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Developing Leading Economic Indicators for Eastern Indonesian Economy

Membangun Leading Economic Indicator Untuk Ekonomi Kawasan Timur Indonesia

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Abstrak

Tujuan dari penelitian ini adalah untuk merumuskan dan menyusun indeks komposit dari variabel ekonomi terpilih sebagai indikator utama PDRB Kawasan Timur Indonesia, dan memberikan arah atau gambaran kondisi PDRB di masa depan, baik pada periode kontraksi maupun periode ekspansi, serta bila ada pembalikan arah. Penelitian ini menggunakan metodologi yang digunakan oleh OECD namun disesuaikan dengan kondisi di Indonesia dalam hal karakteristik unik pola musiman di Indonesia, yaitu musim yang bergerak seperti Tahun Baru Imlek dan Idul Fitri. Hasil penelitian ini menunjukkan bahwa gabungan leading indeks PDRB Kawasan Timur Indonesia telah dibangun dengan komponennya terdiri dari 24 variabel yang relevan dengan perekonomian di Kawasan Timut Indonesia. Indeks leading bergerak mendahului pertumbuhan ekonomi Kawasan Timur Indonesia, sehingga bisa digunakan untuk memberikan arah atau gambaran kondisi PDRB di masa depan.

Abstract

The objectives of this study are to formulate and compile the composite index of selected economic variables as leading indicators the GRDP of Eastern Indonesia, and provide direction or picture of GRDP condition in the future, whether it is in the period of contraction or expansion period, as well as when there is a reversal of direction. This study uses the methodology which was used by the OECD but to be adapted to the conditions in Indonesia in terms of the unique characteristics of seasonal patterns in Indonesia, namely the moving seasonal such as Lunar New Year and Eid Al-Fitr. The results of this study shows that the composite of leading index for GRDP of Eastern Indonesia has been built with its components consist of the 24 variables relevant to the economy of Eastern Indonesia. The index moves ahead of the economic growth of the eastern region of Indonesia, so it can be used to provide direction or picture of GRDP condition in the future.

1. INTRODUCTION

1.1. Background

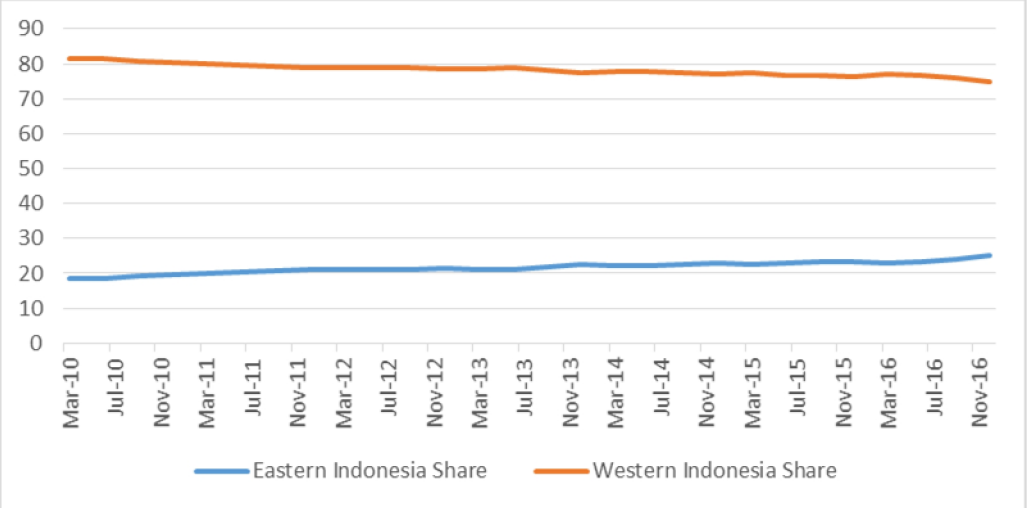
Equality of development between regions, especially villages, Eastern Indonesia and border areas, which is the main agenda of the government of Indonesia needs to continue to be pursued in order to build Indonesia from the periphery by strengthening the regions and villages within the framework of the unitary state. Eastern Indonesia covering provinces in the islands of Kalimantan, Sulawesi, Nusa Tenggara, Maluku and Papua certainly has a distinctive characteristic in its economy. The progress of economic development in the Eastern Indonesia region is measured from the average growth of Gross Regional Domestic Product (GRDP). The Eastern Indonesia is an economic region that grows quite rapidly compared to the Western Indonesia. During the period of Q1 2011 to Q4 2016, the Eastern Indonesia economy has an average quarterly growth of 9.7% (yoy) while the Western Indonesia only grows on average by 4.5% (yoy). However, the economy of Eastern Indonesia faces two challenges: the relatively unstable quarterly economic growth compared to Western Indonesia (see Figure 1) and the relatively lower economic portion of Eastern Indonesia compared to Western Indonesia where the share of Eastern Indonesia is only 22% of the national economy while the Western Indonesia is quite large at around 78% of the national economy (see Figure 2).

The economy of Eastern Indonesia is dominated by sectors in agriculture, forestry and fisheries, and mining and quarrying whereas other sectors such as manufacturing and services are still relatively small. The main commodities of Eastern Indonesia for exports are diverse. For example, Kalimantan's main commodities are CPO, rubber, oil & gas, coal, and forest products; Sulawesi's are rubber, nickel, and cocoa; Maluku's are fish, lobster, other fishery products and ore crush, metal ash; Papua's are copper, gold, cocoa, and coffee; and West Nusa Tenggara's are copper and pearl.

FIGURE-1: Eastern & Western Indonesia Quarterly Economic Growth (yoy)

Source: CEIC

FIGURE-2: Share of Indonesian Economy



Source: CEIC

The volatility of Eastern Indonesia's economic growth stems from both internal and external shocks that could disrupt efforts to sustain the progress of development in Eastern Indonesia. Shocks can cause economic volatility in the long term. These fluctuations will form a business cycle of economic ups and downs that are likely to reoccur in the future. Mistakes in anticipating shock can lead to government policy inaccuracy. Government policies taken at an improper time can lead to a lower economic growth potential or even a recession. In order to determine when the right time to issue a government policy in response to economic conditions would be hard to do given the difficulties in predicting economic conditions. Even macroeconomic indicators such as the GRDP by Badan Pusat Statistik (BPS), the Indonesian statistic agency, are published late from the time period of the data.

As a result of the difficulty of predicting the economy, an early, accurate comprehensive, flexible, and up-to-date detection tool by the Government for policy planning and formulation in the economic field is required. Early detection can be done through the forecast of future economic conditions through indicators that potentially determine the rise and fall of the economy. Therefore, in this study will be using business cycle model. With business cycle analysis, we will get the index of leading, coincidence, and lagging. With leading indicators, we can obtain information about the direction of the economy in the future, whether in the period of contraction or expansion period, and when the occurrence of reversal direction, and also as a reference for the Government in making policies and when the policy should be launched.

Nevertheless, the necessary policy-making related to GRDP through monitoring or surveillance of the its current condition cannot be timely due to the time lag in issuing GRDP data about one quarter. Therefore, in order to monitor and forecast the GRDP development immediately and from month to month, it is necessary to have indicators that move ahead with GRDP where the data of these indicators have existed before GRDP data published by BPS. Those indicators will be very useful if combined in the form of composite index and available in a fairly fast period (monthly) and of course the composite index must move ahead with GRDP. Therefore, a leading index should be developed in form of a composite index of current indicators that move ahead with GRDP.

1.2. Objectives

Using business cycle analysis, the objective of this study are:

1. Formulating and compiling the composite index of selected economic variables as leading indicators to give an early picture of the position and development of the economy.

2. Providing direction or picture of GRDP condition in the future, whether it is in the period of contraction or expansion, as well as when there is a reversal of direction.

Leading index is useful for the Government to anticipate the rise and fall of GRDP, so that appropriate policy and anticipatory measures can be taken in order to achieve the targeted economic growth . In addition the leading index can be used to forecast quarterly growth of GRDP with monthly available data before BPS announces its GRDP growth figures for the quarter.

