How does loan portfolio diversification affect bank profitability?

Miss Kornkanok Sittichobtham

An Independent Study Submitted in Partial Fulfillment of the
Requirements
for the Degree of Master of Science in Finance
Department of Banking and Finance
FACULTY OF COMMERCE AND ACCOUNTANCY
Chulalongkorn University
Academic Year 2019
Copyright of Chulalongkorn University

การกระจายตัวของพอร์ตสินเชื่อส่งผลต่อกำไรของธนาคารอย่างไร

น.ส.กรกนก สิทธิชอบธรรม

Independent Study Title   How does loan portfolio diversification affect bank
                           profitability?
By   Miss Kornkanok Sittichobtham
Field of Study   Finance
Thesis Advisor   Assistant Professor ROONGKIAT
                           RATANABANCHUEN

Accepted by the FACULTY OF COMMERCE AND ACCOUNTANCY, Chulalongkorn University in Partial Fulfillment of the Requirement for the Master of Science

INDEPENDENT STUDY COMMITTEE

.... Chairman
()
.... Advisor
(Assistant Professor ROONGKIAT
RATANABANCHUEN)
.... Examiner
(Assistant Professor RUTTACHAI SEELAJAROEN)
.... Examiner
(Assistant Professor NATHRIDEE SUPPAKITJARAK)

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

กรกนก สิทธิชอบธรรม : การกระจายตัวของพอร์ตสินเชื่อส่งผลต่อกำไรของธนาคารอย่างไร. (How does loan portfolio diversification affect bank profitability?) อ.ที่ปรึกษาหลัก : ผศ. ดร. รุ่งเกียรติ รัตนบานชื่น

| สาขาวิชา | การเงิน | ลายมือชื่อนิสิต .... |
| ปีการศึกษา | 2562 | ลายมือชื่อ อ.ที่ปรึกษาหลัก .... |

6181804326 : MAJOR FINANCE
KEYWOR
D:

Kornkanok Sittichobtham : How does loan portfolio diversification affect bank profitability?. Advisor: Asst. Prof. ROONGKIAT RATANABANCHUEN

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Field of Study:	Finance	Student's Signature
		....
Academic Year:	2019	Advisor's Signature
		....

ACKNOWLEDGEMENTS

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

TABLE OF CONTENTS

Page

Abstract

This research paper examines the effect of loan portfolio diversification in term of business types and loan type on Thai commercial banks profitability. This also examines the shape of the relationship in these two variables. In addition, this paper investigates the effect of loan portfolio diversification and bank return in different economic conditions. The data sample comprises of 14 Thai commercial banks during of period 2009-2019. The panel data is used in this paper to study the relationship in the regression. Based on the analysis, the study find that diversification improve bank profitability. Furthermore, non-liner relationship with concave between diversification in term of loan type is found in the paper. Also, economic conditions have significantly impacted the bank return, while there is no relationship between diversification and bank profitability in different economic conditions.

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

1. Introduction

1.1 Background and Significance of the Problem

Does diversification really give the positive benefit to the bank profitability? There are 2 main theories about the effect of diversification. On one hand, diversification was recommended by traditional theory to decrease credit risk in the portfolio, especially for the idiosyncratic risk and reduce cost of intermediate. In addition, Basel specified that one source of many bank financial crises came from credit concentration risk(Settlements 2010). In practice, regulators in several countries (Brazil, Thailand, Vietnam, Malaysia, etc.) applied single lending limit (SLL) for monitoring and limiting the threshold for large exposure, in order to diversify and reduce concentration risk for the business. This is the example of the regulatory measure to force bank to diversify, in term of large customer.

On the other hand, recent papers found that concentration in the industry that bank expertise can reduce cost and time for the bank to monitor the efficiency. Moreover, diversification can create competition and lead to bank failure in some situations(Winton 1999). This theory has the same concept as corporate financial theory, which state that when the firms focus on particular industries in their area of expertise, they will realize the cost reduction, and finally lead to another firms' supplementary value. Furthermore, Hayden, Porath, and Westernhagen (2006) and Turkmen and Yigit (2 0 1 2) shown the supporting evidence in different countries that bank profitability was improved by industry diversification.

The research contribution related to the precedent literature. Firstly, most literatures performed the analyze by using ROE and ROA (2008) as a proxy of bank performance, but the ratios cannot establish the actual return after adjusted for the risk. So, Return on Risk-Adjusted Capital (RORAC) was used in this paper as the ratio to represent bank performance. RORAC is adjusted for the maximum potential loss that can occur by using capital at risk to adjust in the denominator, in the formula: because banking business has high risk and each bank can generate the different levels of risk to the business, this ratio can be used to compare between bank.

Secondly, the answers of the topic are different, depending on the risk and individual characteristic of the country. Besides, there is no direct evidence regarding the relation between loan portfolio diversification and bank profitability in Thailand. The closest study is the diversification and bank efficiency in six ASEAN countries (Nguyen 2018) which include Thailand, but the paper studied about diversification in term of type of asset and income, which does not answer the question. Hence, this paper will focus on all Thai commercial banks between 2010-2019, to analyze the impact of loan portfolio diversification on bank profitability.

1.2 Objectives

- To investigate the effect of loan portfolio diversification in Thailand on bank profitability, by using RORAC.
- To investigate the impact of loan portfolio diversification in Thailand on bank profitability in different economic conditions.

2. Literature review

Traditional theory suggested bank to diversification as much as possible, because this theory stated that bank profitability will increase by diversification in the bank(Diamond 1984), because expanding loan into the new industries can improve quality of loan portfolio by decreasing risk in the bank, reduce cost of financial intermediate, and increase bank's incentive to monitor loan. The theory was supported by regulators in several countries (Brazil, Thailand, Vietnam, Malaysia, etc.) to avoid concentration risk which is one source of many bank financial crises (Settlements 2010) by applying single lending limit (SLL) into the commercial banks. Commercial banks were forced by this rule not to concentrate in only large customer.

Recent literatures have defended in the benefit of bank loan portfolio diversification which state by traditional theory. This newly concept was argued by Winton (1999) that diversification has increased benefit for the loan with moderate downside risk only. In the low risk situation, bank benefited from concentration or not diversification, as a result of low probability of default. On the other hand, in the high-risk of solvency situation, bank with specific in few sectors received low probability of default in specific loss sector. Besides, banks with concentration in the

sector that they are expertise can reduce cost and time to monitor and grant new loan. This theory has the same concept as corporate finance, which state that when the firms focus on particular industries in their area of expertise, they will realize the cost reduction, and finally lead to another firms' supplementary value.

