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Lending Structure and 3-Factor CAPM Risk Exposures: The Case of Malaysia

(Struktur Pinjaman dan Pendedahan Risiko bagi 3-Faktor CAPM: Kajian Kes di Malaysia)

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ABSTRACT

This study addresses the linkages between lending structure and bank risk exposures via the Capital Asset Pricing Model (CAPM). Based on the 3-factor CAPM, five risk measures are examined; namely, the market, interest rate, exchange rate, total and unsystematic risk exposure. The influence of lending structure is analysed via four measures, the real estate lending, the specialisation index, the short-term lending stability, and the medium-term lending stability. Our findings show that the lending structure affects the market, interest rate, and unsystematic risk exposures. The stability of lending structure in both the short-term and medium-term period positively influence the market and interest rate risk exposure. On the other hand, the medium-term lending structure stability negatively affects the unsystematic risk exposure. Thus, the policy makers, bankers, and investors should not ignore the significant role of the lending structure when developing a strategic risk management framework.

ABSTRAK

Kajian ini melihat hubungan antara struktur pinjaman dengan risiko bank menggunakan pendekatan Model Peletakan Harga Aset Modal (CAPM). Berdasarkan 3-faktor CAPM, lima jenis risiko telah dikaji; iaitu, risiko pasaran, risiko kadar faedah, risiko kadar tukaran asing, risiko sistematik dan risiko keseluruhan. Kesan pengaruh struktur pinjaman terhadap risiko dikaji menggunakan empat ukuran, iaitu pinjaman kepada sektor hartanah, indeks konsentrasi, kestabilan struktur pinjaman bagi jangka pendek dan kestabilan struktur pinjaman bagi jangka masa sederhana. Hasil kajian mendapati bahawa struktur pinjaman mempengaruhi risiko pasaran, risiko kadar faedah dan risiko sistematik. Kestabilan struktur pinjaman bagi jangka pendek dan jangka sederhana mempengaruhi risiko pasaran dan risiko kadar faedah secara positif. Manakala, kestabilan struktur pinjaman jangka sederhana mempengaruhi risiko sistematik secara songsang. Oleh itu, para penggubal polisi, pengurus sektor perbankan dan pelabur seharusnya mengambil kira kepentingan peranan struktur pinjaman dalam membangunkan kerangka strategik bagi pengurusan risiko bank.

INTRODUCTION

The 1997 ASEAN financial crisis, followed by the oil crisis, the U.S subprime crisis, and the ongoing world economic crisis have stimulated research to focus on the risk exposures. While the scope of risk exposure is vast, most studies center on the risk of the market, interest rate and exchange rate. Besides this, the rapid financial liberalisation, the systematic and unsystematic risk exposures have also been of great concern to many researchers. Hence, the aim of this study is to investigate the impact of the lending structure on the five aforementioned risk exposures using the 3-factor CAPM. Why the lending structure? The issue of the lending structure becomes popular since Hanson, Pesaran, and Schuermann (2008) have theoretically proven that there will be further scope for risk diversification if the banking activities come from different sectors, even in the case of a sufficiently large portfolio. In fact, Blasko and Sinkey Jr. (2006) empirically show that concentration in mortgage lending challenges the capability of the U.S. banks to manage the risk of interest rate. With regards to the Malaysian context, Nor Hayati and M. Ariff (2004) provide empirical evidence that lending to risky sectors can negatively affect the market risk exposure of the depository institutions. Interestingly, by separately testing a set of similar variables to depository institutions and commercial banks, Madura, Martin, & Taylor (1994) show inconsistent results. As no studies have been conducted for the commercial banks in Malaysia, this study tries to fulfill the gap in this area. Besides this, the lending structure models developed in this study may have some implications concerning the risk exposure that has been ignored in previous research. Prior research addresses either the real estate lending or lending specialisation. However, this study analyses the stability issue of lending structure in both the short and medium-term period besides the two ordinary measures. This study investigates the stability effect of lending structure. The stability models is adopted from Mansor and Ruzita (2004), Amin Gutierrez de Pineres and Ferrantino (1997, 1999) who examine the stability of export structure. With this background in mind, the novelty of this study can be addressed in at least three ways: by focusing on 1) the

3-factor CAPM risk measures, 2) the four different lending structure models, and finally 3) the Malaysian commercial banks.

LITERATURE REVIEW

There are enormous empirical studies on bank risk exposures. While Madura *et al*. (1994) and Nor Hayati and M. Ariff (2004) examine the determinants of risk exposure *per se*, Saunders, Strock, and Travlos (1990), Anderson and Fraser (2000), Konishi and Yasuda (2004), Hassan (1993), Cebeyonan and Strahan (2004), Gallo, Apilado and Kolari (1996), Gonzales (2004), Marco and Fernandez (2008), Lepetit, Nys, Rous and Tarazi (2008) and Yong, Faff and Chalmers (2009) investigate various issues of bank risk exposure either for a single-country or single-region study.

Madura *et al*. (1994) studied the determinants of the ex-ante risk for the depository institutions and commercial banks in the United States. The ex-ante risk measure is implied based on call option price. Their findings show that the ex-ante risk of depository institutions and commercial banks have different determinants, conjecturing that both institutions cannot be treated similarly. Lending structure and real estate owned are the determinants for the depository institutions; while real estate owned and capital buffer are the determinants for the commercial banks. In the case of Malaysia, Nor Hayati and M. Ariff (2004) investigated the determinants of market, total and unsystematic risk exposures based on the single-factor CAPM. Unlike Madura *et al*. (1994), they only focus on the depository institutions. In Nor Hayati and M. Ariff (2004), the depository institutions comprise the commercial banks, merchant banks and finance companies. Their findings show that the three types of risk exposures have different determinants. The determinants for market risk exposure are loan quality, cost of fund, loan expansion, and lending structure. For the unsystematic and total risk exposure, the determinants are loan quality, cost of fund, and interest rate, with loan expansion being an additional variable for total risk exposure.

