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A Practical Approach to Identify Business Cycles for Equity Investment in Thailand

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Abstract

The objective of this paper is to identify business cycles in Thailand using a simplified methodology which has never been tested empirically. The paper attempted to establish an appropriate proxy and model specification for business cycle identification. Among others, the results show that three competing proxies; GDP, MPI, and CEI could be used as a proxy for business cycle identification. However, the real GDP growth (YoY, Seasonally Adjusted) is the most appropriate proxy according to its highest correlation with equity market return, alignment of peaks and throughs with the equity market index, and it represents aggregate output in both manufacturing and service sectors which is suitable for a service-based economy. Next, we use positive and negative changes of real GDP over the study period to describe the Thai business cycle. We also test two regression models using steady zero-growth line which is a proposed contribution of this study and conventional long-run average trend line in defining stages of the business cycle with dummy variables. The results show that the model using a steady zero-growth line has better model specifications compared to the model using a long-run average trend line in defining business cycle stages. The results confirm the applicability of using real GDP growth (YoY, seasonally adjusted) together with its cyclical fluctuation along the steady zero-growth line as a simplified method for assessment of equity return along the different stages of the business cycle in Thailand.

Keywords

Macroeconomic impact, Business cycle, Stock returns

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Introduction and Motivation of the Study

The business cycle refers to fluctuations in aggregate economic activity over several months or years. Practically, the business cycle consists of four phases which are 1) recovery, 2) expansion, 3) recession and 4) depression. These phases have been widely used in practice due to their simplicity and their ability to apply a general view of fluctuations in the economic condition. These variations obviously encompass shifts over time between periods of relatively hasty economic growth and periods of relative stagnation. The length of a business cycle is the period of time covering a single peak and trough in sequence as depicted in Figure 1. In spite of the often-applied periodic cycles, this sequence of changes is recurring but not predictable.

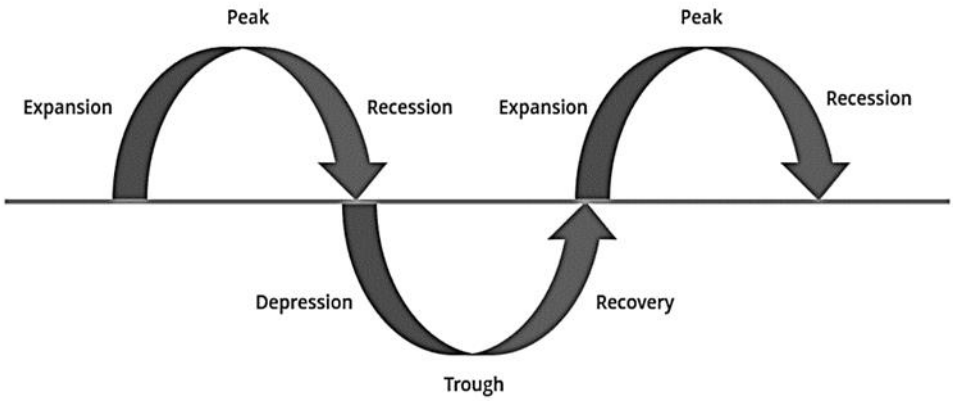

Figure 1 Traditional Four Phases of Business Cycles

Source: Corporate Finance Institute. (n.d.). Business Cycle A Series of Expansion and Contraction in Economic Activity. Retrieved October 28, 2019, from https://corporatefinanceinstitute.com/resources/knowledge/economics/business-cycle/

There are many advantages in knowing the business cycle in the economy. Tracking the business cycle also helps professionals predict the direction of the economy. Understanding that the economy moves through cycles may help companies put current business conditions in better perspective. In principle, different sectors have different responses to macroeconomic shocks depending on the market conditions, industrial characteristics, and the stage of the economy (DeStefano, 2004). Macro business cycles play a vital role in management decisions. When the economy is in a cycle of recession, management will act conservatively, whereas in a cycle of expansion, management may tend to act more aggressively to gain as much competitive advantage as possible.

Another benefit in knowing the business cycle is that investors who recognize that the economy moves through periods of recovery and recession may have a better outlook on

the overall cycle. Studies have attempted to discover the influence of the business cycle on the expected rate of returns from equity investments from both market-wide and sectoral stock returns. DeStefano (2004) investigated sectoral stock returns from the U.S. stock market and the business cycle using dummy variables for each of the four business cycle stages (early expansion, late expansion, early recession and late recession) and found that stock returns decrease throughout economic expansion and become negative during the first half of a recession. The largest stock returns were found in late recession stages which suggested possible expected earnings effect because the investors expect future earnings increase in late recession stage. In contrary, the investors expect future earnings decline in the late expansion stage therefore stock returns slow down. These results support the suggestion from Fama and French that expected stock returns move inversely with business conditions (Fama & French, 1989, as cited in DeStefano, 2004, p. 544). The explanation is that the investors focus more on the expectation of future earnings than the current business environment.

However, there was an argument that "The problem is to identify exact turning points and stages of the business cycle contemporaneously. This lack of clarity may explain why to date academic research has not rigorously tested whether investors can profit from sector rotation based on conventional wisdom." (Stangl et al., 2009, p. 3). The interesting practical issue is; therefore, which proxy is appropriate in identifying the business cycle and what the business cycle looks like, especially in a country outside the U.S. such as Thailand. Hence, this study contributed to the current understanding of a simplified method in business cycle identification for the equity investment perspective, which is theoretically sound but has never been tested in any empirical studies.

The paper is organized into five parts. The first section is dedicated to the introduction and motivation of the study. The second section presents a literature review and constructive framework related to the issue of business cycle proxy. The third section provides the data and methodology used in the study. In the fourth section, we analyze and present the precise period of the business cycle. The last section concludes the study.

Literature Review and Constructive Framework

Theoretically, the business cycle is defined by a change in economic activity of a country during a period which consists of two directions: expansion (growth) and contraction (decline). Essential attributes of business cycle proxies are representations of aggregated economic activities, movement in an expansion-contraction cyclical pattern with turning points around peak and trough, and repeatable in the different chronological periods. The famous definition of the business cycle consists of two aspects: identification of the aggregate economic activities and the existence of synchronization among different variables during certain phases of the business cycle (Burns & Mitchells, 1946 as cited in Diebold & Rudebusch, 1996, p. 67). Škare and Stjepanović (2016) described the business cycle or economic cycle as a change in the economic activity of a country during a particular period.

Using Gross Domestic Product (GDP) or the Manufacturing Production Index (MPI) as a Proxy for Business Cycle Identification

Most of the literature uses Gross Domestic Product (GDP) or the Manufacturing Production Index (MPI) as a proxy of aggregated economic activities measurement (Neftci, 1984; Sarantis, 2001; Kim et al., 2005; Antolin-Diaz et al., 2017; Alqaralleh, 2019). Gross Domestic Product (GDP) is a good measure of economic activity and is commonly use in determination of the business cycle. Fluctuation of the business cycle is a result of fluctuation in aggregate economic activity of the country. Duration of the business cycle varies from more than one year to over ten years (Škare & Tomić, 2015).

Škare and Stjepanović (2016) also mentioned that GDP is a good measure of economic activity and measuring the business cycle is to locate the turning points. One of the most practical methods to define the turning points is to use local maxima and local minima in the time series.

