YIELD CURVE, INTEREST RATE AND BANK PROFITABILITY: EVIDENCE FROM THAILAND

BY

NATAYAR KRIENGKRAIWANICH

AN INDEPENDENT STUDY SUBMITTED IN PARTIAL
FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF SCIENCE
PROGRAM IN FINANCE (INTERNATIONAL PROGRAM)
FACULTY OF COMMERCE AND ACCOUNTANCY
THAMMASAT UNIVERSITY
ACADEMIC YEAR 2024

THAMMASAT UNIVERSITY
FACULTY OF COMMERCE AND ACCOUNTANCY

INDEPENDENT STUDY

BY

NATAYAR KRIENGKRAIWANICH

ENTITLED

YIELD CURVE, INTEREST RATE AND BANK PROFITABILITY: EVIDENCE FROM THAILAND

was approved as partial fulfillment of the requirements for
the degree of Master of Science (Finance)

on June 30, 2025

Chairman ……………………………………………
(Assistant Professor Wasin Siwasarit, Ph.D.)

Member and advisor ……………………………………………
(Assistant Professor Bin Zhao, Ph.D.)

Dean ……………………………………………
(Associate Professor Somchai Supattarakul, Ph.D.)

Independent study title	YIELD CURVE, INTEREST RATE AND BANK PROFITABILITY: EVIDENCE FROM THAILAND.
Author	Natayar Kriengkraiwanich
Degree	Master of Science (Finance)
Major field	Master of Science Program in Finance (International Program)
Faculty	Faculty of Commerce and Accountancy
University	Thammasat University
Independent study advisor	Assistant Professor Bin Zhao, Ph.D
Academic year	2024

ABSTRACT

Monetary policy transmission through interest rates significantly impacts banking sector profitability, particularly through changes in the yield curve slope that affect banks' net interest margin. This study investigates the relationship between interest rate environments and Thai commercial banks' profitability during a period of dynamic monetary policy from 2005 to 2024. The study employs a dynamic model with GMM estimation to analyze quarterly data from 10 Thai commercial banks. Analyzing how yield curve characteristics affect different profitability measures across bank size and economic periods. The findings show that a 100 basis point increase in yield curve slope positively increases net interest margins by approximately 2 percentage points. For bank size, the non-D-SIB banks are more affected; a 100 basis point increase in yield curve slope raises net interest margins by about 3.3 percentage points, while systemically important banks show little to no effect. Crisis periods alter these relationships, with the 2008 financial crisis tripling the yield curve's impact on net interest margins and the COVID-19 pandemic creating persistent negative pressure of approximately 7 to 8 basis points. These results suggest that monetary policy transmission effects vary significantly across bank types, with important implications for both bank risk management and central bank policy.

Keywords: Interest rate, Yield curve, Bank profitability

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to my advisor Assistant Professor Bin Zhao, Ph. D. for her exceptional guidance, patience and expertise throughout this research journey. Her insightful suggestions, and unwavering support were invaluable in completing this work. I deeply grateful to the committee member, Assistant Professor Wasin Siwasarit, Ph. D. for his thoughtful feedback and valuable contributions that enhance the quality of this study. His expertise in economics and banking provided crucial perspectives that strengthened my research.

My appreciation extends to the MIF's staffs especially Miss Sopiya for creating a supportive environment. I am grateful to my MIF 25 for their collaboration and support during the challenging phases of this study.

Finally, I express my gratitude to my family and friends for their encouragement and understanding during this challenging time.

Natayar Kriengkraiwanich

TABLE OF CONTENTS

	Page
ABSTRACT	(1)
ACKNOWLEDGEMENTS	(3)
LIST OF TABLES	(7)
LIST OF FIGURES	(8)
CHAPTER 1 INTRODUCTION	1
CHAPTER 2 REVIEW OF LITERATURE	3
2.1 Factors related to bank profitability	3
2.1.1 Non-interest income margin	4
2.2 Yield curve	5
2.2.1 The nelson-Siegel model	5
2.3 Relationship among Monetary Policy, Interest rate and Yield curve	6
2.4 Impact of monetary policy in banking sectors	7
2.5 Thai monetary policy overview	7
2.6 Thai monetary policy impacts on domestic banking sectors	8
2.7 Foreign monetary policy impacts on domestic banking sectors	9
CHAPTER 3 RESEARCH METHODOLOGY	10
3.1 Dynamic panel model	10
3.2 Fixed effect model	11
3.3 GMM Estimation	12

3.4 Instrument Validity Test 13
3.5 Variable Definition 15
3.5.1 Bank profitability measure 15
3.5.2 Independent Variables 15
3.5.2.1 Interest rate Measures 15
3.5.2.2 Yield curve measure 16
3.5.2.3 Bank-specific control variable 17
3.5.2.4 Macroeconomic control variable 17
3.6 Measurements of Variables 18
3.7 Target bank 19
3.8 Data Description 20
3.9 Conceptual framework 21

CHAPTER 4 RESULTS AND DISCUSSION 22

4.1 Yield Curve 22
4.2 Bank Profitability 22
4.3 Financial Crisis 2008 25
4.4 Covid pandemic 27
4.5 Bank size 30
4.6 Market concentration 34

CHAPTER 5 CONCLUSION 37

REFERENCES 39

APPENDICES

APPENDIX A YIELD CURVE EXTRACTING FROM NELSON-SIEGEL MODEL 42

APPENDIX B YIELD CURVE EXTRACTING FROM NELSON-SIEGEL MODEL 44

BIOGRAPHY 47

LIST OF TABLES

Tables	Page
3.1 Definitions, and the expected effect of the explanatory variables of model on bank profitability	18
3.2 Thai commercial banks	19
3.3 Descriptive Statistics	20
4.1 Dynamic Panel Estimates of Bank Performance Metrics	24
4.2 Crisis 2008 Dynamic Panel Estimation Results	27
4.3 COVID-19 Impact on Bank Profitability	29
4.4 Impact of Yield Curve Slope on Bank Profitability: D-SIB vs Non-D-SIB Comparison	32
4.5 Dynamic Panel Estimates of Bank Performance Metrics (HHI)	34

LIST OF FIGURES

Figures Page

3.1 Research methodology 14

3.2 Conceptual framework 21

4.1 Characteristics of yield curve 23

A.1 The characteristics of Thai yield curve 42

A.2 Tracks yield across different maturities (3-month, 2-year, and 10-year) over nearly two decades, capturing dramatic market events including the 2008 financial crisis peak, zero-lower- bound period, COVID-19 pandemic drops in 2020, and subsequent rate increases 43

B.1 Breaks down these yield curves into their core components level (overall height), slope (steepness), and curvature (bending) demonstrating how the general interest rate level declined over time with significant volatility during crisis periods, while the term structure has undergone multiple transitions between steep, flat, and occasionally inverted configuration 44

B.2 Displays yield curve decompositions at three key timestamps (2005, 2014, and 2024), revealing a progression from a strongly positive-sloped curve (approximately 2- 5%) to increasingly flatter curves (around 2-2.3% by 2024) 45

CHAPTER 1
INTRODUCTION

Monetary policy serves as a central bank's primary tool for influencing the cost of borrowing and controlling money supply within the real economy. Central banks employ the policy interest rate as their key monetary policy instrument, which operates through both direct and indirect channels. Directly, central banks manage short-term interest rates through their policy rate settings. Indirectly, they influence the shape of the yield curve, particularly its slope, by affecting market participants' expectations regarding the future trajectory of policy rates (Borio et al., 2017). The impact of policy interest rate changes, both in the short and long term, can be observed through various transmission mechanisms that affect the broader economy.

The yield curve shows the relationship between short- and long-term interest rates. The interest rate, both short- and long-term, is a key indicator of the market's expectations and the future economy. A normal, also known as an upward-sloping, yield curve implies that the long-term rate is higher than the short-term rate, which signals positive expectations for future economic growth. However, a flat or inverted yield implies that the long-term rate is lower than the short-term rate, signaling the uncertainty in the future economic outlook or an upcoming recession. In the banking industry, the slope of the yield curve is a crucial indicator to measure bank profitability since it reflects the banks' cost of borrowing in the short term and the banks' income from lending in the long term. Thus, the banks' profitability can be determined by the interest rate and shape of the yield curve since banks earn their income from the spread between the interest rate they charge on loans and the rate they pay on deposits, which is called the net interest margin. When the slope of the yield curve is upward, banks benefit because they can borrow at lower costs and lend at higher rates. Conversely, when the slope is inverted, banks face higher borrowing costs and lower lending rates, resulting in a narrower spread. However, these relationships are complex, and other factors such as non-interest income and market conditions also play a role in determining overall bank performance.

According to Windsor et al. (2023) it is said that changes in interest rate do not impact bank profitability as much as net interest margin due to commercial banks' adaptation. During last two decades, there has never been a period which interest rate has risen up quickly from 2022 to 2024 in the US and 2022 to 2024 in Thailand. Thus, banks' ability to earn profits in this environment should be evaluated further. This research seeks to shed light on how different interest rate environments influence the profitability of banks, particularly in economies with dynamic monetary policies.

This study examines the internal, external, and macroeconomic factors influencing banks' profitability. This research aims to investigate the association between interest rates and Thai banks' profitability.

Understanding the interplay between interest rates, the yield curve, and bank profitability is essential for policymakers and banking institutions. As central banks continue to adjust monetary policy in response to global economic conditions, the ability to predict and manage the effects of interest rate changes on bank performance will be critical for maintaining financial stability and ensuring the profitability of the banking sector.

CHAPTER 2
REVIEW OF LITERATURE

2.1 Factors related to bank profitability

According to the literature on determinants that affect bank margin and profitability Demirgüç-Kunt and Huizinga (1999), factors that affect the commercial bank's margin and profitability in a broader range of countries. By exploring various data from the worldwide banking system, the study has offered insight into how internal and external factors affect bank performance. The paper focuses on net interest margin is described as the difference between interest income acquired from loans and interest paid on deposits.

Like Athanasoglou et al. (2008) study, various factors that influence bank profitability are divided into 3 main groups: bank-specific (internal), industry-specific, and macroeconomic determinants. The study had provided the valuable insight into how each factor affects the bank's financial performance across different regions and time periods.

According to Sufian and Habibullah (2009), the GDP is one of the macroeconomic factors that affect the performance of commercial banks. This is because changes in economic activity directly affect the banks' ability to provide more or less liquidity to the public, which in turn affects the banks' ability to make more or less money through interest income.

Regarding the interplay between the yield curve and bank profitability Alessandri and Nelson (2015) had examined the relationship between bank profitability and the shape of the yield curve, which provides valuable insight into how interest rates and the yield curve affect the banks' financial performance. The study found that banks' profitability is highly sensitive to the shape of the yield curve, as a steeper yield curve supports banks' profitability through the widening of the interest margin. On the other hand, an inverted shape of the yield curve is negative to the banks' profitability by narrowing the interest margin. Like Borio et al. (2017), the study found the relationship between the yield curve and the bank's interest margin, which the flatter yield curve tends to reduce the net interest margin. Banks normally fund themselves with short-term liabilities and invest in long-term assets as part of the maturity transformation process. When the term premium is minimal, it can depress the net interest margin.