Table 1-Summary of the Empirical Results on the impact of portfolio diversification on banks' performance.

Authors	Country	Period	Types of diversification	Empirical Results
Bebczuk and Galindo (2008)	Argentina	1999-2004	Industrial sectoral	Diversification have positive impact to bank performance, especially for the larger bank during financial crisis.
Rossi, Schwaiger and Winkler (2009)	Austria	1997-2003	Industrial sectoral and size	Diversification decrease cost, risk and increase profitability efficiency. Moreover, sectoral diversification reduces capital requirement
Atahau and Cronje (2017)	Indonesia	2003-2011	Industry sectoral and types of loan	Diversification has positive impact to bank performance, but the impacts are different depending on bank ownership type. GDP has positive impact of bank return.
Mulwa (2018)	East Africa	2000-2012	Industrial sectoral	Diversification has positive impact to bank return on assets and improve asset quality.
Chen, Wei, Zhang and Shi (2013)	China	2007-2011	Industrial sectoral	Diversification has negative impact to bank risk and return in nonlinear term
Acharya, Hasan and Saunders (2006)	Italy	1993–1999	Industrial sectoral and Types of loan	Concentration has positive impact to return and negative impact to risk. U-shaped in return and diversification
Hayden (2006)	Germany	1996-2002	Industrial sectoral and geographical	Diversification has negative impact to bank performance, relationship between return and focus are a U-shaped in risk: effect of diversification increases while risk increase.
Tabak, Fazio and Cajueiro (2011)	Brazil	2003-2009	Industrial sectoral	Concentration improved bank return and risk but the impact will be difference depending on types of bank-ownership.

Authors	Country	Period	Types of diversification	Empirical Results
Turkmen and Yigit (2012)	Turkish	2007-2011	Industrial sectoral and geographical	Diversification has negative impact to bank performance.
Singh (2014)	India	2002-2012	Sectoral	Diversification neither increase return not decrease risk.

Empirical results are different depending on characteristic of each sample. Bebczuk and Galindo (2008) claimed that diversification provided the positive impact to bank performance supporting by the evidence in Argentina during financial crisis. Furthermore, in normal situation, Austria, Indonesia and East Africa have the positive relation between diversification and return as well (Rossi, Schwaiger and Winkler, 2009: Atahau and Cronje, 2017: Mulwa, 2018).

Chen, Wei, Zhang and Shi (2013) shown the different result that diversification has negative impact to bank risk and return at the same time. Generally, risk and return from diversification will give the opposite side. They explain that diversification increase monitoring costs that decrease bank profit(Winton 1999), while diversification reduced specific risk to receive reducing risk.

Acharya, Hasan and Saunders (2006), Hayden (2006), Tabak, Fazio and Cajueiro (2011), and Turkmen and Yigit (2012) shown the evidence to support Winton (1999) that diversification in Italy, Germany, Brazil, and Turkish have negative relation with bank return. Furthermore, Mulwa (2018), Acharya, Hasan and Saunders (2006), and Hayden (2006) stated that relation of diversification on bank performance is non-linear in U-curve relation.

From the previous of the literature, the answer of the question: "how does loan diversification affect bank profitability?", have been varied, depending on the characteristics of the countries and there is no exact evidence in Thailand to answer this question. Besides, in the previous papers, ROE and ROA were used to represent the return and they did not take different levels of risk into account. Thus, return on risk-adjusted which take into consideration is more appropriate for the high risk and

leverage business as bank and it can be adopted to compare between banks which have the different levels of risk.

In this study, all Thai commercial banks, total 14 banks, are selected as the sample to specify the effect of loan portfolio diversification on bank profitability. Moreover, RORAC which is adjusted for the maximum potential loss that can occur by using capital at risk to adjust in the denominator, in the formula will be applied in this special project to represent bank's return.

3. Research hypothesis

Bank Profit = B_0 + B_1 Diversification + B_2 Diversification^2 + B_3(1-HHI$_{it}$) x size$_{it}$ + Control Variable + error

Research hypothesis is "diversification has negative impacts on bank profit".

Normally, diversification should be the good way to control risk and increase return to the company. Traditional banking theory argue that bank should diversify portfolio as much as possible, because expansion in the new industries can reduce the probability of default to bank (Diamond, 1984). However, this research might not be true in normal situation and theory of Winton (1999) could likely happen. The theory stated that diversification has negative impacts on bank profit, because diversification increases cost and decreases efficiency to monitor in some sectors that bank does not expertise. Moreover, many evidence found that concentration strategic loan portfolio increases bank performance (Tabak, Fazio, and Cajueiro, 2011: Raei, 2016) and supporting by the evidence in Germany, diversify portfolio reduce return to the bank(2006). Furthermore, Adzobu, Agbloyor, and Aboagye (2017) found that neither diversify portfolio does increase return nor reduce risk in the portfolio.

Bank Profit = B_0 + B_1 Diversification + B_2 Diversification^2 + B_3 Economic Condition + B_3 (Diversification x Economic Condition) + Control Variable + error

First research hypothesis is "economic condition has positive effect on bank profitability"

Second research hypothesis is "economic condition has negative effect on the relationship between bank profit and diversification"

Generally, economic condition has the positive relation with the bank profit which supporting by Yudaruddin (2017) , Alexiou and Sofoklis (2009) Their researches shown that GDP has positive impact on bank return. Moreover, Regehr and Sengupta (2016) also found that employment rate has the positive relation with bank profitability.

One main factor that lead to financial crisis is concentration risk. Regulators in several countries (i.e. Brazil, Thailand, Vietnam, Malaysia, etc.) adopt single lending limit (SLL) for monitoring and limiting the threshold for large exposure in order to diversify and reduce concentration risk for the business. Besides, in bad economic situation, not all industries will receive bad effect. Furthermore, if bank focuses in bad sector which receives a huge negative consequence, it can create tremendous loss to the bank. As aforementioned, diversification in downside economic condition should improve return to the bank and vice versa. This can be supported by Bebczuk and Galindo (2008) who found the evidence of Argentina financial crisis in 2001-2002, diversification generate higher benefit in the economic downside of business cycle.