1.3. Methodology and Data

This study uses a quantitative analysis approach that is analysis using business cycle method to determine leading indicators. This study uses monthly data by selecting macroeconomic variables (trade, price, monetary, fiscal, financial, and external and expectation reflecting variables) that move ahead with GRDP of Eastern Indonesia. The analyzed data are limited from January 2010 to December 2016. The secondary data sourced from the Ministry of Finance, BPS, Bank Indonesia, World Bank, International Monetary Fund (IMF), CEIC, Bloomberg, and the Fed. For more details related to the names of variables, units and data sources, can be seen in Table Appendix 1.

2. THEORETICAL REVIEW

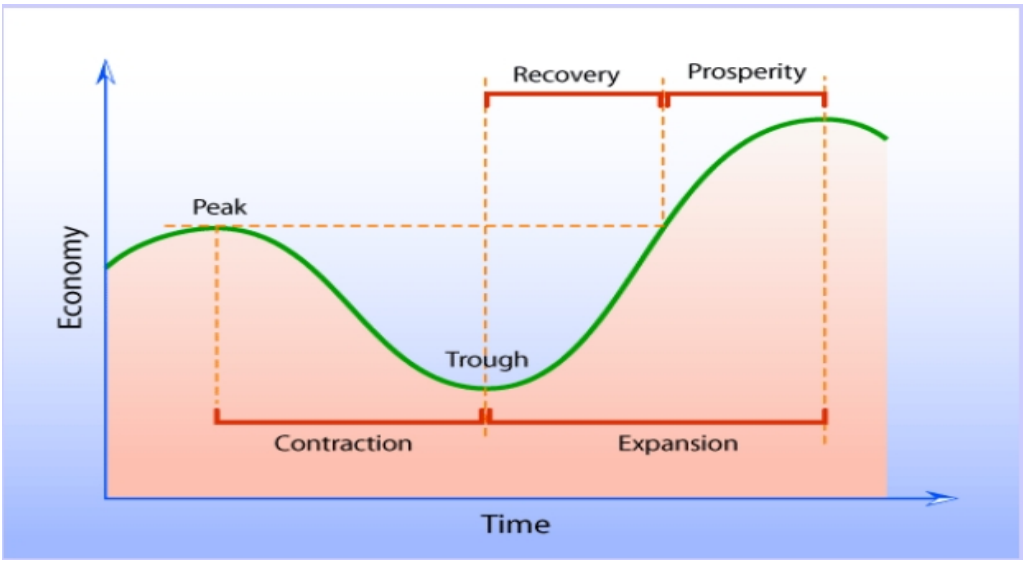
2.1 The Definition of Business Cycle

Burns and Mitchell (1946) define the business cycle as follows:

> *Business cycles are types of fluctuations found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansion 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 changes is recurrent but not periodic; in duration business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own.*

Thus it can be said that the business cycle is the ups and downs of the economy which very likely to recur in the future. The period of the economy in an ascending condition is called the period of expansion and the period of economic decline is called the period of contraction. The economic turning point from expansion to contraction condition is called peak and turning point of economy from contraction to expansion period is called trough (See Figure 3). The determination of a turning point uses the logarithms developed by Bry and Boschan (1971).

FIGURE-3: Business Cycle in the Economy



Source: Riyanto & Hendranata (2013) and Riyanto, et al. (2016)

Then, according to Enders (2015), any time series data can be decomposed into four components: trend, seasonal, cyclical and irregular components. This decomposition can also be applied to business cycles where trends are long-term and described as straight lines where their slopes are affected by long-term factors such as technology, fertility, immigration and education. Meanwhile, the business cycle is a deviation of long-term trends in which the business cycle does not occur at regular intervals. Research conducted by Barsky and Miron (1989) shows that seasonal fluctuations are an important source of variation in all macroeconomic quantity variables. Based on the period, there are two types of business cycles that are less than one year (seasonal cycle) and which is more than one year. According to Ledenyov & Ledenyov (2013) business cycle that occurs more than one year can be divided into:

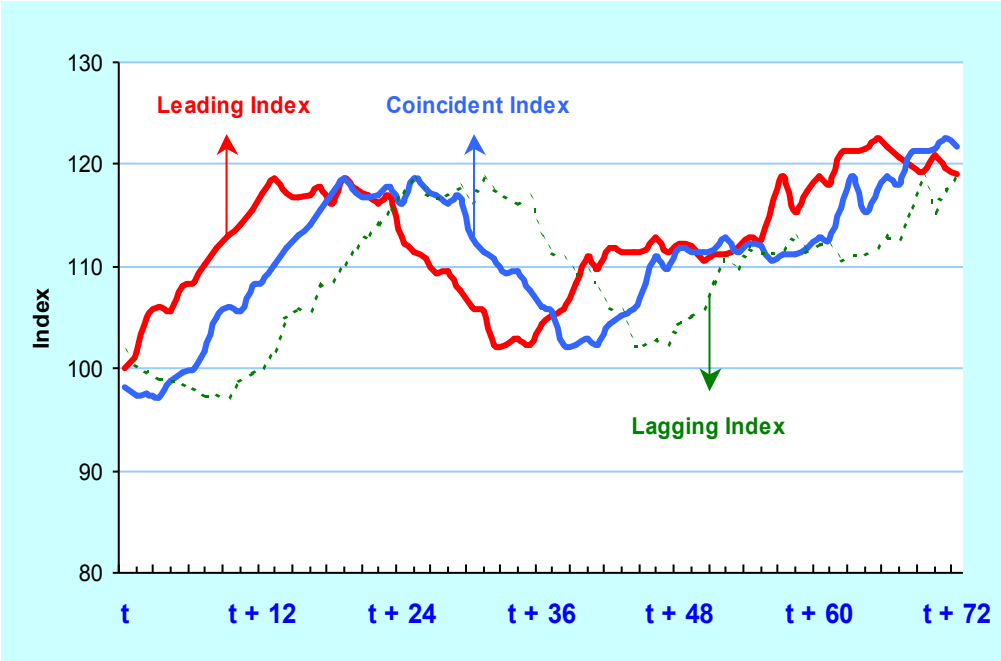
1. Kitchin inventory cycle, with a period of 3 to 7 years (Kitchin, 1923).
2. Juglar fixed investment cycle, with a period of 7-11 years.
3. Kuznets infrastructural investment cycle, with a period of 15-25 years.
4. Kondratieff long wave cycle, with a period of 45-60 years.

2.2 Composite Index

In the business cycle analysis, there are known three kinds of composite indexes, each of which is a combination of several variables. The three indexes are leading, coincident and lagging indexes. The leading index moves ahead of the coincident or reference series. Coincident index moves along with reference series. The Lagging Index follows the coincident or reference series (see Figures 4 and 5)