In addition, despite manufacturing production and industrial production has been introduced as a potential proxy of output growth of the economy in business cycle determination. Research has also mentioned that manufacturing production or industrial production may not be a good predictor for a service economy. Young hypothesized that "The relationship between stock returns and industrial production will cease in 1989-2004 period due to U.S. economy transitioning from manufacturing to a service-oriented economy in the concluding years of 20th century. Additionally, the results for the sub-period 1988-2000 indicate that industrial production can no longer predict stock returns, which confirms the U.S. economy's transition from a manufacturing to a service-oriented economy." (Young, 2006, as cited in Lazarus, 2017, p. 6-7). In this aspect, GDP is a better representative for more comprehensive measurement of the aggregated national economic

activities. Furthermore, GDP represents long-term aggregated economic activities while MPI represents only short-term production.

Using the Composite Economic Index as a Proxy for Business Cycle Identification

In addition to GDP and MPI, the composite economic index such as Coincident Economic Index (CEI) can measure fluctuations and turning points of growth rates of economic activity. Similar to GDP and MPI, CEI also has expansion and contraction swing according to changes in economic activity. It is possible that Coincident Economic Index (CEI) can also be used for business cycle assessment. Bilan et al. (2017) reviewed the Coincident Composite Indicator (CCI) for monitoring the cyclical movement of the economy and its applicability for Slovakia and showed its capability to monitor the Slovak economic cycle overtime. The Composite Leading Indicator (CLI) has also been proposed for monitoring and predicting the business cycle by Tkacova et al. (2017) who found that generated CLI can predict the German economy cycle two quarters in advance with a cross correlation value of 0.867.

Other Economic Indicators as a Potential Proxy for Business Cycle Identification

The authors of this study also reviewed the methods of business cycles identification and key determinants of business cycles. This review found technology shock as a main driver of business cycles remains controversial. Prescott calculates Total Factor Productivity (TFP) and use it as a measurement for exogenous technological shocks (Prescott, 1986, as cited in Škare & Stjepanović, 2016, p. 85-86). However, TFP introduced by Prescott (1986) is not a pure exogenous shock as some studies have shown significant differences between TFP and actual technology shocks. Fisher mentioned that technological shocks affect less than 10 percent of the variation in output (Fisher, 2003, as cited in Škare & Stjepanović, 2016, p. 88). Later studies introduced other variables instead of technological progress as the factor contributed to changes in business cycle through fluctuation and volatility of output changes. These variables include oil shock, fiscal shock and monetary policy shock (Skare & Tomić, 2015).

Some research has observed oil shock instead of technology progress due to its volatility but energy costs represent too small of a share to have a significant impact on economic activity (Škare & Stjepanović, 2016). Some researchers have observed the effect of fiscal shocks but according to the lack of cyclical variation in taxes and government spending. Therefore, cyclical movement in fiscal changes is relatively small to be a primary cause of business fluctuation. The new generation monetary models can generate impulse response functions to monetary shocks similarly to the Vector autoregression technique.

Siriphirunphong et al. (2015) studied the impact of important macroeconomic variables in Thailand (including population, GDP inflation, balance of payments, government cash balance, interest rate and exchange rate) during prosperity and depression stages of the business cycle between 1979-2014 using BVAR and MS-BVAR models. They found that population, GDP, inflation, government cash balance and exchange rate have a positive correlation with GDP while balance of payments and interest rate have a negative correlation with GDP during the prosperity phase of a business cycle. In depression phase GDP, inflation, interest rate and exchange rate have positive correlation with GDP while population, balance of payments and government cash balance have negative correlation with GDP.

Defining the Stages of a Business Cycle

Most of the studies in the area of sectoral stock returns and business cycle use U.S. market data which refer to The National Bureau of Economic Research (NBER) in defining stages of the business cycle. NBER identifies the business cycle based on changes in the general level of production by a two-step process starting from identification of cyclical peaks and troughs in the observed economic variables then determines whether these changes are common in all observed data. NBER publishes periods of recession and expansion by using peak and trough dates where period of expansion begins at the trough date and ends at peak date and the period of recession begins at the peak date and ends at the trough date (DeStefano, 2004). To identify stages of the business cycle, it is important to detect a cycle then identify the turning points to measure repeatable cycle features. The practical approach is to use peaks or local maxima and troughs or local minima of time series. The famous model of business cycle assessment such as DeStefano considers both trend component and cyclical component in its approach (DeStefano, 2004, p. 531). DeStefano (2004) divided business cycle into 4 stages using NBER defined peak date and trough date then further divided expansion into early and late expansion and divided recession into early and late recession by using the midpoint of each period as depicted in Figure 2.

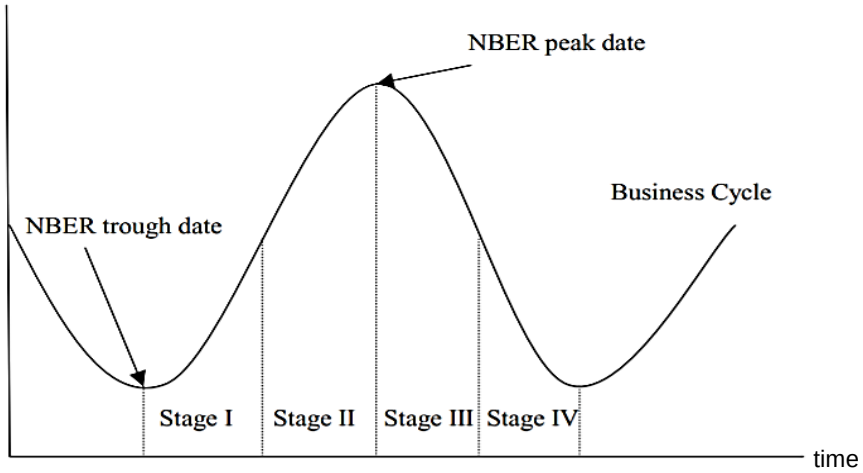

Figure 2 Four stages business cycle defined by DeStefano (2004)

Source: DeStefano, M. (2004). Stock Returns and the Business Cycle. The Financial Review. 39, 531

Evaluation of Stock Market Performance in the Various Business Cycle Conditions

Stangl et al. (2009) studied sector rotation strategy over different stages of the business cycle as a purpose of maximizing annual performance by outperforming the market using U.S. stock market data. The business cycle was determined by peak and trough dates from NBER which enabled them to separate expansion and recession phases. Stangl et al. (2008) defined business cycle stages into five stages referencing Stovall (1996) which were early expansion (stage 1), middle expansion (stage 2), late expansion (stage 3), early recession (stage 4) and late recession (stage 5). However, their results showed that average performance comes from late expansion stage but none of the differences is significant therefore the authors estimated excess market industry performance across business cycle and market outperformance for each industry during business cycle and report Jansen's alpha which being used for each stage of business cycle. Unfortunately, regardless of what measure is being used, there was very little evidence of significant industry outperformance in business cycle stages when they should perform according to conventional wisdom. Only five industries with significant outperformance in the stage where they should perform. The authors also implemented sector rotation by one month, two months and three months prior to NBER business turning points.

Defrizal et al. (2015) studied the determinant factors of sectoral stock return in bullish and bearish conditions within the Indonesian capital market by using Markov regime

switching models to identify bullish and bearish conditions based on Indonesian market stock returns.