4. Data

This paper studies on the effect of loan portfolio diversification and return, by using a sample of Thai commercial banks, evaluating the bank asset size between 2009-2019. Panel data is used in this study including 14 commercial banks, break down by industry during 2009 to 2019 with semiannually, equal to 270 observations. The sources of whole data is derived from public financial report for the bank, classified by business type and note to financial statement for type of loan. Pillar3 report and Bloomberg are the source, including revenue, operating expense, and credit risk-weighted assets to calculate RORAC.

4.1 Diversification measure

Herfindahl-Hirschman Index (HHI) is usually used to measure market concentration which assume equal weight to every bucket of loans. Thus, 1-HHI represent loan portfolio diversification. In this paper, diversification was classified in business type and type of loan observed from financial report and note to financial statement in semiannual basis of each commercial bank.

In Thailand, commercial banks' loans are classified into 6 categories from the business of loan comprised of agriculture and mining, manufacturing and commercial, real estate and construction, public utilities and services, housing loans, and others. Moreover, it can be classified by type of loan into 4 categories including overdrafts, loans, bills, and others.

Example of the data,

Table 2 - example of loan classified by business type in Thailand

Type of customer	Normal	Special Mention	Substandard	Doubtful	Doubtful of Loss	Total
agriculture and mining						
manufacturing and commercial						
real estate and construction						
public utilities and services						
housing loans						
others.						
Total						

Summarized from: KTB (2018a) annual report

Type of loan	20XX	20XX
Overdrafts		
Loans		
Bills		
Others		
Less deferred revernue		
Loans to customer after deferred revernue, net		

Table 3 - example of loan classified by type of loan in Thailand

Summarized from: KTB (2018b) note to financial statement

HHI is calculated by sum of the square of the exposure in each group of loan bucket to total exposure.

$$HHIB_{kt} = \left(\sum_{i=1}^{k} \frac{loan_{kt}}{\sum_{i=1}^{k} loan_{kt}} \right)^2$$

where HHI_{kt}: concentration across business types for bank n and time t

   $Loan_{kt}$: loan in business type k, bank n, and time t

$$HHIL_{jt} = \left(\sum_{i=1}^{j} \frac{loan_{jt}}{\sum_{i=1}^{k} loan_{jt}} \right)^2$$

where HHI_{jt}: concentration across loan types for bank n and time t

   $Loan_{jt}$: loan in loan types j, bank n, and time t

HHI can be 0 to 1. The higher the HHI means higher concentration and lower diversification. If HHI equal to 1, bank loan to the customer is solely for one business type or one loan type, which means no diversification at all.

4.2 Return

In many researches, ROE and ROA were used as proxy of return to the bank(2008). However, banking business is considered as high leverage and high-risk business, and those ratios were not accounted for risk. Therefore, bank can face different level of risk depending on risk and return which bank can tolerance. From this reason, Return on Risk-Adjusted Capital (RORAC) was selected in this study because of its adjusted to risk in denominator (unexpected loss) to represent return. RORAC consider capital at risk which is

$$RORAC_{it} = \frac{Revenue_{it} - Interest\ expense_{it} - Other\ operating\ expense_{it}}{Risk - weighted\ assets_{it}}$$

where $revenue_{it}$ at bank i time t

   $interest\ expense_{it}$ at bank i time t

   $other\ operating\ expense_{it}$ at bank i time t

   $risk\text{-}weighted\ assets_{it}$: credit risk-weighted assets at bank i time t

To calculate RORAC, revenue and operating cost can be collected from Bloomberg, while credit risk-weighted assets which represent risk-based required capital are in pillar3 report from each commercial bank. So as to avoid insolvency, credit risk-weighted assets are calculated for specifying the minimum amount of capital that bank need to maintain. The numbers are calculated from asset multiply by risk weigh, which based on type of customer, asset, and level of risk(Tuovila 2019). In Thailand, according to the Bank of Thailand regulation, the minimum capital requirements are established at 8.5% of total risk-weight asset(BOT 2012). Hence, credit risk-weight asset can be calculated from multiplying 8.5% by minimum capital requirements for credit risk.

Example of the data,

Table 4- Minimum capital requirements

Minimum capital requirements	June 30, 20XX	Dec 31, 20XX
Minimum capital requirements for credit risk		
Minimum capital requirements for narket risk		
Minimum capital requirements for operational risk		
Total capital requirement		

Remark:
The minimum capital requirements are calculated based on the minimum regulartory capital adequacy at 8.5%

Summarized from: BAY (2018) Pillar3

4.3 Economic Condition

In this paper, GDP growth and unemployment rate were used as a representative of different economic conditions to analyze the effect of diversification in different economic conditions on bank return following(2008), because GDP growth and employment rate are the lagging indicator to display the economy's historical performance. GDP can be a key determinant to tell the US economy or situation(Smith 2007). Unemployment rate is an important indicator for economic condition. When the economic is growing or expanding, the need of labor force will increase and decrease in unemployment rate.

4.4 Control Variable

In this paper, bank size, equity ratio, NPL ratio, NIM, efficiency ratio and loan to deposit are used as control variables for the bank specific factors in order not to include this effect into the equation. Moreover, dummy variable of return was used to adjust for the seasonal effect.

Bank size = Log (total asset)

Equity Ratio = Equity / Total Asset

NPL Ratio = Total nonperforming loan / Total loan

Efficiency ratio = Expense / Revenue

Loan to deposit = Loan / Deposit

Dummy variable = 1 for half-year

5. Methodology

In this paper, panel data of 14 commercial banks in Thailand between 2009 to 2019 in semiannual basis for total 270 observations were used to construct the model, in order to test the effect of bank loan portfolio diversification on Thai bank profitability and the effect of diversification on the bank profitability, in different economic conditions. The models were regressed the bank portfolio diversification (1-HHI) with bank profitability (RORAC) by controlling bank size, equity ratio, NPL Ratio and effect ratio

Model 1: $Return_{it} = \alpha + \beta_1(1\text{-}HHI_{it}) + \beta_2(1\text{-}HHI_{it})^2 + \beta_3(1\text{-}HHI_{it}) \times size_{it} + \delta\ C_{it} + \gamma D + \varepsilon_{it}$; i = 1,2, …,14 and t = 1, 2, …, 20

The model 1 tests whether diversification loan portfolio impacts bank profitability or not. By using this model, it can answer the question "does diversification have negative impacts on bank profit?". Furthermore, this paper will test $(1\text{-}HHI)^2$ to answer that "does diversification have non-linear relation with bank profit", which Mulwa (2018), Acharya, Hasan and Saunders (2006) stated that diversification and return have relation in non-linear term (U-curve). This will help to

capture all the impact of diversification in bank profit. Moreover, the effect of diversification in different size of banks will be tested in this model.