Saunders *et al*. (1990) considered three BSV related to capital buffer, operating cost, and size when they examine the impact of ownership structure on the U.S. bank risk exposures based on the 2-factor CAPM. The risk measures are: 1) total risk; 2) unsystematic risk for short-term interest rate; 3) unsystematic risk for long- term interest rate; 4) market risk for short-term interest rate; 5) market risk for long-term interest rate; 6) short-term interest rate, and 7) long-term interest rate risk exposure. The independent variables are:1) Ownership structure: proportion of stock held by managers; 2) Financial Leverage: Capital/TA; 3) Operating Leverage: FA/TA; 4) Size: TA. Their findings show that size is positively related to market risk but negatively related to interest rate risk. The underlying reason for the conflicting signs is that larger banks tend to be sensitive to market movement, but at the same time are more able to diversify their interest rate risk exposure. In a similar study, Anderson and Fraser (2000) examined the single-factor CAPM risk and include an additional BSV, *frequency*. They argue that *frequency* (the ratio of an average daily share volume traded to number of shares outstanding) represents the level of business risk exposure since it 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. Their findings show that size is negatively related to total risk, but positively related to systematic risk. Furthermore, *frequency* is positively related to both total and systematic risks. Whilst Saunders *et al*. (1990) and Anderson and Fraser (2000) analyzed for the case of U.S., Konishi and Yasuda (2004) and Marco and Fernandez (2008) examined a comparable study for the case of Japan and Spanish, respectively. Their studies add value to the existing gap in the literature in terms of the risk measurements. Konishi and Yasuda (2004) analyse CAPM and insolvency risk while Marco and Fernandez (2008) only focus on the insolvency risk exposure. The 2-factor CAPM risk exposure are:1)Total risk, 2)Unsystematic risk for short-term interest rate, 3) Unsystematic risk for long-term interest rate, 4) market risk exposure for short-term interest rate, 5)market risk exposure for long- term interest rate, 6) systematic risk exposure for short-term interest rate, 7)systematic risk exposure for long- term interest rate. The insolvency risk exposure is the Zrisk index. While Konishi and Yasuda (2004) reveal that size and capital buffer are significantly related to the 2-factor CAPM and insolvency risk exposures, Marco and Fernandez (2008) show that size, profitability, and business types are significantly related to the insolvency risk exposure.

Hassan (1993) and Cebenoyan and Strahan (2004) conducted a study on the impact of loan sales on bank risk exposures for the U.S. They analyse seven BSV comprising loan expansion, loan quality, loan structure, GAP analysis, size, capital buffer, and short-term investment securities. While the former estimates risk based on the single-factor CAPM and the subordinated debt models, the later measures risk based on the financial ratios. Hassan (1993)'s findings reveal that lending specialisation and loan expansion are positively related to all types of risk measures; whereas GAP analysis and size produce mixed results. On the other hand, Cebenoyan and Strahan (2004) discover that capital buffer and short-term investment securities are inversely related while loan expansion is positively related to the financial ratio's risk exposures.

Gallo *et al*. (1996) consider loan expansion, capital buffer, short-term investment securities and size as BSV when examining the impact of mutual fund investments on bank risk exposure in the U.S. They estimate that the market and industry risk exposures using the single-factor

CAPM have two types of risk with different determinants. Loan expansion is inversely related to the market risk exposure; whereas loan expansion, short-term investment securities, and mutual fund activities are inversely related to the industry risk exposure.

Lepetit *et al*. (2008) analysed the impact of income structure on the European banks risk exposure by looking at aspects comprising size, capital buffer, profitability, loan expansion, and cost of fund as BSV. Based on the single-factor CAPM and insolvency risk estimations, they find that size and capital buffer are the significant variables. Finally, Yong *et al.* (2009) studied the impact of derivative activities on ten Asia-Pacific countries whereby loan expansion, loan quality, size, capital buffer, short-term investment securities, profitability ratio, and non-interest income as the BSV are considered. They are able to estimate the short-term interest rate, long-term interest rate and exchange rate risk exposures with the use of the 4-factor CAPM. They find that loan expansion is significant to long-term interest rate risk whereas short-term investment securities and loan expansion are significant to short-term interest rate risk exposure. Correspondingly, size, short-term investment securities and loan expansion are significant to exchange rate risk exposure.

DATA AND METHODOLOGY

We adopt the generalised least squares (GLS) unbalanced panel regression estimations to analyse the impact of lending structure on the 3-factor CAPM risk exposures. Three models are tested; namely the 'pooled effect', fixed effect, and random effect model. The best model is selected based on the Likelihood Ratio and Hausman test. To cater for the heteroskedasticity issue, this study incorporates the cross-section weight in the GLS estimation. According to Shahida (2006) and Roza Hazli (2007), the first-order autocorrelation problem is tackled based on the Park's model. This study comprises all eleven listed bank holding companies in Malaysia for year 1994-2006. It ends in the year 2006 because 2007 onwards has witnessed volatile economic developments such as the food crisis, oil price crisis, and the U.S. prime crisis which may indirectly affect our regression analysis. Our research design is expressed as below:

$$\text{Risk} = f(\text{LS}, \text{BSV}) \qquad \text{[Equation 1]}$$

Where the five alternative risk measures are: market, interest rate, exchange rate, total and unsystematic risk exposures. The four alternative lending structure (LS) variables are: real estate lending, specialisation index (SPEC), lending composition change (LCC), and variance of traditionality index (VART). Our BSV are TL, LS, PLL, TE, GAP, INTEXP, INV, LTA, NONII, and MGT. The detailed specifications for the 3-factor CAPM risk, lending structure, and the BSV are as in Table 1, 2, and 3, respectively.

The expected coefficient signs for the BSV follow the justification from previous studies. With regards to loan expansion, Hassan (1993), Madura *et al*. (1994), Gallo *et al*. (1996) suggest that the illiquidity of loans and default issues are the underlying reasons for the positive

TABLE 1. Specification for 3-factor CAPM risk exposures

Variable	Measured as	Mnemonic
Market risk exposure	Beta coefficient measuring the sensitivity of bank portfolio return to daily market return of Kuala Lumpur Composite Index (KLCI) during a one year period.	β_m
Interest rate risk exposure	Beta coefficient measuring the sensitivity of bank portfolio return to daily interest rate changes of 10 year -Malaysian Government securities (MGS) during a one year period.	β_i
Exchange rate risk exposure	Beta coefficient measuring the sensitivity of bank portfolio return to daily nominal effective exchange rate (NEER) changes during a one year period.	β_{forex}
Unsystematic risk exposure	The standard deviation of the error term which captures all other factors that affect bank return that are not taken into account explicitly during a one year period.	standard deviation of ε_t
Total risk exposure	The standard deviation of the return of bank holding companies (BHCs) during a one year period.	standard deviation of R_t

Note: The three-factor CAPM risk measures are based on the single-factor CAPM, initially developed by Sharpe (1964). Sharpe (1964) finds that the sensitivity to stock market can determine the expected return of an asset. However, his assumption that asset pricing depends on a stock market return in explaining the risks inherent in the assets does not hold. Arbitrage Pricing Theory proposed by Ross (1976) suggests that multiple factors affect the expected return of an asset. In the financial sector, the importance of the interest rate leads to the establishment of two-factor CAPM as in Stone (1974), Martin and Keown (1977), Booth and Officer (1985), Flannery and James (1984), Chance and Lane (1980), Lynge and Zumwalt (1980), Jahankhani and Lynge (1980), Bae (1990), and Llyod and Shick (1997). Further, recent studies proposed a three-factor CAPM in pricing the financial institutions. Chamberlain et al. (1997) and Hahm (2004) highlight the significance of exchange rate as the third factor. The risk-return relationship of the three-factor CAPM employed in this study is expressed as: $R_t = \pm + {}^2_m (R_{mt}) + {}^2_i (R_{it}) + {}^2_{forex} (R_{forext}) + \mu_t$ where R_{mt} = daily market return of KLCI for one year; R_{it} =daily interest rate changes of MGS-10 years for one year;, R_{forext} = daily nominal effective exchange rate changes for one year. After five types of risk exposures are estimated based on yearly basis for all eleven bank holding companies, GLS unbalanced panel regression estimation is conducted based on [Equation 1].