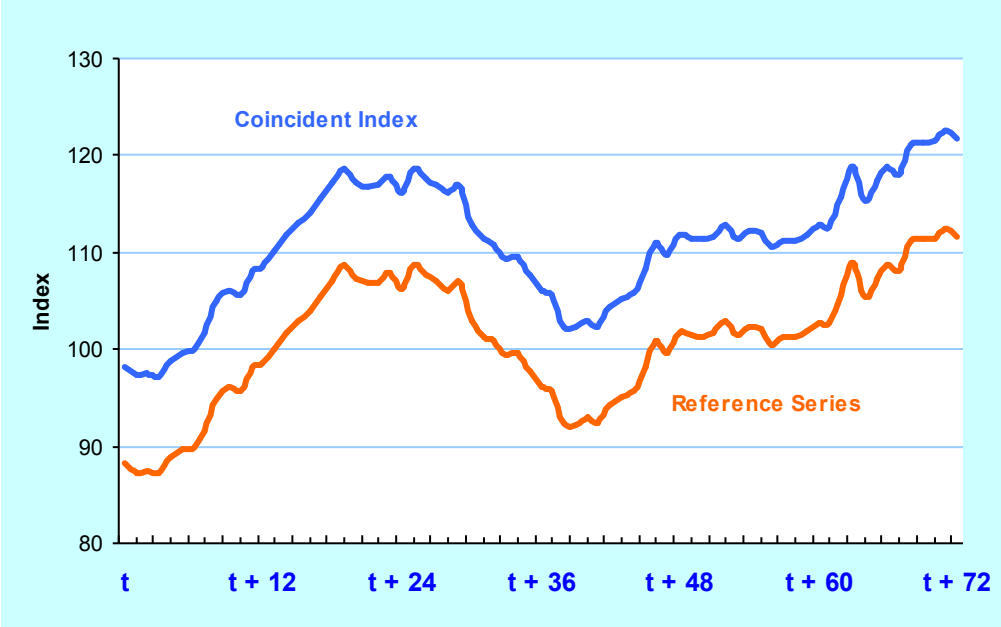
The leading index can provide early warning system on the direction of aggregate economic movements. Meanwhile, the coincident index can provide an overview of the current economic situation. The lagging index can confirm the movement of the two previous indices. The business cycle analysis is intended to accurately predict the reference series movement even though it is not in the form of mathematical equations as in the econometric model Riyanto & Hendranata (2013) and Riyanto, et al. (2016). The reference series are variables that can describe aggregate economic conditions such as GRDP, industrial production index, real money supply, and others.

FIGURE-4: Movement of Leading, Coincident and Lagging Index



Source: Riyanto & Hendranata (2013) and Riyanto, et al. (2016)

FIGURE-5: Concurrent Movement between Coincident Index and Reference Series



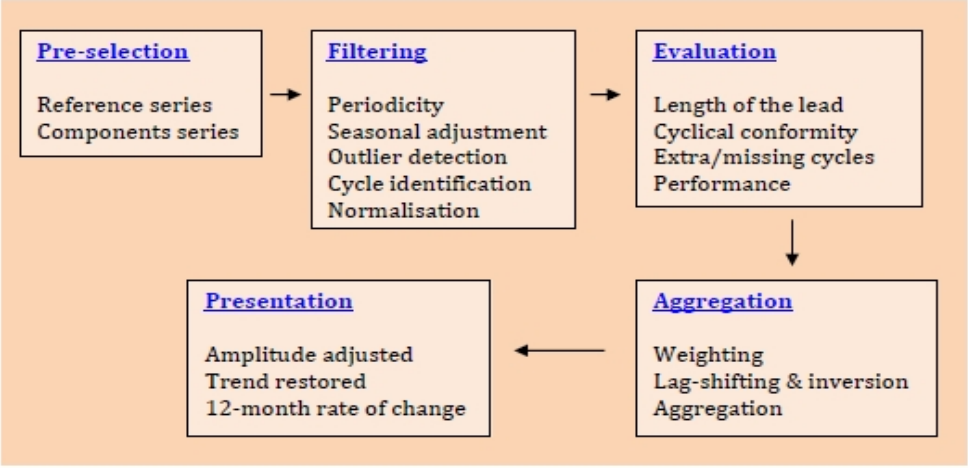
Source: Riyanto & Hendranata (2013) and Riyanto, et al. (2016).

2.3 OECD Composite Index

OECD (2012) has developed a leading composite index since the 1970s to provide early warning of turning point of economic activity. According to the OECD (2012), fluctuations in economic activity are measured by the variation in economic output relative to its long-term output potential. The difference between the realized potential and output is known as the output gap, and the fluctuation in the output gap is known as the business cycle.

In a country that has never experienced a recession, the business cycle index is always on the rise, the fluctuating is its growth. Therefore, the OECD's system of composite leading indicators often refer to the economic cycle as an economic condition that grows below the long-term trend if the economy experiences a slowdown in economic growth and economic conditions that grow above the long-term trend if the economy experiences higher economic growth. OECD conducts business cycle analyzes in OECD countries by compiling composite leading indicators (CLI) and coincident economic index (CEI) with the steps shown in Figure 6.

FIGURE-6: OECD Stages of CLI and CEI Preparation



Source: OECD (2012)

The OECD CLI is formed from time-series economic data that not only has the same cyclical fluctuations as the business cycle but also move ahead the business cycle (Riyanto & Hendranata, 2013). GRDP data is the right reference series to be converted to monthly considering the official publication of GRDP data is quarterly publication. Component series is a series of indicators that will be composite leading indicators. The selection process of the component series considers many short-term economic indicators (monthly) by considering several criteria as follows (OECD, 2012):

- Economic relevance i.e. there must be justification of economic relations between the component series and reference series and the selected component series are those that reflect the wide economic activity.
- Practical consideration such as:
  - Frequency: the data series is available in monthly data
  - Revision: the data series does not undergo significant revisions in the event of a revision
  - Timeliness: data is available immediately and quickly for updates
  - Length: data with a rather long series with no structural break is preferred

After the reference series and component series selection phase, the next step is the filtering stage that includes:

- Periodicity, since composite index compositions are done on a monthly basis, the quarterly component series must be converted to monthly.
- Seasonal adjustment, the seasonal component of the component series must be removed using X12 or TRAMO / SEATS methods.
- Outlier detection, component series that is outside the normal range should be adjusted with the TRAMO / SEATS method.
- Cycle identification, this section aims to identify the cycle pattern of the component series that requires the removal of long-term trends elements and noise on the data.
- Normalisation, because the component series is expressed in different units or scales it is necessary to normalize or equation of units.

Next stage is the evaluation stage which aims to see the performance of the selected component series in terms of conformity pattern of each component series cycle against the reference cycle pattern using statistical methods and econometrics. The result of this evaluation phase is the grouping of component series. The last stage is the aggregation stage which in essence is the stage of composing a composite index of several component series selected as coincidence indicator. The presentation stage is only related to how to present the composite index in accordance with the needs of the user.

3. RESEARCH METHOD

This research uses the composite index stage of leading composite as done by OECD (2012) by doing some modification.

3.1 Reference Series Determination

Reference series was chosen with the consideration that this variable can describe the economic conditions in aggregate, revised rarely, high frequency (monthly), and available enough long series. The reference series is:

1. GRDP of Eastern Indonesia data with quarterly data, so it needs to disaggregate into monthly data, using quadratic-match sum method on EViews.
2. The GRDP of Eastern Indonesia is the sum of GRDP of 17 provinces which includes West Kalimantan, Central Kalimantan, South Kalimantan, East Kalimantan, North Kalimantan, Southeast Sulawesi, North Sulawesi, Gorontalo, West Sulawesi, South Sulawesi, West Nusa Tenggara, East Nusa Tenggara, Maluku, North Maluku, West Papua and Papua.

3.2 Selection of Component series

The component series considered for the GRDP leading index in this study inter alia:

- The money supply, which increases the money supply, will lower interest rates which in turn will drive up investment.
- Retail sales such as cars and motorcycles, where these two indicators can show whether households have spent their money higher or lower than the months previous.
- Consumer loans that can reflect the availability of credit to consumers that may affect consumer spending patterns.
- Sales of cement, where cement is one of the important elements of construction of an infrastructure building so that the increase in cement sales can indicate an increase in investment.
- Import of capital goods i.e. goods used for more than one year and used to produce other goods or services such as machinery, equipment, vehicles, so that the increase in import of capital goods may indicate an increase in investment.
- Investment credit that reflects the availability of credit for investment purposes so that investment credit increase clearly indicates an increase in investment.
- Other economic variables that are theoretically related, such as electricity consumption, transfer to region and balanced fund in the state budget (APBN), consumption goods, imports, export, interest rates, inflation, international commodities prices.

