MARKET INTEGRATION AND CROSS-COUNTRY INDICATORS: THE ASEAN-THREE CASE

BY

MR. NUTCHAPHOL JAROONPIPATKUL

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 2016

Ref. code: 25595802042175GKC

MARKET INTEGRATION AND CROSS-COUNTRY INDICATORS: THE ASEAN-THREE CASE

BY

MR. NUTCHAPHOL JAROONPIPATKUL

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 2016

THAMMASAT UNIVERSITY
FACULTY OF COMMERCE AND ACCOUNTANCY

INDEPENDENT STUDY

BY

MR. NUTCHAPHOL JAROONPIPATKUL

ENTITLED

MARKET INTEGRATION AND CROSS-COUNTRY INDICATORS:
THE ASEAN-THREE CASE

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

on 01 MAY 2017

Chairman

(Assistant Professor Chaiyuth Padungsaksawasdi, Ph.D.)

Member and Advisor

(Associate Professor Tatre Jantarakolica, Ph.D.)

Dean

(Associate Professor Pipop Udorn, Ph.D.)

Independent Study Title	MARKET INTEGRATION AND CROSS-COUNTRY INDICATORS: THE ASEAN-THREE CASE
Author	Mr. Nutchaphol Jaroonpipatkul
Degree	Master of Science (Finance)
Major Field/Faculty/University	Master of Science Program in Finance (International Program) Faculty of Commerce and Accountancy Thammasat University
Independent Study Advisor	Associate Professor Tatre Jantarakolica, Ph.D.
Academic Year	2016

ABSTRACT

This study attempts to identify leading indicators among various economic, financial, external, and sentiment data for Thailand's business cycles, as well as to test the leading economic indices created by Bank of Thailand and Ministry of Commerce. The use of NBER approach for selection of suitable leading indicators is applied, followed by out-of-sample forecasting of GDP to cross check the accuracy of the forecasted series. Eleven indicators were qualified to be suitable leading indicators; all of them also performed well on forecasting GDP, as reflected by low root mean square error and high accuracy on direction change between each period.

Apart from Thailand's data, we also perform the same test to Malaysia and Singapore, in which the latter country displayed the strong performance from leading index. The result supports the claim that we should try utilizing sentiment data in the composite leading index. Lastly, it is found that most components in the official leading economic indices did not pass the test, so it is recommended to have a revision of the indices to replace poor-performance indicators with more promising ones.

Keywords: Leading economic indicator, Leading index, LEI, Business cycles, Turning point analysis, GDP

ACKNOWLEDGEMENTS

First of all, I would like to express my sincere appreciation and gratitude to my advisor, Associate Professor Tatre Jantarakolica, Ph.D. who has continuously given me great advices and guidance, as well as has always pointed out crucial cautions and important key ideas throughout the study process. This independent study would not be completed without his support.

I would like also to take this opportunity to thank my family, the MIF classmates and the Bank of Thailand's colleagues, who always stand by my side, cheer me up in the hard time, and gave me the useful suggestions on many occasions.

A special thanks to my fellow economists from Bank of Thailand, Ms. Warinthip Worasak and Mr. Visarut Malsukhum, who have taught me to understand more on BUSY and EViews, the statistical programs used in this study, as well as guided me how to properly collect, manage, and forecast the data.

Mr. Nutchaphol Jaroonpipatkul

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Symbols/Abbreviations	Terms
GDP	Gross Domestic Product
RGDP/GDPR	Real Gross Domestic Product
BOT	Bank of Thailand
NESDB	The National Economic and Social Development Board
MOC	Ministry of Commerce
OIE	Office of Industrial Economics
NBER	The National Bureau of Economic Research
OECD	The Organisation for Economic Co-operation and Development
CEI	Coincident Economic Indicator/Index
LEI	Leading Economic Indicator/Index
M1	Real Money Supply (Narrow Money)
M2	Real Money Supply (Broad Money)
SET	The Stock Exchange of Thailand
BSI	Business Sentiment Index
BSI3M	Business Sentiment Index (next 3 months)
BEI	Business Expectation Index
CCI	Consumer Confidence Index
BCI	Business Confidence Index
BMCAP	Bond and Stock Market Capitalization
CORPSV	Corporate Loan Executive Survey
ASEAN	The Association of Southeast Asian Nations
EU	European Union
JPN	Japan
MY	Malaysia
SGP	Singapore

CHAPTER 1
INTRODUCTION

1.1 Background of the Study: The Suitable Way to Measure Current Economic Activities

A business cycle, also referred to as an economic cycle, is a natural fluctuation of the economy, where all businesses operate around it. Often times, management decisions are impacted by where the company stands in reference to a particular cycle, notably in either an expansion phase or a contraction (recession) phase. There are various factors that determine the stage of the cycle such as level of employments, consumer spending, interest rates, and so on.

In order to study the business cycle, we must firstly understand the characteristics of economic indicators, in which main function are to analyze economic performance of the particular topic, and predict future performances in some cases. The examples of economic indicators include the likes of manufacturing production index, gross domestic products, unemployment rates, and many more. Among these, the ones that move at approximately the same time as the whole economy are called coincident indicators. Since they provide the information about the current state of the economy, coincident indicators are often used to identify the peaks and troughs of business cycles. In other words, we can say that coincident indicators can be representatives of business cycles' shapes.

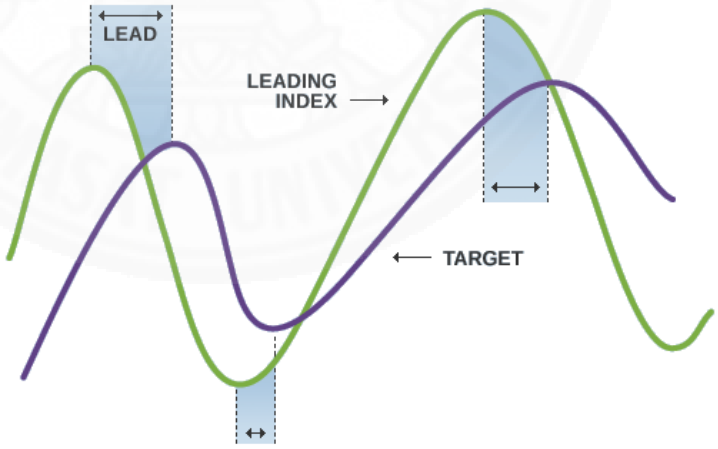
However, one major drawback from most indicators is that it takes time to gather the data, analyze and publish. For example, the notable coincident economic indicator that is globally used is the gross domestic product or GDP. Since GDP itself captures vast amount of information such as Government spending, private consumption and investment from all business sectors, and the foreign trade balance of the nation, the GDP report is not considered as real time indicator. For example, in Thailand's case, the quarterly GDP is officially announced from The National Economic and Social Development Board (NESDB) in a 6 - 7 weeks-delayed basis after the last day of that aforementioned quarter.

Since the coincident indicators data are not timely, and assume that policymakers also need times to analyze, develop, and discuss the suitable policies and measurements to deal with the arise problems, if any, we have to rely on economic indicators that can be the predictors of the economy. In this case, we are talking about leading indicators; the economic indicators that usually change before the economy as a whole change.

1.2 Leading Economic Indicators: Relationship with Business Cycle

If we classify economic indicators according to their usual timing in relation to the business cycle, we will have three groups, which are the coincident indicators, the lagging indicators, and the leading indicators. As their name suggests, the coincident indicators represent the current economic condition. The lagging indicators tend to move after the economy changes. And lastly, the leading indicator are economic data that often change prior to economic adjustment, thus they are believed to predict future economic movement.

Figure 1.1: Leading Index VS Economic Activity[1]



As you can see from Figure 1.1, a leading economic indicator would always consistently turn, or lead a business cycle (target). Therefore, appropriated leading indicators should be able to predict an upward and downward movement of business cycles.

[1] Source: https://www.businesscycle.com

There have been many studies about forecasting business cycle. For example, the U.S.' economists Estrella and Mishkin (1998) tested the predictive power from various financial variables, and found fruitful results in some of their research. The England's Birchenhall et al. (2001) found that money supply can also be used to accurately predict the business cycle, and the accuracy would be even improved when combine with interest rates data. Nevertheless, most studies mentioned are conducted in advanced economies, whereas only a few attempted to emphasize on this topic in developing countries in the past half-century.

Note that because one indicator is not enough to predict the entire economy, famous leading indicators mostly take a form of the composite index, which consists of many economic or/and financial variables, in order to explain the actions in each dimension of the economy. There has been an attempt to find or create leading indicators that could help anticipating economic conditions. For example, The Conference Board publishes a composite Leading Economic Index consisting of ten indicators. Its components include the likes of average weekly hours in manufacturing sectors, interest rate spread, building permits, and the Standard & Poor's 500 stock index. This product is designed to predict the U.S. economic activity for six to nine months ahead.

In Thailand, there are some studies about leading indices for business cycles, with most of them are left without further development when the research was finished. Fortunately, we still have some ongoing leading indicators from Bank of Thailand's Economic and Policy Department and from Ministry of Commerce's Bureau of Trade and Economic Indices. However, there is little emphasis on using these indices as an early warning indicator since the results may not be satisfying enough. Thus, it should be interesting to test the predictive power of each indicator, as well as other interesting economic indicators that look promising.

1.3 Introducing the Cross-Country Analysis

Nowadays, the markets from each nation are more integrated, and might be substantially more connected in the near future. That is, when one country faces economic or financial crisis, the nearby countries are likely to receive similar impacts and consequences.

When we speaking of combined entity, one name that has been standing out in recent years and will continue to grow, is ASEAN. The Association of Southeast Asian Nations consists of ten members, among these nations, only Singapore is the developed country. The list of ASEAN countries by GDP is presented as follows:

Table 1.1: ASEAN Rankings by Nominal GDP[2]

Rank	**Country**	**Population in millions**	**GDP Nominal millions of USD**	**GDP Nominal per capita USD**
1	Indonesia	260.91	936,243	3,600
2	Thailand	68.15	409,536	6,022
3	Malaysia	30.75	309,479	10,073
4	Philippines	102.31	297,314	2,951
5	Singapore	5.7	294,959	53,224
6	Vietnam	94.45	201,805	2,171
7	Myanmar	54.37	74,775	1,269
8	Cambodia	15.92	19,714	1,140
9	Laos	6.92	13,548	1,785
10	Brunei	0.42	9,636	27,759

By looking at each nations' leading indicators, we will see the key difference between them, why the index from this country works and why not, and also what should we suggest to add in for the Thai data to make it a better predictor.

Note that the author will choose only Thailand, Malaysia, and Singapore to study. The main reason is that these three have more availability and reliability of data compared to the others. In addition, Singapore and Malaysia are two countries that have superior economic conditions compared to Thailand; thus, it is worthwhile to study their indicators from Thailand's perspective.

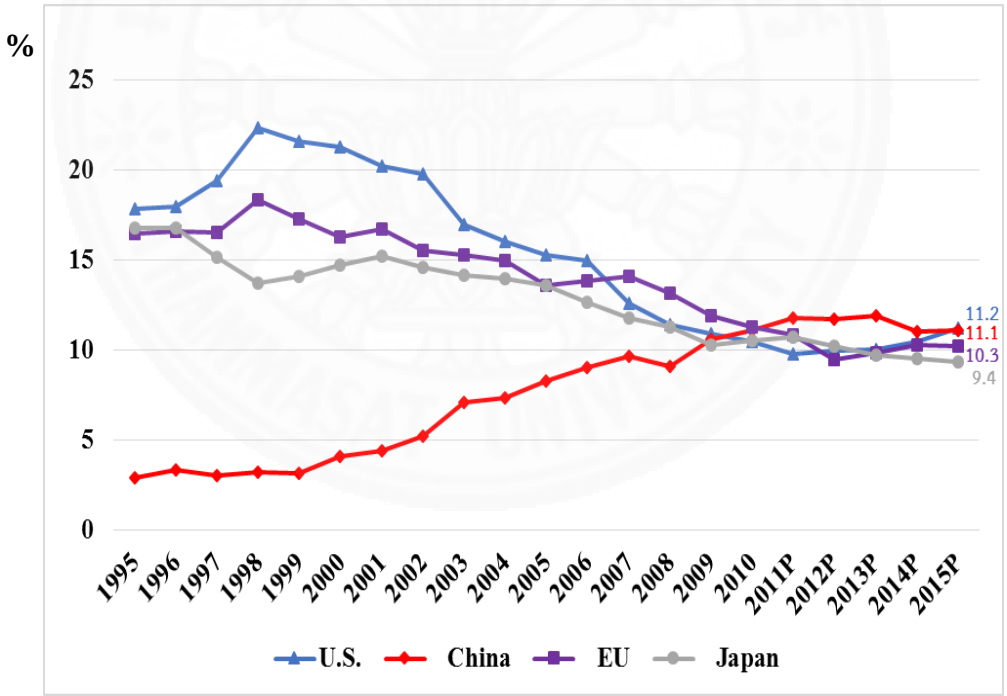
[2] International Monetary Fund's October 2015 estimation.

1.4 Trading Partners' Economy: Influences on Export-Driven Countries

Apart from using the country's own LEIs to predict its business cycle, one interesting idea is to use other countries' indicators.

And why is this idea should work? The answer lies within the economic structure of the country itself. As for the case of Thailand, it is very well known that this nation has an export-driven economy for a long time, rooting back since the early 20th century, where most countries in the world became globalized. Thailand has been one of the top agricultural products exporter, especially in rice and seafood; moreover, in modern days, Thailand main exports includes electronics products such as hard disk drives (HDDs), as well as automotive parts and petrochemical.

Figure 1.2: Export Shares of Major Trading Partners relative to Total Exports of Thailand (1995 – 2015P)[3]



As you can see from the graph above, Thailand's major trading partners are G3 countries (the U.S., EU, and Japan) with the addition of China in recent years. G3 are originally ranked as the top three largest economies for decades, until China overtook Japan's place since 2010.

