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Are Thai Banks Vulnerable? : Structural Analysis of Bank Corporate Loan Portfolio and Implications

Don Nakonthab*

Krongkaeo Kritayakirana+

Sukonpat Chantapant+

*Monetary Policy Group and +Supervision Group

Bank of Thailand

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The views expressed in this paper are those of the authors and do not necessarily represent those of the BOT

Abstract

This paper attempts to gauge the vulnerability of the Thai banking system. Our analysis consists of three main areas. First, we use the publicly available information to construct a few basic financial ratios. Following a conventional analysis, we find that the industry is in reasonably good health and stability. Since the corporate loan portfolio constitutes the largest exposure within the banking sector, we focus the second part of our analysis on the structural risk profiles of these corporate loans. Using the Bank of Thailand's system-wide database, we document the default rates and default correlation matrices at both the aggregate (country portfolio) and the disaggregate levels with respect to size and industry, the two crudest but important credit risk drivers of a corporate loan portfolio. Last, we conduct an analysis of the loan pricing and estimate economic profits achieved by different banks in the last four years.

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1. Introduction

A decade after the 1997 financial crisis crippled the country's banking system for several years, Thai commercial banks have sprung back to life with significant improvements in profitability, asset quality, and risk management. A conventional financial ratio analysis shows an industry in reasonably good health and stability. **Although the level of non-performing loans remains somewhat high, there is no sign of systemic trouble in an immediate horizon.**

As informative as it is, a look at historical financial ratios or a set of financial soundness indicators alone does not provide a complete picture of vulnerabilities facing banks. To get supplementary information, a deeper analysis is warranted. There are several ways to go about this. At a higher level, one can construct pro forma financial statements and look at the projected financial ratios. This is the approach commonly taken by stock and credit analysts. At a more refined level within a bank, a risk manager may use risk models to arrive at the bank's market and credit values at risk. At the other end of the spectrum, system-wide stress testing, either top-down or bottom-up, can help bank supervisors identify potentially vulnerable banks and, as a part of macro-prudential surveillance, and assess the robustness of the banking system as a whole.

In this paper, we employ a database available to the Bank of Thailand to conduct a structural analysis of Thai commercial banks' corporate loan portfolios both over time and in cross section. Specifically, we compute historical default rates and empirical default correlations of Thai corporate obligors from their actual default history between 2000 to 2007 H1. The goal is to gain a deeper understanding of Thai banks' corporate-sector credit risk which is by far their most significant risk exposure. Though computed from historical data, default rates and empirical default correlations are two of the most fundamental metrics used to assess credit risk and, when viewed in relation to macroeconomic variables and banks' risk management practices, they can also provide us with a glimpse into the future. Additionally, we also investigate the extent of risk-based loan pricing in the Thai market. The data are analyzed at both the aggregate (country portfolio) and the disaggregate levels with respect to size and industry, the two crudest but important credit risk drivers of a corporate loan portfolio.

The rest of the paper is organized as follows. Section 2 provides an assessment of Thai banks' financial performance in 2007 H1 based on a conventional financial ratio analysis. A brief description of our data and the results from the analysis of the banks' corporate loan portfolio default risk are presented in Section 3. Section 4 discusses the analysis of loan pricing.

Implications for corporate, banks, and supervisory policy along with the conclusion are covered in Section 5.

2. Thai banks' performance in 2007 H1

After reaching their post-crisis peak performance in 2006[1], Thai commercial banks as a group hit a small bump on the road in 2007 H1. Table 1 shows simple averages of selected financial ratios of Thai commercial banks over the last twelve quarters. Relative to the same period in 2006, profits were down, costs were up, and the capital adequacy ratio declined. Although the average NPL ratio at the end of 2007 H1 was lower than that of 2006 H1, it was up noticeably from the end of 2006. These setbacks were due partly to the softening economy and partly to the IAS-39-related provisioning expenses that cut into banks' net profits. Nevertheless, as shown below, Thai banks as a group remain quite healthy.

Table 1 Key financial ratios of Thai commercial banks, 2004 Q3-2007 Q2 (percent)

	2004		2005				2006				2007	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Number of banks	12	12	12	12	13	14	14	14	14	14	14	14
Profitability												
ROA	1.40	1.25	1.54	1.48	1.48	1.36	1.45	1.33	1.27	0.77	1.06	0.51
PPP	1.30	1.75	1.91	1.86	1.90	1.85	2.20	2.08	2.05	1.88	1.89	1.99
NIM	2.50	2.55	2.76	2.77	2.86	2.85	3.15	3.15	3.16	3.16	3.07	3.13
Efficiency												
Cost-to-income	53.2	54.1	50.1	51.9	51.9	52.7	50.8	52.2	53.1	56.7	55.9	54.3
Operating expenses/avg. assets	1.97	2.05	1.92	2.00	2.05	2.06	2.27	2.27	2.32	2.47	2.41	2.37
Non-interest income/total income	24.8	25.3	22.0	21.9	21.5	21.0	21.3	18.9	18.5	17.9	17.3	17.9
Capital and asset quality												
CAR	12.2	11.9	12.4	12.7	13.2	13.2	13.3	13.4	14.3	13.6	13.9	12.9
Actual to required reserves	135	137	137	131	131	144	153	179	139	121	119	132
Gross NPL	12.6	11.9	11.9	11.5	11.1	9.1	9.1	9.1	8.9	8.1	8.2	8.5

Note: (1) Simple averages
(2) Annualized ratios for ROA, PPP, and operating expenses to averaged total assets
Source: Bank of Thailand website

Perhaps the most troubled figure is Thai banks' return on assets (ROA), which stood at a mere 0.51 percent in 2007 Q2. The last time Thai banks reported an ROA figure of that magnitude was back in 2002, when the industry was still in the early stage of recovery from the 1997 crisis. But to conclude that Thai banks are heading to trouble again based on ROA alone would be completely wrong. As opposed to ten years ago, the decline in the ROA of Thai banks this time was largely a result of IAS-39-compliant loan loss provision burden which will be over by the end of 2007. As Nakornthab (2007) points out, this temporary pain for Thai banks will in

[1] For a detailed assessment (including an analysis by subgroup) of Thai banks' performance in 2006, see Nakornthab (2007).

the end strengthen their financial positions through a greater provision buffer against impaired assets.

For analysts, the ratio of pre-provision profit (PPP) to average total assets must be analyzed together with the ROA. By this measure, Thai banks' profitability remains robust. Though lower than the 2006 figure, the average PPP of Thai banks in the first half of 2007 was higher than those recorded in 2005.[2] More importantly, Thai banks' PPP of around two percent stood up well to the international comparison. Underlying the strength in PPP was the robust net interest margin (NIM) which appeared to have been quite immune to the softening economy.

On the efficiency front, Thai banks' average cost-to-income ratio improved consecutively from 2006 Q4. The improvements in the cost-to-income ratio were aided by the decline in banks' operating expenses. Compared to the same period of 2006, however, both the cost-to-income ratio and the ratio of operating expenses to average assets of Thai banks worsened, reflecting increases in employee expenses and investment in systems and networks necessary to improve efficiency and competitiveness.. Nevertheless, the cost-to-income ratio of 54-56% is within the international norm.

A potential concern for Thai banks in this area is the downward trend in the ratio of non-interest income to total income. Although the rise in the proportion of interest income more or less parallels to the interest rate cycle, the fact that nearly 90% of bank's total income now comes from interest income means that banks are particularly vulnerable to the deterioration of their loan portfolios.

In terms of solvency, the average capital adequacy ratio (CAR) of fourteen Thai commercial banks declined from 13.6 at the end of 2006 to 12.9 at the end of June 2007. Nevertheless, this average CAR remains well above the 8.5% regulatory requirement. The high level of regulatory capital should give Thai banks a protection for most adverse circumstances as well as a comfortable room to meet the additional capital requirement under the Basel II Capital Accord, ensuring a smooth transition to the new capital regime.

The other ratio that looks comforting as well is the ratio of actual reserves to required reserves. The dramatic drop-off of this ratio in 2006 Q3 was simply a reflection of the additional

[2] Technically, 2005 and 2007 ratios cannot be directly compared, for the underlying numbers of banks are different. In the case of Thai banks' PPP, it turns out however that the same conclusion is reached when we exclude the merged and new banks.

loan loss provision burden under IAS 39 and not a cause for concern. This ratio is expected to increase further as banks reach full compliance with IAS 39 by the end of 2007.