3.3 Phase Filtering

Filtering is done by converting quarterly data into monthly data. In addition, historical data collected for long periods is not always available with a uniform observation frequency. Sometimes past data is available only yearly or quarterly, but along with the latest information technology developments, its available monthly. For this problem we need to observe the frequency of observation from yearly to monthly (interpolation) by using one of the following methods according to the data (Riyanto & Hendranata (2013) and Riyanto, et al. (2016)):

- Interpolation either linear, quadratic, or cubic.
- Chow-Lin, by first searching for a variable (monthly frequency) that moves 'in line' with the variable to be interpolated (annual or quarterly frequency) then estimate regression model & data interpolation.
- Spline is applied to data with quarterly series in order to obtain monthly data.

Fluctuations that occur in the past data are not entirely caused by the business cycle, but partly contributed by seasonal factors. In developed countries and some other developing countries this factor is fixed as Christmas and New Year. Meanwhile, in some developing countries, especially Indonesia, this factor is moving or not fixed, for example Eid Al-Fitr Day which is a seasonal move and Lunar New Year which is seasonal and not fixed. Retail sales in the US typically rise significantly during Christmas, a constant season factor, always repeating this month every year. Retail sales in Indonesia rose significantly during Eid Al-Fitr, the month varies from year to year. Retail sales in China rose significantly during Lunar New Year or Imlek (changing between January and February) (Riyanto & Hendranata (2013) and Riyanto, et al. (2016)). To handle the case of seasonal and non-permanent seasons, this study will use the Alper and Aruoba (2001) and Mongardini and Saadi-Sedik (2003) methods by generating dummy variables with the help of the Genhol† application program to be used on X13 -ARIMA. The influence of this season factor should be cleared of any variables that are leading, coincident, or lagging candidates in order to avoid misinterpretation.

† Genhol is a program that can generate seasonal moving weight to be used on the X-13ARIMA-SEATS program. This program can be downloaded at:
https://www.census.gov/srd/www/genhol/genhol_downloads.html

In contrast to OECD using X12 ARIMA in the seasonal adjustment stage, this study uses X-13 ARIMA method. At the filtering stage, OECD uses de-trending data or with cycle data and is indexed. While this study performed the following procedure (Riyanto & Hendranata (2013) and Riyanto, et al. (2016)):

- The result of the seasonal adjustment named Y_SA (Y_11) = T x C x E (which still has elements of Trends (T), Cycles (C) and random error (E), then discarded component errors and outliers, Obtained Y_12 = T x C (which only element Trends and Cycles);
- Y_12 data is indexed using MAD (Mean absolute deviation) and named Y_TDX series with the following formula:

$$Y\_TDX = \frac{y_{TxC,i} - \bar{y}_{TxC}}{\sum_{i=1}^{t} \frac{\left| y_{TxC,i} - \bar{y}_{TxC} \right|}{t}} + 100$$

- Next, Y_12 is done de-trending with Hodrick Prescott Filter to take cycle, so that Y_C is obtained (cycle component only).
- Y_C data is normalized with MAD and named Y_NDX by using the following formula:

$$Y\_NDX = \frac{y_{C,i} - \bar{y}_{C}}{\sum_{i=1}^{t} \frac{\left| y_{C,i} - \bar{y}_{C} \right|}{t}} + 100$$

The above stages are done for all 59 variables.

3.4 Evaluation Stage

Grouping a variable into a leading, coincident, or lagging indicator is performed by conducting the following analysis: first, a literature study to gather best practice information in another country, for example by looking at studies conducted by Stock and Watson (1989) and Levanon at al. (2011) as well as those conducted domestically such as Setiana (2006) and Nasution (2013).

Study conducted by Stock and Watson (1989) shows that leading economic indicator for the United States (U.S.) economy can be built using seven component series: Treasury bond yield spread, interest rate spread, change in the 10-year Treasury bond yield, trade-weighted nominal exchange rate, part-time work in nonagricultural industries, housing authorization, and manufacturers' unfilled orders. Levanon at al.,2011 develop Conference Board Leading Economic Index for the U.S. using the following component series: weekly claims, yield spread, housing permits, S&P500, orders for consumer goods, orders for capital goods, weekly hours, Michigan consumer expectations, real M2, and supplier delivery. Component series which become leading indicator for Indonesian Gross Domestic Product (GDP) according to Setiana (2006) are money supply (M1), exchange rate, stock price index, non oil and gas import, consumer goods import, import, nickel production, raw material import, and plywood export. According to Nasution (2013), the components of leading index for Indonesian economy are building permits, number of foreign tourist arrivals, foreign investment approvals, real effective exchange rate, stock price index, total real exports, and Consumer Price Index (CPI).

Second, perform cointegration test of each component series with reference series, and finally confirm the component series with reference series. Data are not tested for stationarity because only data which cointegrated with gross regional domestic product (GRDP) of Eastern Indonesia which enter the next test to be included in the leading index. According to Thomas (2006), Verbeek (2004) and Wooldridge (2006), the data is not required to be stationary to be included in the cointegration test because cointegration is a long-term relationship between the variables although individually not stationary but the linear combination between these variables can be stationary.

The confirmation of component series with reference series can be done through the graphical method between the reference series with each indicator or variable i.e. by visually visible although this method is sometimes less objective. Another way is by analyzing the cross correlation between the reference series with each indicator and test it with Granger Causality with vector autoregression (VAR). At the evaluation stage for grouping into the leading index, this study uses an analysis of Y_TDX data (index data of existing trend and cycle components) and Y_NDX (index data with only cycle components).

3.5 Aggregation Stage

After obtaining an indicator group that includes leading, then the next step is aggregation, i.e. create a leading composite index. Along with the development of econometrics, aggregation method of business cycle index also experienced many developments. Some methods are used among others (Riyanto & Hendranata (2013) and Riyanto et al. (2016)):

- Simple average method, where each indicator has the same weight.
- The weighted average method, in which each indicator is considered to have different weights in the preparation of the business cycle index. Weighing is done by a relatively simple method.
- Regression method, where the composite coincident and leading index is the fitted value of the model.
- Principal component method or factor analysis.
- Kalman Filter Method, Neural Networks, and others.

This study will use a simple average method with the assumption that each indicator has the same weight.

4. RESULT AND DISCUSSION

4.1 Result of Construction of Composite Leading Index

Business cycle analysis begins by separating the seasonal components contained in the data. The method used is X13-ARIMA and seasonally filtered are seasonal fixed or seasonal moves that are seasonal due to Eid Al-Fitr and seasonal influences due to Lunar New Year (Imlek) influence. After going through a series of best model searches involving procedures in the Genhol program to handle seasonal moves, Table Appendix 2 presents the ARIMA X13 model for seasonal filters contained in each data.

Reading the ARIMA X13 summary results from Table Appendix 2 can be explained by model example of core inflation variables (INF_CORE) with ARIMA X13 model (0,1,1) (0,1,1) with seasonal Lunar New Year – Imlek (-30, -1,1 , 30) and Eid Al-Fitr (-35, -3,3 , 35). This model can be interpreted that for the core inflation variable ARIMA model (0,1,1) with a fixed seasonal with Seasonal ARIMA (0,1,1) and there are seasonal influences of Imlek and Eid Al-Fitr.

The seasonal Imlek (-30, -1,1 , 30) means that the holiday effects for Imlek are 30 days to 1 days before the Imlek holiday, between from 1 days before to 1 days after Imlek and from 1 to 30 days after Imlek holiday effects. The impact of Imlek is only statistically significant at 5% on before Imlek.

The seasonal Eid Al-Fitr (-35, -3,3 , 35) means that the holiday effects for Eid Al-Fitr are 35 days to 3 days before the Eid Al-Fitr holiday, between from 3 days before to 3 days after Eid Al-Fitr and from 3 to 35 days after Eid Al-Fitr. The impact of Eid Al-Fitr is statistically significant at 5% on before, between and after Eid Al-Fitr.