Model 2: Change in $\text{Return}_{it} = \alpha + \beta_1(\text{Change in } (1\text{- HHI}_{it})) + \beta_2(\text{Change in } (1\text{-HHI}_{it}))^2 + \delta\ C_{it} + \gamma D + \varepsilon_{it}$; i = 1,2, …, 14 and t = 1, 2, …, 20

In the model 2, it will be tested that how does level of the diversification change affect the change in return of the bank.

Model 3: $\text{Return}_{it} = \alpha + \beta_1(1\text{-HHI}_{it}) + \beta_2(1\text{-HHI}_{it})^2 + \beta_3 (\text{Economic Condition}_{it}) + \beta_4 ((1\text{-HHI}_{it}) \times \text{Economic Condition}_{it}) + \delta\ C_{it} + \gamma D + \varepsilon_{it}$; i = 1,2, …, 14 and t = 1, 2, …, 20

where return   RORAC

    1-HHI   Diversification

    Economic Condition   GDP/ Employment rate

    C   Control variable (bank size, equity ratio, efficiency ratio, loan to deposit and NPL Ratio)

    D   Dummy variable which control for the seasonal effect of return (half-year and year end)

    ε Error term

In this model, it tests the relation between economic condition interact with HHI on RORAC of the bank. This equation can answer the question that "does economic condition has negative effect on the relationship between bank profit and diversification?"

6. Empirical results

In this paper, 14 commercial banks in Thailand, both listed and non-listed between 2009-2019, total 270 observations are used to study the impact of loan portfolio diversification and bank profitability. The summarized basic statistic of the variables is displayed in Table 6.

Figure 1 – Diversification in term of industry
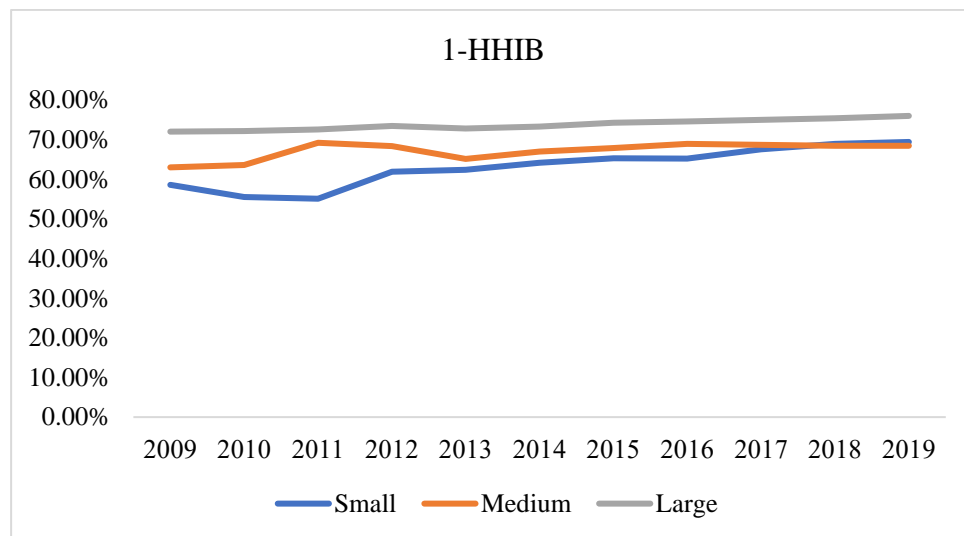
The graph comprises of diversification in term of industry breaking down by size, following BOT classification which is classified by the percentage of total assets of all commercial banks in Thailand. The figure presents that large commercial banks have apparently higher diversification, comparing to the small and medium banks, while small and medium banks move to the similar level of diversification. Moreover, diversification gradually increases every year for small and large size banks. In Thailand, average HHI is at 32.40 percent (Table 6). The diversification in Thai banks is at the same level as Brazilian which is 34.2 percent and higher than the countries in Europe, for example Italian banks which is 23.7 percent and German which is 29.1 percent. This means Thai banks are less diversification than European banks.

Figure 2 – Diversification in term of loan type
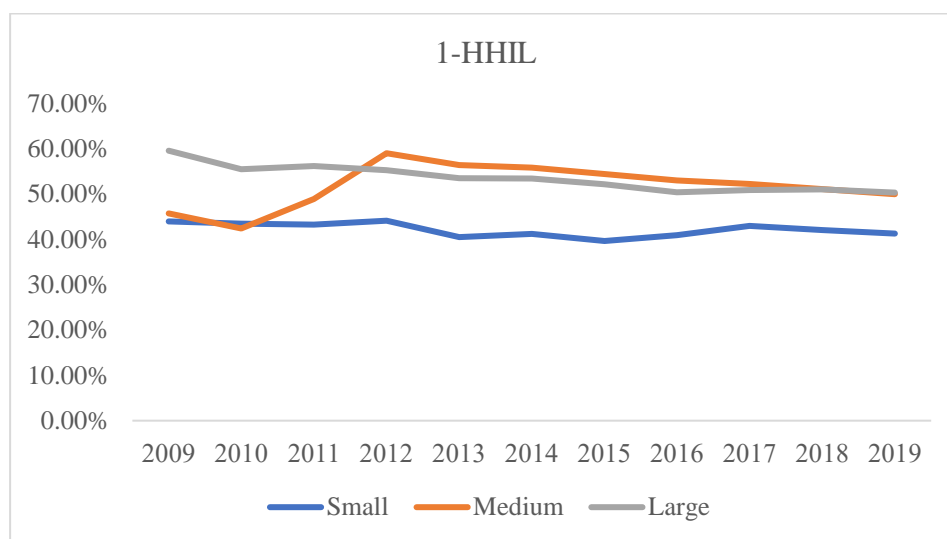
However, in term of diversification classifies by types of loan, the percentage of diversification is lower than the classification by industry. For this dimension, medium and large commercial banks are at the same level of diversification and higher than small bank.