[3] Source: Bank of Thailand, the subscript p indicates the preliminary data

For the advanced economies like the G3, their economic structure is tended to be consumption-driven growth. Combined with the fact that they have plenty of middle and high income population, they need to import commodities from other countries in order to fulfill their resident's demand.

As for China, even though it is still considered as a developing country, the nation has been rapidly grown in the recent decades, which in turn create more wealthy people from its enormous amount of population. As a result, its imports also had to increase to match with the rising demand as well. Furthermore, China's economic situation has been healthy compared to other nations; thus, after the trough from the global financial crisis has passed, China can gain rapid recovery thanks to its relatively large policy space in conducting both monetary and fiscal policies.

Likewise, the global financial crisis since 2008 has been severely affected majority of Asian nations, with higher export driven countries such as Thailand and Malaysia were impacted harder than others with less export oriented. Therefore, the export driven countries such as Thailand has shifted their export to China even more, to gain the most from their rapid growth.

All in all, not only Thailand's major trading partners are import oriented, they are also the top of the world's largest economies. Thus, when these countries' economic conditions face the problems, one of the results from their economic slowdown will be represented with lower imports, due to lower income. Subsequently, export driven economy will suffer from less demand, thus making the exporter-countries' economy decline as well.

1.5 Research Objectives

Consequently, from all the introductions above, this study first aim is to test the predictive power of Bank of Thailand's and Ministry of Commerce's leading economic indices with Thai business cycle, as well as test other interesting economic indicators. Additionally, we will look at leading economic indices from Malaysia and Singapore and study the differences of their construction compared to Thailand. They will be tested separately with the said country's business cycle to investigate their predictive power as well. The cross-country analysis will give the bigger and better picture on the role of predictors of the economy in Thailand and nearby countries. We will see that why some nations' component is a better predictor compared to the rest, in other words, we might be able to identify some issues that obstructs leading index to be better.

The sub-objective is to test whether major partners' leading index can lead Thai economy or Thai leading index or not. The key idea is that the LEI of the partner countries lead the said country's business cycle, which also affect exports of Thailand. Since exports are part of Thailand's LEI, the LEI will move, and the same goes to Thai business cycle in the following period.

As for contributions, this finding will be beneficial to those who engaged in the economic and finance field such as policy makers, economists, analysts, and investors. For instance, we will have a clearer understanding of the predictive power of Thailand's LEI, as well as Malaysia's and Singapore's. In addition, we will be able to check whether LEI from G3+China can be used as Thailand's leading indicators or not, and if it works, just what form of the effects it will create.

In the following section, we will mainly talk about the conceptual framework of business cycle and leading indicators, followed by literature reviews from past studies. Next, we will describe Research Methodology of this study, including data selection. We then finish with the results interpretation and conclusions in the last two sections.

CHAPTER 2
REVIEW OF LITERATURE

2.1 Conceptual Framework

2.1.1 Introduction to Business Cycle

In a short definition, the business cycle or economic cycle is the movement of economic activity level around its long-term growth trend. To understand more in details about this concept, economists Burn and Mitchell (1946) gave the empirical definition of business cycle as:

> " Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; this sequence of change is recurrent but not periodic. Induration business cycles vary from more than a year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own."[4]

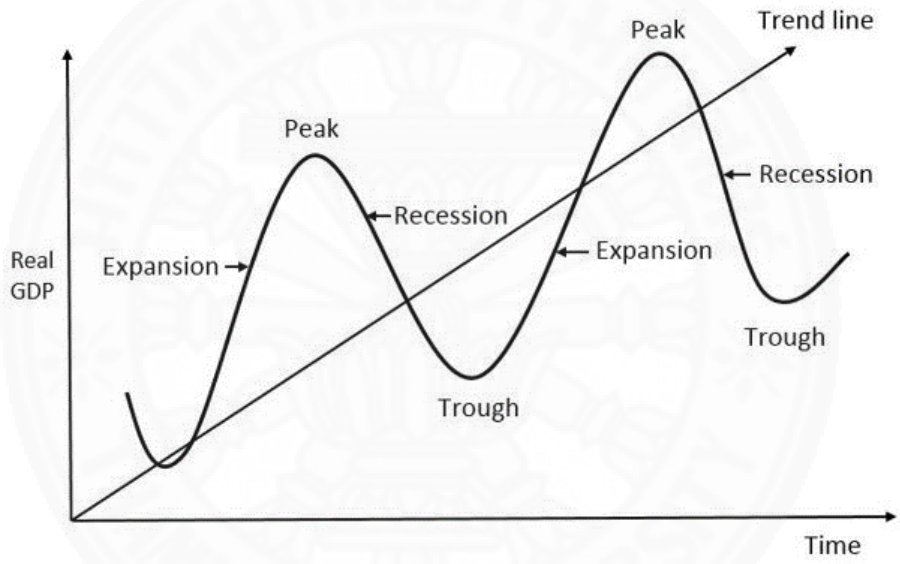
For the business cycle's characteristics, Figure 2.1 shows that economic activity generally has an increasing trend over time, along with the nation's development and population growth in some cases. Occasionally, the economic activity will start to decline which results in what we call a recession, which can be identified with the decrease in real gross domestic product (RGDP), as well as rising unemployment rate and business failures. When the recession is extremely severed, that period of time will be considered as the depression. The Great Depression occurred in the 1930s, where the United States faced the lowest point in a business cycle in 1933; its RGDP fell 27 percent in that year and almost 25 percent of American workers lost their jobs. However, after the trough, the economy slowly began to grow again and reached the same level as the pre-depression period three

[4] Mitchell (1927) is the first person who give a definition to "business cycle". Later on, Burns and Mitchell (1946) had modified the aforementioned definition into the current one, which has been widely cited and used until present days.

years later. We call this period an expansion, where RGDP and population income increase.

As mentioned above, you can see that the business cycle has two types of the turning point. The peak is the highest point that an economic activity can achieve in each cycle; it also signifies the end of an expansion and a beginning of a recession. Another is the trough, which is the lowest point in the cycle; it is where a recession ends and an expansion begins.

Figure 2.1: Phases of Business Cycle[5]



2.1.2 Business Cycle as the Leading Economic Indicators' Origin

Even though the business cycle theoretically has the simple pattern, the actual cycles in the real world are considered unpredictable due to the various magnitude and length that differs from time to time, which is remarkably difficult to forecast. The latest notable example is the Great Depression in 1930s and the Great Recession that occurred from 2007 to 2009, where only few economists can anticipate and expected its impact at the beginning of the event.

After the Great Depression, the United States' National Bureau of Economic Research or NBER, per Minister of Finance's request, had to construct the leading economic indicator from the bureau's database in order to be able to forecast the

[5] Source: http://www.higherrockeducation.org/

business cycle in the U.S. The founding results was published in 1938, and was criticized for being "measurement without theory"[6]; in other words, the results were only the statistical analysis without sound economic theories to back them. Nevertheless, it was viewed as a starting point of the leading economic indicator construction, which has been continuously developed for these past years.

2.1.3 Leading Indicators' Characteristics

As mentioned on the introduction part of this paper, the leading indicators, in theoretically, usually move prior to the overall economy. For example, building permits; a high volume of building permits in the present indicates that in the near future, the construction industry will be more active, which subsequently means there will be more jobs and more spending, thus the economic condition will likely to be better. Thus, build permits can be considered as a leading indicator as it changes before the economy starts to follow that pattern.

Furthermore, thanks to the globalization in this era, imports and exports from countries are common and might be the main growth engine for some nations. Thus, if the importer's economy is healthy, it will import more which equals to more exports from exporter side. Since we have "export volume" as components in the LEI. It means that the economic conditions of the importer can pass through to Thailand, which is the export-driven nation.

Hence, leading indicators are often used to indicate the direction of the economy. Thus, they can be utilized in various purposes from different parties in the economic field. For instance, investors and businesses can look at leading indicators and adjust their plans according to the way the economy is headed. Policymakers can analyze the economic outlook from them in order to create or adjust suitable policies

Note that leading indicators cannot predict the future, but when appropriately utilized along with other data, they can reveal certain trends which everyone can use to anticipate the movement of economic conditions

[6] Koopman, T.C. (1947), "Measurement Without Theory", ***The Review of Economics and Statistics*** 29 (August), pp. 161-172

2.1.4 Decomposition of Time Series Concept

Before moving to methodology section, it has to be addressed that all data used in this study are time series; a sequence of dataset listed in time order which is obtained through repeated measurement over time.

Time series data consist of four components that are responsible for changes over time. The component lists are presented as follows:

1) The trend component, which reflects the long term progression of a series.

2) The cyclical component, which indicates the long term oscillation of a series.

3) The seasonal component, which describes repeated and periodic fluctuations of a series. It exists if a series is influence by seasonal factors such as the specific day of the week, the month, or the quarter of the year.

4) The irregular component, which represents random and residual factors that cause changes of a series other than the aforementioned three.

In order to study the business cycle, as well as other indicators' cycles, we need to extract the "cycle" or cyclical components from each dataset, by seasonal adjusting and detrending the time series. According to the U.S. Census Bureau, seasonal adjustment is the process of removing seasonal component from the data, which is necessary for better analysis since seasonal component can hinder or mask the interpretation of the series. In addition, the irregular component will also be reduced in the seasonal adjustment process (more details on Section 3.2.2).

Lastly, the detrending process is conducted to extract the cyclical component from the remaining data. This process can be done in various approaches, most notably the Hodrick-Prescott (HP) filter which is developed by Hodrick and Prescott (1981) and the Band-pass filter that is developed by Baxter and King (1994, 1999). These filters separate a time series into a trend, and cyclical components, with the Band-pass filter can take out more irregular components compared to the HP filter.

2.2 Literature Reviews

2.2.1 Pioneers of Business Cycle Index in Thailand

In Thailand, there has been some studies in the past to find or create the leading economic indicator, thanks to the increasing interest regarding the business cycle phenomena, which affect the labor market, the overall manufacturing processes, and incomes in a macroeconomic scale from time to time.

There are some researchers in Thailand who interest in business cycle topic, starting from Meesook (1979) who used monthly data of demand, supply, and monetary variables, to construct the composite economic indicator for 1972 – 1979. Then, Sahasakul (1987) published the paper regarding Thailand's leading economic indicator, by mainly using demand, supply, and order cycle analysis in 1970 – 1986. However, it should be noted that the composite leading indicator that Sahasakul created cannot be properly explained on how it leads the economic activity, due to the lack of reference indicator to compare.

Benyasut (1996) is also the one who tried to construct the business cycle index of Thailand. His primary research objective was to forecast the turning points of Thai business cycle. He found that since 1970, Thai economy had faced 5 full cycles; Thailand at 1996 (the time of this publishing) was in the recession period of the sixth cycle. On the average, business cycle in Thailand lasts 59 months, and the leading index he constructed can lead the business cycle around 1.75 months before a trough and 5.6 months before a peak. Subsequently, this research was used to publicize the new economic forecasting method in Thailand at that time, as well as be a feedback receiver for further developing of the leading economic indicator for Thai business cycle.

On his concluding remarks, Benyasut said that the crucial variables that should be included to construct the business cycle index are macroeconomic manufacturing production index (MPI) and labor-market data. However, they were omitted from this study since MPI data obtained from the Bank of Thailand was not compatible with other variables' cycles, and the employment data or unemployment rate cannot reflect the real unemployment situation of the country.

Next, Tinakorn (1998) conducted a research on similar topic, based on past works with newer data and tools. She concluded that from 1980 – 1997, Thailand had faced three business cycles, with an average of 55.7 months per cycle, using Peak-Trough-Peak basis. On the average, the recession period covers 22 months while the expansion period covers 33.7 months. The turning points from each cycle are the reference to identify economic variables that have the leading characteristic for the economy. She found that the suitable composite leading indicator for the past 18 years (1980 – 1997) consists of:

1) SET Index
2) Oil Price from the World Market (Oman)
3) Construction Areas Permitted (Country Wide)
4) New Business Registration
5) Investment from newly open or expanded businesses that received subsidize from BOI
6) Real Money Supply (M1/CPI)
7) Number of Foreign Tourists

Note that these seven variables were all supported and proved to be the proper leading economic indicators, by sound economic reasons the author had provided. This leading index can lead the business cycle around 4 months before a trough and 6 months before a peak, which the author stated that Thailand has around 4 – 6 months in order to prepare for the economic shift, whether it is the expansion or contraction.

However, Tinakorn also gave a reminder that we should not rely too much on one single leading indicator or composite index, since it always still has a probability to create false signal in some cases. The main benefit from creating business cycle index is not that they are the most accurate predictor of the economy, but rather, it should be use to complement the forecasting results from macroeconomic models or support overall economic analysis in the bigger picture.

Lastly, Tinakorn emphasized that business cycle index should be continuously developed and improved by using up-to-date data and tools in order to get the most benefit out of it.

2.2.2 More Lessons from Overseas

2.2.2.1 Suitable leading indicators are varied in different places

Banerjee et al. (2003) conducted a research to determine the leading indicators for Euro-area inflation and GDP growth, from 46 indicators in various aspects including unemployment rate, interest rates and spreads, price indices and other economic variables. The main finding was that single indicator forecasts can perform, as leading indicators, better than the one derived from more complicated methods. Meanwhile, Leigh and Rossi (2002) utilized the Turkey data to find leading indicators for growth and inflation in the said country. The results indicated that a combination of some individual indicators gave the reliable forecasts. Lastly, Chaeung and Granovsky (2016) did a study on whether New Housing Registrations can be leading indicator of the British Colombia (BC) Economy or not. The results were satisfying as NHR for single detached homes can be predictive content for BC economy over the next one to three quarters.