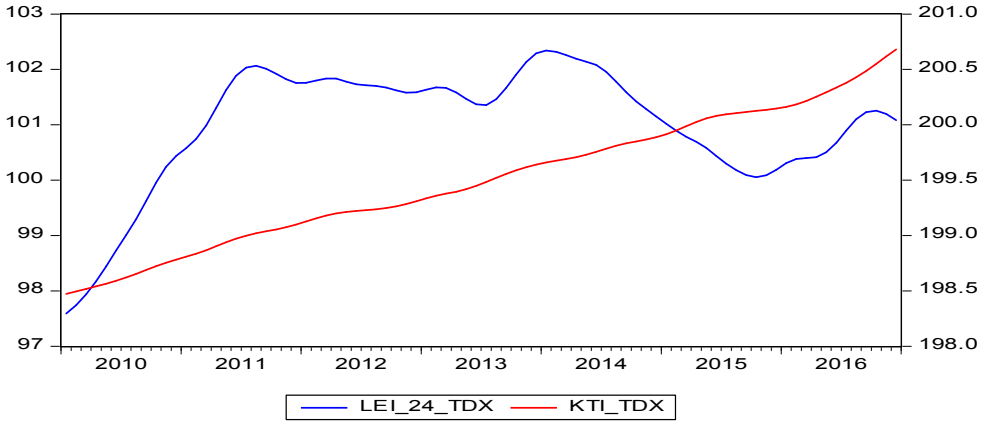
After forming Y_TDX (index of each component series containing trends and cycles) and Y_NDX (index of each compenent series containing only cycles), the next step is to choose a variable that can be used as a leading index of GDRP of Eastern Indonesia. The selection is done by analyzing the Y_TDX data (an index that still contains trends and cycles). And then we group the component series into leading indicators, coincident indicators or lagging indicators. Grouping is

done by using cointegration test, granger causalty test using series containing trend and cycle i.e. the Y_TDX or variablename_tdx. Granger causality tests were performed using the VAR (p) model by selecting the optimal p. The selection is also done by looking at the movement pattern of the component series cycle (eg: INF_CORE_NDX) with reference series (KTI_NDX). The results of this selection process are summarized in Table Appendix 3. From this process we obtained 24 component series as candidate of Composite of Leading indicators (CLI). Furthermore, the 24 component series are aggregated using simple averages, so that the composite leading indicators named LEI_24_TDX are compiled by the following component series:

LEI_24_TDX =(cocoa_tdx +expmigas_tdx +export_tdx +exrus_tdx + ffr_tdx + gold_tdx +ihsg_tdx +ikk_tdx +impcap_tdx +impmigas_tdx +impnonmigas_tdx + import_tdx + inf_core_tdx +inflasihk_tdx+ jii_tdx +kk_tdx+ libor12_tdx+lift_gas_tdx+m2_tdx+ntn_tdx+plywood_tdx+retail_tdx+ salmon_tdx+sbkmk_tdx)/24

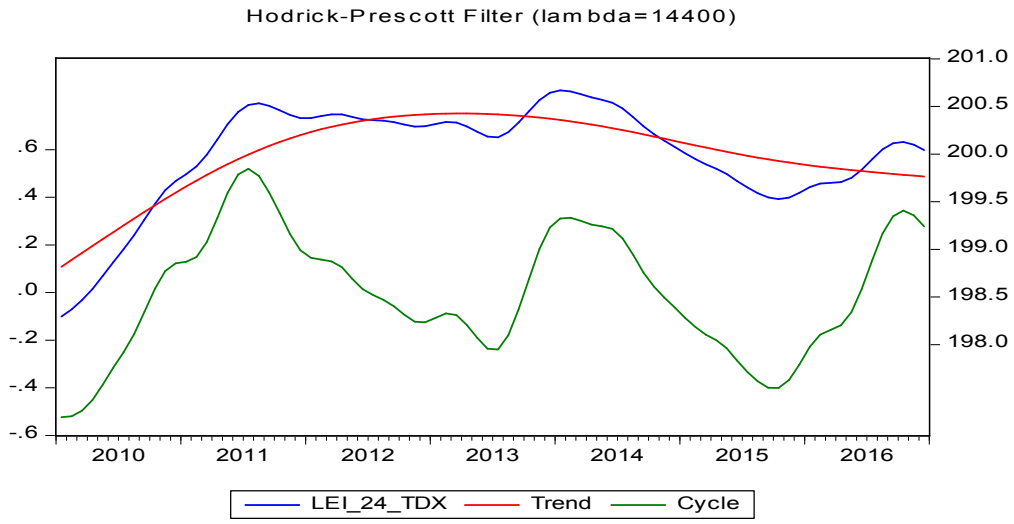
Next LEI_24_TDX, in detrending using Hodrick-Prescott (HP) Filter so obtained LEI_24_C (as growth cycle) and growth cycle is indexed with MAD plus 100, so obtained LEI_24_NDX (growth cycle indexed). The results are shown in Figure 7, Figure 8, and Figure 9.

FIGURE-7 : Composite Leading Indicator LEI_24_TDX and KTI_TDX



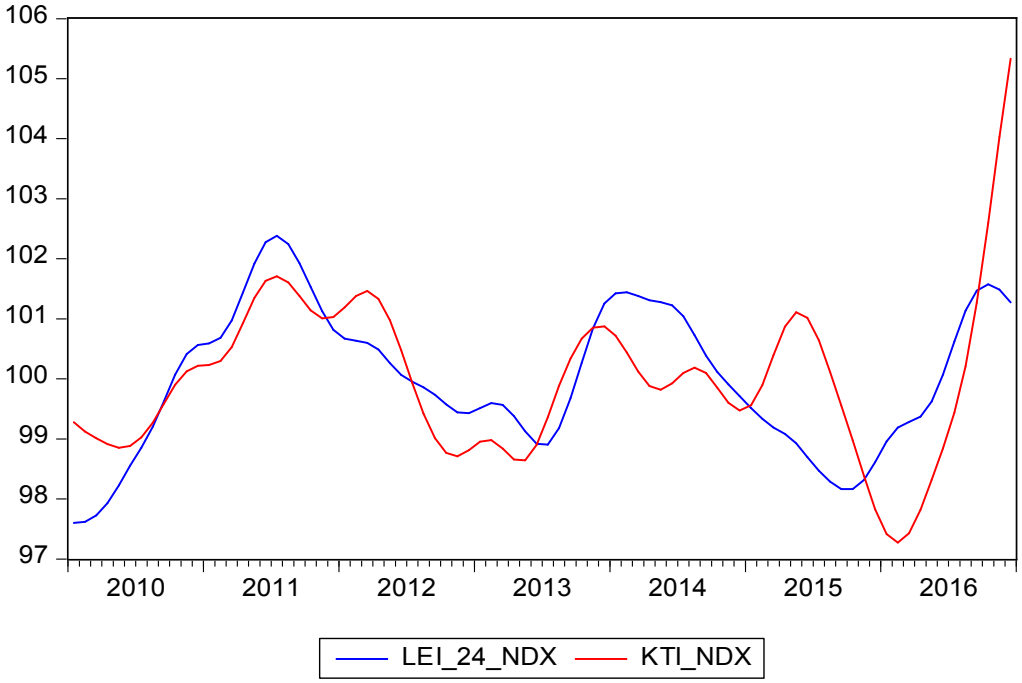
Source: EViews 9 output

FIGURE-8 : Hodrick-Prescott (HP) Filter Composite Leading indicators LEI_24_TDX



Source: EViews 9 output

FIGURE-9 : Cycle of Composite Leading indicators LEI_24_NDX dan KTI_NDX



Source: EViews 9 output

The test results with the granger causality test show that between LEI_24_TDX and KTI_TDX apply the relationship (see Table 1) proving that the index can be used as a leading indicator for KTI_TDX with lag = 12 (12 months moving ahead).