The empirical results in this section are regressed by fixed effects regression. The model is selected to control the effect of time-invariant variables with time-invariant effect and avoid homogeneity problem(Williams 2018).

Table 5 - Correlation Matrix

Correlation	1-HHIB	1-HHIL	NPL	EQT	LTD	Size	Half	Efficiency	GDP	Employment
1-HHIB	1									
1-HHIL	0.1477	1								
NPL	0.1805	-0.0242	1							
EQT	-0.2322	-0.4103	-0.1186	1						
LTD	-0.5432	-0.0881	-0.1912	0.0668	1					
Size	0.4493	0.5137	-0.0162	-0.2308	-0.4087	1				
Half	0.0008	-0.0016	0.0475	-0.0219	-0.0204	0.0119	1			
Efficiency	-0.0297	-0.1715	0.2071	0.0731	-0.1039	-0.2468	-0.059	1		
GDP	-0.0675	-0.0437	-0.0335	0.0753	0.064	-0.0529	0.5515	0.0114	1	
Employment	-0.0904	-0.0215	0.1582	-0.0496	0.0495	-0.1416	-0.526	0.0546	-0.1063	1

Correlation matrix, in Table 5 , shows the relation between x variable. The descriptive statistic displays the level of correlation, correlation between ±0.5 and ±0.69 is high degree and ±0.3 and ±0.5 is medium degree. 1-HHIB has high level of

correlation with LTD (loan to deposit) and medium level with size, while 1-HHIL has high level of correlation with size and medium level with EQT (equity ratio). However, these levels of correlation do not create multicollinearity problem to the model.

Model 1: $Return_{it} = \alpha + \beta_1(1\text{-}HHI_{it}) + \beta_2(1\text{-}HHI_{it})^2 + \beta_3(1\text{-}HHI_{it}) \times size_{it} + \delta\ C_{it} + \gamma D + \varepsilon_{it}$; $i = 1,2, \ldots,14$ and $t = 1, 2, \ldots, 20$

In this model, the relationship between loan portfolio diversification, in term of business types and loan types, and RORAC will be tested. Moreover, shape of the equation will also be studied in the model.

In Table 7, the empirical results show that only 1-HHIL (Model 1 equation 6), which is the diversification in types of loan, has an impact to the RORAC. Moreover, both diversification and its square term are significant at 10 percent significance level. The result can be concluded that there is non-linear term between diversification and bank profitability. This finding is the same as Hayden (2006) and Acharya (2006) who found the non-linear relationship between these two variables. Furthermore, 1-HHIL provides the positive direction to the RORAC with coefficient equal to 0.053, while $(1\text{-}HHIL)^2$ has the negative impact to the RORAC with coefficient equal to -0.054.

Figure 3: Relationship between diversification in loan type and bank profitability
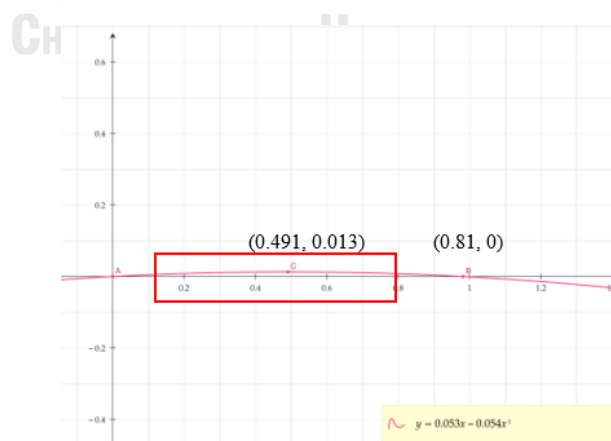
After plotting the graph, it shows the shape of the equation when considering only 1-HHIL (x), RORAC (y), and ignoring control variables. Because 1-HHI is always positive, RORAC is only in quadrant 1 and 4. The impact of diversification in term of loan type and RORAC are concave, which have the positive impact until point B (1-HHIL) equal to 81 percent. It can be explained that when there is more bank diversification in term of product, the diversification will improve bank profitability. In addition, because of concave shape of the relation, diversification at 49.1 percent can provide the highest benefit to the RORAC. With diversification greater than 49.1 percent, the benefit of diversification will be increased at the decreasing rate, while diversification more than 81 percent provides the negative impact to the bank profitability. From the collected data in Thailand, 1-HHIL is in the range of 15.93 percent to 65.75 percent with the mean equals to 47.82 percent, the consequence is the diversification impacts in positive direction. Moreover, the mean of 1-HHIL is almost the maximum benefit of the diversification. It can be explained that bank should diversify in term of loan type to receive the return benefit of diversification.

For diversification in term of business type, the equation 1, which omits size as a control variable, shows the descriptive statistic results that diversification has the positive impact to the bank profitability. The positive relation depicts that the diversification affects to the higher bank profitability. However, after adding size into the equation (equation 3), diversification does not significant with high P-value while size is significant at 5 percent confidence level with positive impact to the bank profit. From this result, it can be concluded that diversification in term of business type and size of the banks can explain bank profitability in similar direction. Nevertheless, size of the bank is stronger to explain the RORAC than diversification.

To study the impact of diversification in different size of banks, equation 7-8 in the Table 7 displays that the interactive term between size and diversification does not significant. This means that diversification in different size of bank does not provide the different impact on bank RORAC, because large banks can enjoy the economy of scale and scope for diversification into the new business than small banks (Bebczuk and Galindo, 2008). Nevertheless, small banks which have lower level of diversification can receive benefit from reducing risk greater than large bank. Hayden

(2006) found non-linear term with u-shape relationship between diversification and risk of the bank. It can be implied that low level of diversification banks (small banks) can receive more benefit from decreasing in credit risk greater than bank with high level of diversification banks (large banks).Model 2: Change in $Return_{it}$ = α + β_1(Change in (1- HHI_{it})) + β_2(Change in (1-HHI_{it}))^2 + δ C_{it} + γD + ε_{it} ; i = 1,2, …, 14 and t = 1, 2, …, 20

In the model 2, it will be tested that how does level of the diversification change affect the change in return of the bank. The result from this model looks like the previous model. Change in diversification in term of business type is not significant but it has positive sign, while change in diversification in term of loan type can explain the change in RORAC with positive impact. It means that increasing in diversification can increase cost to the bank slower than reducing in credit risk.