TABLE 2. Specification for lending structure variables

Variable	Measured as	Mnemonic
Real estate lending	• Real estate sector *per se* is loan given to real estate sector, which comprise residential, non-residential, real estate properties. (Madura *et al*. (1994) and Blasko & Sinkey Jr. (2006))	RE
	• Broad property sector comprises of RE and construction sector. (Roza Hazli (2007))	BPS
	• Risky sector comprises loan given to BPS, purchase of securities and consumption credit. (Nor Hayati & M. Ariff (2004)) All three measures are ratios to total loan.	RISKY
Stability in lending composition in the short- run	$LCC = \sum_{i=1}^{12} \min(s_{it}, s_{it-1})$ where s_{it} is the share of sector *i* in total lending in year *t*. It takes on a maximum value of 1 if there is no change in lending composition and a minimum value of 0 if the portfolio of lending by sector loan was not loaned in the previous year. Thus, a high value of LCC suggests short-run stability of lending composition.	LCC
Specialized index	$C_{it} = \frac{\sum_{i=t_0}^{t} e_{it}}{\sum_{t=t_0}^{t_1} e_{it}}$ where, s_i is the lending share of industry *i* in total lending. A score approaching 1 suggest a high degree of loan concentration while a score approaching 0 indicates a high degree of diversification	SPEC
Stability of lending composition over an intermediate term	$SPEC = \sum_{i=1}^{12} s_{it}^2$ It is a variance of traditionality index (*TI*), calculated using five-year intervals for each sector. The *TI* for the year 1995 is computed using data from 1993 to 1997; for 1996, using data from 1994-1998, and so on. The *TI* formula is as follows: $TI_{it} = \frac{\sum_{l=-2}^{l=2} c_{i,t-1}}{5}$ where, the cumulative lending experience (C_{it}) for each industry is calculated as: $C_{it} = \frac{\sum_{i=t_0}^{t} e_{it}}{\sum_{t=t_0}^{t_1} e_{it}}$ 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 across sector, a high variance indicates an episode of divergent pattern, and vice versa.	VART

TABLE 3. Specification for BSV

Independent Variable	Measured as	Mnemonic	Expected Coefficient sign
Credit Related Variables:			
Loan expansion	Ratio of total loan to total asset	TL	+
Loan quality	Ratio of provision for loan loss to total asset	PLL	+
Capital Related Variables:			
Capital buffer	Ratio of total equity to total asset	TE	-
Interest Rate Related Variables:			
GAP analysis	Absolute value of the ratio of (total market sensitive assets - total market sensitive liabilities) to total asset	GAP	+
Cost of fund	Ratio of interest expense to total asset	INTEXP	+
Liquidity Related Variable:			
Liquid Asset	Ratio of short term investment securities to total asset	INV	-
Business Related Variables:			
Size	Logarithm of total asset	LTA	+/-
Deviation from traditional role of banking	Ratio of non-interest income to total asset	NONII	-
Management efficiency	Ratio of earning asset to total asset	MGT	+/-

relationship between TL and risk. In contrast, when discussing loan default, earlier studies hypothesize that PLL represents the probability of future default (bad loan quality). Thus, it is expected to be positively related to risk. For the case of capital buffer, equity is perceived to provide cushion against loss; hence, increasing TE reduces the risk exposure. For the GAP analysis, a positive GAP indicates that a particular bank is an asset sensitive bank while a negative GAP indicates that it is a liability sensitive bank.

A positive GAP bank (or an asset sensitive bank) is exposed to risk that interest rate will fall whereas a negative GAP bank (or a liability bank) is exposed to risk that interest rate will increase. Thus, the greater the absolute value of GAP, the more the bank is exposed to changes in interest rate. Despite the GAP analysis, Madura *et al*. (1994) argue that bank risk depends on the proportion of funds obtained in the deposit account (measured by interest expense), which is not captured in the GAP analysis. They hypothesize that the higher the deposit, the higher the interest expense, the higher the volatility of net interest income, the riskier is the bank. For the case of INV, risk is linked to it from the perspective of deposit withdrawal. Having cash idle is an opportunity cost to banks, but banks hold short-term investment securities to standby the need for extraordinary deposit withdrawal. With regards to size, Saunders *et al*. (1990) and Hassan (1993) argue that the greater the size, the greater the potential will be to diversify business risk and adjust unexpected liquidity and capital shortfall, thus reducing the bank risk exposure. However, Anderson and Fraser (2000) suggest that the impact of size on risk depends on the lending structure. If the loan composition is the same, bigger banks should have lower risk as compared to smaller banks. Nonetheless, if the loan structure is different, a bigger bank can have higher risk exposure than the smaller one due to its tendency to embark into riskier lending sector that can give higher return. Similarly, Gonzales (2004) mentions that with the existence of the economy of scale, increase market power, and the 'too big to fail' policy for big banks, a bigger bank tends to enter into risky activities either through lending strategy or off-balance sheet activities. Against this background, size can be positively or inversely related to risk exposure. For the case of non-financing activities, Madura *et al*. (1994) offer evidence that diversifying from the traditional role banking (lending) reduces bank risk. Finally, with regards to management efficiency, Angbazo (1997), Nor Hayati and M. Ariff (2004), and Aisyah, Mansor, and Ahamed Kameel (2008, 2009) suggest that management efficiency can influence bank risk exposure. Negative association of MGT infers an efficient management, and vice versa. They believe that investing in earning assets is risky as it is exposed to market, interest rate and exchange rate fluctuations. Thus, if an increase in earning asset is associated to a decrease in risk exposure, it can be implied that the bank management is efficient.