In summary, these studies are prime examples of testing the dataset on various aspects in order to find the suitable indicators of their respective economy.

2.2.2.2 Some simple data can be well-performed overtime

Khramov and Lee (2013) constructed the Economic Performance Index or EPI in order to assess economic activity across time. The main idea behind this research is that the authors saw the disadvantage of using various economic statistics as they did not properly assess the current economic performance of the country, as well as they cannot compare well with their historical performance. Therefore, the EPI is designed and developed to be a simple, yet informative index that can clearly measures the economic performance. After the thoroughly research, they created the raw EPI that has a formula as follows:

100% - | Inflation Rate | - Unemployment Rate – Budget Deficit/GDP + Change in Real GDP

As a result of matching the EPI score with the U.S. historical data from 1790 to 2012, it is proved that the EPI can capture a rise and fall in economic conditions in

most circumstances. Therefore, the purpose of constructing EPI has been accomplished, as the index can measure the health of economy as well as can compare the relative severity of recessions, albeit having a simple formula structure.

2.2.3 Financial Indicators can be used as Leading Economic Indicators

Estrella and Mishkin (1996) started their research of examining the performance of financial variables as predictors of U.S. recessions as they viewed that expectations of future economic event are associated with financial variables such as interest rates, stock price indices, and many more. The benefits provided from this study can be applied for many parties, including policymakers and market participants. The well-chosen indicators can be used to double-check the predictions that came from only macroeconometric models. Furthermore, one of the interesting reasons to look at financial indicators is that they have a simplicity and quickness nature, the traits which economic indicators sometimes lack. In the conclusions part of this study, the authors concluded that yield curve spread and stock prices, can be practically used to supplement the economic models and forecasts. It might be a quick check, but reliable still. All in all, this study served as an initiative that encourages others to see the usefulness of financial indicators in an economic field.

Apart from the above study, there are some researches which also emphasize on testing whether the stock market can be viewed as a leading economic indicator or not. Pearce (1983) argued that stock prices' movement has a direct effect on aggregate spending, thus the stock market can be utilized to predict the economic activity in the United States, in 1956 – 1983. Subsequently, Comincioki (1996) tried to evaluate the stock market as the leading economic indicator by using the U.S. data from 1970Q1 to 1994Q3. The results showed that the stock market can help predicting the future economy and that changes in stock prices Granger-causes changes in GDP. Moreover, Ikoku (2010) conducted the research with a similar topic, and found that All Share Index (ASI) of the Nigerian Stock Exchange (NSE) is a leading economic indicator of real GDP in Nigeria. Ikoku then proposed that ASI should be added to Nigeria's composite index of leading economic indicators, in order to improve its accuracy. And lastly, Jiranyakul (2012) tested the predictive role of stock market return with the

industrial production of Thailand. The result was satisfying since the said predictive role has been confirmed, with the range of data utilized was from 1993 to 2011.

In short, these studies prove that stock market can be used as one of the leading indicators for economic activity.

2.2.4 More modernized Researches for Business Cycle Forecasting in Thailand

Kantawit (2009) pointed out that business cycle in Thailand has been changed from the past. To describe more, he argued that the economy might give the positive growth on a recession period, or a negative growth in an expansion period. And that the reaction from various economic activities such as trading, investing, employment, consumption, and government policies can be greatly differed in different states of the economy. Therefore, the forecasting of business cycle is needed along with the forecasting of the economic growth.

In this paper, there are 26 variables, collected monthly from 1993 – 2009, which are also categorized into 4 groups as follows:

1) Economic variables
2) Components used in the LEI from Bank of Thailand
3) Financial variables
4) Government policy variables

Kantawit carefully tested the predictor's characteristics from these variables one by one, as well as testing them in myriad forms of groups, by using PROBIT Classification model to identify the probability of the expansion and contraction from each variable. As a result, he found that the selected variables gave the proper information in forecasting aspect. In addition, he also found that single variable forecasting had a higher predictive power than using multiple variables altogether.

As mentioned in the previous section, Thailand has two main monthly leading economic indices that are still updated since sometimes after the 1997 financial crisis. One index is created from Bank of Thailand and the other is from Bureau of Trade and Economic Indices, Ministry of Commerce; the latter is divided into two sub-groups which are short leading index and medium-run leading index where it supposes to predict the business cycle on 9 – 11 months ahead. BOT's LEI falls in the

same category as MOC's short leading index since it has a predictive power of 3 – 5 months ahead. The objective of constructing LEI is similar from both organizations; the LEI is created to be an early warning indicator for Thai economy. The components from the index are presented as follows:

Table 2.1: Component Comparison of LEIs from BOT and MOC

BOT	**MOC**	
	Short Leading Index	**Medium-run Leading Index**
1. Permitted Construction Areas in Municipal Zone 2. Authorized Capital of Newly Registered Companies 3. Real Money Supply (M2) 4. Number of Foreign Tourists 5. SET Index 6. Export Volume 7. Oman Oil Price Index (Inverse)	1. Permitted Construction Areas in Municipal Zone 2. Number of Foreign Tourists 3. SET Index 4. New Business Registration Value 5. Export Volume 6. Narrow Money	1. Permitted Construction Areas in Municipal Zone 2. Average Interest Rate from Commercial Banks (Inverse) 3. Industrial Material Price Index Growth Rate 4. Leading Index of the Japan (Inverse) 5. Leading Index of the U.S. 6. New Business Registration Value 7. Broad Money Growth Rate

As you can see, there are several similar components between the BOT's and MOC's LEI. Yet, the predictive power from each LEI might differ. Thus, it should be interesting to test whether which one has the higher accuracy.

Apart from Thailand, we also have LEI data from ASEAN's Malaysia and Singapore, and Thailand's major trading partners such as G3 nations and China. The LEI components of each country are presented in the Appendix A. Note that these LEIs consist of some similar leading indicators such as stock price index, money supply, and building permits, as well as unique indicators of each nation.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Data Selection

3.1.1 Data Sources and Pre-Selection of Indicators

The main data used in this research are the real Gross Domestic Product of Thailand which begins in the first quarter of 1993[7] and ends in the third quarter of 2016[8], while other data will be collected in the same period, given that they have the same length compared to Thai GDP.

To search for the suitable leading economic indicator for Thai business cycle, we choose various data to test with the cycle. According to OECD, the relevance criteria for selecting potential indicators are (1) Economic significance and (2) Wide Coverage. Other practical considerations include frequency of publication, absence of excessive revisions, and availability of the data with no breaks. The prominent indicators we first use are LEIs from Bank of Thailand and from Ministry of Commerce, followed by the economic and financial data, in which most of them are from components of the LEI, or be the variations of some particular components. Some data are chosen because they are components of the LEI of other countries; thus, they are likely to have predictive power over the business cycle. Moreover, we utilize the external data such as Thailand's major trading partners' GDP to test whether they have a predictive power over Thai business cycle. Note that we also utilize some of the hand-made index such as China Manufacturing Index (CMI) and China Service Index (CSI), which are constructed by Bank of Thailand's Economic and Policy Department in order to monitor Chinese economy instead of using its GDP alone[9]. Lastly, we use the sentiment data as they reflect the businesses' confidence of

[7] Office of the National Economic and Social Development Board (NESDB) used the chained-linking method (CVM) to compile the GDP data of Thailand, in which the data are revised up to the first quarter of 1993.

[8] Some data were lagged or took longer time to obtain, thus this paper utilizes the data up until the third quarter of 2016 in order to receive only real data, not the preliminary or/and forecasted ones.

[9] The China GDP data are subjected to controversy of being manipulated, as claimed by many economists and analysts from renowned sources such as the Economist, BBC,

current economic situation and some contain expectations for the near future. Therefore, it is interesting to test these data as they are not in the current LEI components yet.

In summary, the data can be briefly divided into four categories as follows;

Table 3.1: Examples of Data Tested in this Study

Economic Data (Thailand's)	**Finance Data (Thailand's)**	**External Sector Data**	**Sentiment Data (Thailand's)**
• LEI from BOT • LEI from MOC • Average Earnings • Import of Capital Goods • Manufacturing Production Index • Electricity Consumption • Number of Factories Permitted	• SET Index • Policy Interest Rate • Interbank Rate • Minimum Loan Rate • Bond and Stock Market Capitalization • Gold Price • Yield Spread • Real Money Supply	• Real GDP, Consumer Price Index, LEI, and Consumer Confidence Index of Thailand's Major Trading Partners such as the U.S., EU, Japan, and China	• Business Sentiment Index • Consumer Confidence Index • Corporate Loan Executive Survey

All data will be taken from CEIC, Bloomberg, and Bank of Thailand database as well as their respective main information-providing websites. For example, the Bureau of Trade and Economic Indices' LEI data can be collected from http://www.price.moc.go.th.

Note that most data aside from GDP are monthly; thus, we have to convert them into quarterly data, by using 3 month-average calculation.

Reuters, and Forbes. Some of the article links regarding this issue are presented below.
https://www.forbes.com/sites/sarahsu/2017/01/23/chinas-gdp-numbers-can-we-trust-the-data/#12530be56577
http://www.economist.com/blogs/freeexchange/2015/07/chinese-economy
http://www.bbc.com/news/business-353418

3.1.2 Software Programs Required

The statistical programs used in this study are EViews Version 9 and BUSY. The former is used for general econometric analysis, while the latter is particularly used for business cycle analysis such as turning point analysis and performing NBER approach.

3.2 Methodology

3.2.1 Estimating Business Cycle: Real GDP

The main reference data in this study is Thailand's business cycle; in order to estimate the said data, the first process is to obtain the real GDP.

It has to be pointed out that the term widely referred to as "GDP" is actually the nominal GDP, which is evaluated at current market prices. In other words, the data are influenced by the inflation rate of particular years. Therefore, we need to isolate the effect of price changes by dividing the nominal GDP with the price deflator, which is the difference in prices between the current year and the base year. As a result, we now obtained the real GDP; an accurate measure of changes in the economy's output level.

Note that all data in this paper are collected in real term, except those with no price changes' effect such as business sentiment data.

3.2.2 Estimating Business Cycle: Seasonal Adjustment

Since real GDP are time series data, they are made up of four components which are S_t: The seasonal component, T_t: The trend component, C_t: The cyclical component, and E_t: The error/irregular component.

The seasonal component, likes its name suggested, happens with similar magnitude during the same time period each year. Thus, removing the seasonal component will direct focus on other components and allow for a better analysis[10].

To eliminate the seasonal component of the data, in this case, The Bank of Spain's TRAMO/SEAT function from EViews is utilized first for the outlier

[10] Cited from the U.S. Census Bureau's FAQs on Seasonal Adjustment. Last revised: Tuesday, 02-Aug-2011 18:07:10 EDT.

detection. The outliers are the extreme observations in the time series that might cause a measurement error, thus they are needed to be eliminated before going further. After we can identify the outliers, the next step is to seasonally adjust the data by applying the U.S. Census Bureau's X-12-ARIMA function, which is one of the most widely use methods for this procedure.

X-12-ARIMA process can be briefly explained as follows[11]:

1. Estimate the trend-cycle for all periods using moving average smoothing method.
2. Compute centered ratios (ratios of data to trend) to identify seasonal and irregular components.
3. Apply 3x3 moving average to each month of centered ratios to estimate seasonal component.
4. Estimate irregular component by dividing centered ratios with estimated seasonal component.
5. Reduce extreme value of irregular component and get the modified irregular component.
6. Multiply modified irregular component to get modified centered ratios.
7. Repeat Step 3 to get revised seasonal component.
8. Divide original data by the new seasonal component to get the preliminary seasonally adjusted series.
9. Apply the weighted Henderson MA to the preliminary seasonally adjusted series to get the new estimated trend-cycle.
10. Repeat Step 2 with the new estimated trend-cycle.
11. Repeat Step 3-6 using the new centered ratios and applying a 3x5 moving average instead of a 3x3 MA.
12. Repeat Step 7 using a 3x5 moving average instead of a 3x3 MA.
13. Repeat Step 8 using the new seasonal component.
14. Obtain the remainder component by dividing Step 13's seasonally adjusted data with Step 9's trend-cycle.

[11] Cited from https://www.otexts.org

15. Reduce extreme value of irregular component as in Step 5.
16. A series of modified data is obtained by multiplying the trend-cycle, seasonal component, and adjusted irregular component together.

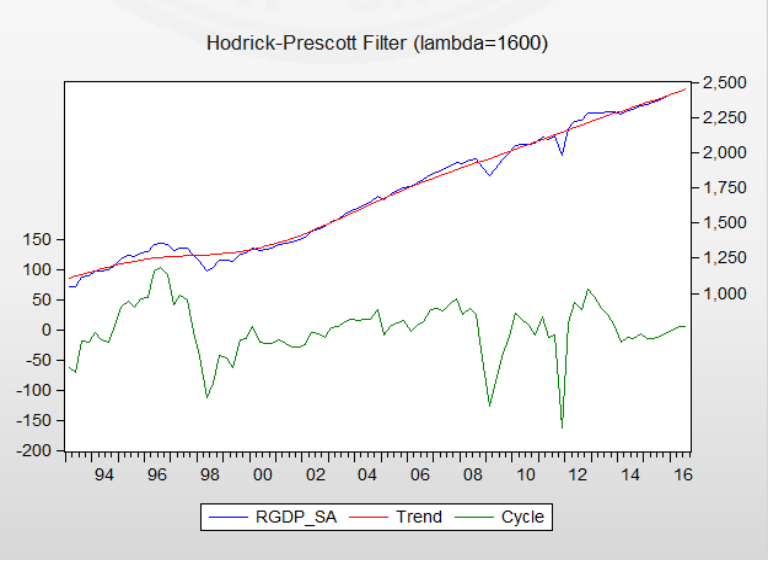
The whole process is then repeated twice with the data obtained from Step 16 each time. On the final iteration, the moving average smoothing method in Step 11 and 12 is replaced by either 3x3, 3x5, or 3x9 basis, depending on the data variability.

