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THE DYNAMIC OF INDONESIA’S SECTORAL ECONOMIC CYCLES

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The purpose of this study is to observe the dynamics of Indonesia’s economic cycles for six main sectors. In constructing the cycles, we use quarterly Gross Domestic Product (GDP) for six Indonesian sectors over the period 2000-2021. We obtain the economic cycles for each of the six sectors using the Hodrick-Prescott filter and the Christiano-Fitzgerald filter techniques. We find evidence that five of six sectors have relatively strong correlation with the aggregate GDP growth cycle. Additionally, by using the concordance index, we further conclude that three sectors are pro-cyclical with the aggregate GDP growth cycle.

Keywords: Sectoral cycles; Cross-correlation; Policy response; Event-analysis; Cycle-identification filter.

JEL Classifications: E30; E32; E61.

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I. INTRODUCTION

In this study, we observe the dynamic of Indonesia’s economic sectoral cycles. Cycle analysis is widely used in various study areas in economics. After the global financial crisis in 2008, policy discussions about financial cycles in driving business cycles became more prevalent (Iacoviello, 2015). Moreover, Christiano et al. (2014) also argue that shocks in the financial sector are common in driving the economic cycle. This is due to the interaction between the business cycle and the financial cycle which could have different impacts from monetary and macroprudential policy responses (Hiebert et al., 2018). In the case of Indonesia, study by Prabheesh et al. (2021) documents that the relationship between the domestic credit cycle and the global financial cycle is rather weak. Additionally, the analysis on the economic cycle also considered sectoral economy for some countries or region. However, none of the previous studies has examined the economic sectoral cycle in the case of Indonesia.

One of the main concept of cyclical analysis is turning point analysis. This turning point analysis is quite important because it becomes the basis for the formulation of policies that are in accordance with the phases of the economic cycle (Kannan et al., 2009). Turning point analysis could show the relationship between the economic phases with a particular shock and can define the maximum and minimum duration of the economic cycle (Everts, 2006a). Policies are generally countercyclical to prevent a deeper contraction in the economy. Appropriate policies based on economic phases could lead to a more stable medium-long economic growth and less extreme fluctuations (Kannan et al., 2009). In addition to turning point analysis, cyclical analysis can provide a correlation that describes its relationship to the overall economy. If the economic sectoral cycles have a relatively high correlation with the aggregate economic cycles, then we can expect that the sectoral economic recovery will reflect strongly in the aggregate economic recovery. Furthermore, analysis on sectoral economic cycles may provide leading information so that it can become an early indicator of the overall economy.

There have been studies discussing sectoral economic cycles. Stock and Watson (1998) show that the sectoral cycles of the United States’ economy generally tend to coincide with the economic cycle, although there are unrelated sectors, such as the mining sector. Afonso and Furceri (2007) examine that the industrial, agricultural, forestry, fisheries, and building and construction sectors in the European Union could promote synchronization of economic cycles. However, the service sector with high added value has low synchronization. Evert (2006b) shows that the agricultural, mining, and electricity sectors in Switzerland are not correlated with economic cycles. Meanwhile, the wholesale and retail trade sectors as well as the transportation industry are strongly correlated with economic cycle. This study also concludes that the wholesale and retail trade sector are leading for two quarters so that it can become an early indicator of the overall economy. Tase (2019) argues that if sectoral changes appear to be smaller and spread across sectors, the correlation between sectoral dynamics and GDP growth will be higher, where the contraction phase will provide a larger change in sectoral composition compared to the expansion phase. While there is an extensive literature on sectoral cycle analysis, the study on Indonesia is unavailable.
This study is motivated by the COVID-19 pandemic that has had a significant impact on the performance of the Indonesian economy. Indonesia’s economy shrank by 2.07% in 2020. Almost all sectors experienced contraction, except for sectors related to basic needs and supporting work/school from home. After experiencing heavy pressure in the first semester of 2020, the Indonesian economy in the second half of 2020 began to show improvement in line with the impact of policy stimulus and global economic recovery. To continue with the economic recovery, the idea emerged that recovery efforts could be first focused on specific sectors that are strongly correlated with the aggregate economy. Using the turning point analysis, we can then identify further countercyclical measures to accelerate the recovery.