Song and Qian (2017) investigated the relationship between sectoral stock returns over 10 sectors of the U.S. stock market (by Dow Jones Sectoral Indexes system) and the U.S. business cycle. To evaluate the behavior of sectoral stock return over the business cycles, they used a similar method as DeStefano (2004) for the identification of the stages in the business cycle by referencing NBER defined peak and trough dates. They then used the middle point of the time span, divided expansion into recovery and prosperity and divided contraction into recession and depression. After defining stages of business cycles, Song and Qian (2017) used four dummy variables corresponding to each stage of the business cycle and set up a regression model to investigate the varying performance of sectoral stock returns over business cycles as follows:

$$SR_{i,t} = c_{i1}D_1 + c_{i2}D_2 + c_{i3}D_3 + c_{i4}D_4 + \varepsilon_{i,t}$$

where SRi,t represents stock return of sector i at period t, D1 to D4 are dummy variables for the four stages of business cycle and ci are their relevant parameters.

The results found that in the recovery stage, positive and significant parameters were detected with finance, energy, industrial and consumer goods (ranked in order of magnitude of dummy variable coefficient respectively). In the prosperity stage, positive and significant parameters were detected with energy, basic materials, industrials and technology (ranked in order of magnitude of dummy variable coefficient respectively). In the recession stage, negative and significant parameters were detected with telecommunication and utilities (ranked in order of magnitude dummy variable coefficient respectively). In the depression stage, negative and significant parameters were detected with finance, industrials, energy, utility and U.S. whole market (ranked in order of magnitude of dummy variable coefficient respectively). Song and Qian (2017) concluded that it was very clear that the business cycle and sectoral stock returns have a close relationship.

Methodology

Data

The study period of this research was from January 2002 to December 2019. Data was analyzed on a monthly basis. The study started in January 2002 to align with the stock listing of PTT Public Company Limited (leading energy company in Thailand). The stock began trading in December 2001. PTT has the highest market capitalization in the Stock Exchange of Thailand (SET) therefore PTT data should be fully included in the analysis period. Studies in the literature have approached at the market level or industry level and not with the sectoral approach. Therefore this study aimed to analyze the sectoral level to provide an additional empirical contribution.

Many studies in the past used the Dow Jones Sectoral Indexes system for categorization of sectors in the stock market which divides the stock market into 10 sectors: consumer goods, financials, industrials, technology, utility, basic materials, consumer service, Health care, Oil & Gas and Telecommunication. This study uses 28 sectors from SET (listed in the Appendix). This has not been previously done.

We obtained the monthly data from Thomson Reuters Eikon Datastream starting from 2 January 2002 to 29 December 2019, providing 215 observations after adjustments for time-series analysis. There are 4 sectors with incomplete data due to SET recategorization during the study period which are Construction Services (data available from February 2014), Industrial Materials & Machinery (data available from August 2006), Property Fund (data available from April 2009) and Steel (data available from February 2014). For sectors with incomplete data, the analysis was made separately with its available data period.

Theory and Econometric Methodology

In the literature, stages of the business cycle are usually defined by expansion and contraction movement of aggregated economic activities using local maximum and local minimum turning points. This study elaborates on these previous studies by partitioning the expansion into recovery and expansion and dividing contraction into recession and depression. There were two methods used to divide recovery-expansion and contraction-depression stages. These included using the steady zero-growth line and the long-run average trend line together with identification of peak and trough. Zarnowitz (2007) and Alqaralleh (2019) used the long-run average trendline together with peak and trough to divide business cycle stages. However, this may not be practical for the investors who are not intentionally conducting research to construct a long-run average trendline as a purpose to assess the stages of business cycle.

Besides, the long-run average trendline is representative only for a particular period. The long-run average trendline changes over time with additional time-series data; therefore, comparing the business cycle stages between the different time-series data becomes problematic because the reference long-run average trendlines are different between each time-series data set. This study intends to prove more simplified practical methodology by using the steady zero-growth line instead of the long-run average trendline. Using the steady zero-growth line to divide the cyclical fluctuation of the business cycle proxy offers possibly a more practical method which could provide consistent staging of the business cycle along the chronological time series of the same economic proxy which makes comparison between the studies using different time periods possible. This method although never being proved in the academic literature has been mentioned in the investment community. This study aimed to prove whether the proposed method of using a steady zero-growth line together with local maxima (peak) and local minima (trough) to divide the business cycle into 4 stages is empirically valid and applicable as a standard methodology in defining business cycle stages.

With the proposed method, the business cycle is divided into 4 stages according to positive and negative change of real GDP along a steady zero-growth line together with local maxima (peak) and local minima (trough) over the study period.

Stage 1 Expansion stage (D_1 or D_{expand}) is defined as positive real GDP growth increasing apart from steady zero-growth line towards local maxima.

Stage 2 Recession stage (D_2 or D_{recess}) is defined as real GDP growth positive but declines from local maxima down towards steady zero-growth line.

Stage 3 Depression stage (D_3 or $D_{depress}$) is defined as declining negative real GDP growth path apart from steady zero-growth line towards local minima.

Stage 4 Recovery stage (D_4 or D_{recov}) is defined as real GDP growth negative but increasing apart from local minima up towards steady zero-growth line.

To identify the stages of the business cycle using a long-run average trend line, the business cycle is divided into 4 stages according to positive and negative change of real GDP along steady zero-growth line together with local maxima (peak) and local minima (trough) over the study period.

Stage 1 Expansion stage (D_1 or D_{expand}) is defined as real GDP growth rising above long-run average trendline until it reaches local maxima.

Stage 2 Recession stage (D_2 or D_{recess}) is defined as real GDP growth declining from local maxima towards a long-run average trendline.

Stage 3 Depression stage (D_3 or $D_{depress}$) is defined as declining of real GDP growth below long-run average trendline until it reaches local minima.

Stage 4 Recovery stage (D_4 or D_{recov}) is defined as real GDP growth increasing from local minima toward long-run average trendline.

The local maxima in this study are defined as the highest point of the output growth curve above the horizontal zero-growth line in the period between two points that the output growth curve crosses the horizontal zero-growth line (or the long-run average trend line). The local minima in this study are defined as the lowest point of the output growth curve below the horizontal zero-growth line in the period between two points that the output growth curve crosses the horizontal zero-growth line (or the long-run average trendline).

To figure out whether it is better to use a steady zero-growth line or a long-run average trend line to define the stages of a business cycle, a simple linear regression model from Song & Qian (2017) is applied using dummy variables of four stages of business cycle (recovery, prosperity, recession and depression) as follows:

$$SR_{i,t} = c_{i1}D_1 + c_{i2}D_2 + c_{i3}D_3 + c_{i4}D_4 + \varepsilon_{i,t}$$

Where SR_{it} is stock return of sector i at time t, D_1 D_2 D_3 D_4 are dummy variables for each stages of business cycle and ci are parameters of each stages accordingly.

Two regression model structures were applied to compare model specifications using dummy variables for the previously defined four business cycle stages from the different methods (using steady zero-growth line versus using long-run average trend line together with their related C_d parameters).

$$R_{i,t} = C_{i1}*D_{expand} + C_{i2}*D_{recess} + C_{i3}*D_{depress} + C_{i4}*D_{recov} \quad (1)$$

Where $R_{i,t}$ is stock return of sector i at time t, D_{expand} represents dummy variable for expansion stage, D_{recess} represents dummy variable for recession stage, $D_{depress}$ represents dummy variable for depression stage and D_{recov} represents dummy variable for recovery stage of business cycle and C_{i1}, C_{i2}, C_{i3}, C_{i4} are their respective coefficients.

$$R_{i,t} = C_{i1}*D_{expand\text{-}tl} + C_{i2}*D_{recess\text{-}tl} + C_{i3}*D_{depress\text{-}tl} + C_{i4}*D_{recov\text{-}tl} \quad (2)$$

Where $R_{i,t}$ is stock return of sector i at time t, $D_{expand\text{-}tl}$ represents dummy variable for expansion stage, $D_{recess\text{-}tl}$ represents dummy variable for recession stage, $D_{depress\text{-}tl}$ represents dummy variable for depression stage and $D_{recov\text{-}tl}$ represents dummy variable for recovery stage of business cycle using new method to define stages with long-run average trend line and C_{i1}, C_{i2}, C_{i3}, C_{i4} are their respective coefficients.