FINDINGS AND DISCUSSION

Table 4 presents the descriptive statistics whereby Figure 1 plots the trend movements of lending structure and 3-factor CAPM risk exposures. For the trend of lending structure, despite a decrease in 1995 and 2005, the real estate lending (BPS, RE, RISKY) show an upward trend. With regards to LCC, the low value in 1996 and 2005 is the result of the consolidation program and the change of reporting style, respectively. Instead of categorising loan by sectors, they are now categorising it by the economic purpose. Loan by sector: 1) agriculture, hunting, forestry and fishing; 2) mining and quarrying; 3) manufacturing; 4) electricity, gas and water; 5) broad property sectors; 6) wholesale, retail trade, restaurants and hotels; 7) transport, storage and communication; 8) finance, insurance and business services; 9) purchase of securities; 10) purchase of transport vehicles; 11) consumption credit; and 12) others. Meanwhile, loan by economic purpose: 1) agriculture, hunting, forestry and fishing; 2) mining and quarrying; 3) manufacturing; 4) electricity, gas and water; 5) broad property sectors; 6) wholesale, retail trade, restaurants and hotels; 7) transport, storage and communication; 8) finance, insurance and business services; 9) purchase of securities; 10) purchase of transport vehicles; 11) consumption credit; 12) community, social, and personal services; 13) general commerce; and 14) others. For SPEC, the trend is similar to a U-shape. Since 1996, it shows a diversified lending portfolio for quite some time before it starts to become specialised in 2004 onwards. Finally, VART shows a divergent pattern of lending structure.

For the trend of the CAPM risk measure, the market risk exposure shows a volatile pattern, ranging from 1.2 to 0.9 from year 1994 to 2006. For the short-term interest rate risk exposure, the trend movement is rather stagnant, except for the year 2001 onwards. In contrast, the long-term interest rate risk exposure appears to be volatile. Interestingly, the short and long-term interest rate risk exposures show an inconsistent trend from year 2001 onwards. While the short-term rate exhibits a stable trend before it drops to the lowest point in 2003, the long-term rate shows an upward trend after going through the weakest point in 2001.

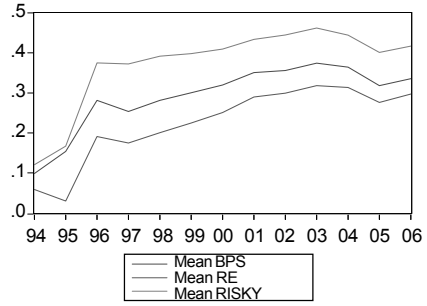
As for the case of exchange rate risk exposure, there is a volatile pattern. Starting from year 1995, it shows an increasing trend and achieves its highest point in 2000. The desired effect of the fixed exchange rate policy in 1997 does not seem to be instantly achieved as the exchange rate risk exposure keeps on increasing until year 2000. This can be due to a stronger negative effect of the 1998 financial crisis on exchange rate risk exposure. Nonetheless, there was a need for a pegging policy when the exchange rate risk exposure decreased to its lowest point in 2002. Unfortunately, it is not long lasting when the government announced a managed floating exchange rate policy in 2005.

TABLE 4. Descriptive statistics

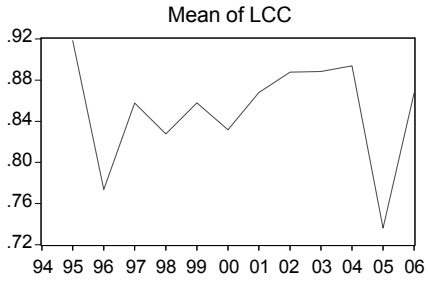
Variables	Mnemonic	Mean	Std.. dev
Market Risk Exposure		1.08	0.40
Interest Rate Risk Exposure (long term)		0.01	0.11
Exchange Rate Risk Exposure		0.01	0.56
Total Risk Exposure		0.03	0.01
Unsystematic Risk Exposure		0.02	0.01
Lending Structure (hypothesis variables)			
Ratio of Real Estate Sector to total loan	RE	0.30	0.10
Ratio of Broad Property Sector to total loan	BPS	0.39	0.08
Ratio of Risky Sector to total loan	RISKY	0.50	0.10
Change of Lending Composition	LCC	0.87	0.11
Degree of Specialization of Lending	SPEC	0.16	0.06
Variance of Traditionality Index	VART	0.02	0.01
Credit related Variables			
Ratio of Total Loans to Total Asset	TL	0.52	0.25
Ratio of Provision of Loan Loss to Total Asset	PLL	0.01	0.01
Capital Related Variables			
Ratio of Total Equity to Total Asset	TE	0.09	0.04
Interest Rate Related Variables			
Ratio of Gap to Total asset	GAP	-0.17	0.19
Ratio of Interest Expense to Total asset	INTEXP	0.03	0.01
Liquidity Related Variable			
Ratio of Short Term Investment to Total Asset	INV	0.14	0.12
Business Operation Related Variables			

FIGURE 1. Trend of lending structure and CAPM risk exposures

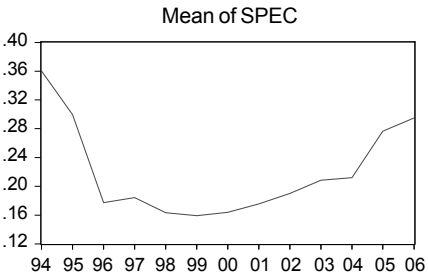
a) The real estate lending.