Busch and Memmel (2016) examine the relationship between banks' net interest margin and the level of interest rate. The study found that an increase in interest rate negatively impacts banks' net interest margin in the short term. However, using over 40 years of data from the German banking system indicates that, in the long run, a 100-basis point rise in interest rate results in a 7-basis point increase in net interest margin.

2.1.1 Non-interest income margin

The literature examining non-interest income and bank profitability reveals a complex relationship moderated by institutional characteristics, market conditions, and regulatory environments. Early theoretical frameworks by Stiroh (2004) and DeYoung and Roland (2001) suggested diversification benefits through reduced earnings volatility, while contrasting agency theory perspectives highlighted potential increased risk-taking behaviors. Empirical evidence presents mixed findings: cross-sectional international studies by Demirgüç-Kunt and Huizinga (2010) documented enhanced profitability from fee-based activities but increased systemic risk from excessive reliance on non-interest income, while longitudinal analyses by Stiroh and Rumble (2006) found diversification benefits often offset by increased volatility exposure. Recent methodological advancements using GMM estimation (Elsas et al., 2010) address endogeneity concerns and reveal that the relationship varies significantly by bank business model, size, and competitive environment. Contemporary research focuses on how digital transformation fintech competition and sustainable banking are reshaping non-interest income streams, suggesting that while diversification generally supports profitability, the optimal mix varies substantially across different types of financial institutions and market contexts.

2.2 Yield curve

The yield curve, also known as the term structure of interest rates, illustrates the relationship between interest rates and maturity periods for specific asset classes, most commonly government bonds. This paper derives the yield curve from the Nelson-Siegel model via the state-space approach.

The yield curve serves as a significant predictive indication for future economic activity and investor expectations, characterized by an upward-sloping curve where long-term rates surpass short-term rates, forecasting a favorable outlook for both the economy and the market. An inverted yield curve, characterized by short-term rates surpassing long-term rates, forecasts economic uncertainty.

2.2.1 The nelson-Siegel model

The Nelson-Siegel model was initially developed by Nelson and Siegel (1987). It is one of the most widely used for modeling the term structure of interest rates. It effectively depicts the key features of yield curves using three factors: level, slope, and curvature.

Diebold and Li (2006) reformulated the Nelson-Siegel model in a dynamic context, treating the parameters as time-varying variables that undergo autoregressive change. Their approach improved yield curve fitting as well as forecasting performance. This dynamic reformulation has made it simpler to understand how monetary policy transmission affects financial markets and institutions.

Moreover, Koopman et al. (2010) used the state-space technique to estimate the Nelson-Siegel model, which is significant advancement in the banking research. By placing the model in a state-space framework and using the Kalman filter, researchers may utilize cross-sectional and time-series data at the same time. This results in more precise parameter estimates and improved outcome prediction.

In banking research, the Nelson-Siegel model has been a very helpful instrument in analyzing how yield curve characteristics impact the behavior and performance of financial organizations. Alessandri and Nelson (2015) discovered that when yield curves are steeper, banks tend to make more money by changing the maturity of their loans, after using the model to break down yield curve elements and see how they affect bank profits. Borio et al. (2017) also employed Nelson-Siegel parameters to analyze how the interest rate environment affected bank profitability under different monetary policy regimes.

Because of its balance of simplicity, flexibility, and economic interpretability, the Nelson-Siegel model is particularly well-suited for our investigation in which yield curve characteristics impact bank profitability.

2.3 Relationship among Monetary Policy, Interest rate and Yield curve

According to Friedman (1968), monetary policy serves as the central bank's critical tool for influencing economic activity through the management of money supply and interest rates. George et al. (2020) examined the impact of monetary policy, demonstrating that its effects can be observed through various transmission mechanisms. Among these transmission channels, interest rates—both short-term and long-term—represent one of the most significant pathways. To provide deeper insight into these transmission mechanisms, Lane (2022) emphasized that monetary policy operates through its influence on the entire yield curve.

Changes in the policy rates are directly affecting the short-term money-market interest rate; however, the expectation of future policy rates is a primary indicator of medium- and long-term interest rates, along with term premium. Similar to Borio and Disyatat (2010) Monetary policy primarily affects the short-term interest rate and the slope of the yield curve.

However, its influence on the yield curve is more indirect. This impact occurs through shaping the market’s expectations about future policy rate changes, known as the signaling channel. Additionally, large-scale purchases of government securities, which alter their prices, are an example of balance sheet policies used to influence the yield curve. These operations are designed to affect long-term rates and broader market conditions. According to Borio et al. (2017), in low-interest rate environments, the potential mechanisms through which low rates could reduce monetary policy effectiveness are. The study implies that low rates may reduce bank profitability through the retail deposits endowment effect, which could result in banks becoming less responsive to further rate cuts. This result suggests that the reductions in short-term interest rates become less effective in stimulating bank lending when in a low-rate environment. This hypothesis is held after controlling for bank-specific and macroeconomic factors.

2.4 Impact of monetary policy in banking sectors

O'Donnell et al. (2024) examined the impact of monetary policy interventions on banking sector stocks during the COVID-19 crisis, revealing how different policy mechanisms produced varied market reactions throughout the pandemic. Their empirical investigation found that interest rate cuts and the Federal Reserve's commitment to maintaining a low-interest rate environment generated negative abnormal returns for U.S. banking stocks. Conversely, short-term announcements regarding intraday credit and liquidity provisions led to positive responses in banking sector stock prices.

The study revealed regional variations in market responses. European banking sectors exhibited muted reactions overall, with negative abnormal returns observed following the European Central Bank's announcements related to its 2% inflation target. In contrast, Chinese banking stocks demonstrated strong positive responses to foreign currency and exchange-related policy announcements by the People's Bank of China.

2.5 Thai monetary policy overview

Charoenseang and Manakit (2007). We can divide the Thai monetary policy background into three distinct eras. The first era started after World War II and lasted until June 1997. Thailand maintained a pegged exchange rate system, where the baht was tied to gold, the US dollar, or the basket of currencies, with the Exchange Equalization Fund (EEF) setting and defending its value daily against the US dollar. This system collapsed during the Asian financial crisis. On June 2, 1997, the baht was allowed to float, which was a major change in monetary policy. The second era started after that. The Bank of Thailand adopted a monetary targeting regime, which aimed to control the money supply to stabilize the economy. This was consistent with the move to a managed float system, and Thailand also received financial aid from the International Monetary Fund (IMF) during this period. The Bank of Thailand (BOT) set targets for the daily and quarterly monetary base to guide its policy. The third era starts on May 23, 2000. The BOT transitioned to an inflation-targeting regime due to the unstable relationship between money supply and output growth. This system is still in use today.

Most central banks typically employ a short-term interest rate as their primary monetary policy instrument. The underlying presumption is that changes in the official policy rate will influence the short-term rates set by commercial banks and other financial institutions throughout the financial system.

2.6 Thai monetary policy impacts on domestic banking sectors

Referring to Ratanavararak and Ananchotikul (2018), Thailand's experience with prolonged low interest rates provides valuable insights into how monetary policy affects domestic banking sector stability and performance. The relationship between policy rates and banking sector outcomes reveals several distinctive patterns that merit careful consideration. The Thai banking sector exhibits clear sensitivity to monetary policy changes, particularly through profitability channels. When the Bank of Thailand maintains low policy rates, banks experience measurable declines in profitability metrics. The research demonstrates that for every percentage point decrease in policy rates, Thai banks face approximately a 0.1 percentage point reduction in return on assets (ROA) and a 0.8 percentage point decline in return on equity (ROE). This effect operates primarily through the compression of net interest margins, a particularly significant factor given that Thai banks derive 75–83% of their income from interest-related activities. The response of the Thai banking sector to monetary policy reveals important structural characteristics. Large Thai banks demonstrate greater resilience to interest rate changes compared to medium and small institutions. This finding takes on particular significance in Thailand's highly concentrated banking market, where a small number of large institutions dominate. The research indicates that foreign banks operating in Thailand, which typically fall into the small bank category, show heightened sensitivity to domestic policy rate changes, suggesting complex international transmission mechanisms.

2.7 Foreign monetary policy impacts on domestic banking sectors

Literature examining cross-border monetary policy effects provides insights into how foreign monetary policy decisions impact domestic banking sectors. Bräuning and Ivashina (2020) emphasize the critical role of monetary policy in shaping the global banking landscape, demonstrating how central bank actions influence bank operations, lending practices, and financial stability with significant implications for the global economy.

The interconnected nature of the global banking system ensures that monetary policy decisions in major economies generate far-reaching cross-border effects. The prevailing academic and policy consensus suggests that monetary easing (tightening) in one country typically produces positive (negative) spillovers on the global lending activities of multinational banks. This relationship is illustrated by research showing that tightening monetary policy by the European Central Bank leads to credit contraction by Eurozone banks operating in countries such as Mexico (Morais et al., 2019). However, Cetorelli and Goldberg (2012) note that these same global banks tend to exhibit more muted responses in their home markets when implementing such adjustments abroad.

CHAPTER 3
RESEARCH METHODOLOGY

This paper will analyze 10 Thai commercial banks with the period between 2005 to 2024. Panel data methods should be applied because the data is cross-sectional time series. The estimation methods employed in the paper include dynamic panel model and GMM panel estimation

3.1 Dynamic panel model

The general panel model to be estimated is the following linear form;

$$Y_{it} = \sum_{k=1}^{k} \beta_k X_{it}^{k} + \varepsilon_{it} \quad \textbf{(1)}$$

Where $\varepsilon_{it} = \eta_i + V_{it}$, η_i is the unobserved time-invariant bank effects, V_{it} is an i.i.d random disturbance

The explanatory variables are grouped into interest rate measure, yield curve, bank-specific, industry-specific and macroeconomic factors respectively.

$$Y_{it} = \sum_{k=1}^{k} \beta_k X_{it}^{k} + \sum_{l=1}^{l} \beta_l X_{it}^{l} + \sum_{m=1}^{m} \beta_m X_{it}^{m} + \sum_{n=1}^{n} \beta_n X_{it}^{n} + \sum_{p=1}^{p} \beta_p X_{it}^{p} + \varepsilon_{it} \quad \textbf{(2)}$$

Additionally, Bank profitability shows tendency to persist over time, therefore employing the dynamic specification of the model by including a lagged dependent variable

$$Y_{it} = \beta_1 Y_{i,t-1} + \beta_2 LleverageL_{it} + \beta_3 LAssetgrowth_{it} + \beta_4 LGdpgrowth_t + \beta_5 Repo_t + \beta_6 DRepo_t + \beta_7 LDRepo_t + \beta_8 Slope_t + \beta_9 DSlope_t + \beta_{10} LDSlope_t + \beta_{11} HHI_t + \varepsilon_{it} \quad \textbf{(3)}$$

Where $\varepsilon_{it} = \eta_i + V_{it}$, η_i is the unobserved time-invariant bank effects, V_{it} is an i.i.d random disturbance, L is the lag operator and D is the first difference operator

To address the challenges posed by the dynamic panel model including the potential endogeneity of the lagged dependent variable. we employ the fixed effects generalized method of moments.