Note that all data with seasonal pattern in this paper are seasonally adjusted.

3.2.3 Estimating Business Cycle: Detrending Data

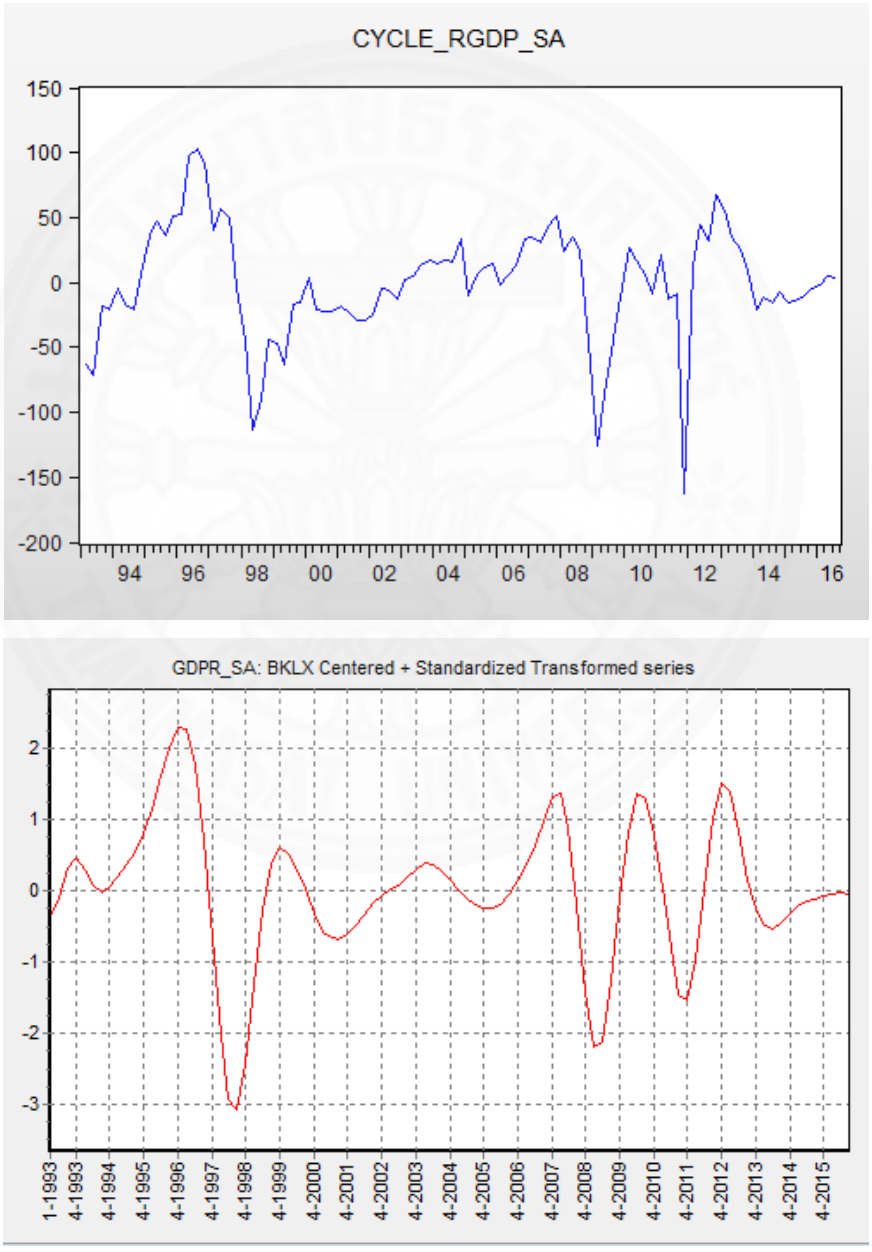
After we obtained the seasonally adjusted data, the subsequent step is to detrend them in order to get only the cyclical component. A trend reflects the long-term progression of the time series. Thus, detrending means removing the component that causes distortion of the mean overtime. One of the famous tool is the Hodrick-Prescott (HP) filter, which will decompose the data into a trend component and a cyclical component. However, HP filter has some limitations since it is sensitive to different values of the smoothing parameter (Bjornland, 2000) and suffers from the end-point problem which means the estimation of the underlying trend can change substantially as new data become available (Borio, Disyatat and Juselius, 2015).

Figure 3.1: Thailand's GDP Components Decomposed with HP Filter (1993Q1 – 2016Q3)



To properly detrend the time series data, Baxter and King (1999) suggested the Band-Pass (BP) filter tool in the case of business cycle study, which is also the method used in this paper. As a result, we get smoother graph of the cycle as shown in Figure 3.2 (Bottom). The Band-Pass filter can also be called the Baxter-King filter.

Figure 3.2: Comparison between Thailand's Business Cycles Decomposed with HP Filter (Top) and with BP Filter (Bottom) (1993Q1 – 2016Q3)



Note that we can also use coincident economic indices, as the representatives of business cycle. In Thailand case, the business cycle decomposed from GDP has a correlation of 0.98 and 0.94 with the CEI from Bank of Thailand and from Ministry of Commerce, respectively. However, this paper will use the business cycle calculated from GDP rather than using CEIs directly since this method is recognized as more standardized.

3.2.4 Business Cycle's Turning Points Identification

Before we run a test on any indicators, it is crucial to understand the pattern of Thailand's business cycle collected from the previous step. Most studies especially from The Organisation for Economic Co-operation and Development (OECD) utilize the Bry-Boschan (1971) to identify the turning points of business cycles, by calculating the trend and deviation value from the trend of data, and specifying the turning points based on these conditions (NBER Approach; Tinnakorn, 1998).

1. The cycle duration must not be less than 15 months. This condition applies for both Peak-Trough-Peak and Trough-Peak-Trough basis.
2. The phase duration (Peak-to-Trough or Trough-to-Peak) must not be less than 5 months.
3. Each turning point must illustrate the obvious turn into the opposite direction.

The next step is to apply these conditions into the BUSY program's Bry-Boschan function, which is created by The Institute for the Protection and Security of the Citizen (IPSC) to identify and visualize the turning points from the dataset.

3.2.5 Evaluating Leading Economic Indicators: NBER Approach

The performance of selected indicators can be evaluated a number of ways, one of the most widely use methods is called NBER approach, which is invented by The National Bureau of Economic Research (NBER). This method considers as descriptive statistics in which the major measurements are (1) Cross-correlation, (2) Coherence, and (3) Mean Delay. These three statistical values are used to analyze the relationship between the interested indicators and the reference series, which in this

case is the Thai business cycle. The details of these three measures are presented below[12]:

1. Cross-correlation: a measure of similarity of two series, which in this case is the reference series and the selected indicators. Significant statistical values from cross-correlation includes the maximum cross-correlation (r max) that indicates the highest correlation of the two series in certain period, which is called t max. A positive value of t max indicates the time period that selected indicator has a high leading power over the reference series. 1 unit of t max, in this paper, equals to a quarter or 3 months.
2. Coherence: a measure that indicates the strength of the co-movement between the reference series and the selected indicators.
3. Mean Delay: a measure of the lead/lag relationship between the reference series and the selected indicators. A positive value means the indicator has a leading trait over the reference series. A negative value on the other hand indicates the lagging trait, and a zero value signifies a coincidence movement.

For the selection criteria, this paper follows the threshold for selecting leading economic indicators that officially imposed by Office of Industrial Economics (OIE), as the following table:

Table 3.2: OIE's Criteria for Selecting Leading Indicators via NBER Approach

NBER approach's Measurements	OIE Criteria
1. Cross-correlation	
- r max	> 0.4
- t max	> 0
2. Coherence	> 0.15
3. Mean Delay	> 0.1

Note that all three criteria have to be met, in order to classify suitable leading economic indicators.

[12] Tongsom, P. (2013) "Constructing Leading Economic Index for SMEs", The Office of SMEs Promotion, September (in Thai).

In addition to the three OIE criteria, we also apply Bry-Boschan's turning point detection procedure for the pass indicators, to check whether their turning points usually lead the turning points of Thai business cycles or not. A negative value of turning point analysis indicates that the turning points of selected indicators lead the turning points of Thai business cycles on average computation.

3.2.6 Forecasting GDP with the Evaluated Leading Indicators

When we found the relationship between Thailand's business cycles and the selected indicators, the next step is to try forecasting GDP with the said indicators, using the out-sample forecast. Note that GDP in this stage is a real term and seasonally adjusted GDP, the same conditions also apply for indicators we select.

To divide the data in-sample and out-sample estimation, the 95-quarter sample period will be divided into two sub-periods. 76 quarters or 80 percent of total data, from 1993Q1 to 2011Q4, will be used to estimate GDP which will also be compared with the remaining 19 quarter, from 2012Q1 to 2016Q3. Note that the estimation window of in-sample and out-sample forecasting stage can be adjusted, depending on the length of the data.

In terms of forecasting period, past studies suggest that the longer period it went back, the worse forecasting power it possesses. Thus, we apply the rolling time series analysis which means we are using the leading indicator actual data from 1^{st} to 76^{th} quarter to forecast the 77^{th} quarter of real GDP, using the actual data from 2^{nd} to 77^{th} quarter to forecast the 78^{nd} quarter of GDP, and keep doing it until the samples are all used up. We utilized EViews program to run the linear regression between GDP and the leading indicators. Note that we apply dlog or first difference of the logarithm to the GDP data in the process, in order to avoid serial correlation problem.

The forecasted GDP series, dubbed GDPF, will be plotted alongside with the actual series. Lastly, the difference from the actual and forecasted series will be checked in direction and magnitude aspects, in a form of accuracy test and Root Mean Square Error, respectively. We test the accuracy of the forecasted data by looking at the sign change from the previous period. If the forecasted data point yield the same direction change as the actual series, we count as one point, otherwise zero. We then calculate the percentage of one points within the forecast horizon; the results will

show the accuracy of the direction-predictive power of the selected indicator for GDP. As for the RMSE, we need to square root the sum-square value of forecasting error (actual series minus forecasted series) divided by the number of forecast-observations.

Indicators that passed the OIE's criteria of NBER approach, and give the acceptable forecasting results of GDP will be recommended to use as leading indicator for Thailand's business cycle, or use as parts of new composite index in the future.

3.2.7 Repeating the Whole Process with Malaysia and Singapore Data

In addition to the study using Thai dataset, we will also repeat the whole process, this time with Malaysia and Singapore data. By comparing these two countries' business cycles with their respective LEIs, we will see the performance of their LEIs and might be able to indicate factors that make them better or worse than Thailand's LEIs in terms of the performance of being the leading indicator against business cycles.

CHAPTER 4
EMPIRICAL RESULTS

4.1 Descriptive Statistics

This section will illustrate the statistical value from some of the main data we used in this study. More values from other series tested can be found in Appendix B.

Note that all data presented below have been seasonally adjusted and are in real terms.

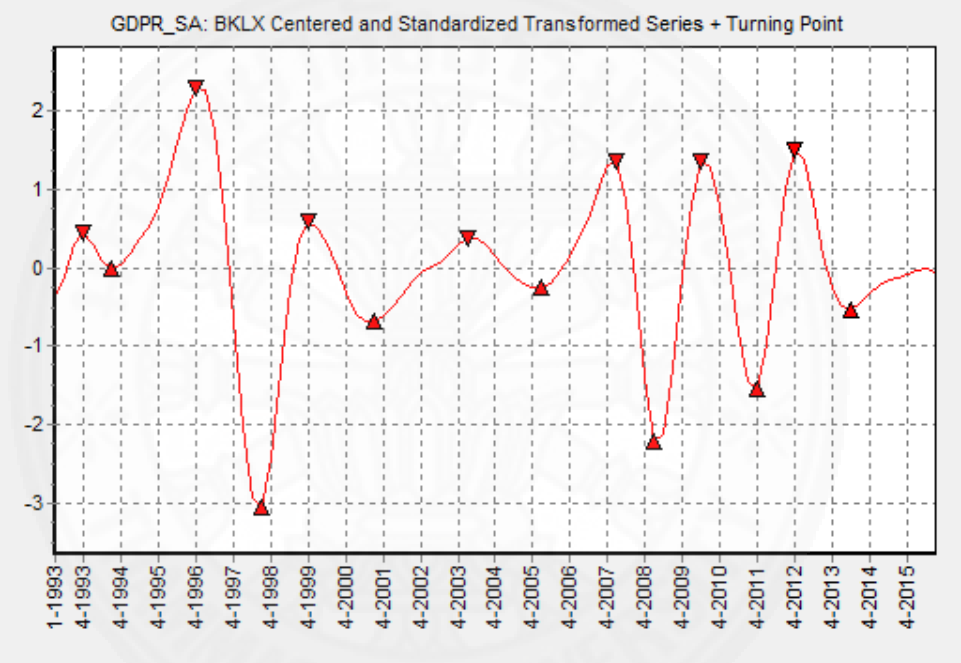
Table 4.1: Summary Statistics of Main Data Used

Series	Periods	Unit	Mean	Median	S.D.
Thailand's GDP	1993Q1 – 2016Q3	Billion Baht	1,697.60	1,665.75	422.90
Bank of Thailand' LEI		-	111.62	112.58	11.59
Ministry of Commerce's Short-run LEI		-	100.02	100.04	14.16
Ministry of Commerce's medium-run LEI		-	98.25	97.60	4.13
Authorized Capital of Newly Registered Companies		Million Baht	40,604.55	37,391.79	15,819.22
Construction Areas Permitted in Municipal Zone		1,000 sq.m.	4,857.00	4,661,33	2,242.90
Exports		Million Baht	886,962	932,849	330,717
Number of Foreign Tourists		Persons	3,515,581	2,981,449	1,894,674
SET Index		-	857.78	738.90	410.07
Broad Money		Million Baht	7,495,304	6,850,253	2,322,109
Oil Price (Oman) Inverse Index		-	0.71	0.57	0.48
Manufacturing Production Index		-	146.14	148.16	52.88

4.2 Findings on Thailand's Business Cycles

After we finished the process of seasonal adjusting and detrending real GDP data, the remaining component which is the cycle, can be plugged into the BUSY program to identify its turning points in the 1993Q1 – 2016Q3 period. By setting the turning point conditions explained in Section 3.2.3, we can illustrate the graph with turning points as follows:

Figure 4.1: Thailand's Business Cycles with Turning Points (1993Q1 – 2016Q3)



The BUSY program's Bry-Boschan function shows the result that from 1993Q1 - 2016Q3, Thailand has 5 full business cycles (Peak-Trough-Peak basis), with the average of 14 quarters or 42 months per cycle, as shown in Figure 4.1. It is worth noting that Thai business cycle has become shorter as of recent years, much less than the figure of 59 months from Benyasut (1996) and 55.7 months from Tinnakorn (1998). Deutsche Bank's research (2010)[13] suggested that business cycles will be shorter compared to the past because cycles were artificially long in the "golden era", which covers from the early 1980s to the early 2000s. In this period, the cycles can be prolonged thanks to the aggressive intervention such as injecting fiscal

[13] Reid, J. and Burns, N (2010), "LT Asset Return Study From the Golden to the Grey Age", Deutsche Bank Special Report, September 2010.

or monetary stimulus into the economy whenever the economic problems occurred. Most economies at that time can perform said acts since the country's leverage and inflationary pressures are still low.