TABLE-1: Granger Causality Test Results between LEI_24_TDX and KTI_TDX

VAR Granger Causality/Block Exogeneity Wald Tests
Sample: 2010M01 2016M12
Included observations: 72

Dependent variable: LEI_24_TDX

Excluded	Chi-sq	df	Prob.
KTI_TDX	7.038825	12	0.8550
All	7.038825	12	0.8550

Dependent variable: KTI_TDX

Excluded	Chi-sq	df	Prob.
LEI_24_TDX	63.33828	12	0.0000
All	63.33828	12	0.0000

Source: EViews 9 output

The result of test with granger causality test also that LEI_24_NDX affect KTI_TDX (see Table 2) proving that the index can be used as a leading indicator for KTI_NDX with lag = 12 (12 months moving ahead). However, visually there are some periods that LEI_24_NDX does not move ahead of KTI_NDX as shown in Figure 9.

TABLE-2: Granger Causality Test Results between LEI_24_NDX and KTI_NDX

VAR Granger Causality/Block Exogeneity Wald Tests
Sample: 2010M01 2016M12
Included observations: 72

Dependent variable: LEI_24_NDX

Excluded	Chi-sq	df	Prob.
KTI_NDX	3.890327	12	0.9853
All	3.890327	12	0.9853

Dependent variable: KTI_NDX

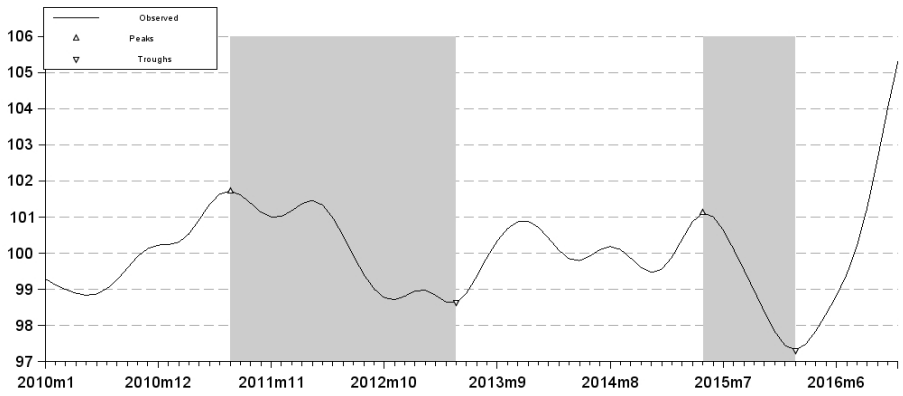
Excluded	Chi-sq	df	Prob.
LEI_24_NDX	41.25503	12	0.0000
All	41.25503	12	0.0000

Source: EViews 9 output

4.2 Peak/Trough Detection

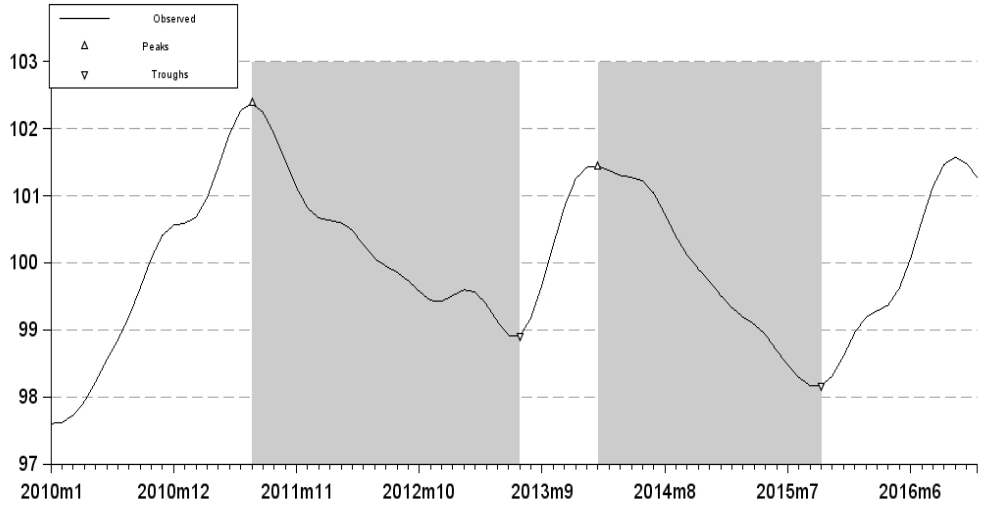
Peak and trough detection of KTI_NDX and LEI_24_NDX data was performed using Bry-Boschan algorithm using Scilab program. The results are given in Figure 10 and Figure 11. The peak and trough identification results show that the economic of Eastern Indonesia (KTI_NDX) during period of January 2010 – December 2016 has two peaks (July 2011 & May 2015) and two troughs (May 2013 & February 2016). The leading indicator (LEI_24_NDX) also has two peaks (July 2011 & February 2014) and two troughs (July 2013 & October 2015). The first peak has the same date as KTI_NDX while the second peak is 15 months ahead of KTI_NDX. Meanwhile, the first trough 2 months behind the KTI_NDX compared to the second trough 4 months ahead of KTI_NDX.

FIGURE-10: Determination of KTI_NDX Turning Points with Bry-Boschan Algorithm



Source: Scilab 6.0.0

FIGURE-11: Determination of LEI_24_NDX Turning Points with Bry-Boschan Algorithm



Source: Scilab 6.0.0

4.3 Utilization of Leading Composite Index

After obtaining the leading index for GRDP of Eastern Indonesia, then the index can be used to monitor the growth of GRDP of Eastern Indonesia by monitoring the movement of indicators/variables that make up the index. Monitoring the development of GRDP of Eastern Indonesia is done by first observing the movement of the 24 indicators of GRDP of Eastern Indonesia leading index. To be able to see the movement, the data of the 24 indicators must be updated every month when the publication data is available. Sometimes due to no update, some data still use estimated data using the assumption that the indicator grows monthly with the previous year's growth or growing at the same rate as the previous year.

In analyzing indicators of that make up leading index it is necessary to note the following seasonal factors. Approaching the fasting month and Eid Al-Fitr, the sale of certain goods will increase. Meanwhile, when approaching the new school year, households will allocate income for school fees (new school academic year) and reduce the purchase of durable goods due to other more necessary needs and limited income. In addition, M2 development data (as a reflection of money circulating in the community) is expected to rise higher, due to disbursement of the 13th and 14th monthly salaries for civil servants. This is expected to encourage consumption through household spending (World Bank 2016).

5. CONCLUSIONS AND RECOMMENDATIONS

Some important things that can be inferred from the analysis are:

1. Leading index for GRDP of Eastern Indonesia is very useful for decision makers because it can provide information promptly about the movement of GRDP of Eastern Indonesia.
2. Using the OECD approach with slight modifications, this study found that there are 24 indicators that can be used as a composer of GRDP of Eastern Indonesia leading index. The 24 indicators are cycled and aggregated into LEI_24_NDX.
3. The 24 indicators include broad macroeconomic variables that include production, trade, price, monetary, financial and external variables. However, fiscal variables are not leading variables but lagging variables.
4. The index moves ahead of the economic growth of the eastern region of Indonesia, so it can be used to estimate the economic growth of the eastern region of Indonesia at the time being observed.

Recommendations for future improvements are:

1. In order to leading index of GRDP of Eastern Indonesia to be useful for the purpose of better monitoring and projecting the development of GRDP of Eastern Indonesia, the data and variables or indicators that make up the index should be updated periodically by using the latest data.
2. After developing leading indicator for the aggregate of Eastern Indonesia (GRDP), the next step is to develop leading indicators for the two major components of GRDP: consumption and investment.
3. If the availability of local data is easier to obtain then it is necessary to develop leading indicators prepared by using more local data that reflect the economic characteristics of a particular region.
4. To monitor and confirm the economic growth of Eastern Indonesia, a coincident index of GRDP of Eastern Indonesia should be developed so that it can assist in monitoring and confirming economic growth more accurately.