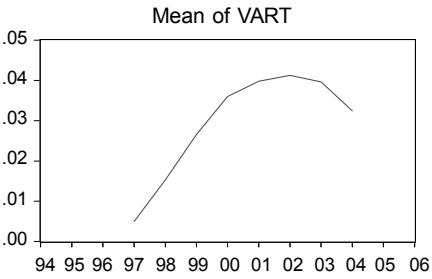
b) Change in lending composition



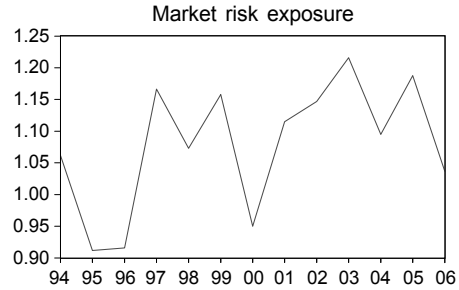
c) Degree of specialization of lending



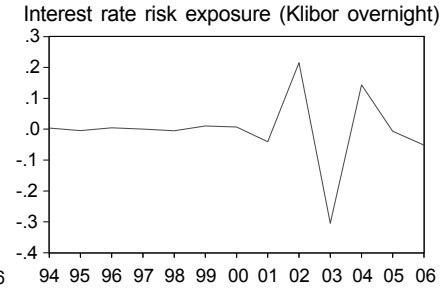
d) Variance of traditionality index



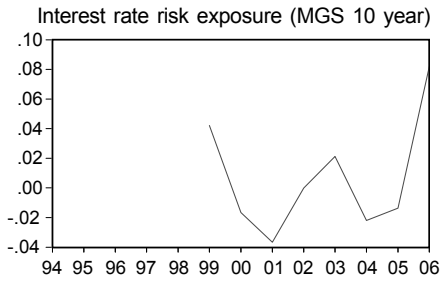
e) Market risk exposure



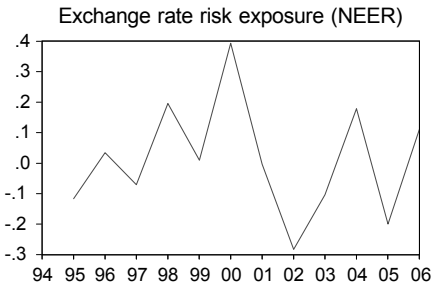
f) Short-term interest rate risk



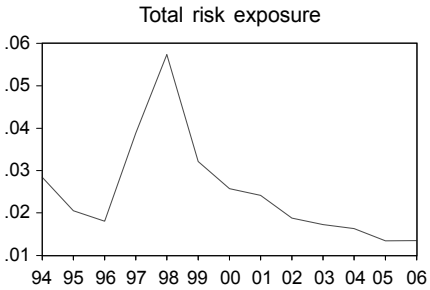
g) Long-term interest rate risk



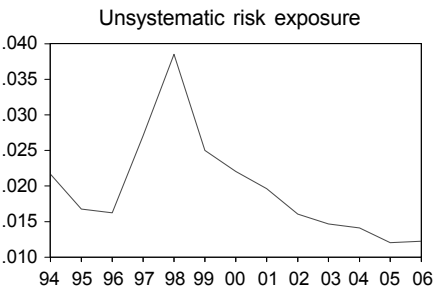
h) Exchange rate risk



i) Total risk exposure



j) Unsystematic risk exposure



For the total and unsystematic risk exposure, both exhibit a similar trend. Corresponding to the boom in economy, they show a low degree of risk exposures prior to 1996. Similarly, at the peak of the financial crisis, the total and unsystematic risk exposure hit their highest points in 1998. Consequently, as the government and market players imposed prudent risk management policies, both began to show a decreasing trend.

Before proceeding to a regression analysis, a correlation matrix test is conducted in ensuring that the BSV are not severely correlated. As the correlation matrix in Table 5 shows lower values than 0.8, we consider the BSV are not seriously correlated, indicating that analysing them simultaneously does not produce a multicollinearity problem. Gujarati (2003) set a cut of point of 0.8 for the correlation coefficient matrix. Values higher than 0.8 indicates that the variables are strongly correlated; thus, should be analysed separately to avoid a multicollinearity issue. For the regression results, fixed effect model appears to be the best model for all types of the CAPM risk exposures. The results for 'none effect' model, random effect model, the Likelihood ratio test, and the Hausman test will be provided upon request. Table 6(a)-(e) present the fixed effect estimations for market, interest rate, exchange rate, total and unsystematic risk exposure.

As for the case of market risk exposure, Table 6(a) shows that real estate lending (BPS, RE, RISKY) as well as specialization index (SPEC) are not significant; whilst short-term lending portfolio stability (LCC) and medium-term lending portfolio stability (VART) indicate positive associations. The finding for real estate lending is consistent with Nor Hayati and M. Ariff (2004), but the finding for SPEC does not support Hassan (1993). Our finding infers that both increasing real estate lending and specialisation does not significantly jeopardise market risk exposure. The positive association of LCC implies that the short-run stability of lending portfolio increases market risk exposure. Even though real estate lending does not significantly influence market risk exposure, it should be noted that a large number of non-performing loan in the BPS may aggravate the market risk exposure to an extent perhaps not fully reflected in the regression

TABLE 5. Correlation matrix of independent variables

	BPS	RE	RISKY	LCC	SPEC	VART	TL	PLL	TE	GAP	INTEXP	INV	LTA	NONII	MGT
BPS	1														
RE	0.82	1													
RISKY	0.87	0.82	1												
LCC	0.19	0.19	0.12	1											
SPEC	0.18	-0.11	-0.09	-0.10	1										
VART	0.18	0.08	-0.01	0.15	0.14	1									
TL	-0.04	-0.10	0.05	0.05	-0.39	0.02	1								
PLL	-0.09	-0.18	-0.04	-0.02	-0.30	-0.05	0.50	1							
TE	0.43	0.43	0.43	0.13	0.07	0.07	-0.08	-0.12	1						
GAP	0.03	-0.16	0.03	-0.36	0.09	0.18	0.02	0.13	0.014	1					
INTEXP	-0.15	-0.30	-0.01	-0.14	-0.17	-0.25	0.32	0.54	-0.15	0.23	1				
INV	0.02	-0.12	0.02	0.08	-0.21	-0.16	0.31	0.23	-0.27	-0.26	0.23	1			
LTA	-0.30	0.12	-0.30	0.10	-0.37	0.10	-0.28	-0.19	-0.17	-0.32	-0.44	-0.06	1		
NONII	-0.06	-0.07	-0.11	-0.41	0.55	-0.19	-0.34	-0.31	0.07	0.13	-0.18	-0.26	-0.13	1	
MGT	-0.02	-0.32	-0.09	0.14	0.32	-0.00	0.389851	0.189109	-0.05207	-0.18425	0.249249	0.214558	-0.4567	0.175105	1

Notes: 1. Correlation Matrix is based on common sample
2. BPS, RE, RISKY, LCC, SPEC, and VART are the alternate measures of lending structure variables.