On the other hand, after declining for several years, Thai bank's gross NPL rose slightly in 2007, reaching 8.5% of total loans at the end of the second quarter. The rise in the NPL ratio reflects the softening economic condition that has been putting pressure on both new and reentry NPLs. In terms of "net NPLs" which do not count NPLs that have been fully provisioned, the ratio is lower at 4.8%, but also represents a slight pickup from the end of 2006. The persistently high level of NPLs has been an Achilles' heel of Thai banks, weighing down their profits through enormous carrying costs and keeping pressure on their credit ratings. Nevertheless, Kasikorn Research Center (2007) points out that, to reduce IAS-39 provision burden, banks may choose to transfer a substantial amount of their NPLs to asset management companies (AMCs), which in turn will lower the ratio of gross NPLs and net NPLs to around 5% and 2%, respectively.[3]

To summarize, while the key financial ratios of Thai banks in 2007 H1 may not be as good as those in 2006, the differences appear to be quite minor especially after taking into account the concurrent macroeconomic and regulatory environments. If anything, these ratios point to an industry in good health and stability. There appears to be no sign of systemic trouble in an immediate horizon.[4]

3. An analysis of default risks of Thai banks' corporate loan portfolios

Despite its useful implications, an analysis of current profitability and financial ratios described in the previous section generally falls short of giving a complete picture of vulnerabilities facing banks especially over the long run. In the cases of Thai financial institutions prior to the crisis, a look at the ratios alone had led us to a conclusion of a robust and thriving banking industry. For example, the average PPP, NIM, and cost-to-income of fifteen Thai banks (including the then-already-in-trouble Bangkok Bank of Commerce) for 1996 were

[3] A major caveat is that, for banks with their own AMCs (five largest private banks do), such NPL transfers merely represent a shift from a direct exposure on their loan books to an indirect exposure through their subsidiaries. To the extent that their AMCs make losses from the transferred loans, they will have to realize these losses on consolidation basis too.

[4] Admittedly, there are variations in Thai commercial banks' financial performance. An analysis at the individual bank level by Nakornthab (2007) suggests that some Thai banks are more vulnerable to an economic downturn and further financial sector liberalization than the others. Nevertheless, even after taking that into account, the likelihood of a systemic trouble in the near term is very limited.

2.5%, 3.5%, and 44%, respectively (data from Krungthai Bank, 1997). These ratios overstated the true profitability and efficiency of Thai banks during the period due to the then lax credit decision and risk management processes which had led to a large amount of accumulated unrealized impaired assets hidden in the system.

To gain a better understanding of Thai banks' vulnerabilities, this section probes deeper into the default risk of Thai banks' corporate loan portfolios. Using the Bank of Thailand's internal database, we compute historical default rates of Thai corporate borrowers from 2000 to 2007 H1 and empirical default correlations from 2000 to 2006. Absent risk models, historical default rates are the best proxies for the probabilities of default (PDs). Theoretically, when correctly measured over multiple business cycles, PDs provides us with the most important ingredient in the calculation of the risk level of doing credit business.

Unlike NPL rates, historical default rates allow us to investigate banks' portfolio vulnerabilities without being distorted by the legacy non-performing loans and their discretionary policies on NPL write-offs and transfers to AMCs. A significant portion of the legacy NPLs consists of debt-restructured companies, usually without sound fundamentals, that become insolvent again and again, causing the NPL level to rise and fall in an unpredictable pattern. The historical default rate minimizes such fluctuation impacts since debt-restructured companies that have not been performing for at least one year are by definition excluded from the default rate calculation. More importantly, the historical default rates are the measure used widely in the industry, thereby providing us with an alternative benchmarking tool.

In addition, it is important to note that the analysis in this paper is an attempt to gauge the stability of the Thai banking system into the future, rather than mixing it with the problems from the past. We intentionally use the default rates rather than levels of NPLs because we do not want the legacy NPLs from the crisis period to stain our analysis. Not that the remaining NPLs should not be resolved, but the skills for managing existing NPLs differ vastly from the skills needed for screening bad risks and preventing credit losses. Going forward, it is the latter skills, aside from economic conditions, that will affect the default rates, which will determine the health of the Thai banking system in the long run.

In the subsections that follow, Thai banks' historical default rates will be computed in three different dimensions: (i) overall default rates of the country portfolio of existing good loans, (ii) default rates by business sector, and (iii) default rates by exposure sizes. A number of

policy implications for both banks and supervisors will then be drawn from the findings in this section.

3.1 The data

The main database used in this study comes from the Data Management System (DMS) project, originated and implemented by the Bank of Thailand's Data Management Department since the last quarter of 2003. The DMS database contains comprehensive information of financial institutions, financial markets and the economy.[5] This project has been critical in enhancing operational efficiency for both supervisors and financial institutions since all regulatory reports are now submitted in an electronic form, making compiling and analyzing data quite simple.

The study makes use of the loan arrangement dataset (DS_LAR) of large corporate with a total credit line above 20 million Baht within a single bank. Financial institutions under the Bank of Thailand's supervision are required to report the facility-by-facility information on a monthly basis.[6] The dataset contains detailed information from the year 2003 onwards of more than 240,000 loan facilities belonging to 23,000 corporate, with exposure totaling 3,100 billion Baht as of December 2006. The data prior to 2003 (an inception of DMS system) comes from TB4 and TB9 regulatory reports, which provide information on loan arrangement of corporate with total credit line above 5 million Baht within the same bank[7]. We believe that the data prior to DMS could be quite incomplete in the electronic format available to us. However, if there is no bias in the missing data, the default rates of all other years should be sufficiently reliable figures.

3.2 Definition of default and computation of default rate

An obligor is flagged default if there is one loan facility being classified as sub-standard or lower according to the BOT loan classification guideline, whose identification is based on either the past-due delinquency status of at least 90 days or any of the qualitative criteria for default status (e.g., obvious inability to pay, poor cash flow projection, or bankruptcy, etc.). In

[5] For more information on DMS project, please see http://www.bot.or.th.
[6] Thai commercial banks, foreign bank's subsidiary, foreign branches and finance companies, in total 43 institutions, as of December 2006, submits data to this dataset.
[7] Significant efforts have been made to align data from the two sources together and to construct a time series of historical default rate of Thai corporate. Because the data reveals that around 80 percents of the corporate borrowers are one bank customer (median of 1 and mean of 1.4), we decide as our first cut to retain obligors with aggregated outstanding across all institutions of more than 20 millions baht in this study. However, there are a large number of companies with less than 100 percent limit utilization that hence would be lost from the study. We address this issue by keeping those with outstanding less than 20 millions baht if they appeared in our DMS database later on.

the case that the obligor has loan facilities with several institutions, the lowest classification class and a default status is assigned accordingly. One should keep in mind that, this is a very conservative approach in default flagging and the results may have to be interpreted with caution. Default status is checked both at half year and at the end of year to ensure that any corporate which default early in the year but become solvent prior to yearend is captured as default events.

The default rate is computed and reported in this paper in two ways, with a different interpretation for each of them. The first one is the headcount default rate[8] or simply the default rate or DR for short-hand notation. Following the methodology used by S&P and Moody's to calculate historical default rates of corporate bonds, we compute DR as a ratio of the number of new defaults in a given year to the number of non-default borrowers at the beginning of that year.[9] New loans in any given year will be included in the following year's pool of good loan. A 2% DR would therefore indicate that two out of 100 obligors in our sample have defaulted over one year. Thus, DR should provide the best feel of the "rank order" of default risks among sectors or size segments within our economy in a given year.

The second type of default rate is also known as the loss rate (LR). This is the overall default rate based on the exposures of the defaulted facilities. A 2% LR would indicate that two out of every 100 baht went to default over one year. As the size distributions of our obligors in the sample are not homogenous, i.e., borrowers in our sample have varying outstanding loan balances, weighing the overall default rates by exposure sizes will give us a better picture of the system vulnerabilities. Consider an extreme example of a portfolio with 100 borrowers, one with 1 billion Baht outstanding and the other 99 with an exposure of one million Baht each. The difference between the default rates (DR) and the loss rates (LR) will be very substantial in two incidents: 1) only the large company defaults; and 2) all 99 small companies default. The default rates (DR) are 1% and 99% for respective incidents. However, the loss rates (LR) are 91% in the first incident and only 9% for the latter case. It will be the first incident that destroys the portfolio value almost completely, not the second. Therefore, the LR gives us a more accurate picture of how vulnerable the system is to the large borrowers.

[8] The headcount default rate is sometimes referred to as an incidence-based (as opposed to exposure-based) default rate.

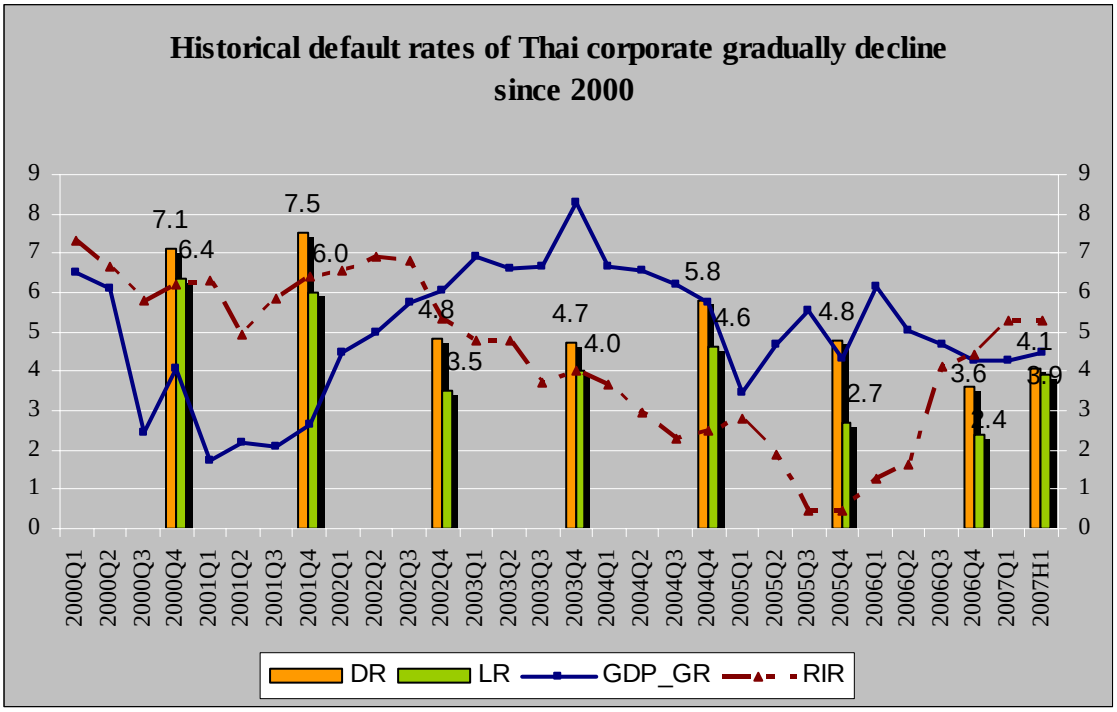
[9] Thus, our default rates correspond to default incidences during each calendar year. The exception is the 2007 H1 default rate which is an annualized figure of half-year defaults..