Table 4.2: Thailand's Business Cycles' Details (1993Q1 – 2016Q3)

Cycle	**Peak**	**Trough**	**Next Peak**	**Duration (Quarters)**		
				Recession	**Expansion**	**Total**
1st	1996Q3	1998Q2	1999Q3	7	5	12
2nd	1999Q3	2001Q2	2003Q4	7	10	17
3rd	2003Q4	2005Q4	2007Q4	8	8	16
4th	2007Q4	2008Q4	2010Q1	4	5	9
5th	2010Q1	2011Q3	2012Q1	6	10	16
Average				6.4	7.6	14

4.3 The Qualified Leading Indicators for Thai Business Cycles

After we extract the cycle component of the selected indices or indicators, using the same approach as the real GDP as done in the previous section, the selected indicators' cycles will be used to compare with the reference series, or business cycle. The qualified indicators that have the trait of being leading indicators against Thai business cycles are presented as follows:

Table 4.3: The Qualified Indicators classified by using NBER Approach and OIE's Criteria

Series/ OIE's Criteria	Coherence	Mean Delay	Cross-correlation		Turning Point Sequences
			r_{max}	t_{max}	
	>0.15	**>0.1**	**>0.4**	**>0**	**<0**
Economic and Finance Data					
*1. Bank of Thailand's Leading Economic Index	0.38	0.75	0.67	2	-2
*2. Broad Money	0.16	1.43	0.67	3	-2.5
3. Bond and Stock Market Capitalization	0.58	0.72	0.83	1	-1
Sentiment Data					
4. Bank of Thailand's Business Sentiment Index	0.62	0.64	0.81	1	-1
5. Bank of Thailand's Business Sentiment Index (next three months)	0.55	1	0.82	1	-1
6. Bank of Thailand's Corporate Loan Executive Survey	0.48	1.3	0.75	1	-0.5
7. Ministry of Commerce's Business Expectation Index (next quarter)	0.56	0.61	0.79	1	-0.75
8. Ministry of Commerce's Consumer Confidence Index	0.38	0.64	0.64	1	-0.44
External Data					
*9. Japan's Consumer Confidence Index	0.35	0.6	0.63	1	-1
10. China's Business Confidence Index	0.56	0.61	0.79	1	-0.75
*11. China' Leading Index	0.25	0.85	0.55	1	-1

Note that the star sign (*) implies the data coverage of 1993Q1 – 2016Q3, the same as Thailand's GDP, while the others would have shorter coverage due to their different starting periods.

Table 4.4: Additional Details of the Qualified Data

Series	Starting Period	Ending Period
*1. Bank of Thailand's Leading Economic Index	1993Q1	2016Q3
*2. Broad Money	1993Q1	
3. Bond and Stock Market Capitalization	1994Q1	
4. Bank of Thailand's Business Sentiment Index	1999Q2	
5. Bank of Thailand's Business Sentiment Index (next three months)	1999Q2	
6. Bank of Thailand's Corporate Loan Executive Survey	2007Q4	
7. Ministry of Commerce's Business Expectation Index (next quarter)	1995Q2	
8. Ministry of Commerce's Consumer Confidence Index	2000Q4	
*9. Japan's Consumer Confidence Index	1993Q1	
10. China's Business Confidence Index	2000Q2	
*11. China' Leading Index	1993Q1	

Consequently, we got the total of eleven indicators that qualify OIE's criteria of NBER Approach on selecting leading indicators. The prominent one is the Bank of Thailand's LEI, including one of its components, broad money. Surprisingly, we found many of the sentiment data to be suitable leading indicators for Thai business cycles, the list includes the likes of Bank of Thailand's Business Sentiment Index, Ministry of Commerce's Consumer Confidence Index, and also some of the external data such as Japan's Consumer Confidence Index and China's Business Confidence Index.

To interpret the results, the higher coherence and cross-correlation's r_{max} indicates stronger relationship between the two series, the selected indicator and the reference. Positive t_{max} also points out how many periods ahead of indicators to

Thailand's business cycle, in which it yields the highest correlation. For example, in the Business Sentiment Index case, the t_{max} equals to 1 means that BSI has a highest correlation with Thailand's business cycle if placing one period ahead. Positive mean delay indicates that the indicator as a whole displays the leading trait with respect to the reference series. Lastly, negative turning point sequences represent that on average, the turning points from the selected indicators move ahead of the turning points from the reference series.

4.4 Forecasting real GDP using the Qualified Indicators

We first separate the eleven qualified indicators into two group; the long and short series, by looking at the length coverage of the data. The long series group consists of indicators that have the starting period before 1999, and the rest fall in the short series group. Each indicator then cut into two periods using the approximated 80:20 ratio. After creating the forecast series using the rolling time series method as explained in the previous chapter, the next process is to calculate errors by subtract the forecast series from the actual series. We then find the square root of the errors' average sum squared value, or root mean square error (RMSE) from each one. Here are the results of RMSE, collecting from forecasting errors of each point.

Table 4.5: Out-of-sample Forecasting Performance

Series	Starting Period	Forecast Period	RMSE	Accuracy Test
Long Series				
Bank of Thailand's Leading Economic Index (2)	1993Q1	2012Q3 - 2016 Q3	22.09	76.47%
Broad Money (2)	1993Q1		19.63	64.71%
Japan's Consumer Confidence Index (1)	1993Q1		18.72	82.35%
China' Leading Index (1)	1993Q1		15.12	82.35%
Bond and Stock Market Capitalization (1)	1994Q1		15.60	77.78%
Ministry of Commerce's Business Expectation Index (next quarter) (1)	1995Q2		15.28	70.59%
Short Series				
Bank of Thailand's Business Sentiment Index (1)	1999Q2	2013Q3 - 2016Q3	14.60	76.92%
Bank of Thailand's Business Sentiment Index (next three months) (1)	1999Q2		13.95	76.92%
China's Business Confidence Index (1)	2000Q2		15.84	84.62%
Ministry of Commerce's Consumer Confidence Index (1)	2000Q4		15.85	84.62%
Bank of Thailand's Corporate Loan Executive Survey (1)	2007Q4	2015Q1 - 2016Q3	7.29	100%

Note: the number inside the parenthesis indicate the lead time of that indicator against GDP.

We found out that by using more recent data for forecasting process, the RMSE tend to be lower as portrait above. For example, RMSE from the Bank of Thailand LEI's forecasting error in 2012Q3 – 2016Q3 was 22.09, while it was reduced to 16.23 if counted only the forecasting error from 2015Q1 – 2016Q3. Therefore, we need to keep in mind that the results from different length of data cannot be perfectly compared with each other.

Note that the correlation matrix of these eleven dataset shows that some of them are highly correlated with others such as Bank of Thailand's Leading Economic Index (BOT LEI) and Broad Money (M2). Thus, they tended to move in the similar direction.

The correlations are calculated using up to all available periods the particular indicator has. For example, the pair of BOT LEI and M2 utilized data from 1993Q1 to 2016Q3 for the correlation computed. On the other hand, the pair of BOT LEI and Corporate Loan Executive Survey (CORPSV) utilized data only from 2007Q4 to 2016Q3, as CORPSV have shorter length of data.

Table 4.6: Correlation Matrix of Qualified Indicators

Series	BOT LEI	JPN CCI	China LEI	M2	BMCAP	BEI	BSI	BSI3M	China BCI	CCI	CORPSV
BOT LEI	1.00	0.02	-0.39	0.99	0.98	0.05	0.16	0.24	-0.43	0.14	0.01
JPN CCI	0.02	1.00	0.19	-0.04	0.06	0.22	0.15	0.28	0.48	0.16	0.58
China LEI	-0.39	0.19	1.00	-0.41	-0.23	0.16	0.06	0.18	0.79	-0.17	0.53
M2	0.99	-0.04	-0.41	1.00	0.97	0.01	0.15	0.21	-0.49	0.12	-0.01
BMCAP	0.98	0.06	-0.23	0.97	1.00	0.04	0.13	0.23	-0.37	0.06	0.07
BEI	0.05	0.22	0.16	0.01	0.04	1.00	0.80	0.74	0.24	0.68	0.70
BSI	0.16	0.15	0.06	0.15	0.13	0.80	1.00	0.90	0.24	0.60	0.70
BSI3M	0.24	0.28	0.18	0.21	0.23	0.74	0.90	1.00	0.43	0.64	0.74
China BCI	-0.43	0.48	0.79	-0.49	-0.37	0.24	0.24	0.43	1.00	0.24	0.56
CCI	0.14	0.16	-0.17	0.12	0.06	0.68	0.60	0.64	0.24	1.00	0.08
CORPSV	0.01	0.58	0.53	-0.01	0.07	0.70	0.70	0.74	0.56	0.08	1.00

4.5 Results from Malaysia and Singapore Data

Before we move to the discussion part, for the next step, we conduct the whole process using dataset from Malaysia and Singapore instead.

After testing the turning point analysis by setting Singapore's business cycles as the reference series, the results indicate that Singapore's Composite Leading Index created by Ministry of Trade and Industry is shown to be strong leading indicator, as reflected by the high value of coherence, mean delay, and cross-correlation's r_{max}.

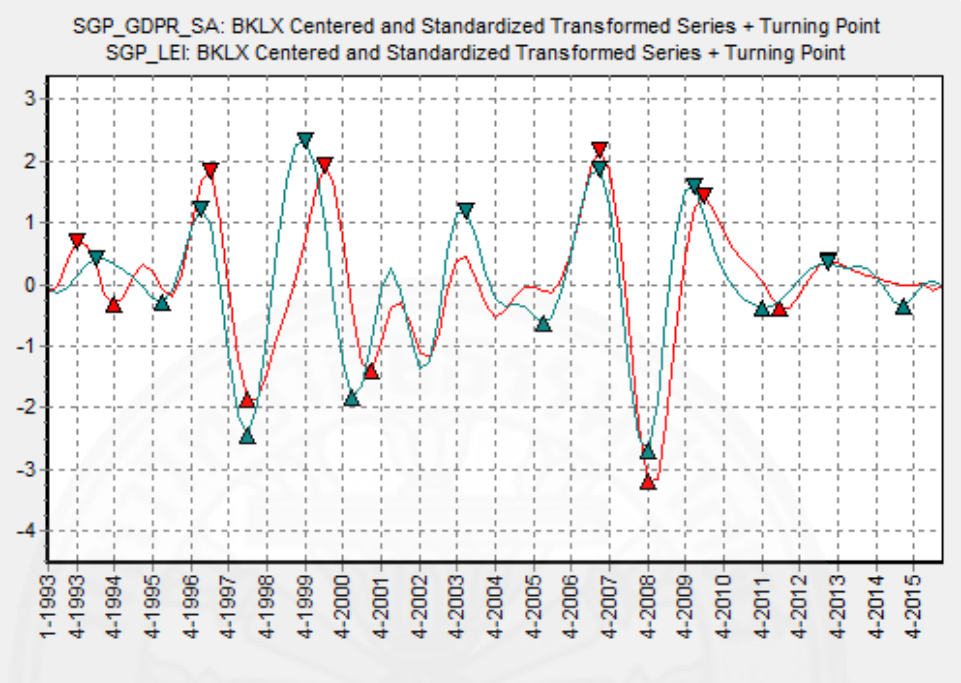
Table 4.7: Singapore's Leading Indicators Performance

Series/ OIE's Criteria	**Coherence**	**Mean Delay**	**Cross-correlation**		**Turning Point Sequences**
			r_{max}	**t_{max}**	
	>0.15	**>0.1**	**>0.4**	**>0**	**<0**
1. Singapore's Leading Index	0.65	0.81	0.87	1	-0.5
2. Business Expectations for Wholesale Trade	0.56	1.25	0.85	1	-1
3. Business Expectations for Stock of Finished Goods (Manufacturing)	0.45	1.02	0.74	1	-1

Note that all three data are collected from 1993Q1 – 2016Q3. The additional business expectations data are components of Singapore's LEI (Table A2). Likewise, they were shown to be a strong leading indicator against the country's business cycles. Hence making them the components of the composite leading index seem to be indeed suitable.

Figure 4.2 shows the business cycles of Singapore (red line) compared with its official leading index (blue-green line).