Both diversifications in term of business and product type show the same result. The diversifications help banks to improve the performance. However, the result is different from the hypothesis, which hypothesizes that loan portfolio diversification should have negative affect to the bank profitability, because diversification increases cost and decreases efficiency to monitor in some sectors that bank does not expertise. RORAC is calculated from net interest income minus operating expense dividing by credit risk weighted asset to representative as bank profitability. It means that diversification reduces risk weighted asset greater that increases cost to monitor the loan. In other word, RORAC which adjusts for the different level of credit risk that each banks face will increase bank profitability when level of diversification increase. For this result, it suggests that bank should diversify because it will increase bank profitability by 1 unit of risk weighted asset. This result is the same as BOT applied single lending limit (SLL) for monitoring and limiting the threshold for large exposure, in order to diversify and reduce concentration risk for the business.

From the result, loan type diversification is more suitable to explain the diversification benefit than the business type diversification. Firstly, bank size is better explained the bank profitability rather than the business type diversification

with the same direction, because the large banks have a chance to grant the new loan into the new business greater than the small banks. Secondly, RORAC can be varied across bank and time because different banks have different target group of customers which possess diverse risk levels. For diversification in term of loan type, it directly affects bank credit risk. However, different loan products have different risk characteristics including maturity, level of collateral, and size of loan. JimÈnez and Saurina (2002) found the results that size, and maturity of loans reveals the importance of the screening process carried out by banks and these characteristics affect bank credit risk. In addition, the cost of this diversification which is derived from lunching the new product will increase but the monitoring and approving cost will not be different significantly.

For using RORAC in the study, this result can be explained by traditional theory (Diamond 1984)which suggested bank to diversify as much as possible to increase bank profitability, because expanding loan into the new industries can improve quality of loan portfolio by decreasing risk in the bank. In addition, this result is similar to the result that found in Argentina(2008), Austria(2009), Indonesia(2017), and East Africa(Mulwa 2018).

In this paper, the control variables including NPL, equity ratio, efficiency ratio, loan to deposit, and size are strongly relative to the bank profitability in most equations. NPL, equity ratio, and efficiency ratio have the negative effect to the bank performance, because higher NPL means bank can generate lower income and have higher cost to carry including write-off, following debt, expected credit loss. This is the same reason with efficiency ratio, which is cost dividing by revenue. When the efficient ratio increases, cost is raiser comparing to the bank revenue.

Nonetheless, loan to deposit and bank size have positive impact on bank profitability. Loan to deposit (LTD) is one variable that is used to assess the liquidity of commercial banks. If banks have too high LTD ratio, it means that banks have possibility of inadequate liquidity to achieve the requirements. In contrast, it means that bank can use the deposit to generate greater interest income. This is the reason why LTD has positive impact to RORAC. For bank size, this strong positive impact of size to RORAC means that size of the bank can help bank improve RORAC of the

bank. Because large bank can reduce operating cost and generate higher income comparing to the smaller bank, this can help profitability to increase.

Model 3: $Return_{it} = \alpha + \beta_1(1\text{-}HHI_{it}) + \beta_2(1\text{-}HHI_{it})^2 + \beta_3 (\text{Economic Condition}_{it}) + \beta_4 ((1\text{-}HHI_{it}) \times \text{Economic Condition}_{it}) + \delta C_{it} + \gamma D + \varepsilon_{it}$; i = 1,2, …, 14 and t = 1, 2, …, 20

In the model 3, impact of economic condition and diversification in different economic conditions will be studied.

In Table 9, GDP and employment rate are representatives of economic condition. The results display that economic condition is significant and has positive impact to the bank performance. This result is also found in Yudaruddin (2017) , Alexiou and Sofoklis (2009) that GDP has positive impact on bank return. In addition, Regehr and Sengupta (2016) also found that employment rate has the positive relation with bank profitability. The simplest reason is that when economic is good, banks can generate more income to the company. This result always occurs in other businesses as well.

For the interactive terms, the results in the Table 10 displayed that interactive term does not significant at any equation, but economic condition still significant in most equations. This can be explained that diversification impacts the same level of return in the different economic conditions in Thailand. The result is different from Tabak, Fazio, and Cajueiro (2011) which found that gain from diversification is higher in the bad time in Argentina. However, the evidence from Argentina displays the different result from Thailand that diversification and bank profitability have the negative relationship, but diversification provides the benefit to the bank return in the bad economic only. For Thailand, diversification has positive effect to the RORAC of the bank and diversification is strong to explain RORAC directly, so diversification in the different economic condition does not create the additional benefit to the bank profitability.

7. Conclusions

The main purpose of this paper is to find the effect of the bank portfolio diversification in term of business and product type on bank profitability. This study focuses on 14 Thai commercial banks both listed and non-listed between 2009-2019 and use fixed effect of panel data to estimate the statistic results to understand the impact. Furthermore, the shape of the relation is tested in the paper.

In the statistic evidences, the results show that bank portfolio diversification improve bank profitability of Thai commercial banks. In particular, the statically results show three main things. Firstly, different term of diversification provides the similar impact direction to the bank return which is positive because banks can reduce risk weighted asset greater that increases cost to monitor the loan when diversify loan portfolio. This is the same as the finding in Argentina(2008), Austria(2009), Indonesia(2017), and East Africa(Mulwa 2018), that diversification improves bank profitability. The reason could be explained by traditional theory (Diamond 1984) which suggest bank to diversify as much as possible to improve loan quality, reduce bank cost, and increase incentive to monitor loan.

Secondly, the relationship between diversification in term of loan types is found in non-linear term with concave. This means that diversification provide the highest benefit at 49.1 percent, which close to the mean at 47.82 percent. Besides, diversification in loan portfolio greater than 81 percent will reduce bank profitability.