Data Analysis and Empirical Results

The analysis was conducted based on monthly data of market and sector returns from the Stock Exchange of Thailand extracted from Thomson Reuters Datastream from January 2002 to December 2019. The preliminary outlook for three proxies of the business cycle are elaborated as follows:

Preliminary Outlooks

The graphical illustrations are created to demonstrate cyclical movement patterns for 3 possible proxies of aggregated national economic activity which are real GDP growth, changes in Manufacturing Production Index (MPI) and changes in Coincident Economic Index (CEI) for Thailand from January 2002 to December 2019.

The real GDP growth, Year on Year (YoY) chart shows clear cyclical expansion and contraction with obvious peak and trough. It is therefore a good proxy for business cycle identification as shown in Figure 3.

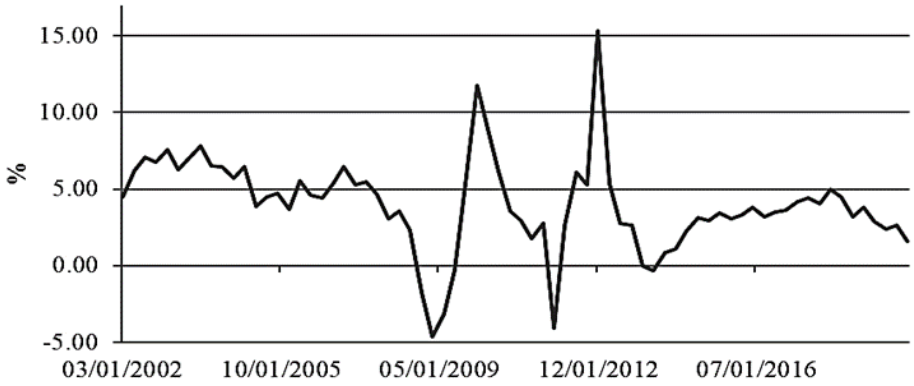

Figure 3 Cyclical Movement Pattern of Real GDP Growth (YoY: Quarterly: Seasonally Adjusted), Thailand, 2002 – 2019

Source: https://www.ceicdata.com/en/indicator/thailand/real-gdp-growth

However, this cyclical pattern is not clear when using Quarter on Quarter (QoQ) data as shown in Figure 4.

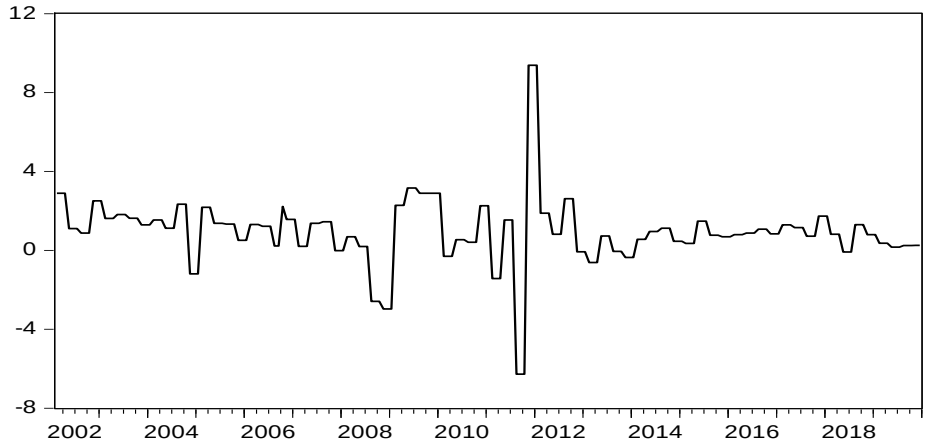

Figure 4 Real GDP Growth (QoQ), Thailand, 2002 – 2019

Source: Author's Calculation Based on Quarterly Data of Thailand Real GDP Growth from Bank of Thailand Statistical Database

The graphical illustration of changes in the Manufacturing Production Index (MPI), Month on Month (MoM), has an unclear cyclical stages pattern, especially from 2002-2007 and from 2013-2019. As shown in Figure 5, the MPI changes are pretty stable with minor fluctuations around the zero line without apparent expansion and contraction movement.

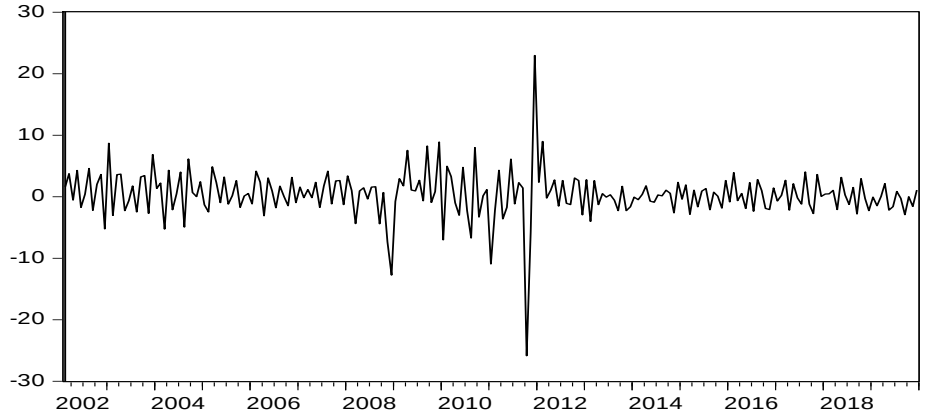

Figure 5 Changes in Manufacturing Production Index (MPI), MoM, Thailand

Source: Author's Calculation Based on Monthly Data of Thailand Manufacturing Production Index from Bank of Thailand Statistical Database

However, when using the Manufacturing Production Index (MPI) on the YoY (Year on Year) basis, the result clearly demonstrates cyclical movement together with peak and trough as compared with real GDP growth (YoY) in Figure 6.

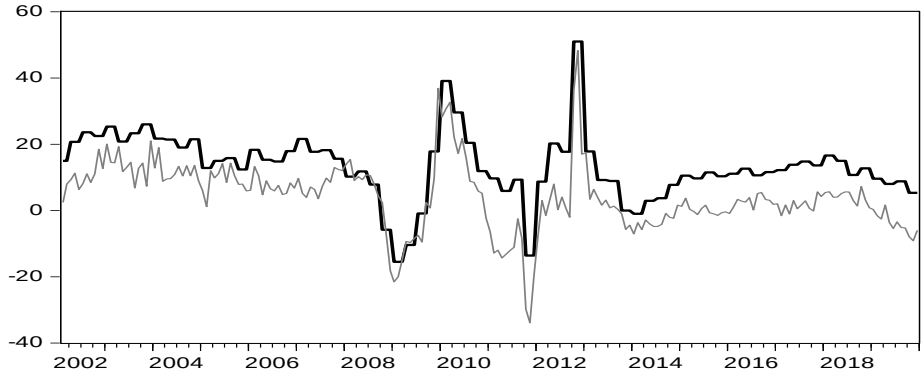

Figure 6 Manufacturing Production Index (MPI) Growth, YoY, Thailand (Thin line) Compared with Real GDP Growth, YoY, Thailand (Thick line)

Source: Author's Calculation Based on Thailand MPI and Real GDP Data from Bank of Thailand Statistical Database

The graphical illustration of the changes in Coincident Economic Index (CEI), Month on Month (MoM) data shows a downward slope pattern in a long-run trend. An expansion and contraction pattern is not clear from 2002-2008 as demonstrated in Figure 7.