Figure 4.2: Singapore's Business Cycles with Turning Points, along with its LEI (1993Q1 – 2016Q3)



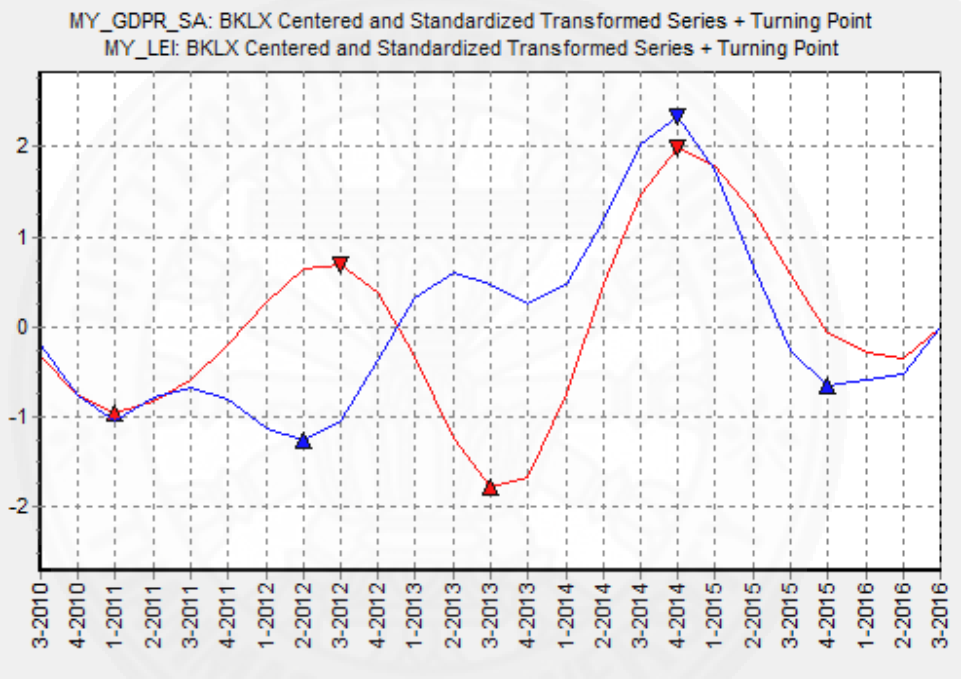
Unfortunately, for the Malaysia's case, we only have the short range of its business cycles data, starting from 2010Q3, since it has been realigned with the rebasing of GDP to year 2010, with their former 2005 based GDP has been discontinued since 2010 also. Therefore, the turning point analysis of Malaysia business cycle and its LEI was suffered from the lack of data coverage, and their results would be too unreliable to claim.

From Figure 4.3, with only 25 observations available, BUSY's Bry-Boschan function can detect only one business cycle from its real GDP (red line). Therefore, the data was insufficient to utilize the turning point analysis.

Table 4.8: Malaysia's Leading Indicators Performance

Series/ OIE's Criteria	Coherence	Mean Delay	Cross-correlation		Turning Point Sequences
			r_{max}	t_{max}	
	>0.15	**>0.1**	**>0.4**	**>0**	**<0**
Malaysia's Leading Index	0.21	0.29	0.46	1	2.5

Figure 4.3: Malaysia's Business Cycles with Turning Points, along with its LEI (2010Q3 – 2016Q3)

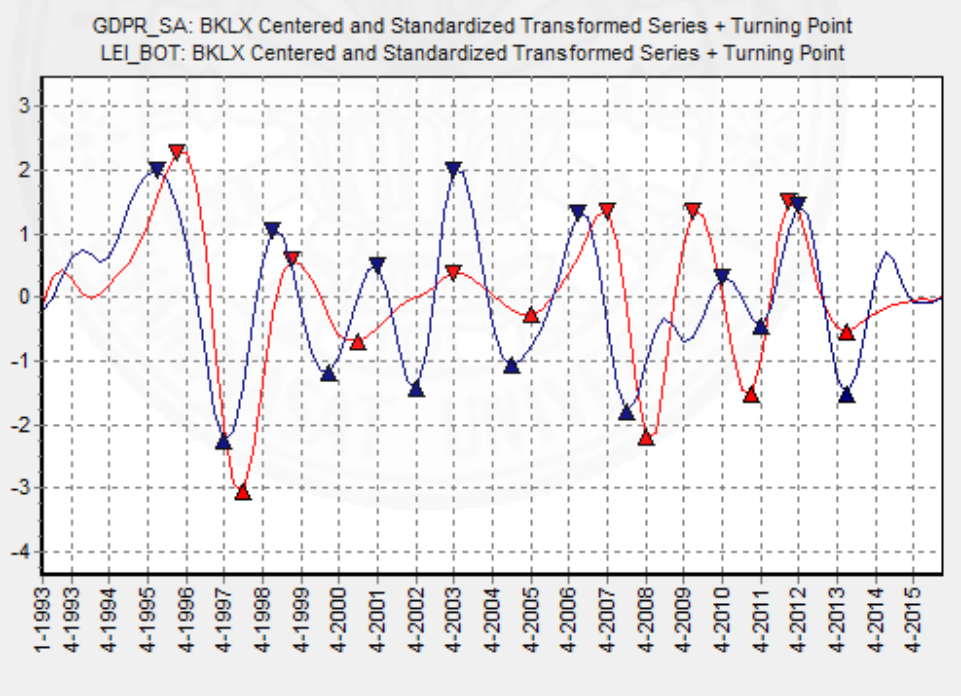


CHAPTER 5
DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Discussion

After conducting the turning point analysis, we found that LEI from Bank of Thailand qualified to be used as leading indicator for Thai business cycles, according to OIE's criteria. It also has sufficient accuracy to forecast real GDP, judging from the low RMSE value and high accuracy rate of direction-forecasting. However, both LEIs from Ministry of Commerce did not pass the test, so it is interesting to take a look at the main differences between the LEIs from these organization.

Figure 5.1: Thailand's Business Cycles with Turning Points, along with Bank of Thailand's LEI (1993Q3 – 2016Q3)

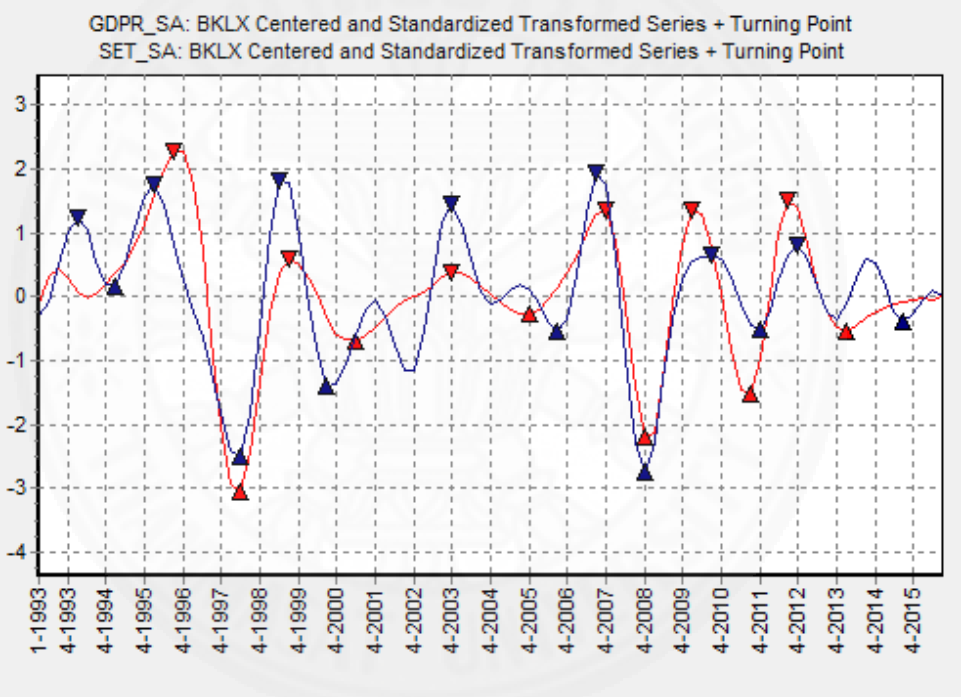


Note: Results from other indicators are shown in Appendix C

One thing to notice, is that components of BOT's LEI and MOC's short-run LEI are quite similar (Table 2.1). The major component that cause the distinct results is the broad money, which is one of the qualified indicators that MOC did not have in the leading index. Additionally, we found that all other components in LEIs from both

BOT and MOC did not pass the test, with the only exception in SET index. The SET index actually passed the OIE's criteria, but failed in terms of turning point sequences. In other words, SET index, as the whole series, displays decent traits of being a leading indicator for Thailand's business cycles, but its turning points did not usually lead the business cycles' turning points. Therefore, we decided to not include it in the qualified leading indicators.

Figure 5.2: Thailand's Business Cycles with Turning Points, along with SET Index (1993Q3 – 2016Q3)



Although it seems astonished that many economic indicators in LEIs did not pass the test, one might argue that the result is actually not that much of a surprise. The same economic indicator might not be a good leading indicator as it was before due to structural changes. If you take a look at Figure 5.1, you will see that BOT's LEI has a worse performance in recent years, arguably after 2009 financial crisis.

Going in details, we have to understand that some indicators have flaws in themselves, which might surface more as of late. For example, all Thailand's LEIs have Permitted Construction Areas in Municipal Zone as one of the components, while the developed countries tend to have Building Permits or Housing Starts as the

component (Appendix A). The Area Permitted that Thailand used sometimes can be a false leading indicator as businesses with granted new area permitted do not have to construct new buildings, or might delay their construction plans if the economy is not doing well at the upcoming periods. However, we still have some limitation if we want to use Housing Starts instead, as Thai denizen, by culture, do not often change or purchase new houses, compared to the like of the U.S. and European nations.

Another example of the indicator that might pose the false signal, especially in recent years, is the Number of Foreign Tourists. It is true that Thailand has tourism sector as one of the main growth drivers; however, the higher number of tourists might not be a good representation of Thai economic activities if compared to the past performance. The reason is that we recently have more influx of tourists who came to Thailand via illegal tour operators, in which the most notorious case being the so called Zero-Dollar Chinese Tours. In this situation, we indeed get higher number of tourists, but the economy is barely improved since those tourists spend only a little.

Apart from LEI components, we found that sentiment data such as Business Sentiment Index and Consumer Confidence Index work well as leading indicators. We also found more evidences from Singapore's case, where it has sentiment data in the LEI, and said data passed the test. Furthermore, the advanced economies such as the U.S. and EU also have sentiment data as their LEI component as well. In Thailand's case, the sentiment data are not included in the LEI, partly maybe because the series are viewed as too short, or it might be due to the response rate of the survey is not high enough to claim for the data credibility. For example, BOT's BSI always have the response rate of a little more than 60%.

In addition to the main objective of this study, we found that the U.S., EU, and Japan LEIs did not pass the test, whereas the China's LEI qualified, consistent with our assumption of China's indicator being relevant to Thailand as the trading between both countries is considered a growing trend. Therefore, it might be beneficial to the improvement of Thailand's LEI by incorporating more of China's indicators instead of relying on the old ones from U.S. or Japan.

In overall, the findings support the concept of leading indicator characteristics as the qualified indicators could represent the prior movement before the economy with logical supporting reasons. The survey-based sentiment data are proved to be

effective leading indicator in the modern era. However, we found many variables such as numbers of foreign tourists, which perform worse than the past, mainly due to the change in economic and business structure.

The evidence of changes in economic structure can be addressed by looking at the duration of cycles. In this study, we found that Thailand, from 1993 to 2016, has five full business cycles with an average duration of 42 months per cycle, significantly lower than those of 59 months from Benyasut (1996) and 55.7 months from Tinnakorn (1998). This suggests that the economy tends to move more rapidly in the present; thus, some economic indicators' performance in Thailand's LEIs might not be able to capture the accurate economic conditions as they were before. For example, SET Index and Oman Oil Price Index (reverse) were among the qualified leading indicator for business cycles in Kantawit's study (2009), while they did not pass the test conducted in this study.

Lastly, the results from testing Singapore data are proved to be as expected. Singapore's LEI as well as some of its components yield an impressive outcome as their performances indicate the strong trait of being leading indicators for the nation's business cycles. Additionally, as two business expectation data of Singapore also passed the test, it further supports the claim that LEIs will likely to receive more benefits from using sentiment data as their components. However, as for Malaysia's case, the newly revised GDP causes the data length to be too short; therefore, all tests of Malaysia's LEI as well as some of the LEI components with respect to its business cycles yielded poor results.

5.2 Conclusions

The results from Bry-Boschan's turning point analysis show that from 1993Q1 to 2016Q3, Thailand has five full business cycles, based on Peak-Trough-Peak basis. Each cycle has the average of 14 quarters or 42 months. In addition, Thailand as of 2016Q3 onwards is likely to be in the expansion stage rather than the recession stage, as predicted using the above information.

As for the leading economic indicator test; by utilizing NBER approach with OIE's criteria, we found eleven qualified indicators. All qualified indicators excluding Bank of Thailand's LEI and Broad Money have the best performance when placing one period (or one quarter) ahead of Thailand's business cycles. Further forecasting test and direction-accuracy test indicate that these indicators should be acceptable thanks to their low RMSE and high direction-accuracy on forecasting GDP. It is noteworthy that most components from Thailand's LEIs did not pass the test, while a good amount sentiment data and some external data such as China's LEI are qualified as leading indicators for Thailand's business cycles. Therefore, to be able to effectively forecast Thailand's business cycles in the future, we might need to revise the LEI components by taking out the poor-performance indicators, and replace them with more promising ones such as sentiment data and Chinese's indicators.

5.3 Recommendations

As stated in the previous section, the author strongly recommends more frequent revision of leading economic indices in Thailand for the benefit of having a better tool to forecast economic conditions. The evidence presented in this study also imply that some indicators which perform well in the past may not be suitable to use as a leading indicator in the current or future economy anymore.