Lastly, there is no difference in diversification and bank profitability in different economic condition. Nevertheless, economic condition provides the positive relationship to the bank profitability which supporting by Yudaruddin (2017), Alexiou and Sofoklis (2009). This can be explained that when economic goes well, the bank profitability will increase.

8. Appendix

Table 6 - panel data summary data of the commercial bank

	Mean	SD	Min	25%	50%	75%	N
RORAC	0.31%	0.63%	-2.54%	0.02%	0.27%	0.63%	270
1-HHIB	67.60%	11.13%	40.09%	60.80%	71.73%	75.95%	270
1-HHIL	47.82%	10.37%	15.93%	40.85%	48.50%	55.86%	270
Asset	972,854	992,640	49,707	229,219	422,467	1,597,114	270
Equity	106,674	115,381	3,010	27,382	42,243	138,073	270
NPL Ratio	3.93%	2.63%	0.75%	2.40%	3.19%	4.77%	270
Equity Ratio	11.33%	3.27%	4.89%	9.01%	10.91%	13.02%	270
Efficiency Ratio	56.68%	33.08%	-72.32%	45.66%	50.90%	61.85%	270
Loan to deposit Ratio	119.18%	42.57%	57.46%	97.00%	105.00%	124.29%	270

This table displays the summary data of the 14 commercial banks which include listed and non-listed banks in Thailand between 2009-2019, totally 270 observations that can be observed. Listed bank data is retrieved from Bloomberg and the non-listed bank data is manually collected from financial report. The data shows that 1-HHIB has a higher mean than 1-HHIL because of higher group segment in industry than type of loan.

Table 7: Finding for Fixed effects regression model1

Model	Model1							
Equation	Equation1	Equation2	Equation3	Equation4	Equation5	Equation6	Equation7	Equation8
Dependent Variable	RORAC	RORAC	RORAC	RORAC	RORAC	RORAC	RORAC	RORAC
1-HHIB	0.007*		0.002		-0.026		-0.056	
	0.004		0.004		0.040		0.058	
$(1-HHIB)^2$					0.024		0.019	
					0.033		0.034	
1-HHIL		0.005		0.003		0.053**		0.059
		0.00		0.00		0.027		0.049
$(1-HHIL)^2$						-0.054**		-0.051
						0.027		0.036
NPL	-0.042***	-0.04***	-0.033**	-0.031**	-0.035***	-0.035***	-0.035***	-0.035**
	0.012	0.012	0.013	0.012	0.013	0.012	0.013	0.013
Equity ratio	-0.027**	-0.027**	-0.026**	-0.026**	-0.024**	-0.022***	-0.027**	-0.022**
	0.011	0.011	0.011	0.011	0.001	-0.005	0.011	0.011
Efficiency ratio	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***
	0.001	0.001	0.001	0.001	0.001	0.003	0.001	0.001
Loan to deposit	0.004***	0.000	0.004***	0.004***	0.004***	0.004***	0.004***	0.004***
	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
HALF	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Log size			0.005**	0.005***	0.005*	0.005**	0	0.006
			0.002	0.002	0.002	0.002	0.006	0.006
Log size x (1-HHIB)							0.007	
							0.010	
Log size x (1-HHIL)								-0.002
								0.011
Constant	0.000	0.003	-0.025**	-0.028**	-0.016	-0.036	0.005	-0.04
	0.003	0.003	0.013	0.012	0.018	0.013	0.035	0.028

Table 8: Finding for Fixed effects regression model 2

Model	Model2			
Equation	Equation 11	Equation 12	Equation 13	Equation 14
Dependent Variable	Change RORAC	Change RORAC	Change RORAC	Change RORAC
Change 1-HHIB	0.808		0.808	
	1.095		1.098	
Change(1-HHIB)^2				
Change 1-HHIL		1.657*		1.654*
		0.659		0.661
Change (1-HHIL)^2				
NPL	-1.840	-0.612	-1.791	-0.520
	2.510	2.552	2.616	2.669
Equity ratio	-0.281	0.705	-0.271	0.714
	2.289	2.361	2.299	2.368
Efficiency ratio	0.284	0.078	0.285	0.081
	0.171	0.166	0.173	0.168
Loan to deposit	-0.130	-0.181	-0.126	-0.173
	0.151	0.172	0.165	0.183
HALF	-0.029	-0.011	-0.029	-0.011
	0.095	0.106	0.095	0.106
Log size			0.031	0.055
			0.452	0.453
Constant	0.037	0.100	-0.150	-0.229
	0.331	0.363	2.757	2.756

Table 9: Finding for Fixed effects regression model 3

Model	Model3			
Equation	Equation1	Equation2	Equation3	Equation4
Dependent Variable	RORAC	RORAC	RORAC	RORAC
1-HHIB	-0.022		-0.014	
	0.039		0.040	
$(1-HHIB)^2$	0.02		0.013	
	0.033		0.033	
1-HHIL		0.048*		0.044**
		0.025		0.025
$(1-HHIL)^2$		-0.05*		-0.045**
		0.027		0.027
NPL	-0.032**	-0.031**	-0.038***	-0.038***
	0.013	0.012	0.013	0.013
Equity ratio	-0.027**	-0.025**	-0.023**	-0.021**
	0.011	0.011	0.011	0.011
Efficiency ratio	-0.003***	-0.003***	-0.003***	-0.003***
	0.001	0.001	0.001	0.001
Loan to deposit	0.004***	0.004***	0.004***	0.004***
	0.001	0.001	0.001	0.001
HALF	0.000	0.000	0.001**	0.001**
	0.001	0.001	0.001	0.001
Log size	0.005**	0.005**	0.007***	0.007***
	0.002	0.002	0.003	0.002
GDP	0.01**	0.009**		
	0.004	0.004		
Employment rate			0.337**	0.309**
			0.147	0.147
Constant	-0.019	-0.037***	-0.035*	-0.047***
	0.018	0.012	0.020	0.014

Table 10: Finding for Fixed effects regression model 3 (Continue)