3.3 Historical default rates of the country portfolio

Figure 1 highlights the declining trend in default rates of Thai corporate obligors in both measures between 2000 and 2006, before picking up in 2007 H1. The default rates (DR) fall from 7.1% in 2000 to 4.7% in 2003 and 3.6% in 2006. The relatively high default rates at the beginning of the study period could be attributed to the lasting effects of the 1997 financial crisis. In any aspect, these have reflected a marked improvement in Thai corporate portfolio quality. Additionally, the loss rates (LR) followed a similar declining trend with DR, suggesting that the overall loss rate of the Thai corporate credit portfolio has also been significantly decreased. Note that the fact that the LR has been consistently lower than DR means that the defaulted loans are on average of smaller sizes than the non-defaulted ones.

Given the sharp drop-off in both the DR and the LR in 2005 and 2006, it is not a coincidence that banks' net interest margin (NIM) and net profit have significantly surged especially in these two years. In short, the Thai real sectors have been doing well and able to meet their debt obligations, contributing to relatively good years for Thai banks.

Figure 1. Historical default and loss rates of Thai corporate obligors, 2000 to 2007 H1



Source: NESDB; BOT; authors' calculation

Figure 1 also shows the y-o-y growth rate of the real GDP and the level of real interest rate RIR (calculated as MLR deflated by the headline CPI) from 2000 Q1 to 2007 H1. An internal study conducted by the Bank of Thailand's Supervision Group using a dynamic fixed-effect panel data estimation finds that the two macroeconomics variables can explain and

forecast Thai banks' NPL rates reasonably well. In particular, NPLs tend to fall with real GDP growth, but rise with RIR with one-quarter lag. The figure also indicates that the same pattern seems to be the case for both the DR and the LR as well.

With only eight time observations (2000-2007 H1)[10], the best way to assess how the DR and the LR statistically relate to the macroeconomy is through bivariate correlation analysis. Table 2 shows correlation coefficients of the DR and the LR with contemporaneous and lagged values of real GDP growth and RIR. The signs of the contemporaneous correlation coefficients confirm what we get from eyeballing Figure 1 although only the correlation between the LR and the RIR is significant statistically.[11]

Both the DR and the LR exhibit virtually no relationship with lagged GDP growth, suggesting that the impact of economic condition on default is immediately felt within the same period. Given the annual frequency of the underlying data, this does not appear very surprising. On the other hand, both the DR and the LR strongly correlate with the lagged RIR. Together with the fact the interest rates often move in cycle, RIR may be a leading indicator of overall corporate default risk.

Table 2. Correlation coefficients of historical default rates with real GDP growth and RIR, 2000 -2007 H1 (annual data)

	GDP_GR	RIR	GDP(-1)	RIR(-1)
DR	-0.45	0.46	0.05	0.77*
LR	-0.33	0.64*	0.01	0.82**

Note: * significant at 5% level; ** significant at 1% level

Beyond macroeconomic factors, **better risk management by Thai banks has also played a crucial role in bringing down the default rates**. A supervisory review by the Bank of Thailand shows that Thai banks' risk management capabilities have improved markedly in recent years. Among the visible changes are significant developments in the banks' internal rating system, greater emphasis on borrowers' ability to pay rather than value of a collateral, and a separation between relationship managers and risk unit to minimize a conflict of interest in the loan approval process. These improvements enable the Thai banks to become more effective at

[10] In principle, we could generate a one-year default rate for every quarter by moving the base year quarter by quarter. For example, a one-year default rate for 2006 Q2 would correspond to default incidences from 2006 Q2 through 2007 Q1. However, due to significant computation costs involved, we leave that for future study and note that both S&P and Moody's also report their historical default rates in year rather than in quarter.

[11] The critical correlation values at 5% and 1% significance level equal to 57% and 79%, respectively (one-sided t-test, degree of freedom = 6). The readers should keep in mind however that a variable with low correlation with a dependent variable may possess a good explanatory power in a well specified regression model.

discriminating good from bad borrowers which in turn contribute to a better credit quality of their portfolios.

3.4 Default rates by business sector

Sectoral exposures are classified according to the ISIC-BOT system (Appendix I). The ISIC code for each loan facility is coded by financial institutions themselves. For corporate with a range of business activities, the representative ISIC code is assigned to be its business sector with the largest aggregate outstanding.

Table 4 provides a breakdown of sectoral exposures and the number of observations in each business sector. The largest exposure is the manufacturing (M) sector, followed by the wholesale and retail sale sector (W) and the real estate sector (R) of 42%, 18% and 10% respectively. Financial intermediation (F) as well as transport, storage and transportations (T), which include telecommunication businesses, have also a sizable exposure in the system. In aggregate, the banks' exposure towards these five sectors accounts for 85% of the total corporate portfolio.

Table 4. Exposures by ISIC business sector

	Average DMS	Percents	
ISIC	**ISIC Description**	**Exposures**	**Observations**
M	Manufacturing	42	41
W	Wholesale and Retail Sale	18	26
R	Real Estate Activities	10	11
F	Financial Intermediation+	8	2
T	Transport, Storage and Transportation	7	3
H	Hotel and Restaurants	5	6
C	Construction	3	5
E	Electricity, Gas and Water Supply	3	1
Y	Agriculture, Fishing and Mining	1	2
Others		2	3
Sum		100	100

Note: + Exclude interbank transaction. Holding company is in sector F
Source: BOT-DMS and author's calculation

In terms of the number of observations, a majority of large corporate belong to manufacturing sector (M) and wholesale and retail sector (W) at 41% and 26% respectively. Real estate (R), hotel (H) and construction (C) sectors account for 11%, 6% and 5% respectively. In aggregate, over 90% of large corporate belongs to these five sectors.

Using the same default rate definition and computation method, we find a similar downward trend of default rates for all sectors.[12] On average, the levels of exposure-weighted default rates (LR) are lower than the default rates (DR), reaffirming that the defaulted loans are on average of smaller sizes than the non-defaulted ones in all sectors.

Certain sectors, however, exhibits a relatively higher level of default rates and degree of default rate variability than the others. These are the real estate sector (R), the construction sector (C), and primary industry like agriculture, fishing, and mining (Y). Given the nature of these industries, their relatively higher default rates are in line with general expectations. Even then, there has also been a clear downward trend in the default rates in these industries.

Table 5 shows how the default rates of Thai banks' three largest sectors correlate with the current and lagged value of real GDP growth, with the manufacturing sector being the most sensitive to economic condition. For DR, the signs of these correlation coefficients of the three exposures are the same at the country-level portfolio. All three sectors also react strongly with current and lagged values of RIR.

In terms of the LR, correlations with the lagged value of the RIR are highly pronounced for the manufacturing sector and a bit less so for the wholesale and retail sector. Somewhat unexpectedly, the real estate sector seems to bear the correlation with the two macroeconomic variables. The correlation with lagged value of GDP even goes the other way. Though statistically significant at 5% level, we think that it is a small sample bias that causes this result rather than some perverse relationship.

Table 5. Correlation of sectoral default rates with GDP growth and RIR, 2000 - 2007 H1 (annual data)

DR	GDP	RIR	GDP(-1)	RIR(-1)
All	-0.45	0.46	0.05	0.77*
M	-0.63*	0.58*	0.02	0.64*
W	-0.28	0.57	0.02	0.86**
R	-0.20	0.13	0.39	0.56*

LR	GDP	RIR	GDP(-1)	RIR(-1)
All	-0.33	0.64*	0.01	0.82**
M	-0.34	0.76*	-0.42	0.88**
W	0.20	0.59*	-0.01	0.58*
R	0.15	-0.14	0.63*	0.17

Note: * significant at 5% level; ** significant at 1% level

[12] Due to a small sample size bias for the majority of the sectors and the fact that we are unable to cross check the consistency of ISIC information inputted by financial institutions, we decide not to disclose the exact default rate figure by sector here. To disclose not-thoroughly-checked results would give a distort picture regarding key driver of industry's risk in the Thai banks' corporate portfolio.