TABLE 6(a). Results for market risk exposure

Independent variables	Expected Coefficient sign	Model 1(a)	Model 1(b)	Model 1(c)	Model 2	Model 3	Model 4
Constant		0.34 (0.37)	0.59 (0.73)	0.40 (0.43)	-0.59 (-0.73)	0.33 (0.31)	0.99 (1.26)
BPS		0.16 (0.55)					
RE			0.33 (1.13)				
RISKY				-0.04 (-0.12)			
LCC					0.46** (2.54)		
SPEC						-0.08 (-0.16)	
VART							4.61* (0.79)
TL	+	0.58** (2.20)	0.52* (1.92)	0.59** (2.22)	0.84* (1.84)	0.58** (2.21)	-0.31 (-0.91)
PLL	+	0.43 (0.23)	0.05 (0.03)	0.91 (0.41)	0.83 (0.42)	0.57 (0.32)	6.07 (1.39)
TE	-	-0.14 (-0.41)	-0.32 (-0.94)	-0.02 (-0.06)	-0.07 (-0.20)	-0.05 (-0.16)	-0.75* (-1.84)
GAP	+	0.28 (1.22)	0.27 (1.26)	0.28 (1.09)	0.33 (1.13)	0.29 (1.13)	-0.26 (-0.95)
INTEXP	+	1.69 (0.94)	1.20 (1.12)	1.33 (0.73)	3.27* (1.94)	1.43 (0.81)	-1.56 (-0.70)
INV	-	-0.35 (-1.19)	-0.39 (-1.34)	-0.31 (-0.93)	-0.67* (-1.73)	-0.32 (-1.21)	-1.08*** (-3.71)
LTA	+/-	0.13 (0.94)	0.09 (0.80)	0.13 (0.95)	0.21 (1.52)	0.14 (0.82)	0.05 (0.40)
NONII	- +/-	8.04 (1.43)	7.82 (1.43)	8.07 (1.37)	11.15* (2.36)	8.10 (1.37)	5.38* (1.75)
MGT		(-4.04)	(-4.10)	(-3.93)	(-3.87)	(-4.08)	(-0.09)
R-squared		0.81	0.82	0.81	0.86	0.80	0.86
Adj R-squared		0.77	0.78	0.77	0.82	0.76	0.81
S.E. of reg		0.27	0.27	0.27	0.27	0.27	0.27
F-Statistic		13.00	13.27	12.98	13.28	12.70	10.99
Prob (F)		0.00	0.00	0.00	0.00	0.00	0.00
D.W. statistics		2.09	2.09	2.09	2.08	2.09	2.30

Notes:
1. Market risk exposure = f(LS, BSV)
2. Four different models of lending structure are analysed. Model 1(a)-(c) test the real estate lending, model 2 tests the stability of lending structure in short run, model 3 tests the specialization index and model 4 tests the stability of lending structure in medium term period.
3. White cross-section heteroskedasticity-consistent covariance matrix estimators are reported.
4. Figures in parentheses are t-statistics
5. ***, **, * denotes significant at 1 %, 5% and 10% confidence level, respectively.
6. All independent variables except LTA are deflated by total asset. LTA is the log of total asset.

TABLE 6(b). Results for long-term interest rate risk exposure

Independent variables	Expected Coefficient sign	Model 1(a)	Model 1(b)	Model 1(c)	Model 2	Model 3	Model 4
C		0.24 (0.51)	0.28 (0.52)	0.27 (0.55)	0.10 (0.22)	-0.26 (0.63)	-1.27 (-0.96)
BPS		0.09 (0.61)					
RE			0.18 (1.10)				
RISKY				0.07 (0.54)			
LCC					0.14** (2.06)		
SPEC						-0.51 (0.00)	
VART							5.05*** (8.01)
TL	+	-0.29 (-1.55)	-0.31* (-1.79)	-0.32* (-1.66)	-0.31 (-1.46)	-0.36 (0.03)	-0.20** (-2.55)
PLL	+	-2.27* (-1.68)	-2.31* (-1.67)	-2.32* (-1.70)	-2.05 (-1.42)	-2.17 (0.11)	2.72** (2.40)
TE	-	-0.39 (-1.31)	-0.47 (-1.33)	-0.42 (-1.44)	-0.49* (-1.85)	-0.35 (0.18)	-0.07 (-0.31)
GAP	+	0.06 (0.66)	0.05 (0.49)	0.07 (0.83)	0.03 (0.34)	0.01 (0.87)	-0.49*** (-3.50)
INTEXP	+	2.95** (2.14)	3.14** (2.44)	2.81** (2.02)	3.33* (1.92)	3.44* (1.91)	14.54*** (5.49)
INV	-	0.06 (0.23)	-0.04 (-0.16)	0.09 (0.35)	-0.09 (-0.36)	-0.10 (0.61)	-0.42 (-1.45)
LTA	+/-	0.06 (1.16)	0.05 (0.82)	0.05 (1.04)	0.07 (1.61)	0.1 5(0.01)	0.32** (2.17)
NONII	-	1.26 (0.68)	1.25 (0.73)	1.12 (0.62)	1.88 (1.15)	1.11 (0.42)	5.63*** (3.80)
MGT	+/-	-0.65* (-1.83)	-0.62* (-1.84)	-0.62* (-1.72)	-0.70* (-1.80)	-0.66* (-1.80)	-1.56*** (-3.26)
R-squared		0.36	0.36	0.36	0.38	0.39	0.67
Adj. R-squared		0.15	0.16	0.16	0.18	0.19	0.41
S.E. of regression.		0.09	0.09	0.09	0.10	0.09	0.06
F-Statistic		1.77	1.80	1.83	1.91	2.00	2.59
Prob (F)		0.04	0.03	0.03	0.03	0.01	0.01
D.W. stats		1.96	1.95	2.00	2.15	2.05	2.43

Notes:

1. Long-term interest rate risk exposure = f(LS, BSV)
2. Four different models of lending structure are analysed. Model 1(a)-(c) test the real estate lending, model 2 tests the stability of lending structure in short run, model 3 tests the specialization index and model 4 tests the stability of lending structure in medium term period.
3. White cross-section heteroskedasticity-consistent covariance matrix estimators are reported.
4. Figures in parentheses are t-statistics
5. ***, **, * denotes significant at 1 %, 5% and 10% confidence level, respectively

result. As in June 2009, the monthly aggregate data for the Malaysian commercial banks shows that the highest non-performing loan comes from the BPS, which is around 45.66% (NPL for BPS is RM14.8 million out of total NPL RM32.4 million). (BNM statistical bulletin, August 2009). Unfortunately, the data limitation at the firm-level makes it impossible to test the non-performing loan of real estate lending in this study.

With regards to VART, the positive relationship infers that the medium-term instability of lending portfolio increases market risk exposure. Macroeconomic disturbances such as the increasing real estate price and global recession may contribute to the disruptions in the lending structure. To the extent that macroeconomic disturbances induce divergent patterns of lending structure with increasing financial liberalisation, the Malaysian banking sector is vulnerable to macroeconomic shock; hence, it should be more alert to the domestic and external economic developments.

For the case of interest rate risk exposure, only long-term interest rate risk model produces significant F-statistics while the short-term interest rate risk fails the F-Statistic test. This implies that the significant role of short term interest rate in the two-factor CAPM as highlighted by Stone (1974), Martin and Keown (1977), Lynge and Zumwalt (1980), Flanerry and James (1984), Brooth and Officer (1985), Saunders *et al*. (1990), and Konishi and Yasuda (2004) does not hold for the case of commercial banking sector in Malaysia. One reason for this phenomenon can be that the fluctuation in the market has fully captured the movements in short term interest rates. The result for long-term interest rate risk exposure is shown in Table 6(b). Among the four lending structure measurements, only LCC and VART show significant result.