Model	Model3					
Equation	Equation5	Equation6	Equation7	Equation8	Equation9	Equation10
Dependent Variable	RORAC	RORAC	RORAC	RORAC	RORAC	RORAC
1-HHIB	-0.022		-0.004		-0.002	
	0.039		0.040		0.041	
$(1\text{-HHIB})^2$	0.02		0.006		0.005	
	0.033		0.034		0.034	
1-HHIL		0.049**		0.047**		0.046*
		0.025		0.025		0.025
$(1\text{-HHIL})^2$		-0.05**		-0.047**		-0.046*
		0.027		0.027		0.027
NPL	-0.032**	-0.031**	-0.036***	-0.035***	-0.033**	-0.032**
	0.013	0.013	0.013	0.013	0.014	0.013
Equity ratio	-0.027**	-0.025**	-0.023**	-0.021*	-0.026**	-0.023**
	0.011	0.011	0.011	0.011	-2.370	0.018
Efficiency ratio	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***
	0.001	0.001	0.001	0.001	0.001	0.001
Loan to deposit	0.004***	0.004***	0.004***	0.004***	0.004***	0.004***
	0.001	0.001	0.001	0.001	0.001	0.001
HALF	0.000	0.000	0.001**	0.001**	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001
Log size	0.005**	0.005**	0.007***	0.008***	0.007***	0.007***
	0.002	0.002	0.003	0.002	0.003	0.002
GDP	0.01	0.011			0.011	0.011
	0.019	0.018			0.019	0.018
GDP x (1-HHIB)	0.000				-0.005	
	0.028				0.028	
GDP x (1-HHIL)		-0.003				-0.005
		0.027				0.026
Employment rate			1.036*	1.056*	0.97	0.976**
			0.585	0.559	0.589	0.561
Employment rate x (1-HHIB)			-1.065		-1.09	
			0.028		0.866	
Employment rate x (1-HHIL)				-1.145		-1.139
				0.907		0.826
Constant	-0.019	-0.003	-0.04***	-0.052***	-0.038*	-0.05***
	0.018	0.027	0.020	0.014	0.020	0.014

REFERENCES

(2006) Does diversification improve the performance of German banks?
https://papers.ssrn.com/

(2008). "Financial crisis and sectoral diversification of Argentine banks, 1999–2004."
Financial Economics: 199-211.

(2009). "How loan portfolio diversification affects risk, efficiency and capitalization: A
managerial behavior model for Austrian banks." Journal of Banking & Finance: 2218-
2226.

(2017). "Does Diversification Lead to Better Loan Portfolio Returns? Empirical
Evidence from Indonesian Banks." DLSU Business & Economics Review: 25-40.

Acharya, V. V., et al. (2002). "The effects of focus and diversification on bank risk and
return: evidence from individual bank loan portfolios."

Atahau, A. D. R., et al. (2017). "Does Diversification Lead to Better Loan Portfolio
Returns? Empirical Evidence from Indonesian Banks." **26**(2): 25-40.

Bebczuk, R. and A. J. A. F. E. Galindo (2008). "Financial crisis and sectoral
diversification of Argentine banks, 1999–2004." **18**(3): 199-211.

BOT (2012)

Chen, Y., et al. (2013). "Sectoral diversification and the banks' return and risk:
Evidence from Chinese listed commercial banks." **18**: 1737-1746.

Claessens, S., et al. (2018). ""Low-For-Long" interest rates and banks' interest margins
and profitability: Cross-country evidence." **35**: 1-16.

Diamond, D. W. (1984). "Financial Intermediation and Delegated Monitoring." Oxford
Journal: 393-414.

Diamond, D. W. J. T. r. o. e. s. (1984). "Financial intermediation and delegated
monitoring." **51**(3): 393-414.

Foster, S. and S. Bailey (2015). "Does Revenue and Loan Portfolio Diversification
Improve Bank Performance & Stability? Evidence from Jamaican Commercial Banks."

Hayden, E., et al. (2007). "Does diversification improve the performance of German banks? Evidence from individual bank loan portfolios." **32**(3): 123-140.

Heffernan, S. A. and X. J. A. F. E. Fu (2010). "Determinants of financial performance in Chinese banking." **20**(20): 1585-1600.

Mulwa, J. M. (2018). "Sectoral credit diversification, bank performance and monitoring effectiveness; a cross-country analysis of east African banking industries." <u>Journal of Finance and Investment Analysis</u>: 17-36.

Mulwa, J. M. (2018). "Sectoral credit diversification, bank performance and monitoring effectiveness; a cross-country analysis of east African banking industries."

Nguyen, T. L. A. (2018). "Diversification and bank efficiency in six ASEAN countries." <u>Global Finance Journal</u>: 57-78.

Nguyen, T. L. A. J. G. F. J. (2018). "Diversification and bank efficiency in six ASEAN countries." **37**: 57-78.

Rossi, S. P., et al. (2009). "How loan portfolio diversification affects risk, efficiency and capitalization: A managerial behavior model for Austrian banks." **33**(12): 2218-2226.

Settlements, B. f. I. (2010). The Basel Committee's response to the financial crisis: report to the G20 Basel, Bank for International Settlements.

Singh, R. I. J. J. o. F. and B. Management (2014). "Effect of Loan Diversification on Risk and Returns: An Empirical Study of Central Cooperative Banks in Punjab." **2**(2): 27-41.

Smith, K. (2007). moneycrashers. <u>moneycrashers</u>.

Tabak, B. M., et al. (2011). "The effects of loan portfolio concentration on Brazilian banks' return and risk." **35**(11): 3065-3076.

Tuovila, A. (2019). investopedia. <u>investopedia</u>.

Turkmen, S. Y. and I. J. A. i. j. o. c. r. Yigit (2012). "Diversification in banking and its effect on banks' performance: Evidence from Turkey." **2**(12): 111-119.

Williams, R. (2018) nd.edu. https://www.nd.edu/

Winton (1999). Don't Put All Your Eggs in One Basket? Diversification and Specialization in Lending. United States, Finance Department University of Minnesota.

Winton, A. J. D. and S. i. Lending (1999). "Don't put all your eggs in one basket? Diversification and specialization in lending."

Yudaruddin, R. J. I. J. o. A. B. and E. Research (2017). "The impact of economic conditions on bank profitability of regional development bank in Indonesia." **15**(19): 1-12.

VITA

NAME	Kornkanok Sittichobtham
DATE OF BIRTH	15 August 1994
PLACE OF BIRTH	Bangkok
INSTITUTIONS ATTENDED	Master of Science in Finance, Chulalongkorn University
HOME ADDRESS	88 Ekkachai Road Bangbon Bangbon Bangkok 10150