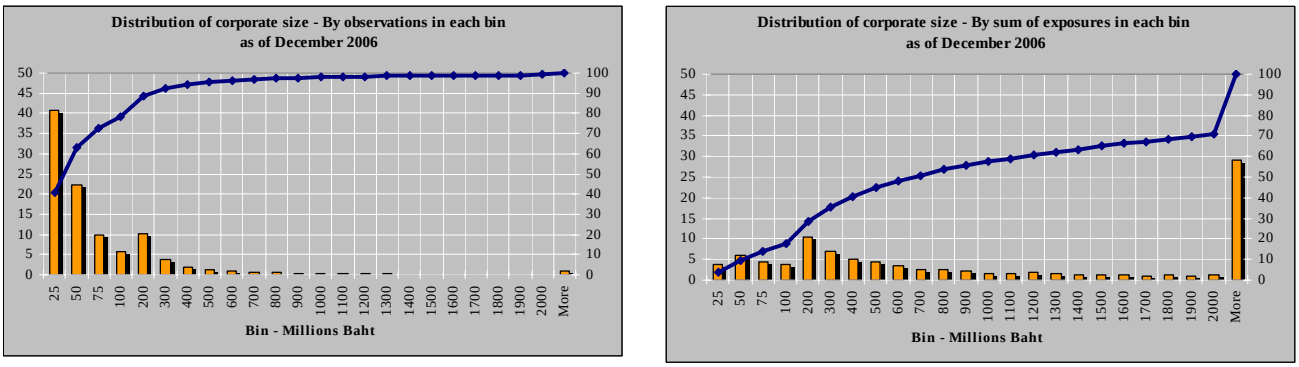
3.5. Default rates by loan sizes

In credit business, size matters because it affects both the likelihood of the defaults and the magnitude of the loss impact on the system. Several proxies are candidates for representing the size of the borrowers, such as assets size, sales size, and exposure size. Due to data limitations from the corporate financial statements, the aggregate limit exposure belonging to the same obligor in the system, summing across all banks, is our choice as a size proxy.

Borrowers are classified into 3 size segments according to their total exposures. The smallest (S) segment includes firms with total exposures no larger than 75 million Baht. The medium (M) segment's exposures fall in the range 75-500 million Baht. The rest of the companies with exposures of more than 500 million Baht belong to the large (L) segment.

Figure 2 provides a distribution of total exposures in December 2006. Small corporate (S) accounts for 73 percents of total firms and 14% of outstanding exposures. The medium firms (M) account for 23% of the headcounts and 31% of the exposures. Last, large corporate (L) represents 5% and 55% of firms and exposures respectively.

Figure 2. 2006 country portfolio distribution by size



Source: BOT-DMS and authors' calculation

The results of default rates by loan sizes for each year are shown in Table 7. Consistent with the aggregate trend of the system, the overall default rates have continually come down for each size segment. In the largest segment (L), the DR has come down most dramatically, from 10.7% in 2000 to 8.9% in 2003, with a further reduction to 3.3% in 2006, but went back up to 6.6% in the first half of 2007. At the other end of the spectrum, the smallest firms (S) have experienced the slowest decline in DR, from 6.3% in 2000 to 3.4% in 2006. Medium-sized firms have experienced the same trend with the rate of the DR decline being in between S and L.

One unexpected result here is that, on average, the default rates (DR) of the smallest segment (S) are also the smallest among the three size segments. A conventional credit analysis

will generally expect larger firms to have deeper pockets and more access to sources of financing, and hence, less default rates in general. We do not believe that Thai firms diverge from this convention. Rather, the surprising findings could be a result of a few plausible explanations. First, unlike small firms which are usually one-bank customers, larger firms have business relationship with many banks using a large number of facilities. Given our conservative default flagging definition, there is generally a higher probability that larger firms will be picked up as defaults even though the event may be caused by short-term mismanagement rather than insolvency problem. Second, the selected cut-off point may not reflect the true default characteristics of firms with different sizes. In particular, our large segment may not yet be truly large. Third, it could be that smaller businesses had not been the center target of a bank's business strategy. Hence, only the best of the small firms have been served by the banks. Many Thai banks have already decided to take advantage of this underserved market segment by the announcing of significant growth in SME lending.

Although the DR trend is clearly changing into the expected direction, one should further check these unexpectedly low default rates among firms in the smallest segment (S) by considering the exposure-weighted default rates (LR) as reported in Table 6 panel B. After giving exposure weights to the default rates, we see that the loss rates inversely vary with size, more in line with our expectations. On average, the loss rates in the smallest (S) segment are the largest, while those in the largest (L) segment are the lowest. This relationship is more consistent with the default pattern of businesses throughout the world. Lower loss rates of the larger (L) businesses also confirm the declining vulnerabilities in the system as well because it takes fewer defaults of large firms to hurt the health of a banking system.

Table 6. Default rates by loan size

Panel A : DR			
Year	**0-75MM**	**75-500**	**500+**
2000	6.3%	8.6%	10.7%
2001	6.5%	9.0%	13.1%
2002	4.2%	5.8%	6.7%
2003	3.4%	5.5%	8.9%
2004	5.1%	7.5%	6.6%
2005	3.6%	4.9%	5.4%
2006	3.4%	4.3%	3.3%
2007H1	4.4%	6.3%	6.6%

Panel B : LR			
Year	**0-75MM**	**75-500**	**500+**
2000	6.0%	6.1%	6.7%
2001	6.1%	5.7%	6.1%
2002	3.7%	3.7%	3.4%
2003	2.6%	3.1%	4.5%
2004	4.8%	5.2%	4.3%
2005	3.9%	3.7%	2.1%
2006	3.2%	2.7%	2.1%
2007H1	4.3%	3.8%	3.5%

Source: authors' calculation

Table 7 shows that default rates of small (0-75M) corporate obligors are more sensitive to economic condition as measured by their correlation with real GDP growth. At the other end of the spectrum, default rates of the large (500+) obligors seem to be less invariant to economic condition. However, given a short time series of the data, one should be careful in drawing a conclusive interpretation of this result.

All three size portfolios bear statistically significant correlation with RIR even though the country portfolio does not. This suggests that there are some portfolio diversification benefits at play. Somewhat surprisingly, as the size of loan portfolio becomes larger, the correlation of its default rate with the real interest rate increases. The 500+ portfolio, in particular, exhibits the strongest correlation to both the current and the lagged values of RIR.

Table 7. Correlation of default rates by loan size with GDP growth and RIR, 2000 – 2007 H1 (annual data)

DR	GDP	RIR	GDP(-1)	RIR(-1)
All	-0.45	0.46	0.05	0.77*
0-75M	-0.57*	0.58*	-0.03	0.65*
75-500	-0.44	0.58*	0.07	0.71**
500+	-0.42	0.64*	-0.09	0.82**

LR	GDP	RIR	GDP(-1)	RIR(-1)
All	-0.33	0.64*	0.01	0.82**
0-75M	-0.66*	0.43	0.07	0.50
75-500	-0.43	0.42	0.17	0.65*
500+	-0.23	0.68*	-0.05	0.88**

Note: * significant at 5% level; ** significant at 1% level

3.6 Empirical default correlation

Many Thai businesses are intertwined. When a company is unable to make payments to its counterparts, some of them may start to experience difficulties meeting their payments as well. During the 1997 crisis, we saw a contagion of credit defaults. Understanding default correlations between sectors or size segments are thus very crucial for regulators and banks.

Unlike most credit portfolio models which assume a correlation structure in order to gauge the vulnerability of a portfolio, we try to empirically estimate default correlation matrices using the default history in Thai corporate portfolio from 2000-2006. The correlation measure adopted in this paper is called the "binomial correlation measure," as used by recognized rating agencies (de Servigny and Renault, 2002). The idea is that if the observed joint default probability of corporate in sector A and B is greater than product of a probability of default of corporate in sector A and probability of default of corporate in sector B, in other words the joint probability under the independent assumption, then there exists positive correlation between default event of these two sectors.

Before getting into our analysis, we would like to caution a direct interpretation of these low correlation numbers. Because a credit business is highly dependent on the overall economic

conditions of an economy, default correlations are usually not constant. The correlation numbers usually vary positively with the severity of the economic recessions. Since our observation period is from 2000-2006, a relatively short time span during expansion years for the Thai economy, the authors do not wish to have these correlation numbers be interpreted at the "absolute" level. Rather, we focus on the interesting patterns that we see here.

Table 8 reports an empirical default correlation matrix between all the sectors. We see that the correlations at the absolute level are very low, especially when compared to US experiences where more than half of the correlations are over one percent[13]. As expected, most large positive correlations are found within a given industry (diagonal). The default events in the real estate sector (R) appear to have the largest impact across all sectors, measured by the sum of default correlations.