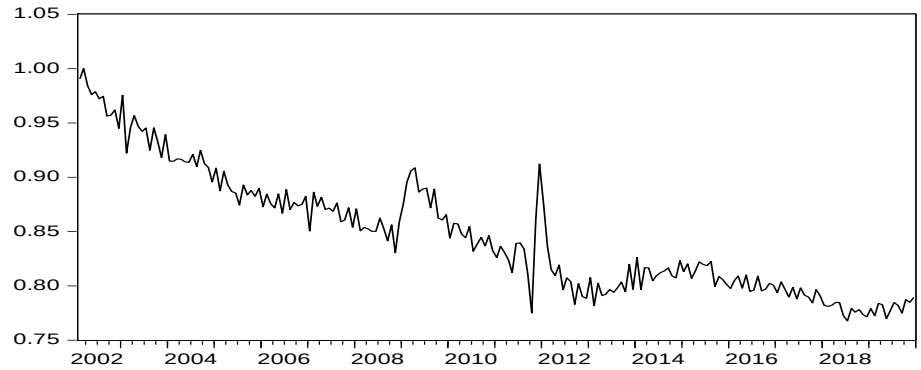

Figure 7 Changes in Coincident Economic Index (CEI), MoM

Source: Author's Calculation Based on Thailand Coincident Economic Index from Bank of Thailand Statistical Database

When using Year on Year (YoY) data, the changes in Coincident Economic Index (CEI) shows clear cyclical movement together with peak and trough as compared with real GDP growth (YoY) in Figure 8.

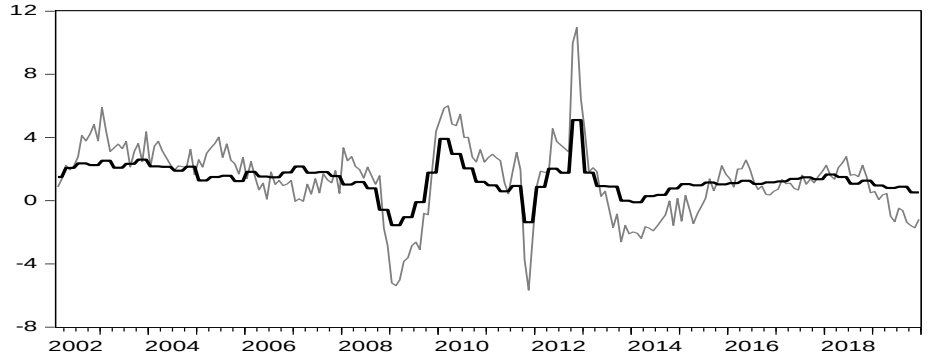

Figure 8 CEI, YoY, Thailand (Thin line) and real GDP growth, YoY, Thailand (Thick line)

Source: Author's Calculation Based on Thailand Coincident Economic Index and Real GDP from Bank of Thailand Statistical Database

Graphical comparison of all 3 output growth proxies (YoY) are demonstrated in Figure 9.

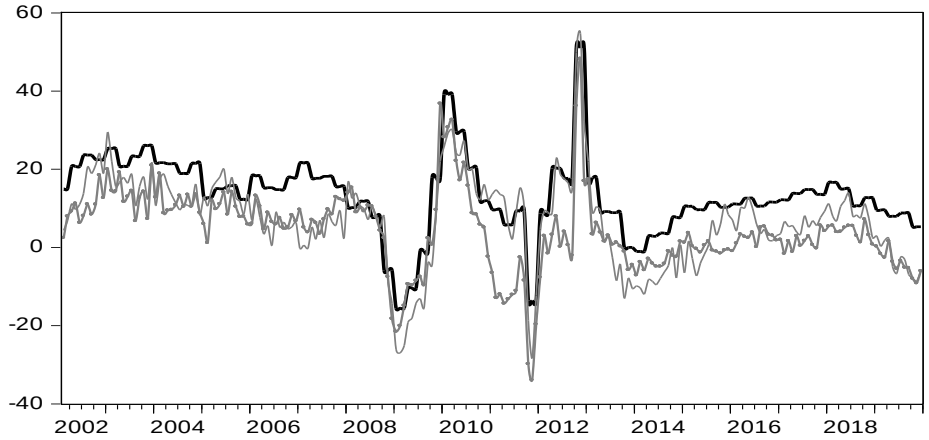

Figure 9 Three Proxies of Output Growth of Thailand for Business Cycle Identification which are Real GDP Growth, YoY (Thick line), MPI Growth, YoY (Medium line) and Growth of CEI, YoY (Thin line)

Source: Author's Calculation Based on Thailand Real GDP, MPI and CEI Data from Bank of Thailand Statistical Database and CEIC Database

This finding implies that whether one uses real GDP growth, Manufacturing Production Index (MPI) growth or a composite index like the Coincident Economic Index (CEI) as a proxy of real output growth for business cycle determination it will not matter because they offer similar peak and trough and cyclical movement where the cycles from each proxy are very close as demonstrated in Figure 9. Besides, the correlation coefficients between these three business cycle proxies were calculated. Real GDP growth has 84% correlation with MPI growth and has 86% correlation with CEI growth while MPI growth and

CEI growth have 81% correlation. However, it should be addressed that Year on Year (YoY) data is more preferred to Month on Month (MoM) or Quarter on Quarter (QoQ) growth data because YoY data produces much clearer cyclical movement pattern in the graphical illustration.

Comparison of peaks and troughs from the three business cycle proxies (real GDP growth, MPI growth, and CEI growth) and their deviations from peaks and troughs of the market returns (r_m) are demonstrated in Table 1.

Table 1 Comparison of the three business cycle proxies with equity market return

	real GDP growth	**MPI growth**	**CEI growth**	**Stock Market Return (r_m)**
Correlation with r_m	0.05	0.02	-0.004	N/A
Peak 1 (number of months deviated from peak of r_m)	Dec 2003 (0)	Dec 2003 (0)	Jan 2003 (11)	Dec 2003
Trough 1 (number of months deviated from trough of r_m)	Feb 2009 (4)	Feb 2009 (4)	Feb 2009 (4)	Oct 2008
Peak 2 (number of months deviated from peak of r_m)	Jan 2010 (9)	Dec 2009 (8)	Feb 2010 (10)	Apr 2009
Trough 2 (number of months deviated from trough of r_m)	Nov 2011 (2)	Nov 2011 (2)	Nov 2011 (2)	Sep 2011
Peak 3 (number of months deviated from peak of r_m)	Nov 2012 (4)	Nov 2012 (4)	Nov 2012 (4)	Feb 2012
Trough 3 (number of months deviated from trough of r_m)	Jan 2014 (5)	Jan 2014 (5)	Oct 2013 (2)	Aug 2013
Peak 4 (number of months deviated from peak of r_m)	Mar 2018 (4)	Oct 2018 (7)	Jun 2018 (1)	Jul 2018
Average months deviated from peak / trough of rm	4	4.29	4.86	N/A

Source: Author's Calculation Based on Market Returns Data of The Stock Exchange of Thailand from Thomson Reuters Datastream, Real GDP Growth data from CEIC Database , MPI and CEI data from Bank of Thailand Statistical Database

Comparison between the three business cycle proxies (real GDP growth, MPI growth and CEI growth) in Table 1 shows that real GDP growth has closest peak and trough with stock market return. Therefore, real GDP growth is the most suitable proxy of business cycle compared with MPI growth and CEI growth.