TABLE 6(c). Results for exchange rate risk exposure

Independent variables	Expected Coefficient sign	Model 1(a)	Model 1(b)	Model 1(c)	Model 2	Model 3	Model 4
C		-3.91**	-3.44**	-3.63**	-5.40**	-3.63**	-4.57
		(-2.50)	(-2.22)	(-2.44)	(-2.60)	(-2.36)	(-1.60)
BPS		0.49					
		(0.98)					
RE			0.33				
			(0.83)				
Risky Sectors				0.03			
				(0.10)			
LCC					0.43		
					(1.41)		
SPEC						-0.02	
						(-0.02)	
VART							-7.94
							(-1.04)
TL	+	-0.04	-0.07	-0.01	-1.11*	-0.01	-1.63*
		(-0.09)	(-0.16)	(-0.02)	(-1.91)	(-0.01)	(-1.69)
PLL	+	9.04*	9.29*	10.23**	12.89***	10.29*	9.37*
		(1.72)	(1.79)	(2.11)	(2.48)	(1.94)	(1.76)
TE	-	-1.54	-1.55	-1.35	-1.61	-1.34	-0.91
		(-1.55)	(-1.54)	(-1.44)	(-1.63)	(-1.51)	(-0.98)
GAP	+	-0.73**	-0.73**	-0.75**	-1.04**	-0.75**	-1.26*
		(-2.03)	(-1.99)	(-2.03)	(-2.25)	(-2.02)	(-1.91)
INTEXP	+	6.03*	5.45	4.92	3.48	4.89	1.88
		(1.69)	(1.53)	(1.41)	(0.62)	(1.34)	(0.65)
INV	-	0.98*	1.02*	1.11*	1.06*	1.12*	1.29**
		(1.67)	(1.81)	(1.94)	(1.88)	(1.92)	(2.13)
LTA	+/-	0.48**	0.43**	0.47**	0.66***	0.47**	0.43*
		(2.63)	(2.20)	(2.61)	(3.14)	(2.52)	(1.92)
NONII	-	0.53	0.05	0.37	0.34	0.36	-6.83
		(0.07)	(0.01)	(0.05)	(0.04)	(0.05)	(-0.95)
MGT	+/-	0.07	0.12	0.05	0.90	0.04	3.06
		(0.07)	(0.13)	(0.05)	(0.82)	(0.04)	(1.41)
R-squared		0.28	0.27	0.27	0.37	0.27	0.57
Adj R-squared		0.12	0.11	0.11	0.22	0.11	0.39
S.E. reg.		0.49	0.49	0.49	0.50	0.49	0.55
F Stats		1.76	1.68	1.71	2.40	1.71	3.24
Prob (F)		0.03	0.05	0.04	0.00	0.04	0.00
D.W statistics		2.59	2.61	2.61	2.46	2.61	2.62

Notes:

1. Exchange rate risk exposure = f(LS,BSV)
2. Four different models of lending structure are analysed. Model 1(a)-(c) test the real estate lending, model 2 tests the stability of lending structure in short run, model 3 tests the specialization index and model 4 tests the stability of lending structure in medium term period.
3. White cross-section heteroskedasticity-consistent covariance matrix estimators are reported.
4. Figures in parentheses are t-statistics.
5. ***, **, * denotes significant at 1 %, 5% and 10% confidence level, respectively

The positive relationship of LCC shows that the increasing stability of lending structure in the short-run increases the long-term interest rate risk exposures. This implies that when a bank abides by its current lending portfolio, its long-term interest rate risk exposure increases. This can be due to the fact that around 40% of loans are given to BPS. (mean value for BPS in this study is 0.393711). Property loans are long-term in nature. Thus, when banks keep on giving loans to long-term borrowers, they are vulnerable to long-term interest rate risk exposure as the loans are either tied to a fixed rate or vulnerable to change as compared to the short-term interest rates. Correspondingly, the positive relationship of VART implies that the increasing divergence of medium-term lending stability increases the long-term interest rate risk exposure. Thus, this suggests that banks are incapable of effectively allocating their lending portfolio (especially the long-term loan) with respect to long-term interest rate fluctuations.

For the exchange rate risk exposure, the results in Table 6(c) show that all lending structure models are insignificant. This implies that the exchange rate risk exposure is not significantly determined by the change in real estate lending, lending specialisation, and lending stability. Nonetheless, PLL, INV, LTA, and GAP are the significant BSV that affect the exchange rate risk exposure.

Similar to exchange rate risk exposure, all lending structure models are not significant for the total risk exposure (Table 6(d)). This implies that the lending structure does not affect the overall risk exposure for the Malaysian commercial banks. Meanwhile, TL, INTEXP, and LTA are the significant BSV in determining the total risk exposure.

TABLE 6(d). Results for total risk exposure

Independent variables	Expected Coefficient sign	Model 1(a)	Model 1(b)	Model 1(c)	Model 2	Model 3	Model 4
C		0.08 (1.48)	0.09* (1.67)	0.09 (1.59)	0.13*** (4.41)	0.09 (1.51)	0.03 (0.50)
BPS		0.01 (0.74)					
RE			0.01 (0.85)				
Risky Sectors				-0.00 (-0.20)			
LCC				0.001	(0.07)		
SPEC					0.01	(0.10)	
VART							-0.14 (-1.62)
TL	+	0.03*** (3.01)	0.03*** (2.91)	0.03*** (3.11)	0.02 (1.25)	0.03*** (3.01)	-0.01 (-1.28)
PLL	+	-0.07 (-1.01)	-0.07 (-1.01)	-0.07 (-0.88)	-0.001 (-0.05)	-0.07 (-0.91)	-0.17 (-1.01)
TE	-	0.00 (0.17)	0.00 (0.02)	0.01 (0.47)	0.001 (0.11)	0.01 (0.29)	0.001 (0.16)
GAP	+	-0.01** (-2.07)	-0.01* (-1.94)	-0.01 (-1.66)	-0.01 (-0.84)	-0.01 (-1.49)	-0.01 (-1.05)
INTEXP	+	0.74*** (4.34)	0.74*** (4.41)	0.73*** (4.23)	0.63*** (6.27)	0.73*** (4.42)	0.62*** (4.69)
INV	-	-0.01 (-1.30)	-0.01 (-1.32)	-0.01 (-1.07)	-0.032*** (-3.72)	-0.01 (-1.25)	-0.03*** (-3.55)
LTA	+/-	-0.01** (-2.10)	-0.01** (-2.25)	-0.01** (-2.08)	-0.02*** (-4.18)	-0.01* (-1.86)	-0.01 (-0.60)
NONII	-	-0.09 (-0.55)	-0.10 (-0.59)	-0.10 (-0.61)	0.062 (0.50)	-0.10 (-0.63)	-0.13 (-1.02)
MGT	+/-	0.01 (0.38)	0.01 (0.44)	0.01 (0.27)	-0.01 (-0.37)	0.01 (0.28)	0.03 (1.28)
R-squared		0.84	0.84	0.84	0.90	0.84	0.94
Adj. R-Squared		0.80	0.80	0.80	0.87	0.80	0.91
S.E. of regression.		0.00	0.01	0.01	0.00	0.01	0.01
F Stats		20.21	20.58	21.2	19.53	20.45	21.03
Prob (F)		0.00	0.00	0.00	0.00	0.00	0.00
D.W. statistics		1.78	1.78	1.77	1.85	1.77	2.36