Table 8 Empirical default correlation between sectors

Empirical Default Correlation (DR)										
	M	**W**	**R**	**F**	**T**	**H**	**C**	**E**	**Y**	**Other**
M	0.3%	0.3%	0.3%	0.6%	0.2%	0.3%	0.3%	-0.4%	0.4%	0.3%
W	0.3%	0.3%	0.3%	0.5%	0.2%	0.3%	0.3%	-0.2%	0.4%	0.4%
R	0.3%	0.3%	0.5%	0.6%	0.3%	0.4%	0.5%	-0.4%	0.5%	0.2%
F	0.6%	0.5%	0.6%	1.7%	0.3%	0.9%	0.8%	-1.2%	1.0%	0.6%
T	0.2%	0.2%	0.3%	0.3%	0.3%	0.2%	0.3%	0.0%	0.4%	0.1%
H	0.3%	0.3%	0.4%	0.9%	0.2%	0.6%	0.5%	-0.7%	0.5%	0.4%
C	0.3%	0.3%	0.5%	0.8%	0.3%	0.5%	0.5%	-0.7%	0.5%	0.4%
E	-0.4%	-0.2%	-0.4%	-1.2%	0.0%	-0.7%	-0.7%	2.3%	-0.5%	-0.6%
Y	0.4%	0.4%	0.5%	1.0%	0.4%	0.5%	0.5%	-0.5%	1.1%	-0.1%
Other	0.3%	0.4%	0.2%	0.6%	0.1%	0.4%	0.4%	-0.6%	-0.1%	1.1%

Source: authors' calculation

Next, we report default correlations by size segments in Table 9. We do not see any strong pattern in the correlations here. However, since defaults are likely to spread within the same sector first, we further check for default correlations among firms within the same sector, dissected into three size segments.

Table 9. Empirical default correlation between corporate with different sizes

Empirical Default Correlation (DR)			
	0-75MM	**75-500**	**500+**
0-75MM	0.3%	0.4%	0.5%
75-500	0.4%	0.5%	0.7%
500+	0.5%	0.7%	1.4%

Source: authors' calculation

[13] See de Servigny and Renault (2002).

Finally, Table 10 shows that large firms are more correlated with one another than small firms, given the same sector. Companies in the Manufacturing sector (M) have the largest correlations among larger firms. The stronger correlation among larger firms is consistent with one of the main assumptions of Basel II framework. The prescribed capital calculation allows for reductions in asset correlations used for small businesses. The Basel Committee believes that large corporate is more correlated with one another than the smaller ones in the G-10 economies. The correlation pattern we find confirms the validity of this assumption in the Thai context.

As the regulator collects longer series of default history, these default correlation matrices should provide banks and regulators with a more powerful tool to monitor the respective credit portfolio quality, especially for managing credit concentrations. Banks and regulators will be able to identify vulnerable areas with respect to different types of macro or micro shocks to the economy. Banks with concentrated exposures in the sectors or segments with smaller correlations will be less vulnerable than if they are in the sectors or segments with a high level of default correlations.

Table 10. Default correlation by key sector and size

		Empirical Default Correlation (DR)								
		Manufacturing (M)			Wholesale and retail sale (W)			Real estate (R)		
		Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
M	Small	0.2%	0.4%	0.6%	0.3%	0.3%	0.5%	0.3%	0.3%	0.7%
	Medium	0.4%	0.6%	1.0%	0.4%	0.5%	0.8%	0.4%	0.3%	0.9%
	Large	0.6%	1.0%	**2.7%**	0.6%	0.5%	1.3%	0.4%	-0.3%	1.4%
W	Small	0.3%	0.4%	0.6%	0.3%	0.3%	0.6%	0.3%	0.3%	0.7%
	Medium	0.3%	0.5%	0.5%	0.3%	0.6%	1.0%	0.4%	0.5%	1.1%
	Large	0.5%	0.8%	1.3%	0.6%	1.0%	**2.1%**	0.5%	0.6%	1.9%
R	Small	0.3%	0.4%	0.4%	0.3%	0.4%	0.5%	0.4%	0.5%	0.8%
	Medium	0.3%	0.3%	-0.3%	0.3%	0.5%	0.6%	0.5%	1.2%	1.3%
	Large	0.7%	0.9%	1.4%	0.7%	1.1%	1.9%	0.8%	1.3%	**2.8%**

Source: authors' calculation

4. An analysis of Thai banks' risk pricing

The results from Section 3 should provide bankers with some useful benchmarks and regulator with additional surveillance tools. However, an analysis focusing only on the downside of the credit business tells us only a part of the story. This is because what matters for banks is not the risk or the return per se but the risk-adjusted return. Taking risks is the nature of the banking business, and the bottom line for banks is that these credit risks are well managed and compensated for. Incorporating the findings from Section 3 with how banks manage the risks and charge obligors according to their risks will thus be the focus of this section.

Badly battered by the 1997 crisis, Thai banks have come to understand that loan decisions are very crucial for their long-run survival and profitability throughout the business cycles. Prior to the crisis when asset price bubble prevailed, banks and finance companies focused on how the collaterals of the loans would cover the defaulted exposures more than on the obligors' ability to repay. The asset price slump coupled with the long and painful recovery process after the crisis have enlightened banks that it is imperative to prevent bad loans from entering their portfolios rather than to resolve them. As a result, every bank sees the need to adopt a "credit rating system" to help separate good risks from bad risks, facilitating their credit decisions and monitoring processes.

Unlike the retail credit which can be processed relatively easy with a well-calibrated credit scoring model, corporate lending decisions must be handled individually and usually requires a customized tool for each major category of businesses. There is no such thing as a one-size-fits-all credit rating system. The most advanced rating systems in the world always have customized tools for businesses in different sectors and size segments. The analysis of default rates in the previous section confirms the necessity to incorporate differences in sectors and size segments during the rating systems design.

Although it is always expensive and painful before the first set of a bank's internal rating system can function effectively, Thai banks are well aware of the benefits from having them and therefore are investing heavily in them. Ultimately, rating systems will not only help prevent bad risks from entering banks' portfolios, but also provide sophisticated banks with the tool to charge different premiums for different risks.

The ability to price the risk accurately depends critically on a stable and effective rating system. Since a few Thai banks today have had some forms of internal rating system for quite some time, a natural question to ask is whether they have been able to charge risk premiums according to risks. We incorporate additional data from the BOT-DMS database in order to answer this question[14].

The remaining of this section begins with an analysis of the pricing trend in the Thai portfolio. Then we focus on the rate differentials between defaulted and non-defaulted obligors (Subsections 4.2) along with the pricing differentials among sectors and size segments

[14] For years prior to DMS, the authors do not have data of the rates charged to individual facilities.

(Subsection 4.3-4.4). The last part of the analysis in this section (Subsection 4.5) presents a crude assessment of individual banks' economic profits from conducting the credit business.

4.1 Computation of portfolio lending rates and banks' costs of funds

In addition to the outstanding and limit exposures reported to the BOT, banks are required to also report the bounds of the interest rates that they may charge for each facility. In order to calculate the pricing for each facility, the mid point between the minimum and maximum rates is first computed as a proxy for the rate charged for that facility. Then, for each respective sample in the following tables, we calculate the exposure-weighted average of these mid points, rather than taking a simple average of mid-points of all facilities. The quantum average is chosen because it is a better estimate of the rate of interest income that banks make from issuing these corporate loans[15].

In addition to the rates, annual costs of funds for each bank in our sample are also computed. Using banks' monthly financial statements reported in the DMS, we estimate the costs of funds for these banks from three sources: deposits, inter-bank facilities, and other loans. The interest expense from each category is divided by the corresponding outstanding balance for each of the source. The overall annual costs of funds are then calculated by weighing each cost with the average total outstanding balance in each year.

4.2 Risk pricing in country portfolio

Table 12 reports the exposure-weighted interest rates charged in the Thai banking portfolio along with the LR rates from 2003-2007 H1. We begin with the discussion of a few noteworthy observations of the pricing trend in the market. During the period shown, the overall rate charged by Thai banks consistently exceeded the LR rates. A deeper look at the data reveals that the gap between the overall lending rate and the LR rate had widened sharply in 2005 and 2006 before dropping off a bit in 2007 H1, consistent with the trend of Thai banks' profitability observed in Table 1. Nevertheless, the readers should be aware that the difference between the two rates does not translate directly into the profitability of the bank. Using the rule of thumb for banking business, when the interest charged is below the default rate, banks are most likely making losses. To assess banks' profitability in making loans, one would need some additional information on the costs of funds and operating costs. In the case of Thai banks, the former has been moving up roughly in line (with some lag) with the interest rate trend while the latter has

[15] We also have done the analysis by taking the simple averages of these midpoints and found that the results of the analysis remain largely the same.

been creeping up during the past couple of years. This means that Thai banks' profitability is likely lagged behind the widening gap. In Section 4.5, we will return to the issue of banks' profitability associated with the lending business in more detail.

The column denoted Defaulted in Table 12 refers to the average rates charged to the facilities that became default during each year and the column denoted Non-Defaulted refers to average rates charged to those that remain good loans throughout each period. Comparing the average rates in these two columns, defaulted obligors were charged higher rates than their non-defaulted peers, hinting the possibility that Thai banks are capable of discriminating ex-ante bad from good obligors.

Table 12. Pricing differences of good and bad risks

	LR	Pricing		
		Overall	Defaulted	Non-Defaulted
2003	4.0%	4.84	7.74	4.10
2004	4.6%	5.23	7.48	4.76
2005	2.7%	6.30	8.62	5.93
2006	2.4%	7.35	9.01	7.13
2007 H1	3.9%	6.67	8.69	6.39

Source: authors' calculation

Since the way we calculate the "defaulted" pricing in Table 12 could possibly be over-inflated by the unattainable reported penalty rates, we thus conduct a further analysis to test for this ex-ante pricing differentiability by banks. For each year, we limit our sample to only non-default loans. Then we separate the sample into two groups: one group contains borrowers that become defaulted in the following year; the other group consists of borrowers that remain good. Table 13 reports the rates charged to these two respective groups. For example, in 2003, the average rate charged to the good loans that become defaulted in 2004 is 5.15%. The "non-defaulted" column reports the average rate charged to those facilities that remain good in 2004, and the rate is equal to 4.03%. Table 13 shows that banks, on average, charge higher rates to the obligors that have a greater chance of default by about 1.2%, with the exception of the year 2004.