According to the plots, Real GDP growth of Thailand during the study period (January 2002 to December 2019) has the clearest cyclical fluctuation of expansion and contraction movement together with clearest turning point of movement compared with MPI and CEI. Therefore, this study selects real GDP growth rather than MPI growth or CEI growth due to smoothness of graph, its broader representation of aggregate economic activities of the country and in order to make similarity in business cycle proxy with other studies.

The Figure 9 shows that from 2008 – 2013, external shocks impact the economy rapidly, and recovery also occurred rapidly in a V-shape pattern as the graphical illustration shows the rapid drop in output growth during crisis periods and fast rebound pattern. This finding may be different from the past (before 2000). Two complete cycles occurred during these five years, which is an atypical finding and different from other periods in history. It is possibly explained by the overlapping U.S. subprime mortgage crisis (December 2007 – June 2009) and the European sovereign debt crisis (October 2008 – September 2012), creating two depressions within five years period. The rapid rebound is possibly explained by the series of Quantitative Easing (Q.E.) imposed by the U.S. Federal Reserve, causing money supply reflux to ease the economic crisis.

Under the Steady Zero-Growth Line method, local maxima are defined as the highest point of the output growth curve above the horizontal zero-growth line in the period between two points that the output growth curve crosses the horizontal zero-growth line. The local minima are defined as the lowest point of the output growth curve below the horizontal zero-growth line in the period between two points that the output growth curve crosses the horizontal zero-growth line.

The graphical illustration of business cycle stages in Thailand during 2002-2019 are demonstrated in Figure 10.

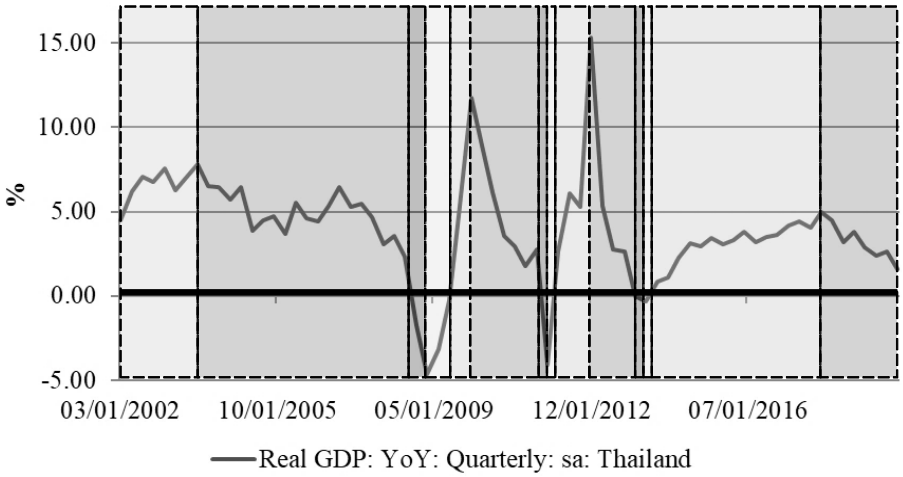

Figure 10 Stages of Business Cycle around Steady Zero-Growth Line in Thailand During Period 2002-2019 Using Real GDP Growth

Source: The Above Image is Modified from CEIC Graphical Illustration and Database.

Using Steady Zero-Growth Line method, we can identify peak and trough during the year 2008 – 2013. It occurred rapidly and created two complete short cycle spans within a 5-year period as previously mentioned. Thus, each stage of the business cycle is defined as in Table 2.

Table 2 Reference business cycle dates and stage partitions using steady zero-growth line

Expansion	Recession	Depression	Recovery
Jan 2002 – Mar 2003	Apr 2003 – Sep 2008	Oct 2008 – Mar 2009	Apr 2009 – Sep 2009
Oct 2009 – Mar 2010	Apr 2010 – Sep 2011	Oct 2011 – Nov 2011	Dec 2011 – Jan 2012
Feb 2012 – Dec 2012	Jan 2013 – Dec 2013	Jan 2014 – Mar 2014	
Apr 2014 – Mar 2018	Apr 2018 – Dec 2019		

The important global and local events which create positive and negative shocks to the economy of Thailand are summarized in Table 3.

Table 3 Global and Local Positive and Negative Shocks to the Economy of Thailand

	Shock to Economy	Defined Period
Negative Shocks	U.S. Subprime Mortgage Crisis	Dec 2007 – June 2009
	European Sovereign Debt Crisis	Oct 2008 – Sep 2012
	Bangkok Flood (Natural Disaster)	Aug 2011 – Dec 2011
Positive Shocks	U.S. Quantitative Easing (QE 1)	Nov 2008 – June 2010
	U.S. Quantitative Easing (QE 2)	Nov 2010 – June 2011
	U.S. Quantitative Easing (QE 3)	Sep 2012 – Oct 2014
	EU IMF Bailout Package	May 2010 – Dec 2010
	EU Stability Mechanism (ESM)	Dec 2010 – Dec 2017
	European Quantitative Easing	Jan 2013 – Dec 2019

Another method uses a long-run average trendline to help with the identification of stages in business cycle instead of using a steady zero-growth line. The long-run average trend line is generated from real GDP growth data using Microsoft Excel. The long-run average trend line of Thailand's real GDP growth from 2002-2019 shows a declining slope as demonstrated in Figure 11.

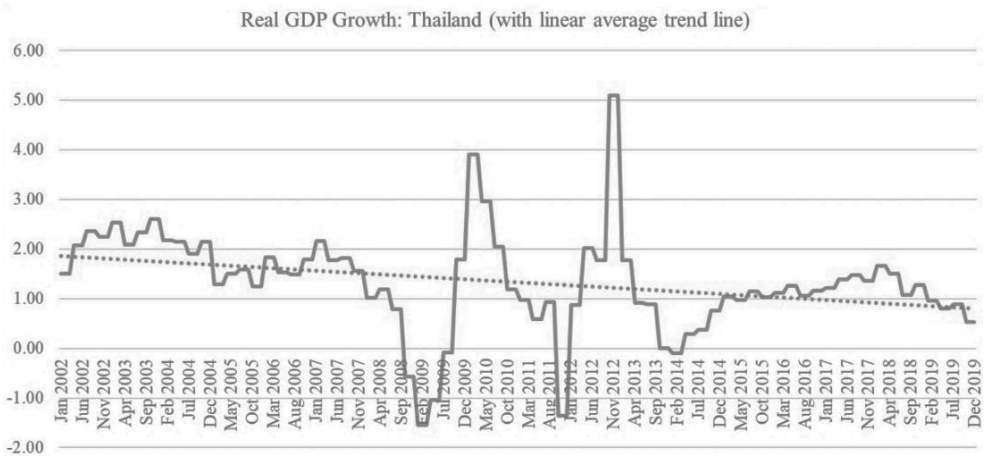

Figure 11 Stages of Business Cycle from Long-Run Average Trend Line (dotted line) in Thailand During Period 2002-2019 Using Real GDP Growth

Source: Author's Calculation Based on Thailand Real GDP Data from CEIC Database

Using the Long-Run Average Trend Line, each stage of the business cycle in Thailand from 2002-2019 is defined in table 4.