The methodology utilized in this study could also be replicated with some adjustments to investigate the updated information. Different conditions on business cycles' turning point and qualifying criteria could be applied to check for new results. In addition, other approaches should be explored to improve the leading indicator test, such as using other models for GDP forecasting. This way, we might be able to narrow down even more indicators, and be able to identify the best leading indicators that can pass any scenario tests.

Further study should include creating new composite leading economic index using the qualified indicators for monitoring economic activities, with the weight of each indicator is subjected to be test on the later step. Additionally, as we are unsuccessful on comparing results between Thailand and Malaysia due to the latter's insufficient data, further study should try extending GDP series back, by utilizing old GDP series' growth movement. This way, we would get the same period of coverage and be able to compare them, just like Thailand's and Singapore's data in this study.

REFERENCES

1. Banerjee, A., Marcellino, M, and Masten, I. (2003), "Leading indicators for Euro area inflation and GDP growth", *Oxford Bulletin of Economics and Statistics*, Vol. 67, Issue Supplement s1, December 2005, 785-813.

2. Benyasut, P. (1996), "A Study on the Construction of Leading Indices for Business Cycles in Thailand", *Thammasat Economic Journal*, Year 14th, Issue December 4th 1996.

3. Cheung, C. and Grenovsky, D. (2016), "New Housing Registrations as a Leading Indicator of the BC Economy", Bank of Canada Staff Discussion Paper 2016-3, February 2016.

4. Comincioli, B. (1996), "The Stock Market As A Leading Indicator: An Application Of Granger Causality", The University Avenue Undergraduate Journal of Economics, Vol.1, Issue 1, 1996.

5. Estrella, A. and Mishkin, F. S. (1996), "Predicting U.S. Recessions: Financial Variables as Leading Indicators", Federal Reserve Bank of New York Research Paper No. 9609.

6. Ikoku A. (2010), "Is the Stock Market a Leading Indicator of Economic Activity in Nigeria?", Journal of Applied Statistics, Central Bank of Nigeria, December 2010.

7. Izani, I., Raflis, A., & Che, O. (2004), "The lead-lag pattern of leading, coincident and lagging indicators in Malaysia", Investment Management and Financial Innovations, 1(2), 34-41.

8. Jiranyakul, K. (2012), "The Predictive Role of Stock Market Return for Real Activity in Thailand", Asian Journal of Empirical Research, 3(3):317-328.

9. Kantawit, A. (2009), "Forecasting Thailand's Business Cycles", Faculty of Commerce and Accountancy, Thammasat University.

10. Khramov, V. and Lee, J.R. (2013), "The Economic Performance Index (EPI): an Intuitive Indicator for Assessing a Country's Economic Performance Dynamics in an Historical Perspective", International Monetary Fund, IMF Working Papers WP/13/214, Washington, D.C.

11. Leigh, D. and Rossi, M. (2002), "Leading Indicators of Growth and Inflation in Turkey", International Monetary Fund, IMF Working Papers WP/02/231, Washington, D.C.

12. Mauro, P. (2000), "Stock Returns and Output Growth in Emerging and Advanced Economies", International Monetary Fund, IMF Working Papers WP/00/89, Washington, D.C.

13. Okonkwo, O. N. et al. (2014), "Stock Market Performance and Economic Growth in Nigeria: An Empirical Appraisal", European Journal of Business and Management,Vol.6, No.26, 2014.

14. Tanaka, K. (2010), "China's ties with Southeast Asia: From Green Shoots to Sustained Recovery", ERIA – OECD Research Brief, April 2010.

15. Tinnakorn, P. (1998), "An Analysis of Leading Economic Indicators: The case of Thailand", Thailand Development Research Institute, September (in Thai).

APPENDICES

APPENDIX A
ADDITIONAL DETAILS OF ECONOMIC INDICES MENTIONED IN CHAPTER 2

Table A.1: Components Comparison from the 3 Thai Researchers' Works

Meesook (1979) Composite Economic Indicator	**Sahasakul (1987) Leading Indicator**	**Benyasut (1996)**	
		Reference Indicator (Coincident Indicator)	**Leading Indicator**
1. Aggregate Demand • Government Expenditures • Exports • Private Consumption • Private Investment 2. Aggregate Supply • Real Imports (adjusted by CPI) • Real Money Supply (adjusted by CPI) 3. Price Pressure • M1 Money Supply • Consumer Price Index (CPI) • Import Price Index • Export Price Index 4. Domestic Stability • Narrow Money • Broad Money • Domestic Credit 5. Balance of Payments and Foreign Exchange Reserves	***Statistically significant variables*** 1. Import Price Index 2. Export Price Index 3. M1 Money Supply 4. Domestic Credit 5. Electricity Usage 6. Crude Oil Usage 7. Cement Sale ***Statistically insignificant variables*** 1. Trading Partner Country's Economic Index 2. SET Index 3. Import of Capital Goods	1. Composite Production Index • Commercial Vehicle Production • Cement Production • Beer Production • Motorcycle Production 2. Department Store Sale 3. Car Sale 4. Business Tax 5. Composite Import Index • Import Value • Import Duty	1. M1 Money Supply 2. SET Index 3. Construction Areas Permitted in Bangkok 4. New Business Registration 5. Export Value 6. Number of Foreign Tourists

Table A.2: Components of LEIs from Malaysia and Singapore

Malaysia	Singapore
1. Real Money Supply M1 2. Bursa Malaysia Industrial Index 3. Real Total Traded (Eight Major Trading Partners: Japan, USA, Germany, UK, Singapore, Thailand, China, Canada) 4. CPI for Services (inverted) 5. Industrial Material Price Index 6. Ratio of Price to Unit Labor Cost (Manufacturing) 7. Number of Housing Permits Approved 8. Number of New Companies Registered 9. Trend Adjustment Factor.	1. Total New Companies Formed 2. Money Supply (M2) 3. Stock Exchange of Singapore Indices 4. Business Expectations for Wholesale Trade 5. Business Expectations for Stock of Finished Goods (Manufacturing) 6. US Purchasing Managers' Index (Manufacturing) 7. Total Non-Oil Seaborne Cargo Handled 8. Domestic Liquidity Indicator 9. Total Non-Oil Retained Imports.

Table A.3: Components of LEIs from Japan and China

Japan	China
1. Real Operating Profits 2. Dwelling Units Started 3. Business Failures 4. Index of Overtime Worked 5. Stock Price Index 6. Six-Month Growth Rate of Labor Productivity 7. Tankan Business Conditions, All Enterprises, All Industries 8. Real Money Supply, M2 + CD Money 9. Yield Spread, (10 year gov't bonds minus Uncollateralized: Overnight Rate) 10. New Orders for Machinery and Construction	1. Hang Seng China Mainland Circulation Index 2. Investment in Newly Started Project 3. Ratio of Industrial Production 4. Real Estate Development Leading Index 5. Money Supply M2 6. National Debt Interest Rate Spread 7. Consumer Expectations Index 8. Logistics Index

Table A.4: Components of LEIs from the U.S. and EU

The U.S.	**EU**
1. Average weekly hours, manufacturing 2. Average weekly initial claims for unemployment insurance 3. Manufacturers' new orders, consumer goods and materials 4. ISM® Index of New Orders 5. Manufacturers' new orders, nondefense capital goods excluding aircraft orders 6. Building permits, new private housing units 7. Stock prices, 500 common stocks 8. Leading Credit Index™ 9. Interest rate spread, 10-year Treasury bonds less federal funds 10. Average consumer expectations for business conditions	1. Yield Spread, 10 year ECB Benchmark Rate minus ECB Minimum Bid Rate 2. Consumer expectations of general economic situation over next 12 months Balances, percent 3. Markit® Manufacturing New Orders 4. Markit® Business Expectations Index (Services) 5. Stock Price (Average Closing Price) EURO STOXX® Index 6. Systemic Stress Composite Indicator 7. Capital Goods New Orders Index 8. Index of Residential Building Permits

APPENDIX B
ADDITIONAL DESCRIPTIVE STATISTICS OF DATA USED IN THIS STUDY

Table B.1: Additional Summary Statistics of Main Data Used

Series	Starting Periods (End at 2016Q3)	Unit	Mean	Median	S.D.
The U.S. Purchasing Managers' Index	1993Q1	-	52.23	52.54	4.63
Japan Purchasing Managers' Index		-	100.01	99.08	6.88
China Purchasing Managers' Index	2005Q1	-	52.04	51.60	2.64
The U.S. Business Confidence Index	1993Q1	-	99.87	99.89	0.98
Japan Business Confidence Index		-	99.71	99.98	1.17
China Business Confidence Index	2000Q2	-	100.00	99.95	1.43
The U.S. Consumer Confidence Index	1993Q1	-	100.13	100.46	1.45
Japan Consumer Confidence Index		-	99.49	99.55	1.21
China Consumer Confidence Index		-	99.90	100.01	2.05
The U.S. GDP		Billion USD	13,413.24	13,950.40	2,089.74
EU GDP		Million Euro	2,405.41	2,476.13	214.23
Japan GDP		Billion Yen	4,509.41	4,507.72	188.47
The U.S. LEI	1993Q1	-	1.24	1.51	0.81
Japan LEI		-	97.95	98.76	8.18
Singapore LEI		-	82.32	80.90	15.27
Singapore Business Expectations for Wholesale Trade		%	4.97	6.36	12.36
Singapore Business Expectations for Stock of Finished Goods (Manufacturing)		%	-4.27	-3.63	8.31
Bank of Thailand's Business Sentiment Index	1999Q2	-	47.85	48.68	3.53
Bank of Thailand's Business Sentiment Index (next three months)	1999Q2	-	52.54	53.04	3.26
Ministry of Commerce's Business Expectation Index (next quarter)	1995Q2	-	56.40	57.52	10.45

Series	Starting Periods (End at 2016Q3)	Unit	Mean	Median	S.D.
Ministry of Commerce's Consumer Confidence Index	2000Q4	-	29.60	28.40	12.65
The Federation of Thai Industries' Thai Industries Sentiment Index	2002Q4	-	92.86	92.23	10.48
Commercial Car Sales	1998Q1	Units	100,979	107,615	44,448.71
Capacity Utilization	2000Q1	%	62.35	63.44	5.04
Inflation Rate	1993Q1	%	3.02	2.91	2.48
Bank of Thailand's Private Consumption Index	1995Q1	-	91.25	91.40	15.38
Bank of Thailand's Private Investment Index	2000Q1	-	94.13	91.49	24.80
Bank of Thailand's Real Effective Exchange Rate Index	1993Q1	-	91.88	93.78	8.46

APPENDIX C
OTHER GRAPHICAL RESULTS FROM CHAPTER 4
(BUSINESS CYCLE ARE ALWAYS THE RED LINES)

Figure C.1: Thailand's Business Cycles with Turning Points, along with Broad Money (1993Q3 – 2016Q3)

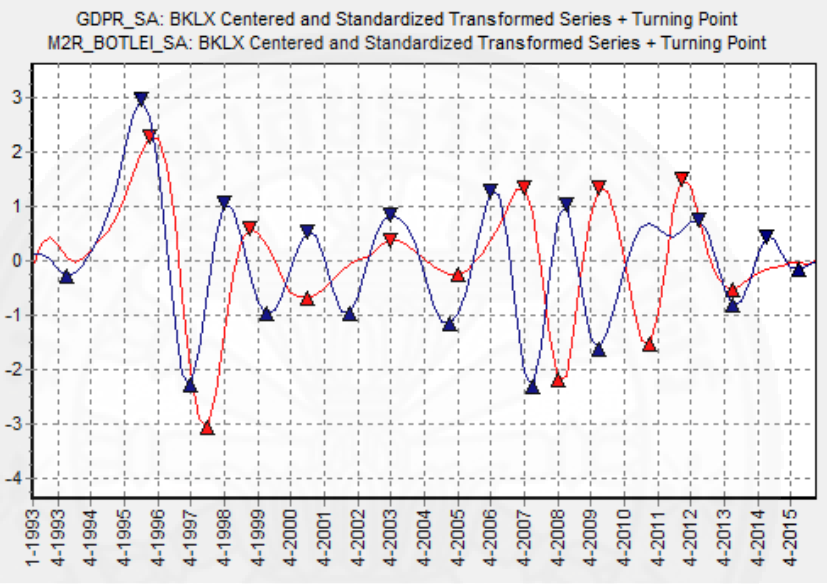


Figure C.2: Thailand's Business Cycles with Turning Points, along with Japan's CCI (1993Q3 – 2016Q3)

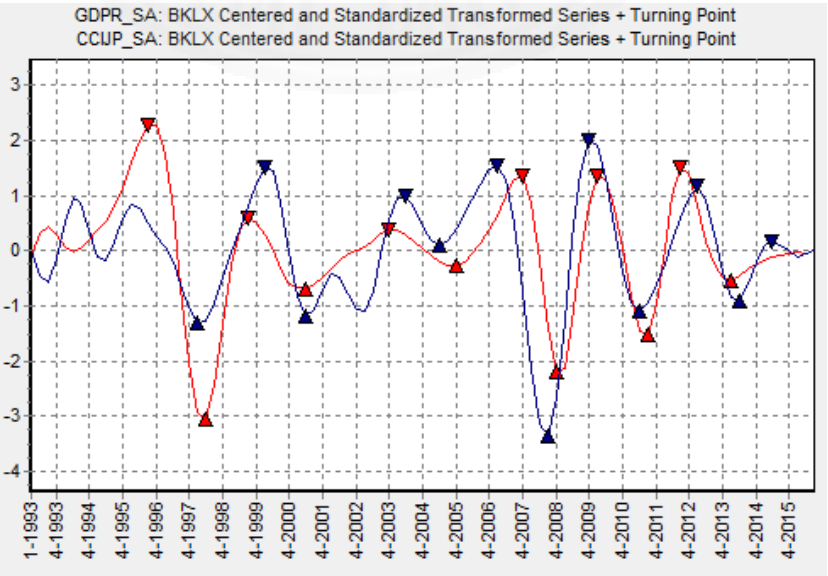


Figure C.3: Thailand's Business Cycles with Turning Points, along with China's Leading Index (1993Q3 – 2016Q3)