Table 13. Pricing differences of "predicted" good and bad risks

	Pricing		
	Overall	Defaulted	Non-Defaulted
2003	4.07	5.15	4.03
2004	4.87	5.23	4.85
2005	5.97	7.21	5.92
2006	6.98	8.20	6.94

Source: authors' calculation

There is also an important caveat with regards to the interest rate differentials. The table only summarizes the fact that there exists rate differentials between the good and bad risks posed to obligors by banks. However, one cannot infer the sufficiency of price differentiations of good and bad risks in the system. Nor that banks with lower rate differentials between the two groups will necessarily have lower ability to price the risks or profits. It depends on the risk appetite of each bank too.[16] We find that some banks show good economic profits but have minimal pricing differentials between the facilities that defaulted and the ones that did not. We believe that that is due to their low risk appetite for their portfolios. These banks prefer very low default rates and hence offer small price differentials because they only lend to the best possible customers with similarly attractive rates.

4.3 Risk pricing for different sectors

Section 3 suggests that sectors and sizes affect risks. So we check here whether on average there are rate differentials among sectors and size segments as well. Table 14 summarizes the interest rates charged for the three largest sectors – manufacturing (M), wholesale and retail (W), and real estate (R), from 2003 to 2007 H1.

Overall, the extent to which Thai banks price different sectors differently according to their risks is not clear. Despite the fact that manufacturing firms (M) have slightly higher default rates (actual figures not reported here) than wholesale and retail companies (W), there are little differences in the rates charged between these two sectors. The more significant result is that the Thai banking sector charge additional risk premium (relative to the other two sectors) of no larger than 1.5% on average. This is understandable since the Thai banking sector has suffered large loss from real estate loans during the crisis. Longer time series of data will tell us whether the rate differentials are sufficient for the additional risk premiums required in riskier sector. If the loss rates and the pricing gaps between these sectors remain as they have been over a complete business cycle going forward, we may find that the rate differentials among sectors are not quite enough to compensate for greater risks banks take in real estate businesses. Borrowers that are in less risky sectors are perhaps still subsidizing riskier businesses. However, this conclusion is purely a conjecture from the comparison of rates by the rule of thumb. We have incomplete information compared to each bank, which has its private information about the costs of funds and the operating costs for doing the lending businesses in each sector. Along the line of this logic, each bank should be able to answer this question more accurately than we can.

[16] For confidentiality reason, our analyses of interest rate differential by bank will not be reported here.

Table 14. Pricing differences in the largest sectors

	Sectors (Rates charged / Loss Rate)			
	Overall	**Manufacturing (M)**	**Wholesale & Retail (W)**	**Real Estate (R)**
2003	4.84	4.64	5.03	5.93
2004	5.23	5.10	5.06	6.46
2005	6.30	6.11	6.37	7.40
2006	7.35	7.37	7.52	8.10
2007 H1	6.67	6.73	6.78	7.56

Source: authors' calculation

4.4 Risk pricing for different loan sizes

The interest rates charged to firms of various exposures have a clearer pattern. Larger firms enjoy significantly lower rates than small firms do. The rate differentials between companies with large (L) and small (S) segments differ by over 2% during the periods of low interest rates with the medium segment somewhere in between. With one exception, the rates charged exceeded their respective LR rates. It is interesting to note that the rates charged to large companies seem to have climbed much faster than the rates charged to small companies over the years. One plausible explanation could be that the loss rates (LR) of firms in large segment (L) averaged to be not significantly smaller than those of the smallest segment (S).

Again, one cannot ignore how operating costs affect the final rates for providing funds for small businesses when compared to the larger ones. Doing many of the small deals requires a larger number of qualified relationship managers and credit analysts than doing "wholesale" deals with the large businesses. As the relative risks for larger segment has declined, and the operating costs for smaller firms remain larger, a conclusion about cross-subsidization among size segments seems to be less of an issue here.

Table 15. Pricing differences in the sizes

		Total Exposures (Rates charged / Loss Rate)		
Year	**Overall**	**0-75MM**	**75-500**	**500+**
2003	4.84	6.39	5.34	4.10
2004	5.23	6.75	5.88	4.40
2005	6.30	7.24	6.71	5.73
2006	7.35	8.37	7.79	6.82
2007 H1	6.67	7.82	7.10	6.14

Source: authors' calculation

4.5 Economic Profits from Doing Credit Businesses

Comparing loss rates (LR) to the interest rates charged to the borrowers in Sections 4.2-4.4 gives us some sense of how different risk profiles are priced in the market. This section attempts to get closer to the measure of the economic profit that banks are gaining from conducting the corporate lending business. In the credit business, if banks are not required to hold any capital against potential losses, economic profit from each deal can be crudely approximated by:

Economic Profit from the Deal (%) ≅ Interest rate charged (%)
- Costs of Capital (%)
- Expected Loss from that facility (%)
- Operating Costs from doing the deal (%)

In this section, we try to estimate economic profit of each bank. Therefore, interest rate charged is simply the exposure-weighted interest rate that we used in Sections 4.2-4.4, but calculated for each bank's portfolio. Costs of funds are computed for each bank following the description in Section 4.1.

Expected loss (EL) is the measure of credit risk level of the banks' portfolio. It is computed by multiplying loss rates (LR)[17] by an assumed level of loss given default (LGD)[18]. LGD is equal to one minus the recovery rate after a default event, and also is measured as a percentage. LGD is assumed to be at 50%[19] throughout the remaining of this paper. This is a common measure used for calculating risk premium that banks should get at the minimum in order to cover credit losses that are expected to be a part of the business.

Since the operating costs banks report in the profit and loss statements include all types of costs incurred in the bank, including costs from taking deposits and lending to both corporate and retail borrowers, banks should know best about their specifics. However, for the purpose of

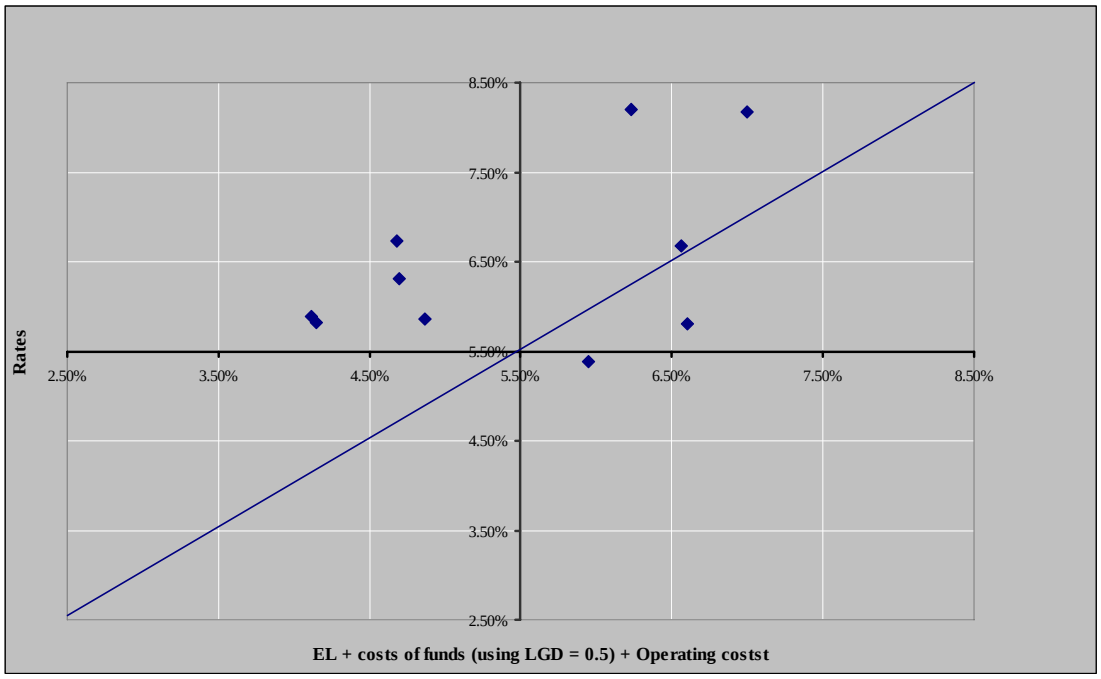
[17] For credit portfolio managers, LR is our best proxy for the Probability of Default (PD) as previously mentioned.
[18] LGD is the present value of the recovered cash flows after a default event, subtracted by the recovery costs. Usually, unless a borrower recovers through debt-restructuring program or becoming "cured" by itself, it takes a long time to go through a legal process and the NPV of the discounted cash flows are very low, especially in unsecured corporate facilities.

[19] The assumption of LGD at 50% is ten percent larger than the estimated LGD for the G-10 countries by the Basel Committee on Banking Supervision (BCBS). Since the legal and market infrastructure in the G-10 group is more favorable for creditors than that of the emerging markets, we believe that the estimated 50% LGD is a good approximation. We also check for the LGD being 30% and 70% and did not change the analysis in this section.

the analysis in this section, we assume that the costs of operations in credit business are the same across banks at the level of 1.5%.