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APPENDIX

TABLE APPENDIX-1: Variables Used in the Analysis

No.	Variable Name	Unit	Source
1	ALUMINUM (Aluminum Price)	$/mt	World Bank
2	BALFUND (Balanced Fund)	Rp trillion	MoF
3	CADEV (Reserves)	$ million	Bank Indonesia
4	CAR (Car Sales)	Unit	CEIC
5	CEMENT (Cement Consumption)	Ton Thousand	CEIC
6	COAL (Coal Price)	$/mt	World Bank
7	COCOA (Cocoa Price)	$/kg	World Bank
8	COPPER (Copper Price)	$/mt	World Bank
9	EXPMIGAS (Oil & Gas Export)	$ million	CEIC/BPS
10	EXPNONMIGAS (Non Oil & Gas Export)	$ million	CEIC/BPS
11	EXPORT (Total Export)	$ million	CEIC/BPS
12	EXRUS (Exchange Rate US$/Rp)	Rp	CEIC/BPS
13	FFR (Fed Fund Rate)	%	Bloomberg
14	GKG (Dried Grain Milled Price)	Rp/kg	BPS
15	GOLD (Gold Price)	$/troy oz	World Bank
16	ICP (Indonesian Crude Oil Price)	$/barrel	ESDM
17	IHSG (Jakarta Composite Index)	Index	Bloomberg
18	IKK (Consumer Confidence Index)	Index	Bank Indonesia
19	IMPCAP (Capital Goods Import)	$ million	CEIC/BPS
20	IMPCONS (Consumption Goods Import)	$ million	CEIC/BPS
21	IMPMIGAS (Oil & Gas Import)	$ million	CEIC/BPS
22	IMPNONMIGAS (Non Oil & Gas Import)	$ million	CEIC/BPS
23	IMPORT (Total Import)	$ million	CEIC/BPS
24	IMPRAW (Raw Material Import)	$ million	CEIC/BPS
25	INF_CORE (Core Inflation)	%	BPS
26	INF_VOL (Volatile Inflation)	%	BPS
27	INFLASIHK (Head Line Inflation)	%	BPS
28	IRON (Iron Ore Price)	$/dmtu	World Bank
29	JII (Jakarta Islamic Index)	Index	Bloomberg
30	KI (Bank Loan for Investment)	Rp trillion	Bank Indonesia
31	KK (Bank Loan for Consumption)	Rp trillion	Bank Indonesia
32	KMK (Bank Loan for Working Capital)	Rp trillion	Bank Indonesia
33	KOPI (Coffee Price)	$/kg	World Bank
34	LIBOR12 (LIBOR 12 month)	%	Bloomberg
35	LIFT_GAS (Gas Lifting)	Barrel	ESDM
36	LIFT_MIGAS (Oil & Gas Lifting)	Barrel	ESDM
37	LIFT_OIL (Oil Lifting)	Barrel	ESDM
38	LISTRIK (Electricity Consumption)	KWh million	CEIC/PLN
39	LNG (Liquefied natural gas Price)	$/mmbtu	World Bank
40	LQ45 (Jakarta Stock 45 Index)	Index	Bloomberg
41	M1 (M1 Money Supply)	Rp trillion	Bank Indonesia
42	M2 (M2 Money Supply)	Rp trillion	Bank Indonesia
43	MOTOR (Motorcycle Sales)	Unit	CEIC

No.	Variable Name	Unit	Source
44	NICKEL (Nickel Price)	$/mt	World Bank
45	NTN (Fisherman Terms of Trade)	Index	BPS
46	NTP (Farmer Terms of Trade)	Index	BPS
47	OIL (Crude Oil Price Average of Brent, WTI and	$/barrel	World Bank
48	PALMOIL (Palm Oil Price)	$/mt	World Bank
49	PLYWOOD (Plywood Price)	cents/sheet	World Bank
50	RETAIL (Retail Sales Index)	Index	CEIC
51	RUBBER (Rubber Price)	$/kg	World Bank
52	SALMON (Salmon Price)	$/kg	IMF
53	SBKI (Interest Rate of Bank Credit for Investment)	%	Bank Indonesia
54	SBKK (Interest Rate of Bank Credit for	%	Bank Indonesia
55	SBKMK (Interest Rate of Bank Credit for Working	%	Bank Indonesia
56	SIBOR12 (SIBOR 12 month)	%	Bloomberg
57	TOTKRED (Total Bank Credit)	Rp trillion	Bank Indonesia
58	TRANSFER (Central Government Transfer to	Rp trillion	MoF
59	US_UNEMP (US Unemployment Rate)	%	The Fed

Source: Processing Results

TABLE APPENDIX-2: X-13ARIMA-SEATS Monthly Seasonal Adjustment Method for Each Variable

No	Series Name	ARIMA Model	Lunar New Year – Imlek (-30, -1,1 , 30)	Eid Al-Fitr (-35, -3,3 , 35)
1	ALUMINUM	(0 1 1)(0 1 1)	-	-
2	BALFUND	(0 0 0)(0 1 1)	Not Significant	After
3	CADEV	(0 1 1)(0 1 1)	Not Significant	Not Significant
4	CAR	(0 1 1)(0 1 1)	Not Significant	Between
5	CEMENT	(0 1 1)(0 1 1)	Not Significant	Between & After
6	COAL	(0 1 1)(0 1 1)	-	-
7	COCOA	(0 1 1)(0 1 1)	-	-
8	COPPER	(0 1 1)(0 1 1)	-	-
9	EXPMIGAS	(0 1 1)(0 1 1)	Not Significant	Not Significant
10	EXPNONMIGAS	(0 1 1)(0 1 1)	Not Significant	Before & Between
11	EXPORT	(0 1 1)(0 1 1)	Not Significant	Before & Between
12	EXRUS	(3 1 1)	Before & After	Between
13	FFR	(0 1 1)(0 1 1)	-	-
14	GKG	(0 1 1)(0 1 1)	Not Significant	Not Significant
15	GOLD	(0 1 1)(0 1 1)	-	-
16	ICP	(0 1 1)(0 1 1)	-	-
17	IHSG	(0 1 1)(0 1 1)	Not Significant	Between
18	IKK	(0 1 1)(0 1 1)	Not Significant	Not Significant
19	IMPCAP	(0 1 1)(0 1 1)	Not Significant	Between
20	IMPCONS	(0 1 1)(0 1 1)	Not Significant	Between
21	IMPMIGAS	(0 1 1)(0 1 1)	Between	Not Significant
22	IMPNONMIGAS	(0 1 1)(0 1 1)	Not Significant	Between
23	IMPORT	(0 1 1)(0 1 1)	Not Significant	Between
24	IMPRAW	(0 1 1)(0 1 1)	Not Significant	Between
25	INF_CORE	(0 1 1)(0 1 1)	Before	Before, Between &
26	INF_VOL	(0 1 1)(0 1 1)	Not Significant	Between
27	INFLASIHK	(0 1 1)(0 0 1)	Not Significant	Before & After
28	IRON	(0 1 1)	-	-
29	JII	(1 1 0)	Not Significant	Not Significant
30	KI	(0 1 1)(0 1 1)	Not Significant	Not Significant
31	KK	(0 1 1)(0 1 1)	Not Significant	Before
32	KMK	(0 1 1)(0 1 1)	Not Significant	Before
33	KOPI	(0 1 1)(0 1 1)	-	-
34	LIBOR12	(0 1 1)(0 1 1)	-	-
35	LIFT_GAS	(0 1 1)(0 1 1)	Not Significant	Not Significant
36	LIFT_MIGAS	(0 1 1)(0 1 1)	Not Significant	Not Significant