3.2 Fixed effect model

The analysis employs fixed effects panel regression as a complementary approach to the System GMM estimation. The fixed effects model accounts for unobserved, time-invariant heterogeneity across banks by allowing each institution to have its own intercept term Greene (2012). This approach is particularly appropriate for our analysis as it controls for bank-specific characteristics that may influence profitability but remain relatively stable over time.

$$Y_{it} = \gamma Y_{i,t-1} + \alpha_i + \beta X_{it} + \varepsilon_{it} \quad \textbf{(4)}$$

Where Y_{it} represents the dependent variable (NIM, NON-NIM, ROA, or ROE) for bank I at time t α_i is the bank the bank-specific fixed effect

$Y_{i,t-1}$ is the lagged dependent variable capturing persistence in bank profitability

X_{it} is a vector of explanatory variables

ε_{it} is the error term

While the fixed effects estimator effectively controls for time-invariant bank characteristics, it has known limitations when applied to dynamic panel models. Specifically, the inclusion of a lagged dependent variable can lead to what is known as the "Nickell bias" in panels with a small-time dimension Nickell (1981). Although our relatively large T dimension (approximately 79 time periods) mitigates this concern, we interpret these results alongside our System GMM estimates to ensure robust conclusions.

The fixed effects approach serves as an important robustness check for our primary System GMM findings, allowing us to examine whether the relationship between bank size and profitability measures remains consistent across different estimation techniques. This methodological triangulation enhances the credibility of our empirical results Angrist and Pischke (2009).

3.3 GMM Estimation

The Fixed Effects Generalized Method of Moments estimator is a well-known econometric technique that we will employ in our study to address several key challenges inherent in analyzing panel data on bank profitability. This approach offers significant advantages over simple estimation methods, particularly when dealing with the complex dynamics of financial institutions over time. At its core, The Fixed Effects Generalized Method of Moments estimator allows us to account for bank-specific fixed effects. This is crucial because each bank in our sample likely has unique, time-invariant characteristics that influence its profitability. By incorporating fixed effects, we can capture this unobserved heterogeneity across banks, ensuring that our estimates of the effects of interest rates and the yield curve are not biased by these bank-specific factors.

Another key advantage of the Fixed Effects Generalized Method of Moments estimator is its ability to handle the endogeneity issues that arise in dynamic panel models. In our case, we are including a lagged dependent variable as an explanatory variable, recognizing that a bank's current profitability is likely influenced by its profitability in previous periods. This creates an endogeneity problem because the lagged dependent variable is correlated with the error term. The Fixed Effects Generalized Method of Moments approach addresses this issue through the use of instrumental variables, allowing us to obtain consistent estimates of the model parameters.

3.4 Instrument Validity Test

3.4.1 Hansen J statistic

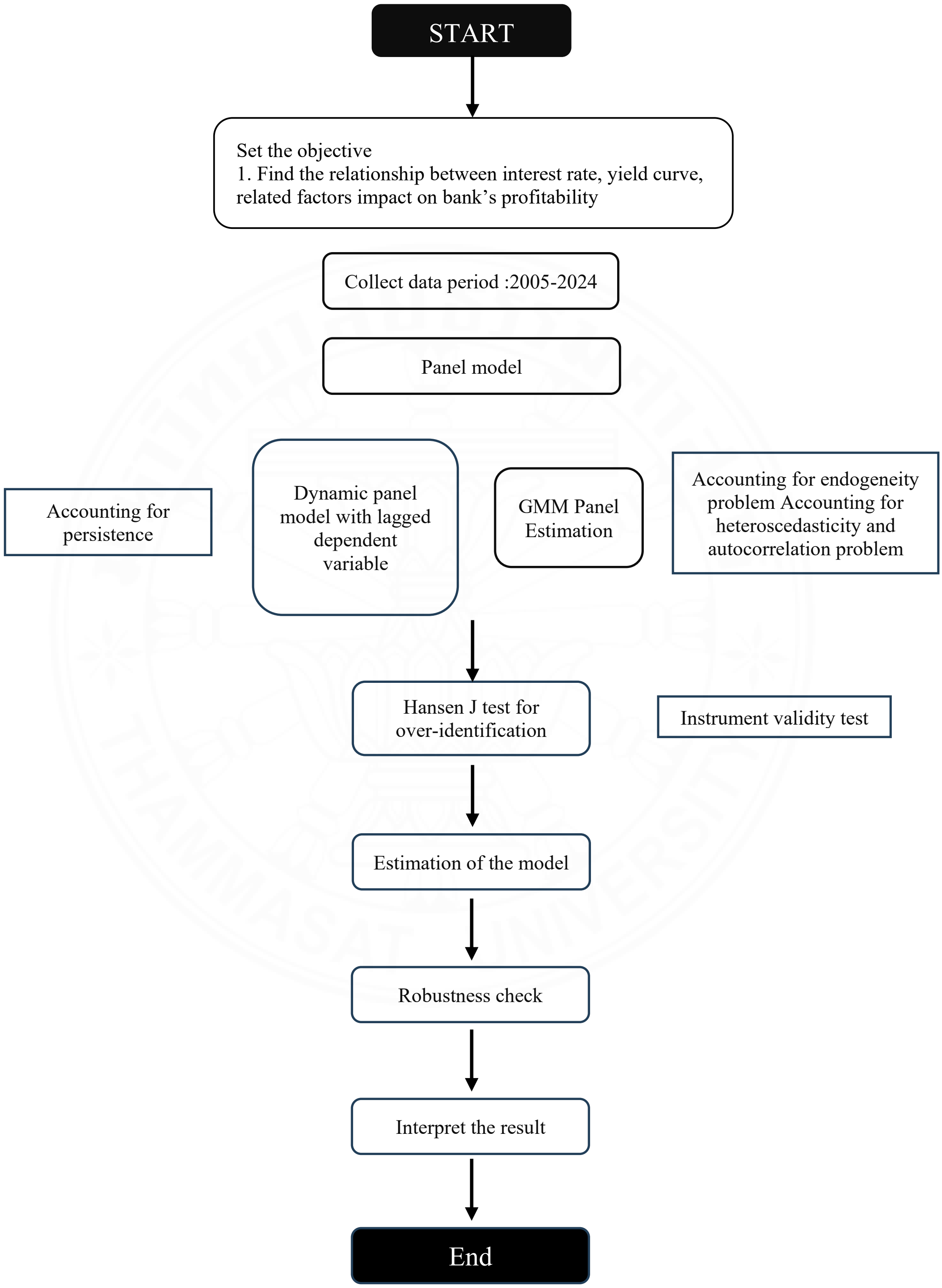
Baum et al. (2003) the Hansen J statistic is a key test for overidentifying restrictions in Generalized Method of Moments (GMM) estimation.

The Hansen J statistic tests whether the instruments used in a GMM estimation satisfy the orthogonality conditions, meaning they are truly exogenous and valid instruments. It can only be calculated when the model is overidentified - that is, when there are more instruments than endogenous variables. The null hypothesis: all instruments are valid

The J statistic follows a chi-square distribution with degrees of freedom equal to L-K, where L represents the number of instruments and K represents the number of endogenous regressors. Rejection of the null hypothesis indicates that some instruments may be invalid.

Figure 3.1

Research methodology



3.5 Variable Definition

3.5.1 Bank profitability measure

The profitability variable is represented by three alternative measures

3.5.1.1 Net interest margin (NIM) is a well-known metric to measure a bank's profitability. As defined by several papers, net interest margin is the spread between a bank's interest income and interest expense, expressed as a percentage of its average interest-earning assets.

3.5.1.2 Return on Asset (ROA) is one of the key financial ratios measuring a company's profitability relative to its total assets. This ratio implies how efficient a company using its assets to generate income. In the context of banking, ROA is an important indicator as it provides insight into how a bank is using their asset base, which mostly consists of loans and investments. These two are their core business, so the ability to generate profit from these assets is crucial for their success.

3.5.1.3 Return on Asset (ROE) is another one of the key financial metrics that capture a company's profitability relative to its shareholders' equity. This ratio indicates how effectively a company is using its equity capital to generate profits.

3.5.1.4 Non-interest income margin (NON-NIM) is a financial performance metric that measures a bank's ability to generate income from non-interest-based activities. Which reflects the diversification of banks to diversify their income streams beyond interest-bearing activities.

3.5.2 Independent Variables

3.5.2.1 Interest rate Measures

(1) Short-term interest rate—the 14-day repo rate is a proxy for short-term monetary policy. The 14-day repurchase rate, or "14-day repo rate," was the Bank of Thailand's primary policy interest rate from 2000 until January 2007. This rate represented the cost at which commercial banks could borrow money from the central bank by selling securities with an agreement to repurchase them in 14 days.

3.5.2.2 Yield curve measure

(1) Slope of the yield curve

The slope of the yield curve in this paper is derived from the Nelson-Siegel model, which is a widely recognized parametric approach to modeling the term structure of interest rates. The slope parameter specifically captures the steepness of the yield curve, representing the difference between long-term and short-term interest rates (Nelson & Siegel, 1987; Diebold and Li, 2006). This approach has been extensively employed in banking literature to examine the relationship between yield curve characteristics and financial institution profitability Borio et al. (2017); As noted by Alessandri and Nelson (2015), the slope parameter is particularly relevant for analyzing banking sector performance given the industry's fundamental role in maturity transformation. The state-space implementation of the Nelson-Siegel model significantly enhances its empirical application by treating the yield curve factors as unobserved dynamic processes that evolve over time Diebold and Li (2006). This approach enables more robust estimation of the yield curve parameters, including the slope factor, by incorporating time-series dynamics and cross-sectional constraints simultaneously.

In our state-space formulation, the measurement equation links the observed yields to the unobserved yield curve factors

$$Y_t(\tau) = \beta_{0t} + \beta_1(\frac{1 - e^{-\tau/\lambda}}{\lambda}) + \beta_2(\frac{1 - e^{-\frac{\tau}{\lambda}}}{\frac{\tau}{\lambda}} - e^{e^{-\frac{\tau}{\lambda}}}) + \varepsilon_t(\tau)$$

Where $Y_t(\tau)$ is the yield at time t for maturity τ

$\varepsilon_t(\tau)$ is the measurement error

The transition equation captures the evolution of the unobserved factors over time

$$\begin{bmatrix} \beta_{0t} \\ \beta_{1t} \\ \beta_{2t} \end{bmatrix} = \begin{bmatrix} \mu_0 \\ \mu_1 \\ \mu_2 \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} a_{13} \\ a_{21} & a_{21} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{bmatrix} \beta_{0,t-1} - \mu_0 \\ \beta_{1,t-1} - \mu_1 \\ \beta_{2,,t-1} - \mu_2 \end{bmatrix} + \begin{bmatrix} \eta_{0t} \\ \eta_{1t} \\ \eta_{2t} \end{bmatrix}$$

Where μ_i represents the mean of each factor $a_{i,j}$ are autoregressive parameters, and η_{it} are innovations.