We chose a subset of banks in our sample and plot the average interest rates charged in the years 2003-2006 against the sum of costs of funds and operations with EL, averaged over the same time period[20] in Figure 3. Banks that do not focus on corporate lending are excluded from the sample. Banks that are farthest away in the North-West direction are the most profitable ones. If we assume that operating costs are at about 1.50% per facility, with LGD at 50%, any bank that make it to the left side of the 45-degree line would have been operating profitably in the past three years. This plot suggests that the level of competitiveness of banks in the sub-sample varies quite significantly. If any bank would like to improve their long-run profitability, they should either work on lowering their funding or operating costs, or most importantly, lowering their EL by improving their internal risk management.

Figure 3 Plot of average interest rates charged against costs of credit business



In sum, Section 4 highlights the fact that the banking sector is growing more sophisticated in conducting their business according to risks. Not only can they screen risk better as suggested in Section 3, but they also have improved capabilities of pricing risks accordingly, as reflected in the increase in banks' profitability in recent years. In addition, although risk

[20] The analysis done for each year in the past 3 years yields a similar pattern.

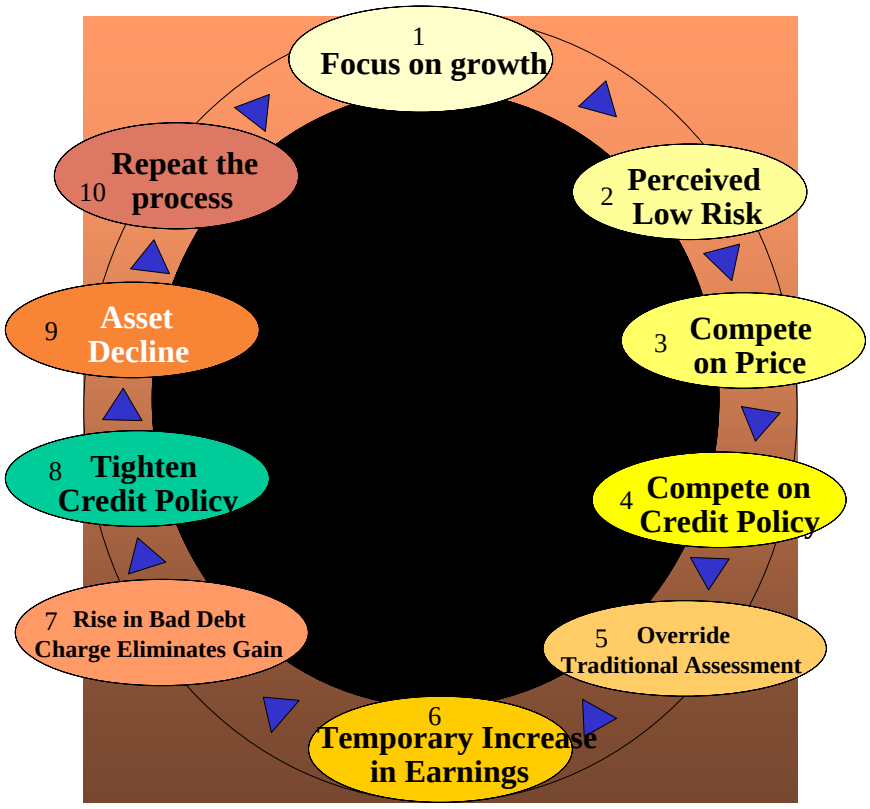
profiles vary by sector and size, a bank' profitability will not increase by excluding riskier segments. The enhanced profitability relies on how well banks exclude bad risks from within each segment as well as how they price their risks accordingly. That is why the development of a functioning internal rating system is at the heart of profitability in modern banking. The road to catch up with the industry best practice lies ahead for all the Thai banks, and harder work remains for some banks.

5. Implications and Conclusions

Fifteen years after the Raja Finance crisis in 1983, Thai banks suffered severely from the 1997 financial crisis. One remaining question is left to be answered, is the Thai banking sector immune from the repeated history? The analysis in this paper gives us reasons to believe the Thai banking sector is breaking free from this pattern. Banks in emerging market countries, including Thailand in the past, are often stuck in what is called the "doom loop," that results from asset growth for growth's sake (Forrest, 2001). Myopia, caused by poor risk management, leads to a perception of low risk during an economic expansion leads to price competition and easy credit policy that overrides prudent risk assessment. The temporary increase in earnings associated with asset growth is subsequently wiped out by the rise in bad debt charges associated with the downturn of the business cycle. At this stage, credit policy is tight and bank's asset base declines. As the situation improves, they fall back on the old ways of doing things of focusing on asset growth rather than risk-adjusted return and the vicious cycle is repeated again.

Overall, the results in this paper along with other anecdotal evidence suggest that the Thai banking system as a whole is breaking free from the systemic threat stemming from the doom loop. Since the year 2000, the Thai banking system began to recover and the economy started to pick up. Yet, most Thai banks seem to have learned an expensive lesson from the crisis and have held back from excessive growth of their credit portfolio. **Perhaps the most important change is the marked improvement in Thai banks' risk management**.

Figure 5. The "doom loop" of bank credit process



Source: Omega Performance Corporation

Going forward, only the banks themselves can determine the system's stability in the future, but the transition period for everyone will be harder if there remain less sophisticated banks which take advantage of the economic expansion to fuel their credit portfolio growth with hidden flaws. Although the credit business is very cyclical in nature, grandstanding short-term profitability by lending to "bubbled" businesses without genuine prospects will only amplify the severity of the problems of during the time of a recession. Therefore, banks with excessively lax credit policies and poor risk management will not do anyone a favor, not even themselves, over the long run. If a banking system has a consistently good credit discipline overall, the country's credit portfolio value should not deteriorate so drastically during a downturn. Then, the banking sector overall should not be more vulnerable to the business cycles more than other businesses.

Thus what worries us a bit is the fact there are variations in banks' abilities to discriminate good risks from bad risks and price accordingly, as evident from analysis in Section 4.5. Though the sector as a whole may be immune to the systemic problem, banks can not afford complacency especially in this volatile market environment. They must continue to improve their risk management capability into the future.

The burden to ensure the end of the doom loop lies on three parties: the banks and the regulator, and the corporate borrowers, especially the smaller and mid-sized companies, with the lion's share of the burden falling primarily on the first two

Let us begin with the corporate as its involvement is the least obvious. In this new coming risk-sensitive credit environment, the relationship between the banks and the borrowers will change. Due to the need to closely screen and monitor their obligors, which cannot be done at arm's length as in the past, bankers' relationship with the corporate will get closer to that of a business partner and advisor. Incidentally, it will affect smaller and mid-sized firms more than the large or listed ones. In order for bankers to know how their money will be spent and how their repayments can be secured, corporate clients are expected be professional, transparent, and disciplined. These characteristics are less prominent in small businesses. However, just like an exercise routine and healthy diets prescribed by your doctor, corporate that can achieve these characteristics is more likely to be healthy and thriving. Eventually, corporate that can adjust to this risk-sensitive environment will reap full benefit in terms of lower funding cost. Capital allocation in the system will become more efficient and the banking sector will suffer lower default rates in general.

Next, we focus in detail on the tasks to be achieved by the banks. Every bank realizes that they need to put in significant efforts in order to break free from the loop permanently. Yet, a desire to grow rapidly will always conflict with the interests to keep the credit risk in the portfolio down. This conflict starts at the CEO level, down to every credit officer within the bank. Therefore in order to ensure a sound risk management practice, its ownership should start, with delegations and monitoring, at the board level.

At the heart of a sound credit risk management system, data and relevant experiences must be recorded systematically. Therefore, if the significant increase in operating costs in these past few years has been from the spending on data and IT improvements to serve as the main infrastructure for improved credit risk management, then banks are heading in the right direction. However, banks have to bear in mind that achieving sound credit risk management practice is a long process that one cannot simply buy off the shelf. As discussed in Sections 3 and 4, every system must be customized to individual portfolios and business needs. Although knowledge and sophisticated techniques on modeling could be transferred from vendors and consultants, a lack of internal capacity to learn and adapt the system will soon prove the purchased solutions to be impractical.

Even after achieving a well-designed rating system for the bank, putting it to use is a challenging task[21]. The most evident use of a rating system is for loan origination. First, a rating system helps screen good risk from bad risks. Although risk profiles differ across sectors and sizes, it does not mean that banks must exclude any particular sector or size entirely. They simply must learn to turn down bad risks within each segment when they can never be sufficiently compensated for. Second, as we have mentioned, a rating system can be used in developing a pricing model. Insightful risk-return analyses have become the heart of the business strategy formation for the sophisticated banks. Risk managers are now at the forefront, as important as the relationship managers, as a determining factor for banks' profitability.

Corporate with marginally acceptable risk profiles should be handled with additional tools beyond a rating system such as underwriting policy and covenants. Bullet financing should be minimized while iron-clad covenants must be in place, closely monitored, and diligently enforced. Building a strong credit culture within a bank involves all the staff related to credit business, so all the risk management tools that the risk department introduces must gain general acceptance as a way to do business.