No	Series Name	ARIMA Model	Lunar New Year – Imlek (-30, -1,1 , 30)	Eid Al-Fitr (-35, -3,3 , 35)
37	LIFT_OIL	(0 1 1)(0 1 1)	Not Significant	Not Significant
38	LISTRIK	(0 1 1)(0 1 1)	Not Significant	Between & After
39	LNG	(0 1 1)(0 1 1)	-	-
40	LQ45	(0 1 1)(0 1 1)	Not Significant	Not Significant
41	M1	(0 1 1)(0 1 1)	Before	Before
42	M2	(3 1 1)(0 1 1)	Not Significant	Before & After
43	MOTOR	(0 1 1)(0 1 1)	Not Significant	Between
44	NICKEL	(0 1 1)(0 1 1)	-	-
45	NTN	(0 1 1)(0 1 1)	Not Significant	Before & Between
46	NTP	(0 1 1)(0 1 1)	Between	Before, between, &
47	OIL	(0 1 1)(0 1 1)	-	-
48	PALMOIL	(0 1 1)(0 1 1)	-	-
49	PLYWOOD	(1 1 0)	-	-
50	RETAIL	(1 1 1)(1 0 0)	Between	Before & Between
51	RUBBER	(0 1 1)(0 1 1)	-	-
52	SALMON	(0 1 1)(0 1 1)	-	-
53	SBKI	(0 2 1)	After	Not Significant
54	SBKK	(0 1 1)(0 1 1)	Not Significant	Not Significant
55	SBKMK	(0 1 1)(0 1 1)	Between	Between
56	SIBOR12	(1 1 2)	-	-
57	TOTKRED	(0 1 1)(0 1 1)	Not Significant	Before
58	TRANSFER	(2 0 2)(0 1 0)	Not Significant	Between
59	US_UNEMP	(0 1 1)(0 1 1)	-	-

Source: Processing Results

TABLE APPENDIX-3: Summary of Analysis of Variable Grouping as Leading Index Based on Data Containing Trends and Cycles (Y_TDX)

No.	Component Series	VAR Optimal Lag	Granger Causality Test	Cointegration	Grouping
1	ALUMINUM	6, 9, 10	KTI → ALUMINUM	Yes, lag = 6 & 9	Lagging
2	BALFUND	6, 7, 8	KTI → BALFUND, all lags BALFUND → KTI df=6, 7 BALFUND← →KTI, df=8	Yes	Not Clear
3	CADEV	6, 10, 12	KTI → CADEV	Yes	Lagging
4	CAR	5, 10	KTI → CAR lag=10	Yes, lag=10	Lagging
5	CEMENT	5, 9, 11	KTI ←→Cement df=11	Yes, lag =9, 11	Coincident
6	COAL	5, 7, 12	KTI ←→Coal, lag = 5,7 Coal → KTI, lag =12	Yes, lag = 5, 7	Coincident
7	COCOA	6, 7, 9	Cocoa → KTI, df=6, 7, 9	Yes	Leading
8	COPPER	5, 7, 9	Copper ←→KTI, lag =5, 7, 9, df =7 Copper → df=5, 9	No	-
9	EXPMIGAS	5, 7, 12	Expmigas → KTI	Yes, lag=5, 12	Leading
10	EXPNONMIGAS	5, 9	Expnonmigas ←→ KTI, lag=5, 9 & df=9 Expnonmigas → KTI, df=5	Yes	Coincident
11	EXPORT	5, 9, 12	Export → KTI	Yes	Leading
12	EXRUS	8, 12	Exrus → KTI	Yes	Leading
13	FFR	5, 12	FFR → KTI	Yes	Leading
14	GKG	5, 8, 12	KTI → GKG	Yes, lag = 12	Lagging
15	GOLD	7, 12	Gold → KTI	Yes	Leading
16	ICP	5, 10	ICP←→KTI	Yes, lag=10	Coincident
17	IHSG	6, 8	IHSG → KTI	Yes, lag = 6	Leading
18	IKK	5, 12	IKK → KTI	Yes, lag=12	Leading

No.	Component Series	VAR Optimal Lag	Granger Causality Test	Cointegration	Grouping
19	IMPCAP	5, 12	IMPCAP → KTI, lag = 12	Yes, lag = 12	Leading
20	IMPCONS	5, 6	IMPCONS → KTI, lag = 5	No	-
21	IMPMIGAS	5, 8	IMPMIGAS → KTI	Yes	Leading
22	IMPNONMIGAS	5, 10, 12	IMPNONMIGAS → KTI	Yes	Leading
23	IMPORT	7, 10	IMPORT → KTI	Yes	Leading
24	IMPRAW	7, 11	IMPRAW → KTI, lag = 7	No	-
			IMPRAW ←→KTI, lag = 11		
25	INF_CORE	6, 9, 12	INF_CORE → KTI	Yes	Leading
26	INF_VOL	5, 12	KTI → INF_VOL	Yes	Lagging
27	INFLASIHK	7, 12	INFLASIHK → KTI	Yes	Leading
28	IRON	7, 9	IRON ←→KTI	No	-
29	JII	6, 8	JII ←→KTI lag = 6, 8	Yes, lag = 6	Leading
			JII → KTI df= 6, 8		
30	KI	5, 8	KTI → KI	Yes	Lagging
31	KK	5, 6	KK → KTI, df = 6	Yes	Leading
32	KMK	5, 7, 12	KMK ←→ KTI, df = 5, 7, 12	Yes, lag = 5, 7	Coincident
33	KOPI	5, 11, 12	Kopi ←→ KTI	Yes	Coincident
34	LIBOR12	5, 6, 9	LIBOR12 → KTI, df=5,6,9	Yes	Leading
35	LIFT_GAS	5, 6, 10	Lift_gas → KTI	Yes	Leading
36	LIFT_MIGAS	7, 9	Lift_migas → KTI, df=7	Yes	Not Clear
			Lift_migas ←→KTI, df=9		
37	LIFT_OIL	7, 10	Lift_oil → KTI, df=7	Yes, lag=7	Not Clear
			Lift_oil ←→ KTI, df=9		
38	LISTRIK	5, 6, 12	Listrik → KTI, df=5,6	No	-

No.	Component Series	VAR Optimal Lag	Granger Causality Test	Cointegration	Grouping
			Listrik←→KTI df=12		
39	LNG	5, 12	LNG ←→ KTI	Yes	Coincident
40	LQ45	6, 8	LQ45←→KTI, lag = 6, 8 & df = 8	Yes	Coincident
			LQ45 →KTI, df=6		
41	M1	5, 8, 12	KTI → M1	Yes, lag=5, 8	Lagging
42	M2	5, 8, 9	M2 → KTI	Yes, lag=5, 8	Leading
43	MOTOR	5, 8	No	No	-
44	NICKEL	5, 7	Nickel ←→KTI	Yes	Coincident
45	NTN	5, 6	NTN → KTI, df=6	Yes, lag=6	Leading
46	NTP	5, 9	KTI → NTP, lag=df=9	Yes, lag=9	Lagging
47	OIL	8	Oil ←→KTI	Yes	Coincident
48	PALMOIL	5, 10, 12	KTI → Palmoil, lag=df=5	Yes, lag=5	Lagging
			Palmoil → KTI, lag=df=10, 12		
49	PLYWOOD	7, 10, 12	Plywood → KTI	Yes	Leading
50	RETAIL	5, 9, 11	Retail → KTI	Yes	Leading
51	RUBBER	5, 9	KTI → Rubber	Yes, lag=5	Lagging
52	SALMON	5, 7, 8	Salmon ←→KTI, lag=5, 7, 8	Yes	Leading
			Salmon → KTI, df=5,7,8		
53	SBKI	5, 7, 12	SBKI ←→KTI	Yes	Coincident
54	SBKK	5, 6, 12	KTI → SBKK, df=6, 12	Yes, lag=12	Lagging
55	SBKMK	6, 9, 10	SBKMK → KTI	Yes	Leading
56	SIBOR12	5, 7, 10	KTI → SIBOR12	Yes, lag=5, 7	Lagging
57	TOTKRED	6, 11, 12	Totkred ←→KTI, lag=11	Yes	Not Clear
			Totkred → KTI, df=6, 12		

No.	Component Series	VAR Optimal Lag	Granger Causality Test	Cointegration	Grouping
			Totkred ←→KTI, df=11		
58	TRANSFER	5, 6	KTI → Transfer	Yes	Lagging
59	US_UNEMP	5, 6	No	Yes	-

Source: Processing Results