The slope factor (β_{1t}) is extracted using the Kalman filter, which provides optimal estimates of the unobserved states given the observed yields Koopman et al. (2010). This approach allows for more efficient extraction of the yield curve components by exploiting both cross-sectional and time-series information.

Implementation follows the refinements proposed by Christensen et al. (2011), who extended the dynamic Nelson-Siegel framework to ensure arbitrage-free properties, a critical consideration when analyzing bank profitability responses to yield curve changes.

This state-space approach to extracting the yield curve slope aligns with the methodologies employed in recent banking literature examining the relationship between term structure dynamics and financial institution performance Borio et al. (2017)

3.5.2.3 Bank-specific control variable

(1) Leverage ratio – To controls and captures fundamental aspects of a bank's balance sheet structure that can influence its performance

(2) Log total asset is defined as the natural logarithm of total assets, measured in thousands of monetary units. This transformation is applied to normalize the highly skewed distribution of bank size and to allow for more meaningful interpretation of coefficients in our econometric models. Following standard practice in banking literature. It is used as primary measure of bank scale. The logarithmic transformation enables us to interpret coefficients as semi-elasticities and reduces the influence of extreme values in the sample.

(3) Growth rate of real total asset - The percentage change in a bank's total assets after adjusting for inflation. This metric captures the actual expansion or contraction of a bank's balance sheet in real terms, providing crucial information about its operational scale and growth dynamics. Demirgüç-Kunt and Huizinga (2010)

3.5.2.4 Macroeconomic control variable

(1) Real GDP growth rate - the percentage change in a country's total economic output, adjusted for inflation. In banking research, this metric captures the overall economic environment in which banks operate. (Borio et al., 2017)

(2) CPI included in our econometric models as a critical control variable that captures the impact of inflation on bank profitability.

(3) Industry-specific variable

(4) Herfindahl-Hirschman Index (HHI) is an index that widely used in market concentration. In this paper HHI is used as a proxy for concentration. It is defined as follows:

$$HHI_{i,t} = \sum_{j=1}^{n} s_{itj}^{2}$$

Where S_{itj} is the ration of asset of j-th financial institution to total asset of financial institutions

3.6 Measurements of Variables

Table 3.1

Definitions, and the expected effect of the explanatory variables of model on bank profitability

				Expected relationship		
	Variable	Measure	Source	Sign (NIM)	Sign (ROA)	Sign (ROE)
Dependent variables	Net interest margin (NIM)	(Interest income – interest expense)/average earning asset	Bank financials' statement / author's calculation			
	Return on equity (ROE)	Net profit / Total Equity	Bank financials' statement / author's calculation			
	Return on asset (ROA)	Net profit / Total Asset	Bank financials' statement / author's calculation			
	Non -Interest margin (NON-NIM)	Non-interest income/total asset	Bank financials' statement			
Interest rate measures	Short term interest rate	14-Day repurchase rate	BOT	+	+	+
Yield curve measures	The slope of the yield curve	Difference between the 10-year government bond rate and the 3- month treasury bill rate	ThaiBMA and author's calculation	+/-	+/-	+/-
Bank-specific measure	Leverage ratio	Debt / Total asset	Bank financials' statement	+/-	+/-	+/-
	Growth rate of real total asset	Growth in Real Total Assets (%)	Bank financials' statement	+/-	+/-	+/-
	Log total asset	Logarithm of total asset	Bank financials' statement / author's calculation			

Table 3.1

Definitions, and the expected effect of the explanatory variables of model on bank profitability (Cont.)

				Expected relationship		
	Variable	Measure	Source	Sign (NIM)	Sign (ROA)	Sign (ROE)
Macroeconomic measure	Real GDP growth	Growth in Real GDP (%)	BOT/author's calculation	+	+	+
	CPI	Captures the impact of inflation on bank profitability.	BOT/author's calculation			

3.7 Target bank

The study will focus on a specific time frame which between 2005-2024, which may include a period of significant interest rate era and volatility. Historical data from the past two decades will be used to conduct the analysis. Data will be sourced from banks' financial, quarterly reports. Empirical analysis will be supported by quantitative data and qualitative insights.

The researcher collects the list of Thais' bank financial statements during 2005-2024 as follows

Table 3.2

Thai commercial banks

NO	Thai Commercial bank
1	Bangkok Bank Public Company
2	Bank of Ayudhya Public company
3	CIMB Thai Public company
4	Kasikornbank Public Company
5	Kiatnakin Phatra Bank Public company
6	Krungthai Bank Public company
7	Thanachart Capital
8	TMB bank Public company
9	Tisco bank Public company
10	Siam Commercial Bank Public company

3.8 Data Description

Data is obtained from Datastream.

Table 3.3

Descriptive Statistics

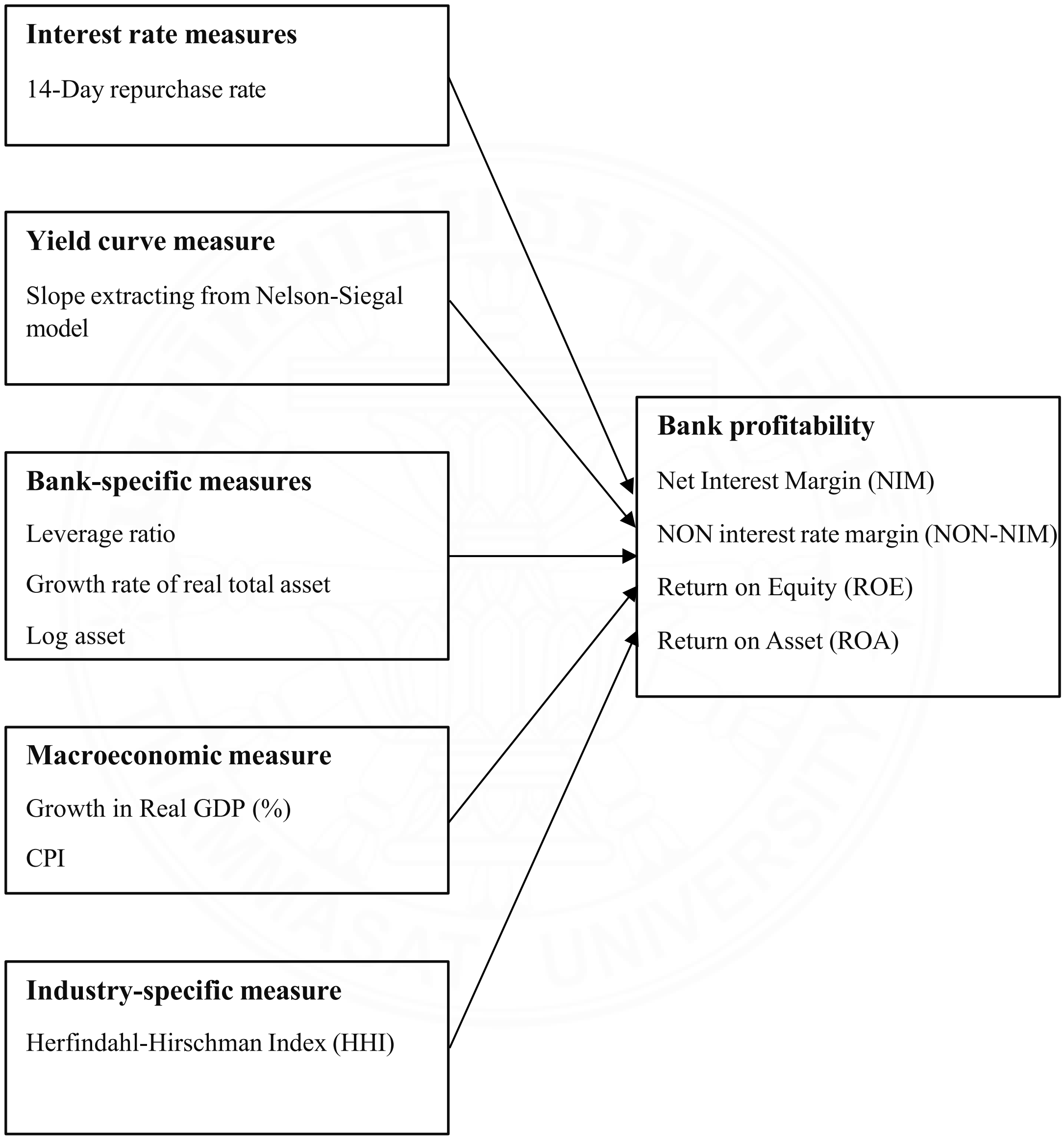
	count	**mean**	**sd**	**min**	**max**
nim	799	0.0090	0.0028	0.0000	0.0211
non_nim	800	0.0031	0.0019	-0.0189	0.0164
roa	800	0.0123	0.0106	-0.0640	0.0520
roe	800	0.0864	0.2158	-2.8436	0.2778
leverage	800	0.1314	0.1502	0.0000	1.0592
log_asset	800	5.9213	0.5277	0.0000	6.6589
asset_growth	799	0.0185	0.0737	-0.8512	1.0626
real_gdp_growth	800	0.8183	5.7136	-15.8599	12.2834
repo_rate	800	0.0211	0.0111	0.0050	0.0500
slope	800	0.0193	0.0107	0.0028	0.0507
level	800	0.0390	0.0125	0.0160	0.0701
curvature	800	0.0065	0.0073	-0.0060	0.0322
cpi	800	0.0200	0.0228	-0.0277	0.0751
hhi	800	0.1513	0.0037	0.1463	0.1597

This table presents descriptive statistics for the sample period.