Table 4 Reference business cycle dates and stage partitions using long-run average trend line

Expansion (tl)	Recession (tl)	Depression (tl)	Recovery (tl)
Apr 2002 – Dec 2003	Jan 2004 – Dec 2004	Jan 2005 – Dec 2005	Jan 2002 – Mar 2002
Oct 2006 – Mar 2007	Apr 2007– Dec 2007	Jan 2008 – Mar 2009	Jan 2006 – Sep 2006
Oct 2009 – Mar 2010	Apr 2010 – Sep 2010	Oct 2010 – Dec 2011	Apr 2009 – Sep 2009
Apr 2012 – Dec 2012	Jan 2013 – Mar 2013	Apr 2013 – Mar 2014	Jan 2012 – Mar 2012
Apr 2016 – Mar 2018	Apr 2018 – Sep 2019	Oct 2019 – Dec 2019	Apr 2014– Mar 2016

Comparison of Model Specifications

The assumptions required for regression analysis have been tested. The histogram for the normality test showed that the residuals are normally distributed. The centered Variance Inflation Factors (VIF) values for each equation are less than 5, which implied no multicolinearity problem in the model. Durbin-Watson statistics revealed no first-order autocorrelation. A serial correlation LM test also revealed no higher-order autocorrelation up to the lag level suggested by the correlogram. The Breusch-Pagan-Godfrey test showed no heteroscedasticity problem, which implied homoscedasticity of the residuals. The model specifications between two regressions (the one which used steady zero-growth line to define stages of the business cycle and the other one which used long-run average trend line to define stages of business cycle) with Adjusted R-squared, F-statistic and Sum-Squared Residuals demonstrate as table 5. Monthly data from sectoral stock returns of the Stock Exchange of Thailand are being used in the model specification analysis.

Table 5 Model Comparison between Two Business Cycle Stages Identification Methods (Steady Zero-Growth Line vs Long-Run Average Trend Line)

Sector (Ri)	A model using steady zero-growth line to define business cycle stage dummies Ds			A model using long-run average trend line to define business cycle stage dummies Ds-tl		
	Adj R^2	F-Stat	SSR	Adj R^2	F-Stat	SSR
AGRI	**0.359071**	**29.41230**	**6497.283**	0.338265	28.34804	6582.811
AUTO	0.415763	39.07241	5509.607	**0.417343**	**39.32072**	**5494.707**
BANK	**0.748991**	**160.6397**	**2324.506**	0.742012	154.8739	2389.136
COMM	0.484278	51.23799	3339.159	**0.491456**	**52.70232**	**3292.681**
CONMAT	**0.704754**	**128.7051**	**2885.783**	0.701825	126.9251	2914.412
CONS	**0.439668**	**14.73151**	**1788.930**	0.427673	14.07690	1827.288
ETRON	**0.394773**	**35.89654**	**6930.397**	0.390036	35.21014	6984.633
ENERG	**0.694005**	**122.3397**	**3783.297**	0.692709	121.6021	3799.326
FASHION	**0.237364**	**17.65144**	**2098.102**	0.226430	16.65983	2128.185
FIN	**0.621451**	**88.82904**	**4520.065**	0.620899	88.62352	4526.648
FOOD	0.536492	62.92417	2625.261	**0.560056**	**69.10629**	**2491.800**
HELTH	**0.253790**	**19.19562**	**6644.299**	0.245595	18.41681	6717.267
HOME	0.320682	26.25545	6763.928	**0.330880**	**27.36989**	**6669.552**
ICT	**0.444259**	**43.76778**	**5645.589**	0.439052	42.87430	5698.477
IMM	**0.604511**	**62.14054**	**4433.602**	0.585837	57.58037	4642.940
INSUR	0.278324	21.63302	3447.068	**0.291116**	**22.97079**	**3385.967**
MEDIA	**0.542011**	**64.31503**	**4084.062**	0.533270	62.12732	4162.008
MINE	**0.232435**	**17.20094**	**23687.73**	0.230492	17.02491	23747.70
PKG	**0.329823**	**27.32966**	**8936.101**	0.328896	27.21934	8948.467
PERSON	0.053487	4.023232	1210.21	**0.054136**	**4.062047**	**12001.96**
PETRO	**0.618612**	**87.77692**	**7308.225**	0.616904	87.15163	7340.948
PF&REITs	**0.222967**	**10.18231**	**459.7904**	0.192269	8.617167	477.9552
PAPER	**0.070709**	**5.070762**	**14719.66**	0.059422	4.379890	14898.44
PROF	0.199311	14.31745	19529.46	**0.218448**	**15.95355**	**19062.69**
PROP	**0.727625**	**143.9206**	**3709.959**	0.724022	141.3563	3759.034
STEEL	**0.542162**	**32.38076**	**1801.710**	0.529468	30.85514	1850.485
TOURISM	0.324359	26.68401	4468.395	**0.343689**	**29.01622**	**4340.553**
TRANSP	**0.626047**	**90.56619**	**4757.166**	0.625038	90.18125	4770.000

Source: Author's Calculation Based on Monthly Sector Returns Data in The Stock Exchange of Thailand from Thomson Reuters Datastream

A better model specifications rate has been calculated in comparison between both methods considering the above three model specifications (Adjusted R^2, F-Stat and Sum Squared Residual). A better model specifications rate is calculated by number of sectors which the method provides better model specifications divided by total stock sectors being tested. Using steady zero-growth line provides better model specifications in 20 of total 28 sectors (Better model specifications rate = 20/28 or 71.43% while using long-run average trendline provides better model specifications in only 8 of total 28 sectors (Better model specifications rate = 8/28 or 28.57%).

Table 6 Comparative test of predictive accuracy rate between the two competing methods

	Using Steady Zero-Growth Line	**Using Long-Run Average Trend Line**
Accuracy Rate*	71.43% (better in 20 of 28 sectors)	28.57% (better in 8 of 28 sectors)

Note: Accuracy Rate = Number of Equity Sectors which the Method Provides Better Model Specifications (Adjusted R2, F-Stat, SSR) than the other Method Divided by Total Equity Sectors (28 Sectors for SET in this Study)

Source: Author's Calculation Based on Monthly Sector Return Data in The Stock Exchange of Thailand from Thomson Reuters Datastream

The regression results are close to each other whether using steady zero-growth line or long-run average trendline to identify the stages of business cycle. However, the regression model using steady zero-growth line provides slightly better regression model specification in overall sectors. Therefore, the results from this study reveal that the dummies of each stages of the business cycle obtained from steady zero-growth line method in business cycle stages identification can be used for further studies related to business cycle analysis.

Discussion

The objective of this study was to propose a simplified methodology that helps identify business cycles in Thailand. Determination of a business cycle requires repeatable cyclical pattern movements of aggregate economic activities with expansion and recession periods together with turning points, specifically, peak and trough. This study aimed to determine whether it is appropriate to use real GDP growth, Manufacturing Production Index (MPI) growth, or a composite index like the Coincident Economic Index (CEI) as a proxy of real output growth for business cycle determination. The results found that it does not matter which measure is used since they offer similar peak and trough. The recurring movement and the cycles are very close. The correlation coefficient also confirmed a high correlation between these 3 business cycle proxies where real GDP growth has 84 % correlation with

MPI growth and 86% correlation with CEI growth while MPI growth and CEI growth have 81 % correlation. Real GDP growth had the highest correlation and closest peaks and troughs with stock market return. Therefore, real GDP growth is more appropriate as a business cycle proxy in the equity investment context.

