, the Hausman test, depicts that it is not significant based on random effect. Table C.2 describes the Hausman test analysis.

Table C.2. Analysis of Hausman test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	6.719479	12	0.8756

Since contradictions were found in the panel data selection, a decision on the better method was difficult. Thus, the author had to look back on the statistical analysis reported in Table B. The data analysis showed that the variables signs between RE and FE were constant and both methods did not have problems with autocorrelation. Thus, the author's decision depended on the statistical analysis. Based on the statistical analysis, adjusted *r*-square was higher in FE model compared to RE model. Hence, the FE model was decided as the better model in the first place. However, the value of adjusted *R*-square was quite low indicating that the FE model might not be good. It is important to note that estimation analysis from the best method only can be relied on for purposes of economic analysis. Thus, a decision was made to employ the second approach, that is, the GLS method by estimating the OLS model with cross-section weights. The finding shows that the random effect model (GLS) is better, with adjusted *R*-square value being quite high (58.5%) compared to the first approach; further, the analysis found that 5 variables are significant in explaining credit risk in Islamic banks. Indeed, previous tests had already shown that each estimation model does not have problems with autocorrelation or heteroscadasticity. Hence, the author concludes that the RE Model is better than the FE Model. The other possible reasons why this study preferred to use the random effect model are: (i) all Islamic banks from this sample only operate in Malaysia, thus it is assumed that banks did not apply different methods; (ii) all Islamic banks from this sample operate under the

same regulation, that is, all Islamic banks are under the control of the Central Bank of Malaysia. As the Central Bank of Malaysia is recognised as a regulator and supervisor for financial institutions, it has been vested with legal powers to regulate and supervise the financial system including the Banking and Financial Institutions Act 1989 and Islamic Banking Act 1983. Thus it is assumed that all Islamic banks are supervised in a similar manner. Indeed, this study involved a sample of 15 Islamic banks that were selected randomly from the total population of 20 Islamic banks. Hence, the GLS random effect is adequate to represent the model of credit risk in Islamic banks for the period 1999-2007.