3.9 Conceptual framework

Figure 3.2

Conceptual framework



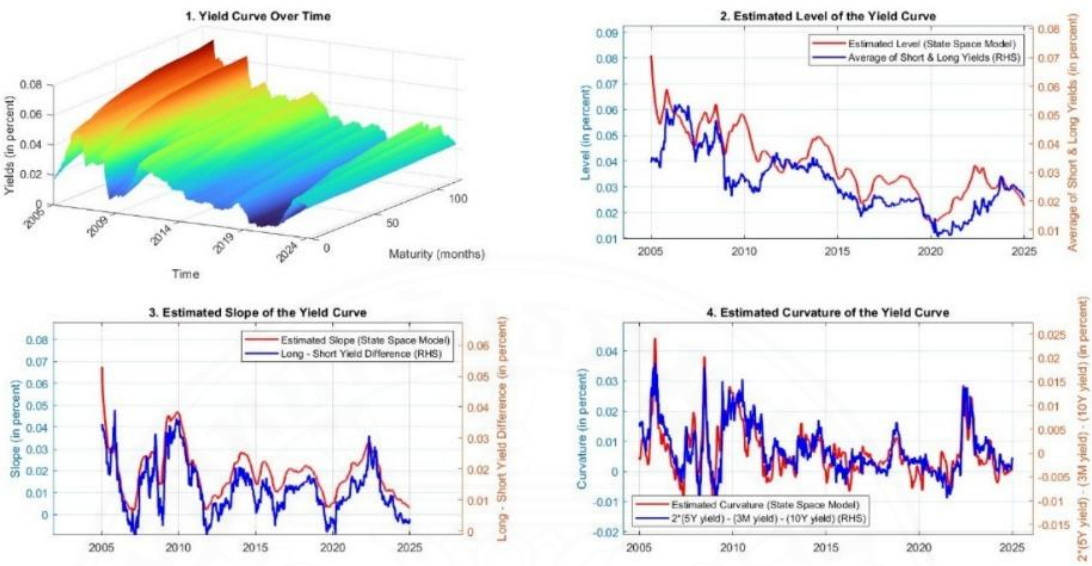
CHAPTER 4
RESULTS AND DISCUSSION

4.1 Yield Curve

The Thai yield slope extract from nelson-Siegel model using state-space model. Figure 1 presents a comprehensive four-panel analysis of yield curve dynamics from 2005 to 2024. The first panel displays a colorful 3D surface plot showing the entire yield curve evolution over time, with height and colors (red/orange for high yields, blue/purple for low yields) representing interest rate levels across different maturities. The remaining three panels break down the curve's behavior into fundamental components. Panel 2 tracks the overall level (height) of the curve, showing a general decline from approximately 6% in 2005 to lows near 2% in 2020, before partially recovering to around 3% by 2024. Panel 3 examines the slope factor, which reveals periods of both steep curves (2005, 2010-2011, 2021) and flat/inverted curves (2007, 2019-2020, trending toward flatter in 2023-2024). Panel 4 illustrates the curvature factor, capturing the "belly" of the yield curve with notable volatility during 2005-2006, 2008-2009, and again in 2022-2023. Together, these components explain nearly all yield curve variations, with the model's estimates (red lines) closely tracking traditional market measures (blue lines), validating the state space modeling approach and providing valuable insights for understanding interest rate dynamics and their potential economic implications.

Figure 4.1

Characteristics of yield curve



4.2 Bank Profitability

The regression result based on bank profitability is presented in Table 4.1. For overall profitability, a bank is measured by net interest margin, non-interest margin, return on asset (ROA), and return on equity (ROE), respectively. The research is using a two-step GMM estimation system, covering data from 10 Thai banks from 2005 to 2024. The model demonstrates strong persistence in NIM, as shown by the highly significant lagged dependent variable coefficient of 0.843, which aligns with (Aydemir & Ovenc, 2016).

Our finding found that the repo rate has a significant positive relationship with NIM, which implies that a 100-basis point rise in the repo rate would increase NIM by 1.6 percentage points per quarter. For the yield curve, the result in Table 4.1 shows a significant positive relationship with NIM a 100-basis point rise in the yield curve would increase NIM by 2 percentage points per quarter. The results are mostly consistent with all international and Thai research. Regarding macroeconomic factors, the inflation variable demonstrates a negative relationship with NIM. Real GDP growth shows a positive relationship with NIM.

Non-interest margin, the model shows weaker persistence compared to NIM. For both repo rate and yield curve, having insignificant to NON-NIM implies that the monetary transmission has not affected this type of bank's income.

The results indicate that both policy indicators, the repo rate and the yield curve, show an insignificant relationship with ROE. Likely to ROA the result shows insignificant.

Table 4.1

Dynamic Panel Estimates of Bank Performance Metrics

	(1) Net Interest Margin	(2) Net Interest Margin (FE)	(3) Non-Interest Income	(4) Non-Interest Income (FE)	(5) Return on Assets	(6) Return on Assets (FE)	(7) Return on Equity	(8) Return on Equity (FE)
L.Net Interest Margin	0.843^{***}	0.784^{***}						
	(0.118)	(0.033)						
Lagged Leverage	-0.001^{***}	-0.001^{*}	-0.000	-0.001^{*}	-0.000	-0.000	-0.006	-0.005
	(0.000)	(0.000)	(0.001)	(0.000)	(0.003)	(0.001)	(0.006)	(0.018)
Repo Rate	0.016	0.032^{***}	-0.003	0.002	-0.029	-0.058	-0.355^{**}	-1.008
	(0.010)	(0.005)	(0.015)	(0.010)	(0.036)	(0.049)	(0.181)	(0.864)
Yield Curve Slope	0.020^{***}	0.031^{***}	0.002	0.007	0.010	0.001	0.059	-0.005
	(0.007)	(0.008)	(0.012)	(0.009)	(0.027)	(0.031)	(0.118)	(0.320)
Inflation (CPI)	-0.003	-0.004^{*}	-0.003	-0.005	0.010	0.017^{**}	0.098	0.296
	(0.002)	(0.002)	(0.002)	(0.003)	(0.011)	(0.007)	(0.131)	(0.180)
Real GDP Growth	0.000	0.000	0.000	-0.000	-0.000	-0.000	-0.000^{*}	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
L_asset_growth		-0.000		0.001		0.002		0.080
		(0.001)		(0.001)		(0.002)		(0.062)
Log Total Assets		0.001^{***}				-0.000		0.004
		(0.000)				(0.002)		(0.019)
L.Non-Interest Income			0.220^{*}	0.451^{***}				
			(0.120)	(0.059)				

Table 4.1

Dynamic Panel Estimates of Bank Performance Metrics (Cont.)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Net Interest Margin	Net Interest Margin (FE)	Non-Interest Income	Non-Interest Income (FE)	Return on Assets	Return on Assets (FE)	Return on Equity	Return on Equity (FE)
L_real_gdp_growth				0.000				
				(0.000)				
D_cpi				0.001				
				(0.002)				
L.Return on Assets					0.920***	0.873***		
					(0.071)	(0.034)		
L.Return on Equity							1.010***	0.847***
							(0.047)	(0.026)
Constant	0.001	-0.007**	0.003***	0.002***	0.001	0.003	0.003	0.002
	(0.001)	(0.002)	(0.001)	(0.000)	(0.001)	(0.015)	(0.006)	(0.129)
Observations	789.000	789.000	790.000	789.000	790.000	789.000	790.000	789.000
AR(1) p-val	0.099		0.055		0.105		0.138	
AR(2) p-val	0.447		0.660		0.139		0.808	
Hansen J p-val	0.702		0.345		0.096		0.597	

4.3 Financial Crisis 2008

The key finding in Table 4.2 arises from the interaction term between yield curve slope and the crisis period (slope_crisis). The net interest margins, the coefficient, are 0.021 at a significant level of 5%, which, adding to the baseline slope of effect of 0.011, reveals that the total impact of yield curve steepening on NIMs during the crisis was approximately 0.032, which is triple the yield curve's impact on bank interest margin during the normal circumstance. This sensitivity implies that during the crisis, banks became more dependent on traditional transformation activities where other sources of revenue were under pressure.

The baseline yield curve slope coefficient for NIMs is 0.011, with a significant level at 10%. This indicates that, under normal circumstances, a one percentage point increase in the yield curve slope can raise NIMs by approximately 1.1

basis points. However, the crisis altered this relationship across different profitability metrics. NIMs became more sensitive to the yield curve; other profitability metrics show different patterns. The ROA and ROE slope_crisis coefficients are negative and large in magnitude, where they are -0.066 and 2.932, respectively. Suggesting that high uncertainty in these relationships during the crisis.

The direct crisis (crisis_2008 variable) shows mixed effects across profitability matrices. Most notably, the non-interest margins have a significant negative effect (-0.001 at a significant level of 10%), indicating that fee-based and trading revenue were under pressure during the crisis. However, NIM, ROA, and ROE lack a significant direct effect, suggesting that the crisis's impact operated through changed relationships with economic variables rather than a simple level shift in profitability.

The impact of the repo rate implies striking monetary policy transmission effects. During the crisis, the repo rate coefficient for ROE is -0.976 at a significant level of 10%, suggesting that easing of the monetary policy to support the economy has depressed bank profitability through narrower lending spreads. These are the challenging trade-offs for a central bank to maintain between supporting the economy and maintaining bank profitability.

The persistence parameters (lagged dependent variables) remain high and significant across all metrics, where the strongest persistence is ROE and ROA, at 1.021 and 0.930, respectively. The high persistence during the crisis implies that bank profitability maintained momentum during the volatile market, possibly due to the smoothing effect of loan portfolios and regulatory measures.

The diagnostic tests confirm the robustness of the results, where all models pass the AR(2) test for serial correlation and the Hansen test p-value indicates that all the instruments are valid. The high Hansen p-value suggests that the models are not over-identified.

Table 4.2

Crisis 2008 Dynamic Panel Estimation Results

	(1) NIM	(2) ROA	(3) ROE	(4) Non-NIM
L.nim	0.839***			
	(0.104)			
slope	0.011*	0.012	-0.402	0.003
	(0.006)	(0.014)	(0.465)	(0.010)
slope_crisis	0.021**	-0.066	-2.932	0.017
	(0.009)	(0.075)	(2.775)	(0.010)
repo_rate	0.008	-0.026	-0.976*	-0.004
	(0.009)	(0.024)	(0.586)	(0.011)
crisis_2008	-0.001	0.003	0.162	-0.001*
	(0.000)	(0.003)	(0.141)	(0.000)
L.roa		0.930***		
		(0.068)		
L.roe			1.021***	
			(0.056)	
L.non_nim				0.238*
				(0.139)
_cons	0.001	0.001	0.018	0.002***
	(0.001)	(0.001)	(0.018)	(0.001)
Observations	789.000	790.000	790.000	790.000
Groups	10.000	10.000	10.000	10.000
AR(1) p-value	0.097	0.106	0.135	0.058
AR(2) p-value	0.454	0.139	0.833	0.708
Hansen p-value	0.581	0.156	0.153	0.416

4.4 Covid pandemic

In the table shown in 4.3. The key finding is the persistent negative impact of COVID-19 on net interest margin (NIMs). The coefficient for 2021 shows a significant decrease of 0.08 basis points, which continued into 2022 with a 0.07 basis point decline, both statistically significant at the 1% level. This conclusion implies that the pandemic created pressure on banks' core lending profitability, likely due to the low-interest-rate environment maintained by the central bank to support the economy's recovery.

The impact on overall bank profitability metrics shows a mixed pattern. Return on assets (ROA) actually improved slightly in 2022, with a coefficient of 0.0019 significant at 10%. This result implies that NIMs suffered from the pandemic; banks may have compensated from other sources of revenue or cost management strategies. The return on equity (ROE) showed a negative effect in 2021 with a coefficient of -0.0323 at a significant level of 10% but recovered by 2022, indicating that banks adapted their capital management strategies over a period of time.

The control variables reveal additional insights into bank performance. Bank leverage shows a consistent negative relationship with NIMs with a coefficient of -0.0018 and a significant level at 1%, suggesting the more leveraged, the more pressure on their interest margins. The repo rate coefficient for NIMs is positive and highly significant, with a coefficient of 0.0198, indicating the banks benefit from higher policy rates through improved interest rate margins. Similarly, the yield curve slope positively affects NIMs with a coefficient of 0.0405 at a significant level of 5%, confirming that a steeper yield curve enhances a bank's maturity transformation profits.

Bank size, measured by log assets, shows a negative coefficient across all profitability metrics. This suggests that larger banks face greater challenges in maintaining profitability ratios, possibly due to regulatory burden or operational complexities.