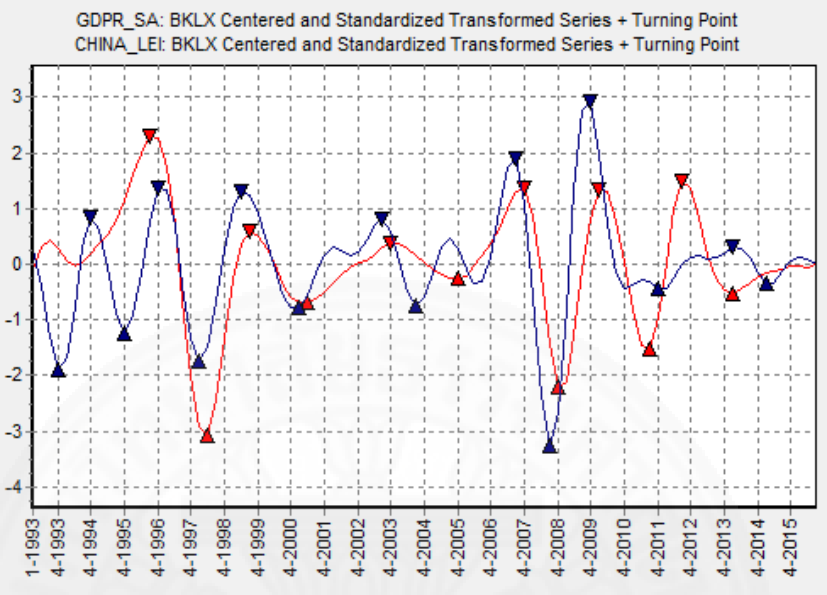


Figure C.4: Thailand's Business Cycles with Turning Points, along with Bond and Stock Market Capitalization (1994Q1 – 2016Q3)

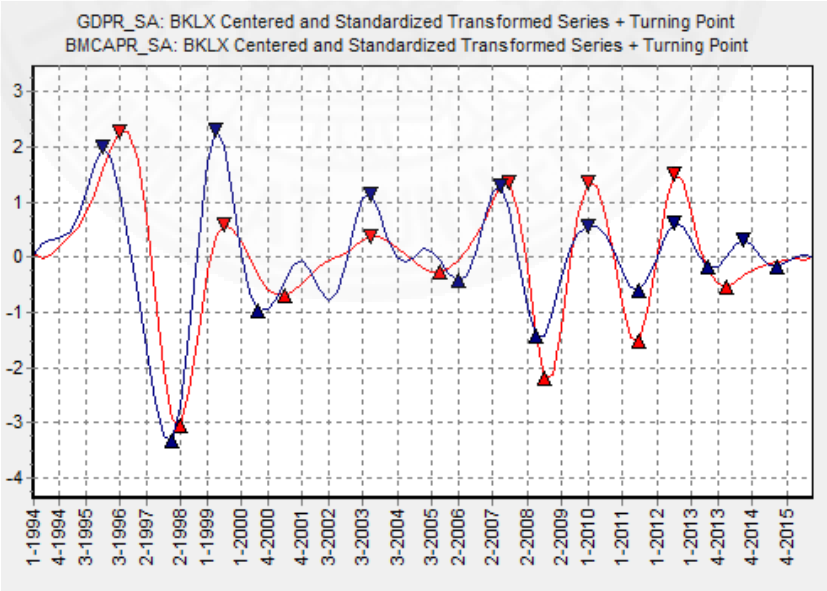


Figure C.5: Thailand's Business Cycles with Turning Points, along with BEI (1995Q2 – 2016Q3)

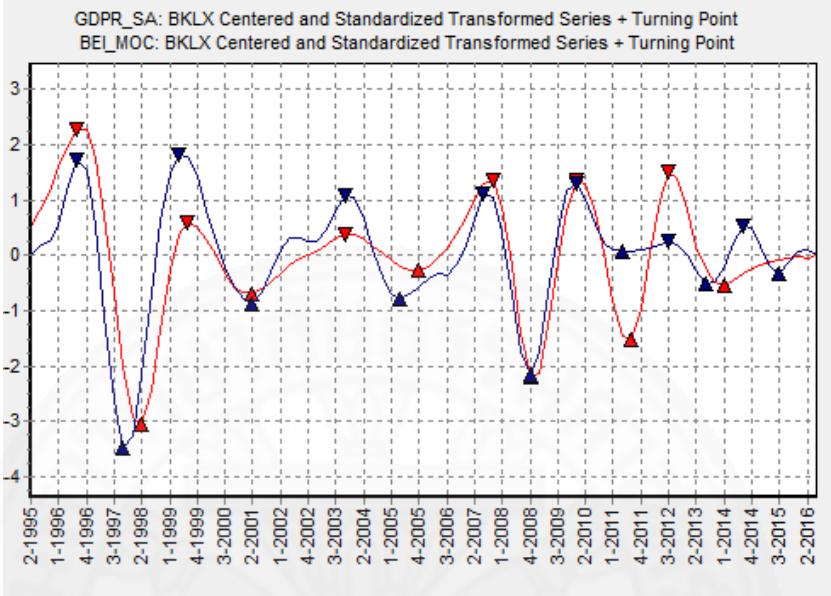


Figure C.6: Thailand's Business Cycles with Turning Points, along with BSI (1999Q2 – 2016Q3)

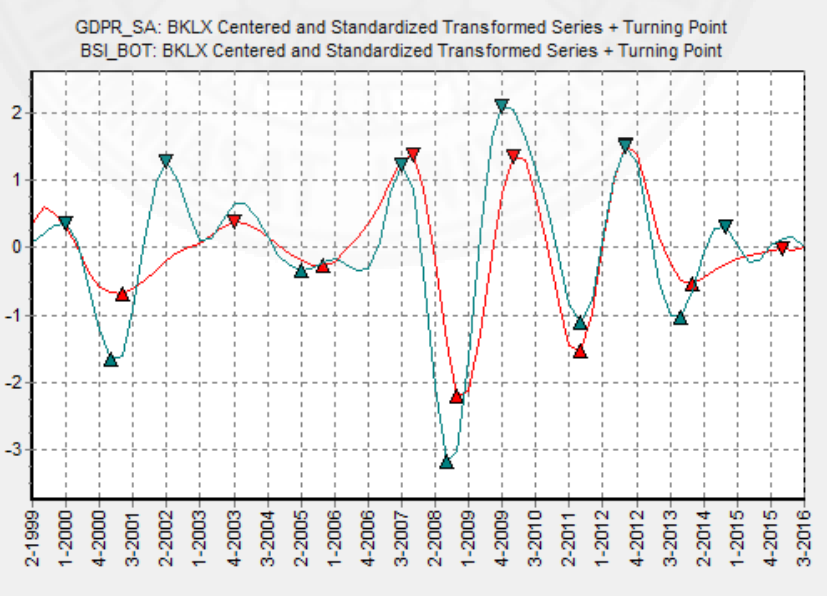


Figure C.7: Thailand's Business Cycles with Turning Points, along with BSI (next three months) (1999Q2 – 2016Q3)

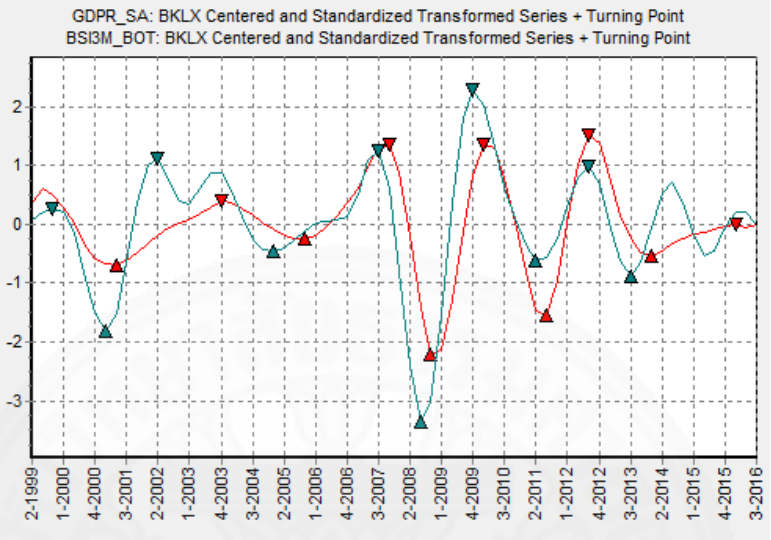


Figure C.8: Thailand's Business Cycles with Turning Points, along with China's BCI (2000Q2 – 2016Q3)

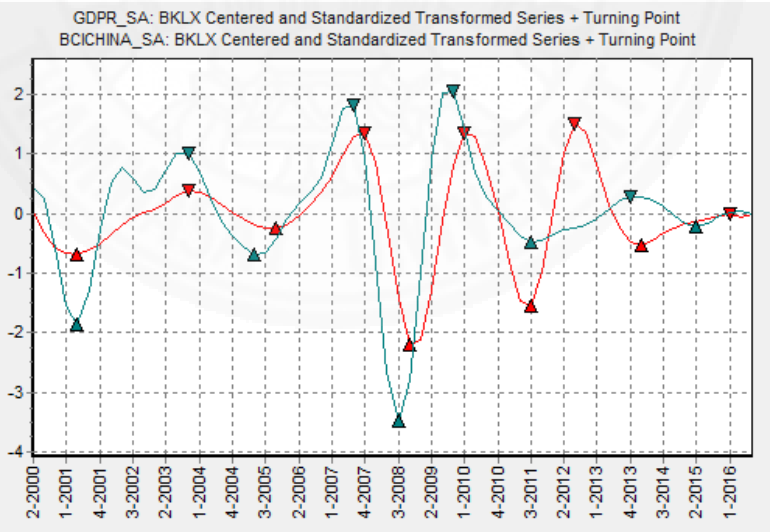


Figure C.9: Thailand's Business Cycles with Turning Points, along with Ministry of Commerce's CCI (2000Q4 – 2016Q3)

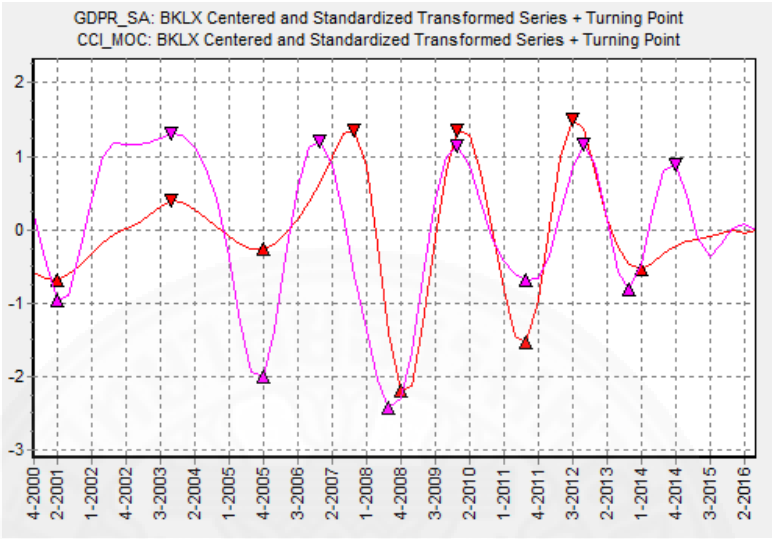
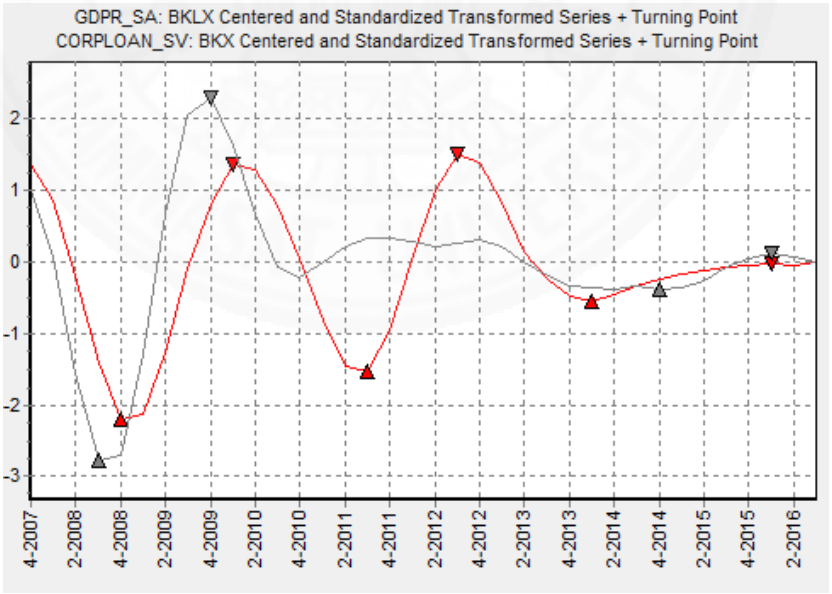


Figure C.10: Thailand's Business Cycles with Turning Points, along with Bank of Thailand's Corporate Loan Executive Survey (2007Q4 – 2016Q3)



BIOGRAPHY

Name	Mr. Nutchaphol Jaroonpipatkul
Date of Birth	January 7, 1991
Educational Attainment	2009: The Bachelor of Arts Program in Economics
Work Position	Economist, Economic and Policy Department Bank of Thailand