Notes:

1. Total risk exposure = f (LS, BSV)
2. Four different models of lending structure are analysed. Model 1(a)-(c) test the real estate lending, model 2 tests the stability of lending structure in short run, model 3 tests the specialization index and model 4 tests the stability of lending structure in medium term period.
3. White cross-section heteroskedasticity-consistent covariance matrix estimators are reported.
4. Figures in parentheses are t-statistics.
5. ***, **, * denotes significant at 1 %, 5% and 10% confidence level, respectively

With respect to the unsystematic risk exposure, VART is the only significant lending structure model as shown in Table 6(e). (Recall that a high value of VART indicate instability of lending structure). The inverse relationship of VART infers that the medium-term instability of lending structure reduces the unsystematic risk exposure. It implies that if a bank responds to the development of the economy by changing its lending structure, its ability to grab the business opportunities reduces its unsystematic risk (risk that is unique to individual banks, not to the whole banking industry).

CONCLUSION

In general, our findings indicate that lending structure to some extent affects the market, interest rate, and unsystematic risk exposure. For the market risk exposure, the stability of lending structure both in the short and medium-term period have significant impact in determining the market risk behavior of the Malaysian banks. Meanwhile, short-term lending structure stability is significant for long-term interest rate risk exposure and medium-term lending structure stability is significant for the unsystematic risk exposure. Out of the four lending structure models, it can be inferred that the stability factor of lending structure plays a significant role as opposed to real estate lending and lending concentration. Thus, the policy makers as well as regulatory bodies should be aware of the significant role of effective lending strategy as their decision to enforce policies, incentives, and guidelines on certain sectors may affect various types of bank risk exposures. Also, by knowing the impact of lending structure on various types of risk exposures,

TABLE 6(e). Results for unsystematic risk exposure

Independent variables	Expected Coefficient sign	Model 1(a)	Model 1(b)	Model 1(c)	Model 2	Model 3	Model 4
C		0.09** (2.30)	0.09** (2.57)	0.09** (2.23)	0.10*** (3.25)	0.08* (1.89)	0.08* (1.74)
BPS		0.01 (1.24)					
RE			0.01 (0.89)				
Risky Sectors				-0.01 (-0.04)			
LCC					0.01 (0.87)		
SPEC						-0.01 (-0.58)	
VART							-0.12** (-2.32)
TL	+	0.01 (0.67)	0.01 (0.56)	0.01 (0.68)	0.02** (2.34)	0.01 (0.56)	-0.01 (-0.77)
PLL	+	0.03 (0.41)	0.03 (0.55)	0.04 (0.56)	-0.02 (-0.40)	0.04 (0.62)	-0.04 (-0.54)
TE	-	-0.01 (-0.86)	-0.01 (-0.94)	-0.01 (-0.53)	-0.01 (-0.61)	-0.01 (-0.64)	0.01 (0.05)
GAP	+	-0.01 (-0.12)	-0.01 (-0.10)	-0.01 (-0.08)	-0.01 (-0.97)	0.01 (0.01)	-0.01* (-2.00)
INTEXP	+	0.32*** (2.94)	0.30*** (2.89)	0.30*** (2.73)	0.39*** (4.66)	0.30*** (2.93)	0.28*** (3.25)
INV	-	-0.01 (-0.51)	-0.01 (-0.44)	-0.01 (-0.26)	-0.01*** (-2.99)	-0.01 (-0.38)	-0.01* (-1.97)
LTA	+/-	-0.01** (-2.41)	-0.01** (-2.57)	-0.01** (-2.20)	-0.01*** (-3.42)	-0.01* (-1.75)	-0.01** (-2.03)
NONII	-	-0.19* (-1.73)	-0.20* (-1.78)	-0.19* (-1.73)	-0.10 (-0.96)	-0.20* (-1.67)	-0.03 (-0.47)
MGT	+/-	0.01 (1.12)	0.01 (1.26)	0.01 (1.22)	-0.00 (-0.48)	0.01 (1.27)	0.02 (1.64)
R-squared		0.86	0.86	0.85	0.89	0.86	0.93
Adj R-squared		0.83	0.83	0.82	0.86	0.83	0.90
S.E. of reg.		0.01	0.01	0.01	0.01	0.01	0.00
F Stats		19.46	19.30	18.54	21.20	18.90	20.69
Prob (F)		0.00	0.00	0.01	0.00	0.00	0.00
D.W.statistics		1.86	1.87	1.87	1.90	1.88	2.33

Notes:

1. Unsystematic risk exposure = f(LS, BSV)
2. Four different models of lending structure are analysed. Model 1(a)-(c) test the real estate lending, model 2 tests the stability of lending structure in short run, model 3 tests the specialization index and model 4 tests the stability of lending structure in medium term period.
3. White cross-section heteroskedasticity-consistent covariance matrix estimators are reported.
4. Figures in parentheses are t-statistics.
5. ***, **, * denotes significant at 1 %, 5% and 10% confidence level, respectively

bankers and investors can anticipate the degree of risk exposures that they are willing to undertake, thus helping them make accurate decisions. Last but not least, it is worthy to mention that lending structure may not only affect risk exposures, but it may also affect a bank's profitability, capital structure decision, and the degree of risk tolerance. Moreover, it may also influence the overall economic performance. Hence, when a bank is strategising its lending structure while focusing only on the risk aspect, it is not done in isolation. Instead, it involves a complicated process relating to profitability, capital structure, economic growth, etc. Therefore, studies on the relationship between the lending structure and the potential interactions of those variables can be an interesting avenue for future research.

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