The diagnostic tests confirm the robustness of these results, with all models passing the AR (2) test for absence of second-order serial correlation. The joint COVID test p-values imply that the pandemic years collectively have a statistically significant effect on profitability measures, validating the importance of examining this pandemic's period impact on the banking sector.

Table 4.3

COVID-19 Impact on Bank Profitability

	NIM	ROA	ROE	Non-NIM
covid_2020	-0.0001	0.0013	-0.0458	-0.0004
	(0.0001)	(0.0024)	(0.0372)	(0.0004)
covid_2021	-0.0008***	0.0027	-0.0323*	0.0002
	(0.0002)	(0.0029)	(0.0176)	(0.0005)
covid_2022	-0.0007***	0.0019*	0.0016	-0.0001
	(0.0003)	(0.0012)	(0.0094)	(0.0003)
L.leverage	-0.0018***	-0.0013	-0.0146	0.0019
	(0.0006)	(0.0022)	(0.0539)	(0.0011)
repo rate	0.0198***	-0.0164	-3.3160	-0.0163
	(0.0073)	(0.0334)	(2.7697)	(0.0203)
Slope	0.0405**	-0.0061	-2.2524	-0.0073
	(0.0161)	(0.0430)	(2.2356)	(0.0057)
real_gdp_growth	0.0000**	-0.0000	-0.0010*	-0.0000
	(0.0000)	(0.0000)	(0.0005)	(0.0000)
L.asset_growth	0.0001	0.0021	-0.1467	-0.0001
	(0.0007)	(0.0032)	(0.1421)	(0.0004)
L.log_asset	-0.0005**	-0.0016***	-0.0188**	-0.0004**
	(0.0003)	(0.0006)	(0.0088)	(0.0002)
Observations	758	760	760	760

Standard errors in parentheses

Notes: This table presents results from system GMM estimation using quarterly data from 2005-2024.

The dependent variables are Net Interest Margin (NIM), Return on Assets (ROA), Return on Equity (ROE), and Non-Interest Margin (Non-NIM).

All specifications include four lags of the dependent variable and are estimated using system GMM with robust standard errors clustered at the bank level.

Diagnostic Tests - AR(1) p-values: NIM(%5.3far1_nim), ROA(%5.3far1_roa), ROE(%5.3far1_roe), Non-NIM(%5.3far1_non_nim)

Diagnostic Tests - AR(2) p-values: NIM(%5.3far2_nim), ROA(%5.3far2_roa), ROE(%5.3far2_roe), Non-NIM(%5.3far2_non_nim)

Joint COVID test p-values: NIM(%5.3fjoint_nim), ROA(%5.3fjoint_roa), ROE(%5.3fjoint_roe), Non-NIM(%5.3fjoint_non_nim)

All models pass the AR(2) test ($p > 0.05$), confirming the absence of second-order serial correlation.

*, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Standard errors are reported in parentheses.

$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

4.5 Bank size

The D-SIB framework was established by the Bank of Thailand on September 25, 2017, representing steps toward the full implementation of Basel III international regulations, which impose higher capital requirements on banks that could significantly impact the financial system in the event of their failure or impairment. The six major commercial banks classified as D-SIBs are Krungthai Bank, Siam Commercial Bank, TMBThanachart Bank, Kasikorn Bank, Krungsri Bank, and Bangkok Bank. The term “D-SIBs” refers to domestic systemically significant banks that are considered too large to fail and the Non-D-SIBs are CIMBT bank, Tisco bank and Kiatnakin Phatra Bank.

The most striking finding concerns the differential impact of yield curve slope on Net Interest Margins. Non-D-SIB banks show a strong positive relationship, with a coefficient of 0.0328 (significant at 1%), meaning that when the yield curve steepens by one percentage point, their NIMs increase by approximately 3.3 basis points. In contrast, D-SIBs show virtually no sensitivity to yield curve changes (-0.0020, not statistically significant). This suggests that smaller, non-systemically important banks are much more reliant on traditional maturity transformation activities - borrowing short-term and lending long-term - to generate profits. The D-SIBs' lack of sensitivity likely reflects their more diversified business models and sophisticated interest rate risk management strategies.

For Return on Assets, both bank types show positive coefficients for yield curve slope, though only the non-D-SIB coefficient (0.0355) achieves statistical significance at the 5% level. This indicates that non-D-SIBs experience meaningful improvements in overall profitability when the yield curve steepens, while D-SIBs' ROA remains relatively unaffected. The pattern extends to Return on Equity, where non-D-SIBs show a significant positive coefficient of 0.4828 (at 5% level), suggesting that yield curve steepening substantially enhances their equity returns.

The persistence parameters (lagged dependent variables) reveal interesting dynamics about profitability stability. D-SIBs demonstrate higher persistence in most profitability measures, with lagged ROA coefficient of 0.9123 compared to 0.8602 for non-D-SIBs, and lagged ROE of 0.8905 versus 0.8214. This higher persistence suggests that D-SIBs maintain more stable profitability over time, likely due to their diversified revenue streams and market power.

Bank size effects also differ between the two groups. For non-D-SIBs, larger size within their category is associated with higher NIMs (coefficient 0.0013, significant at 10%) and higher non-interest income ratios (0.0010, significant at 5%). However, D-SIBs show a negative relationship between size and non-interest income (-0.0009, significant at 10%), possibly indicating diseconomies of scale or regulatory burdens at the largest sizes.

The macroeconomic control variables show limited impact overall, though CPI inflation appears to benefit D-SIBs' NIMs (0.0025, significant at 10%) while negatively affecting their non-interest income (-0.0090, significant at 5%). This suggests D-SIBs may have better pricing power to pass through inflation in their lending rates but face challenges in fee-based services during inflationary periods.

The high within R-squared values, particularly for D-SIBs (ranging from 0.672 to 0.816), indicate that the models explain a substantial portion of profitability variation. The systematically higher R-squared for D-SIBs across most specifications suggests their profitability follows more predictable patterns compared to non-D-SIBs.

Table 4.4

Impact of Yield Curve Slope on Bank Profitability: D-SIB vs Non-D-SIB Comparison

	Net Interest Margin		Return on Assets					
	Non-D-SIB	D-SIB	Non-D-SIB	D-SIB	Non-Interest Margin Non-D-SIB	D-SIB	Return on Equity Non-D-SIB	D-SIB
Lagged NIM	0.7922***	0.8116***						
	(0.0588)	(0.0562)						
Lagged ROA			0.8602***	0.9123***				
			(0.0495)	(0.0142)				
Lagged Non-NIM					0.4651***	0.3578		
					(0.0506)	(0.1785)		
Lagged ROE							0.8214***	0.8905***
							(0.0053)	(0.0033)
Yield Curve Slope	0.0328***	-0.0020	0.0355**	0.0299	0.0085	0.0002	0.4828**	0.5106
	(0.0034)	(0.0026)	(0.0084)	(0.0205)	(0.0096)	(0.0028)	(0.1455)	(0.3780)
Log(Assets)	0.0013*	-0.0001	0.0005	0.0010	0.0010**	-0.0009*	0.0231	0.0122
	(0.0006)	(0.0002)	(0.0025)	(0.0009)	(0.0002)	(0.0004)	(0.0100)	(0.0152)
Real GDP Growth	0.0000	0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0023	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0018)	(0.0002)
CPI Inflation	-0.0025	0.0025*	0.0001	0.0120	0.0010	-0.0090**	0.0984*	0.1190
	(0.0019)	(0.0011)	(0.0042)	(0.0065)	(0.0058)	(0.0030)	(0.0357)	(0.0722)
Constant	-0.0059	0.0022	-0.0016	-0.0059	-0.0037*	0.0077**	-0.1213	-0.0796
	(0.0028)	(0.0015)	(0.0145)	(0.0060)	(0.0012)	(0.0026)	(0.0550)	(0.1039)
Observations	315	474	315	474	315	474	315	474
Within R^2	0.731	0.672	0.727	0.816	0.266	0.190	0.678	0.790

Standard errors in parentheses

Notes: This table reports dynamic panel fixed effects estimation results examining the impact of yield curve slope on different bank profitability measures.

Columns (1)-(2) show net interest margin (NIM) results, columns (3)-(4)

show return on assets (ROA) results, columns (5)-(6) show non-interest income ratio results, and columns (7)-(8) show return on equity (ROE) results.

D-SIB banks include Bangkok Bank, KASIKORNBANK,Krung Thai Bank, Siam Commercial Bank, Bank of Ayudhya (Krungsri), and TMBThanachart Bank (TTB). All specifications include bank fixed effects and lagged dependent variables. Control variables include bank size, real GDP growth, and

CPI inflation. Standard errors are robust and clustered at the bank level. *, **, *** denote significance at 10%, 5%, and 1% levels, respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.0$

4.6 Market concentration

The initial results suggested that market concentration has a statistically significant negative effect on most performance metrics. Specifically, HHI showed negative associations with NIM in the GMM model (-0.035*), NON-NIM in both GMM (-0.083***) and FE (-0.084***) models, ROA in the GMM model (-0.098*), and ROE in both GMM (-1.586*) and FE (-2.113***) models. Our Granger causality tests revealed bidirectional relationships between market concentration and performance metrics, with stronger evidence supporting that bank performance influences market concentration ($F(2, 761) = 8.11$, $p < 0.001$ for NIM→HHI direction) rather than the reverse ($F(2, 761) = 1.62$, $p = 0.198$ for HHI→NIM direction). This finding fundamentally challenges the traditional interpretation that would attribute performance differences to market structure effects. Rather than supporting either the market power hypothesis (Berger et al., 2004) or the efficiency hypothesis in their conventional forms, our results suggest a performance-structure relationship where bank performance characteristics drive subsequent changes in market concentration. This aligns with the "relative efficiency" perspective in banking literature (Boone, 2008; Schaeck and Cihák, 2014), which suggests that performance differentials among banks lead to endogenous market structure outcomes through competitive processes. The consistent evidence across multiple performance metrics indicates that the relationship between bank performance and market concentration is more complex and bidirectional than previously understood in much of the banking literature.

Table 4.5

Dynamic Panel Estimates of Bank Performance Metrics (HHI)

	NIM		NON-NIM		ROA		ROE	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	GMM	FE	GMM	FE	GMM	FE	GMM	FE
L.NIM	0.877***	0.788***						
	(0.116)	(0.043)						
HHI	-0.035*	**0.001**	-0.083***	-0.084***	-0.098*	-0.031	-1.586*	-2.113***
	(0.019)	(0.014)	(0.020)	(0.017)	(0.055)	(0.051)	(0.951)	(0.768)

Table 4.5

Dynamic Panel Estimates of Bank Performance Metrics (HHI) (Cont.)