Despite manufacturing production can be a potential proxy of output growth of the economy which can be used in the business cycle determination, some have argued that manufacturing production or industrial production may not be a good predictor for a predominantly service economy. In Thailand, the service economy comprises 52.7% of GDP, while the agriculture and manufacturing sector comprises around 13.3% and 34% respectively (Koonnathamdee, 2013). Therefore, real GDP growth is being used as a proxy of the business cycle in this study. Using real GDP growth; therefore, may be the best option to avoid this issue for a service-based economy.

Regarding the growth metrics used, this study also found that Month on Month (MoM) or Quarter on Quarter (QoQ) output growth cannot be used for business cycle identification since these growth metrics provide an unclear cyclical movement pattern. Cyclical pattern of output growth is clearly demonstrated only in Year on Year (YoY) data regardless of any proxy used. Potential challenge in studying business cycle may occur if the output growth has minimal fluctuation which may cause difficulty in business cycle stages identification. Future studies should consider using a different Composite Economic Index as a proxy of business cycle identification.

Most of the previous literature has divided the business cycle into expansion and recession stage with peak and trough while some authors have elaborated by dividing expansion and recession into early expansion (recovery), late expansion, early recession and late recession (depression) using either a long-run average trend line or steady zero-growth line. For the study period (2002 - 2019), the real GDP growth of Thailand shows a declining long-run average trend line which is not expected from the theoretical perspective that real output growth should be positive in the long run. This study tested two regression models using the steady zero-growth line and long-run average trend line. It also separated the business cycle into 4 stages, namely expansion, recession, depression, and recovery.

Specifically, we used dummy variables to represent each stage of the business cycle and sectoral stock return including market return to determine which method would provide better regression model specifications. The results show that the model using a steady zero-growth line has better model specifications, measured by Adjusted R^2, F-statistics and Sum-Squared Residuals, compared to a model using long-run average trend line in defining business cycle stages. In addition, the steady zero-growth line is practical and easier to standardize and compare with other studies which vary in period of time and country of reference.

Theoretically, the long-run average trend line of real GDP growth should be expected to have an inclining upward slope reflecting long run increasing pattern of nation's aggregate economic activities through technological improvement and better productivity. However, it shows declining downward slope of long-run average trend line of real GDP growth in the study period for Thailand which contradicts the theoretical principle. With the better model specification test results and applicability in real practice, the business cycle stages in this study are defined by using the steady zero-growth line and the business cycle stages are specified as expansion, recession, depression and recovery according to movement of real GDP growth around steady zero-growth line and local maxima or local minima between steady zero-growth line crossing points.

This provides a practical and standardized method of business cycle stages determination which is applicable for any different period of time, different country and different GDP growth movement pattern. While commonly used methodology in the literature mostly depend on the U.S. stock market and NBER defined peak and trough dates, the methodology used in this study is more universal in practice and applicable for broader study conditions. The comparison of advantages and disadvantages between different methodology of business cycle stages identification are illustrated in Table 7.

Table 7 Summary discussion of pros and cons between different methodology of business cycle stages identification in literatures and this research work

Methodology in defining stages of business cycle	**Pros**	**Cons**
DeStefano (2014) and Song & Qian (2017)	• Peak and trough are defined by central agency (NBER) therefore similar to all studies using this method	• Applicable only for U.S. market study because NBER does not announce peak and trough date for other countries • Challenges in identifying middle points to divide half of expansion and contraction • No separation between stages of positive and negative output (GDP) growth

Table 7 Summary discussion of pros and cons between different methodology of business cycle stages identification in literatures and this research work (Continued)

Methodology in defining stages of business cycle	Pros	Cons
This Study	• Applicable to all markets, not only limited to U.S. • Simplified and standardized methodology using steady zero-growth line which clearly separate stages of positive output (GDP) growth and stages of negative output (GDP) growth then peak and trough are being identified by local maxima and local minima • More practical for applicability to investment because the accuracy test has been performed using sectoral stock returns data	May be a challenge when output growth is steady with minimal fluctuation around steady zero-growth line

Limitations of the Study

The methodology proposed in this study has never been published in any literature before as the authors aim to introduce a new simplified process for business cycle stages identification that is applicable for the investors. Therefore, the data of this method in the literature is limited.

In addition, the proof of methodology for this study was based on the data for Thailand, where the service sector comprises more than half of the GDP, and during the study period (2002-2019), the long-run average trendline for real GDP growth of Thailand was in a declined slope, so the contribution of this study may be limited to economies with a similar structure. Future studies may explore economies with different settings such as technology-based production and long-run incline slope or frontier economies with rapid GDP growth. Besides, the COVID-19 pandemic, which arose in the last quarter of 2019, has transformed economic structure and behavior, creating a new normal in business and lifestyles, which brought the opportunity for technology disruption; hence future research should provide more insights into this change. In this study, it was a peak period for the tourism economy in Thailand, possibly being disrupted with a new normal economy after

the COVID-19 pandemic. However, the pandemic has not ended when this article was written, so future research during the post-pandemic era will confirm whether a similar business cycle pattern in pre-pandemic period still exists or not.

Conclusion

This study provides a simplified methodology to identify the stages of the business cycle using Thailand data as a study case in the analysis. We concluded that Real GDP growth (YoY, Seasonally Adjusted) is the best proxy of the nation's aggregated economic activities for business cycle identification, especially for the service-based economy. Business cycle stages can be divided into the following; expansion, recession, depression, and recovery using a steady zero-growth line of the Real GDP growth. The proposed business cycle identification method is practical and applicable for investment analysis. The results from a case study using secondary data of sectoral stock returns from the Stock Exchange of Thailand presented in this paper supports accuracy of our proposed methodology.

Contributions of the Study

This study has proven a simplified method for business cycle stages identification which is consistent across time horizons using a steady zero-growth line of the Real GDP growth which enables similar business cycle stages comparison across different study periods as the horizontal steady zero-growth line will not change from time to time as for the long-run average trendline. The academic contribution of this study is the proposed simplified methodology which enables the studies using business cycle stages at different time spans to be comparable. Due to simplification, practicability, and applicability of the proposed methodology, it also contributes to investment analysis, business outlook, and economic evaluation.

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Appendix

List of 28 stock sectors in the Stock Exchange of Thailand (SET)

1) Agribusiness (.SETA, AGRI)
2) Automotive (.SETAU, AUTO)
3) Banking (.SETB, BANK)
4) Commerce (.SETC, COMM)
5) Construction Materials (.SETCO, CONMAT)
6) Construction Services (.SETCS, CONS)
7) Electrical Components (.SETEC, ETRON)
8) Energy and Utility (.SETEN, ENERG)
9) Fashion (.SETFA, FASHION)
10) Finance & Securities (.SETF, FIN)
11) Food and Beverages (.SETFB, FOOD)
12) Healthcare Services (.SETHC, HELTH)
13) Home and Office Products (.SETHM, HOME)
14) Information and Communication Technology (.SETIC, ICT)
15) Industrial Materials and Machinery (.SETIM, IMM)
16) Insurance (.SETIN, INSUR)
17) Media and Publishing (.SETMP, MEDIA)
18) Mining (.SETMN, MINE)
19) Packaging (.SETPK, PKG)
20) Paper and Printing Materials (.SETPA, PAPER)
21) Personal Product and Pharmaceuticals (.SETPS, PERSON)
22) Petrochemicals and Chemicals (.SETPT, PETRO)
23) Property Fund (.SETP, PF&REITs)
24) Professional Services (.SETPF, PROF)
25) Property Development (.SETPR, PROP)
26) Steel (.SETST, STEEL)
27) Tour and Leisure (.SETTO, TOURISM)
28) Transportation and Logistics (.SETTP, TRANS)