Lastly, as suggested by a potential structural shift of the loans made in the smallest sector (S), banks must be careful not to become over-aggressive in the newly discovered underserved segment. Relying on historical default and loss rates (DR or LR) in this case might provide a false sense of security about additional risks that may pose to the banks as the market in this segment expands. More importantly, for any new market that they get in, banks must ensure that they will have sufficient resources, risk management tools, and qualified credit officers, growing proportionately to the their market penetration rates in order to keep risk under control. Blindly yet aggressively growing in the unknown territory will likely result in portfolio damage as badly as taking excessive risks in the well-seasoned market.

The last of the three parties responsible for ending the doom loop is the regulator. In Thailand, the BOT has adopted risk-based supervision[22] in order to ensure that banks have sound credit process to prevent bad risks from entering the system, rather than injecting capital into troubled financial institutions when accumulated bad risks hit the banks at the same time. For

[21] Rating systems are the integral part of credit business in sophisticated banks. They can be used for loan origination (screening and pricing), capital calculation, portfolio management, business strategy formation, etc. Details on the use of a rating system are well documented on the "Use Test" in Basel II context.

[22] Risk-based supervision does not only focus on credit risk, but also on four other major risks faced by the banks such as market and liquidity. The discussion of the management of other risks, though very important, is beyond the scope of this paper.

example, the BOT puts an emphasis on the check and balance in the lending decision process. A credit analysis of a deal proposed by relationship managers whose performance indicators are based on revenue growth or short-term profits, must be checked by an independent analyst or a member of the risk team who is motivated by the number of non-default incidents.

Going forward, the role of the regulator will also need to function as a partner with the banks to help them achieve the aforementioned difficult tasks. One of the key areas that the regulator could contribute to the banking sector is to help enhance the lack of knowledge and human resource within both the industry and the regulator. It should help promote knowledge sharing among different players in the market. For example, in the past few years, the BOT's Supervision Group has arranged a number of workshops and seminars, bringing in experts from banks and other countries to share their know-hows.

In addition, the adoption of Basel II will enforce the use of more risk-sensitive capital standards. Especially banks with very sophisticated risk management tools will be able to hold capital according to the level of risks in their portfolio[23]. Basel II provides good banks, which are able to keep their risks low, with the incentives of lower costs from capital savings. However, Basel II alone may not help push weaker banks from moving forward quickly enough. The BOT will have to ensure that the banks that lag behind are able to catch up as soon as possible.

Last but most importantly, the regulator must develop robust surveillance tools as well as prompt corrective actions to monitor and manage the banking system closely. Although we do not see a sign of systemic threat to the banking sector as a whole at the moment, the vulnerabilities could return from small weaknesses in this fast-changing world. **The stress-test exercises by the regulators and the banks, as introduced by the IMF and the Supervision Group, should be conducted on a regular basis**. **Other surveillance tools, such as those suggested in this paper, will prove to be very useful over time, especially once the data series span at least an entire business cycle.**

Breaking away from the doom loop will not be easy, but it is not impossible. With perseverance and concerted efforts by all three parties, it will be accomplished. The key is not to let overoptimism and complacency get into the way, especially for the banks themselves. In

[23] Unlike the Standardized approach (SA), the Internal-Ratings Based (IRB) approach, allows banks to calculate on their own some key risks parameters such as PD (or DR) and LGD for capital calculation. Banks with sound risk management will thus be able to hold capital according to their portfolio's risk.

writing this paper, we also hope that Thai banks will on their own constantly conduct similar analyses as in the paper, and beyond, in order to benchmark their performance as well as to identify potential weaknesses in their credit processes and address them quickly. Then the doom loop should no longer be our concern.

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Appendix I : ISIC-BOT

Original ISIC	Paper refer to as	ISIC Description
A000000	Y	***Agriculture, Hunting and Forestry***
A010000		Agriculture, Hunting and Related Service Activities
A020000		Forestry, Logging and Related Service Activities
B000000	Y	***Fishing***
B050000		Fishing, Operation of Fish Hatcheries and Fish Farms; Service Activities Incidental to Fishing
C000000	Y	***Mining and Quarrying***
C100000		Mining of Coal and Lignite; Extraction of Peat
C110000		Extraction of Crude Petroleum and Natural Gas; Service Activities Incidental to Oil and Gas Extraction Excluding Surveying
C120000		Mining of Uranium and Thorium Ores
C130000		Mining of Metal Ores
C140000		Other Mining and Quarrying
D000000	M	***Manufacturing***
D150000		Manufacture of Food Products and Beverages
D160000		Manufacture of Tobacco Products
D170000		Manufacture of Textiles
D180000		manufacture of wearing apparel; dressing and dyeing of fur
D190000		Tanning and Dressing of Leather; Manufacture of Luggage, Handbags, Harness and Footwear
D200000		Manufacture of Wood and of Products of Wood and Cork, Except Furniture; Manufacture of Articles of Straw and Plaiting Materials
D210000		Manufacture of Paper and Paper Products
D220000		Publishing, Printing and Reproduction of Recorded Media
D230000		Manufacture of Coke, Refined Petroleum Products and Nuclear Fuel
D240000		Manufacture of Chemicals and Chemical Products
D250000		Manufacture of Rubber and Plastics Products
D260000		Manufacture of Other Non-Metallic Mineral Products
D270000		Manufacture of Basic Metals
D280000		Manufacture of Fabricated Metal Products, Except Machinery and Equipment
D290000		Manufacture of Machinery and Equipment N.E.C.
D300000		Manufacture of Office, Accounting and Computing Machinery
D310000		Manufacture of Electrical Machinery and Apparatus N.E.C.
D320000		Manufacture of Radio, Television and Communication Equipment and Apparatus
D330000		Manufacture of Medical, Precision and Optical Instruments, Watches and Clocks
D340000		Manufacture of Motor Vehicles, Trailers and Semi-Trailers
D350000		Manufacture of Other Transport Equipment
D360000		Manufacture of Furniture; Manufacturing N.E.C.
D370000		Recycling

E000000	E	***Electricity, Gas and Water Supply***
E400000		Electricity, Gas, Steam and Hot Water Supply
E410000		Collection, Purification and Distribution of Water
F000000	C	***Construction***
F450000		Construction
G000000	W	***Wholesale, Retail Sale and Repair of Motor Vehicles, Motorcycles, Personal and Household goods***
G500000		Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Automotive Fuel
G510000		Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles
G520000		Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Personal and Household Goods
H000000	H	***Hotels and Restaurants***
I000000	T	***Transport, Storage and Transportation***
I600000		**Land Transport; Transport via Pipelines**
I610000		Water Transport
I620000		Air Transport
I630000		Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
I640000		Post and Telecommunications
J000000	F	***Financial Intermediation***
J650000		Financial Intermediation, Except Insurance and Pension Funding
J660000		Insurance and Pension Funding, Except Compulsory Social Security
J670000		Activities Auxiliary to Financial Intermediation
K000000	R	***Real Estate Activities, Renting and Business Activities***
K700000		Real Estate Activities
K710000		Renting of Machinery and Equipment without Operator and of Personal and Household Goods
K720000		Computer and Related Activities
K730000		Research and Development
K740000		Other Business Activities
L000000	Other	***Public Administration and Defense; Compulsory Social Security***
M000000	Other	***Education***
N000000	Other	***Health and Social Work***
O000000	Other	***Provision of services to Community, Society and other Private sector***
O900000		Sewage and Refuse Disposal, Sanitation and Similar Activities
O910000		Activities Of Membership Organizations N.E.C.
O920000		Recreational, Cultural and Sporting Activities
O930000		Other Service Activities
P000000	Other	***Private Households with Employed Persons***
Q000000	Other	***Extra-Territorial Organizations and Bodies***

Appendix II: Estimation of empirical default correlations

1. The correlation measure adopted in this paper is referred to as "binomial correlation measure". It is used by recognized rating agencies to obtain default correlation between a group of obligors. The idea is that if the observed joint default probability of corporate in sector A and B is greater than product of a marginal probability of default of corporate in sector A and B, in other words joint probability under the independent assumptions, then there exists a positive correlation between default events of these two sectors.

2. Joint default probability of corporate in sector A and B can be computed as $\frac{T_{A,df} T_{B,df}}{N_A N_B}$ where $T_{A,df}$ and $T_{B,df}$ are the numbers of defaulted company from sector A and B respectively, N_A and N_B are the total numbers of company in sector A and B at the beginning of the year respectively.

3. Once the yearly estimator of joint probability has been obtained, we aggregate the individual yearly probabilities in an average probability over the entire period. We weight each year data by its relative size smoothing out year specific noise. $p_{A,B}^{df,df} = \sum_{t=1}^{n} [\frac{(N_A^t + N_B^t)}{\sum_{s=1}^{n} (N_A^s + N_B^s)}] \frac{T_{A,df}^t T_{B,df}^t}{N_A^t N_B^t}$

4. Denote p_A^{df} as a marginal probability of default of corporate in sector A, it is calculated as $\frac{T_{A,df}}{N_A}$, then we aggregate individual yearly probability over the entire period using the same weight as the joint probability.

5. Given 3 and 4, empirical default correlation between sector A and B is given by

$$\rho_{A,B}^{df,df} = \frac{p_{A,B}^{df,df} - p_A^{df} p_B^{df}}{\sqrt{p_A^{df}(1 - p_A^{df}) p_B^{df}(1 - p_B^{df})}}$$