	NIM		NON-NIM		ROA		ROE	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	GMM	FE	GMM	FE	GMM	FE	GMM	FE
repo_rate	0.000	0.030***	-0.022	-0.017*	-0.050	-0.065	-0.687*	-1.436
	(0.014)	(0.009)	(0.015)	(0.009)	(0.032)	(0.044)	(0.378)	(1.088)
Slope	0.012	0.030***	-0.000	0.003	0.006	-0.001	-0.014	-0.059
	(0.008)	(0.010)	(0.011)	(0.008)	(0.024)	(0.030)	(0.123)	(0.457)
cpi	-0.002	-0.004**	-0.002	-0.003	0.012	0.018**	0.136	0.345*
	(0.002)	(0.002)	(0.002)	(0.003)	(0.010)	(0.007)	(0.161)	(0.190)
real_gdp_growth	0.000	0.000	0.000	-0.000	-0.000	-0.000	-0.000*	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
L_asset_growth		-0.000		0.001		0.002		0.074
		(0.001)		(0.001)		(0.002)		(0.058)
log_asset		0.001**				-0.000		0.005
		(0.001)				(0.003)		(0.026)
L.NON_NIM			0.229	0.410***				
			(0.156)	(0.076)				
L_real_gdp_growth				0.000				
				(0.000)				
D_cpi				0.002				
				(0.002)				
L.ROA					0.900***	0.873***		
					(0.082)	(0.040)		
L.ROE							1.007***	0.843***
							(0.050)	(0.035)
Constant	0.006***	-0.008*	0.016***	0.015***	0.017**	0.008	0.250*	0.326
	(0.002)	(0.005)	(0.004)	(0.003)	(0.008)	(0.016)	(0.149)	(0.217)
Observations	789.000	789.000	790.000	789.000	790.000	789.000	790.000	789.000
AR(1) p-val	0.080		0.062		0.108		0.138	
AR(2) p-val	0.434		0.681		0.141		0.815	
Hansen J p-val	0.865		0.341		0.093		0.462	
Within R-squared		0.720		0.245		0.773		0.730

Standard errors in parentheses

GMM: Two-step system GMM with lag(2 4), robust standard errors

FE: Fixed effects with bootstrapped standard errors (500 reps)

AR(1)/AR(2): Arellano-Bond tests for autocorrelation

Hansen: test of over-identifying restrictions

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

CHAPTER 5
CONCLUSION

The study examined the relationship between interest rate environments and Thai commercial banks' profitability from 2005 to 2024, with particular focus on yield curves and their differential impacts across bank size and economic periods.

The finding shows that the yield curve slope significantly affects bank profitability, with a 100 basis point increase in slope positively increasing net interest margins by approximately 2 percentage points. This relationship shows the striking importance of maturity transformations in Thai banking profitability. However, the impact varies across bank size. Non-D-SIB banks show stronger sensitivity to yield curve changes than the D-SIB banks. Non-D-SIBs experience 3.3 basis point increases in net interest margins for each percentage point of yield curve steepening, while D-SIBs banks show no sensitivity to yield curve changes, reflecting their more diversified business models and superior risk management strategies.

Crisis periods fundamentally shift these relationships. During the 2008 financial crisis, the yield curve's impact on net interest margins tripled to approximately 3.2 percentage points, indicating the heavy dependence on traditional banking activities when other revenue streams were under pressure. The COVID-19 pandemic reveals persistent negative pressure on net interest margins, with significant declines of 7–8 basis points in 2021 and 2022, which aligns with the prolonged low interest rate environment.

The study on market concentration, the results of this study challenge the conventional wisdom, revealing that bank performance influences market structure rather than the reverse, which suggests that competitive dynamics in Thai banking are driven by performance differentials rather than market power effects, supporting efficiency-based explanations of market evolution.

These findings have important implications for bank management and monetary policy. Bank managers should consider their institution's size and systemic importance when developing strategies for managing interest rate risk, as smaller banks face greater exposure to yield curve fluctuations. Policymakers should recognize that monetary policy transmission effects vary significantly across bank types, with larger banks potentially requiring different considerations in policy design.

This study's limitations include its focus on Thai banks, which may limit generalizability to other emerging markets with different banking structures. Additionally, the analysis period, while covering major crisis events, may not capture all possible interest rate environments.

Future research should examine whether these patterns hold across other emerging markets and investigate the specific mechanisms through which bank size affects interest rate sensitivity. Long-term studies of post-pandemic banking dynamics would also offer helpful information regarding the persistence of COVID-19's effects on bank profitability relationships.

REFERENCES

Books

Angrist, J. D., & Pischke, J.-S. (2009). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press. https://doi.org/10.2307/j.ctvcm4j72

Greene, W. H. (2012). *Econometric analysis* (Pearson International Edition). Pearson Education, Limited.

Windsor, C., Jokipii, T., & Bussiere, M. (2023). *The impact of interest rates on Bank profitability: A retrospective assessment using new Cross-country bank-level data*. Reserve Bank of Australia.

Articles

Alessandri, P., & Nelson, B. D. (2015). Simple banking: Profitability and the yield curve. *Journal of Money, Credit and Banking, 47*(1), 143–175.

Athanasoglou, P. P., Brissimis, S. N., & Delis, M. D. (2008). Bank-specific, industry-specific and macroeconomic determinants of bank profitability. *Journal of international financial Markets, Institutions and Money*, *18*(2), 121-136.

Aydemir, R., & Ovenc, G. (2016). Interest rates, the yield curve and bank profitability in an emerging market economy. *Economic Systems*, *40*(4), 670-682.

Baum, C. F., Schaffer, M. E., & Stillman, S. (2003). Instrumental variables and GMM: Estimation and testing. *The Stata Journal*, *3*(1), 1-31. https://doi.org/10.1177/1536867X0300300101

Berger, A. N., Demirgüç-Kunt, A., Levine, R., & Haubrich, J. G. (2004). Bank concentration and competition: An evolution in the making. *Journal of Money, Credit and Banking, 36*(3b), 433-451. https://doi.org/10.1353/mcb.2004.0040

Borio, C., Gambacorta, L., & Hofmann, B. (2017). The influence of monetary policy on bank profitability. *International finance*, *20*(1), 48-63.

Borio, C., & Disyatat, P. (2010). Unconventional monetary policies: An appraisal. *Yale Program on Financial Stability Documents*, 885. https://elischolar.library.yale.edu/ypfs-documents/885

Boone, J. (2008). A new way to measure competition. *The Economic Journal*, *118*(531), 1245-1261. https://doi.org/10.1111/j.1468-0297.2008.02168.x

Cetorelli, N., & Goldberg, L. S. (2012). Banking globalization and monetary transmission. *The Journal of Finance*, *67*(5), 1811-1843. https://doi.org/10.1111/j.1540-6261.2012.01773.x

Christensen, J. H. E., Diebold, F. X., & Rudebusch, G. D. (2011). The affine arbitrage-free class of Nelson–Siegel term structure models. *Journal of Econometrics*, *164*(1), 4-20.

Charoenseang, J., & Manakit, P. (2007). Thai monetary policy transmission in an inflation targeting era. *Journal of Asian Economics*, *18*(1), 144-157

Demirgüç-Kunt, A., & Huizinga, H. (1999). Determinants of commercial bank interest margins and profitability: Some international evidence. *World Bank Economic Review, 13*(2), 379–408.

Demirgüç-Kunt, A., & Huizinga, H. (2010). Bank activity and funding strategies: The impact on risk and returns. *Journal of Financial Economics*, *98*(3), 626-650. https://doi.org/10.1016/j.jfineco.2010.06.004

DeYoung, R., & Roland, K. P. (2001). Product mix and earnings volatility at commercial banks: Evidence from a degree of total leverage model. *Journal of financial Intermediation*, *10*(1), 54-84.

Diebold, F. X., & Li, C. (2006). Forecasting the term structure of government bond yields. *Journal of Econometrics*, *130*(2), 337-364. https://doi.org/10.1016/j.jeconom.2005.03.005

Elsas, R., Hackethal, A., & Holzhäuser, M. (2010). The anatomy of bank diversification. *Journal of Banking & Finance*, *34*(6), 1274-1287.

Friedman, M. (1968). The role of monetary policy. *The American Economic Review*, *58*(1), 1-17. https://www.jstor.org/stable/1831652

Bräuning, F., & Ivashina, V. (2020). Monetary policy and global banking. *The Journal of Finance*, *75*(6), 3055-3095. https://doi.org/10.1111/jofi.12959

Koopman, S. J., Mallee, M. I. P., & Van der Wel, M. (2010). Analyzing the term structure of interest rates using the dynamic Nelson-Siegel model with time-varying parameters. *Journal of Business & Economic Statistics*, *28*(3), 329-343.

Lane, P. R. (2022). Monetary policy in the euro area: the next phase. In *Remarks for high-level panel "High Inflation and Other Challenges for Monetary Policy", Annual Meeting*.

Morais, B., Peydró, J.-L., Roldán-Peña, J., & Ruiz-Ortega, C. (2019). The international bank lending channel of monetary policy rates and QE: Credit supply, reach-for-yield, and real effects. *The Journal of Finance*, *74*(1), 55-90. https://doi.org/10.1111/jofi.12735

Nelson, C. R., & Siegel, A. F. (1987). Parsimonious modeling of yield curves. *Journal of Business, 60*(4), 473–489.

Nickell, S. (1981). Biases in dynamic models with fixed effects. *Econometrica*, *49*(6), 1417-1426. https://doi.org/10.2307/1911408

O'Donnell, N., Shannon, D., & Sheehan, B. (2024). The impact of monetary policy interventions on banking sector stocks: An empirical investigation of the COVID-19 crisis. *Financial Innovation*, *10*, Article 44.

Ratanavararak, L., & Ananchotikul, N. (2018). Bank profitability and risk-taking in a low interest rate environment: The case of Thailand. *Puey Ungphakorn Institute for Economic Research Discussion Paper*, *89*.

Schaeck, K., & Čihák, M. (2014). Competition, efficiency, and stability in banking. *Financial Management*, *43*(1), 215-241.

Stiroh, K. (2004). Diversification in banking: Is noninterest income the answer? *Journal of Money, Credit and Banking*, *36*(5), 853-882.

Stiroh, K. J., & Rumble, A. (2006). The dark side of diversification: The case of US financial holding companies. *Journal of Banking & Finance, 30*(8), 2131–2161.

Sufian, F., & Habibullah, M. S. (2009). Bank specific and macroeconomic determinants of bank profitability: Empirical evidence from the China banking sector. *Frontiers of Economics in China*, *4*(2), 274-291. https://doi.org/10.1007/s11459-009-0016-1

APPENDICES

APPENDIX A
YIELD CURVE EXTRACTING FROM NELSON-SIEGEL MODEL

Figure A.1

The characteristics of Thai yield curve

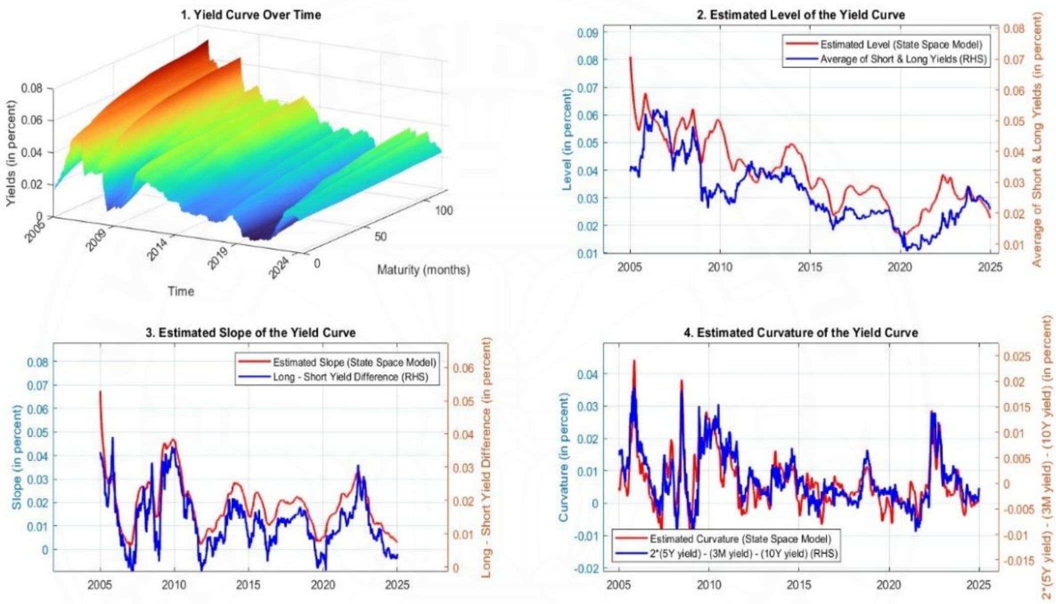
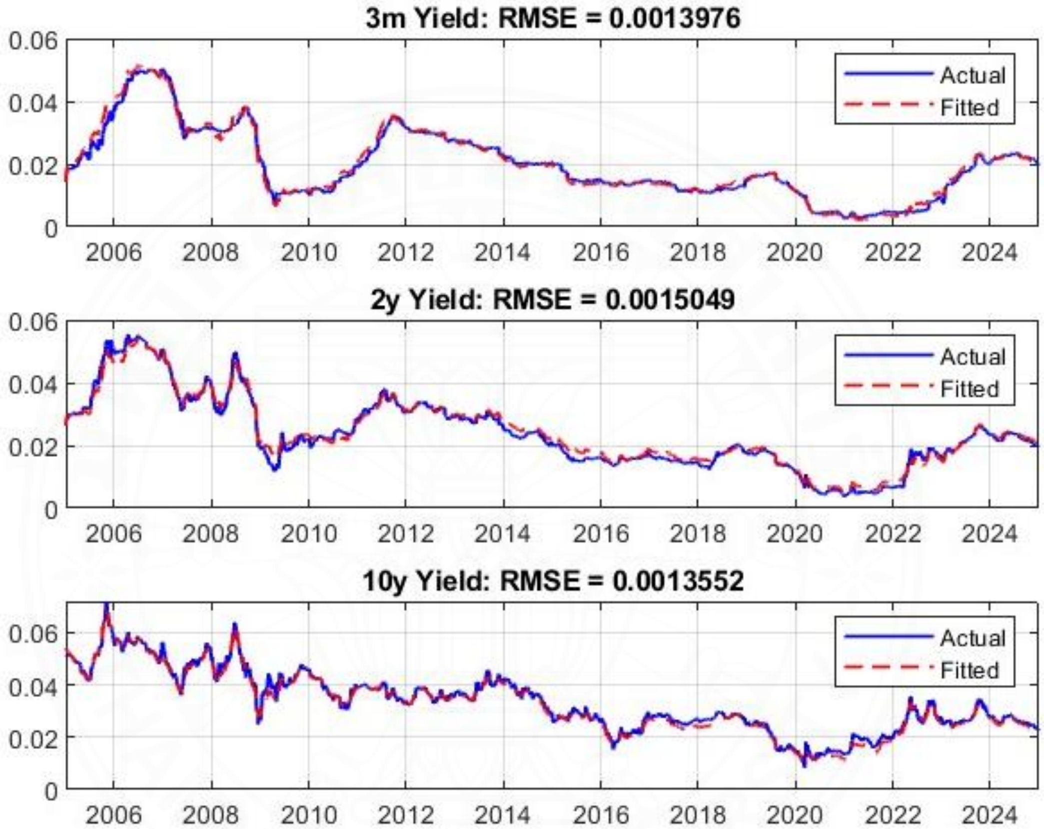


Figure A.2

Tracks yield across different maturities (3-month, 2-year, and 10-year) over nearly two decades, capturing dramatic market events including the 2008 financial crisis peak, zero-lower- bound period, COVID-19 pandemic drops in 2020, and subsequent rate increases



APPENDIX B
YIELD CURVE EXTRACTING FROM NELSON-SIEGEL MODEL

Figure B.1

Breaks down these yield curves into their core components level (overall height), slope (steepness), and curvature (bending) demonstrating how the general interest rate level declined over time with significant volatility during crisis periods, while the term structure has undergone multiple transitions between steep, flat, and occasionally inverted configuration

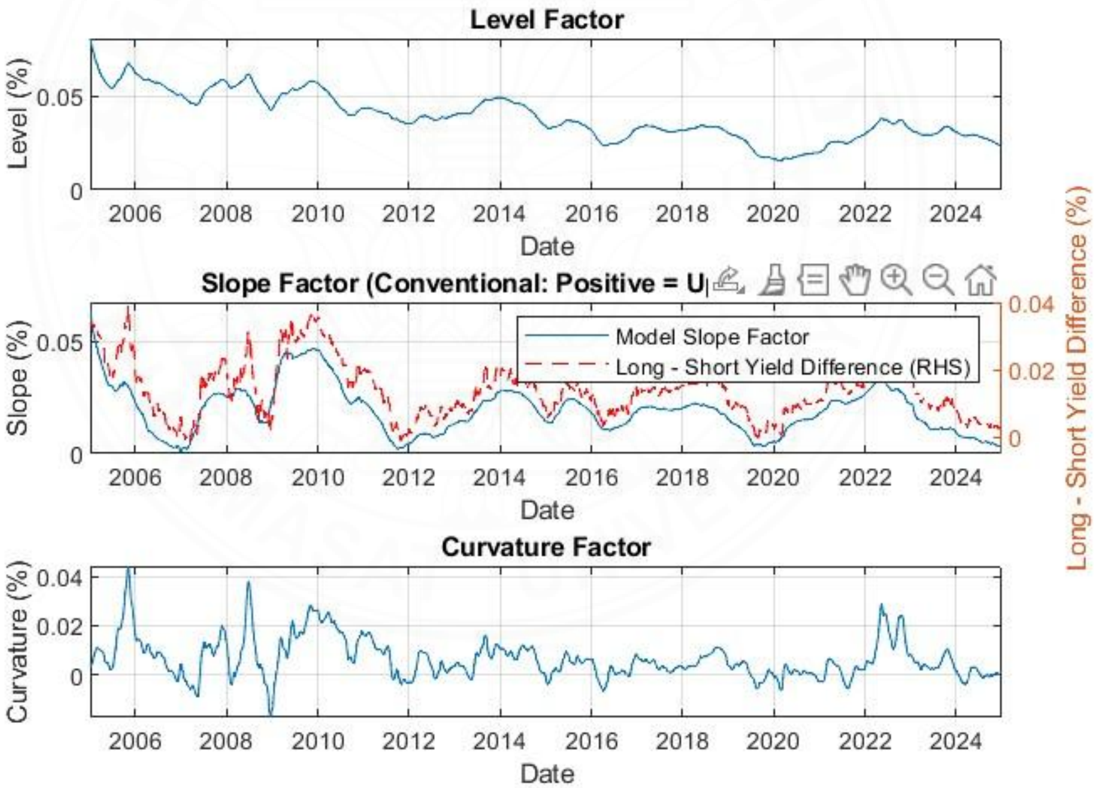
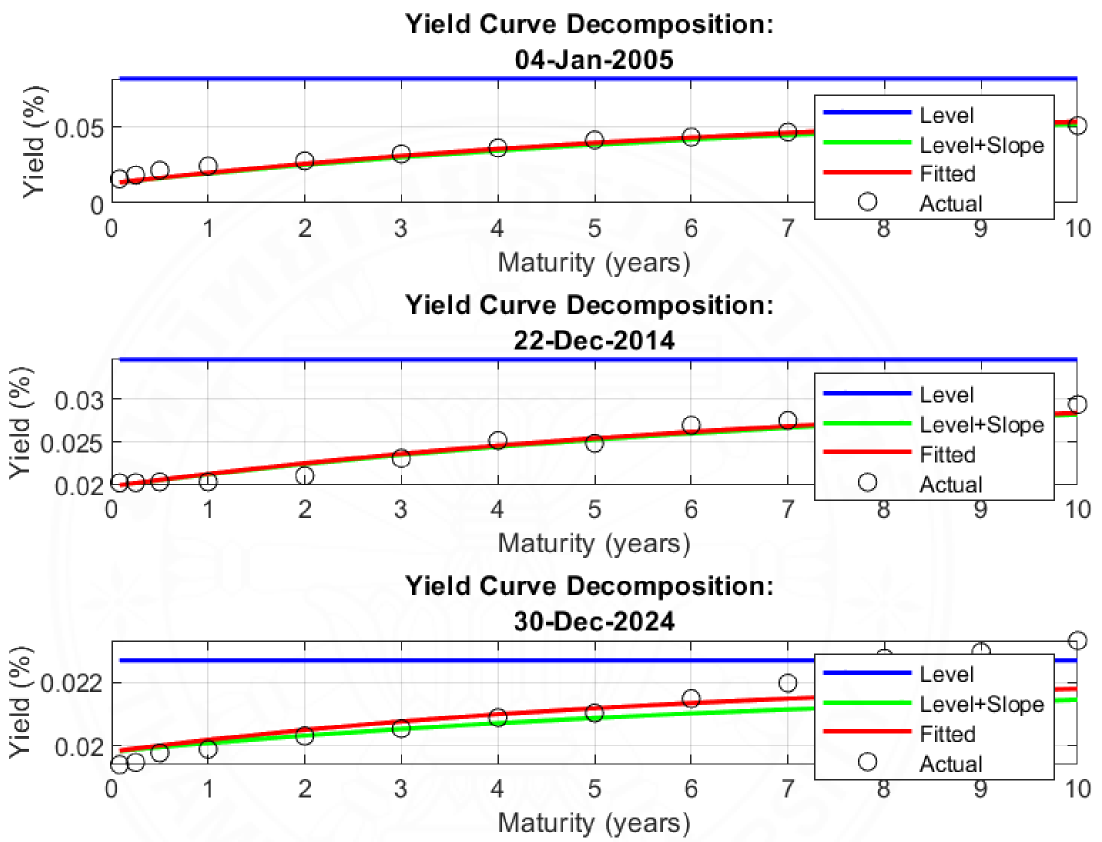


Figure B.2

Displays yield curve decompositions at three key timestamps (2005, 2014, and 2024), revealing a progression from a strongly positive-sloped curve (approximately 2- 5%) to increasingly flatter curves (around 2-2.3% by 2024)



BIOGRAPHY

Name	Natayar Kriengkraiwanich
Educational attainment	2019: Bachelor of Science, Mahidol University