Studies at the sector level are important in order to examine the sources of economic growth from the supply side including in the recovery phase. Indonesian economy is mainly driven by six main sectors, namely the (i) manufacturing industry; (ii) agriculture, forestry, and fisheries; (iii) wholesale and retail trade, repair of motor vehicles and motorcycles; (iv) transportation and storage; (v) construction; and (vi) mining and quarrying. In 2020, these six sectors contributed to the Indonesian economy by 63.8%. Therefore, using aggregate GDP growth and six main sectors of GDP growth we examine the dynamic of the cycles. We use GDP in growth form over the period 2011Q1 to 2021Q2. This study estimates the cycles by applying Hodrick-Prescott filter (HP Filter). To ensure that the results of this study can be justified, we also conduct a robustness check by using Christiano-Fitzgerald filter (CF filter). The results are relatively consistent and robust. Furthermore, to evaluate the relationship between two cycles, we use concordance index to measure the degree of synchronization between two cycles. The concordance index is preferable over conventional correlation analysis, as it is less susceptible to cycle amplitude, so it might not give misleading results. Finally, yet importantly, this study provides analysis on turning point to identify economic phases and countercyclical policies taken to drive the cycles into the expansion phase.

This study provides evidence that economic recovery already takes place as cycles of aggregate GDP and six main sectors are in the acceleration phase. Shorter duration of the deceleration phase in six main sectors than the acceleration phase supports economic prospects. In addition, based on the duration of the current acceleration phase, which is still below the historical average, the aggregate economic cycle and all six main sectors’ GDP growth cycles are predicted to continue with the recovery. In terms of correlation, five of six main sectors’ cycles have strong correlation with total GDP’s cycle. Additionally, based on concordance index, we can conclude that three sectors are pro-cyclical with the aggregate GDP growth cycle. Lastly, we conduct the event analysis of each of the six main sectors. Those sectors enter deceleration phases mainly driven by external shocks. The policy measures (such as the provision of social assistance and tax incentives) taken to drive the recovery towards the acceleration phase were to improve the demand side. However, there are also specific structural policies to support growth acceleration, such as accelerating the development of infrastructure. Specifically related to the COVID-19 pandemic, policy responses were also directed to support the production side, such as business incentives, ease of licensing, and accelerated vaccination.
The rest of the paper is arranged as follows. Section II discusses the methodology of generating cycles and data used in this paper. Section III analyzes and summarizes the results. Section IV concludes the paper.

II. DATA AND METHODOLOGY

A. Data
We use Indonesia’s aggregate GDP growth and six main sectors’ GDP growth on a quarterly basis, year-on-year, over the period 2011Q1 to 2021Q2. We use these periods according to the latest GDP base year. The six main sectors are: (i) manufacturing industry; (ii) agriculture, forestry, and fisheries; (iii) wholesale and retail trade, repair of motor vehicles and motorcycles; (iv) transportation and storage; (v) construction; and (vi) mining and quarrying. We source data from Statistics Indonesia. Meanwhile, for the purpose of an event analysis, all cycles are based on the quarterly growth data over the period 2001Q1 and 2021Q2.

B. Methodology
We use a qualitative and cross-correlation analysis to identify sectoral economic cycles using the OECD tool and to test for the cyclical behavior of the lag, lead, and co-movement of sectors.

B.1 Quantitative Analysis for Cycle Identification
The OECD Cyclical Analysis and Composite Indicators System (CACIS-OECD) is a program for both cyclical analysis and compilation and study of composites indicators. It is designed directly to compute the composite indicators. The publicly available CACIS-OECD program has not changed much since 2010, and its user interface and generated visualization are obsolete. However, CACIS is the only existing program developed directly to analyze business cycle and contains the necessary visualization (Vrana, 2018).

In the CACIS tool, there are filtering steps to eliminate factors such as seasonality, outliers, and trends before getting a cycle. Aspects that are considered in the filtering process are as follows:

- Seasonal adjustment: the seasonal factor in the component series is removed by using a common method, such as X12.
- Outlier detection: outlier is data in a period that is outside the normal range. Usually, outliers are (i) additive outliers (temporary shock in one period); (ii) transitory changes (temporary shock in several periods); or (iii) level shifts (permanent shock). One method to identify the outliers and become part of CACIS is TRAMO (Time Series Regression with ARIMA Noise, Missing Observations).
- Cycle identification: this process is carried out to (i) see the cyclical pattern of data/indicators, i.e., by eliminating long-term trends (de-trending) and noise (smoothing) using several general methods, such as the Hodrick-Prescott filter and Christiano-Fitzgerald filter; and (ii) to detect turning points using the Bry-Boschan algorithm.
The Dynamic of Indonesia’s Sectoral Economic Cycles

i. HP Filter

*HP Filter* is one of the most commonly used de-trending methods. Trend estimation is conducted by using optimization equation:

\[ y_t = \tau_t + c_t \quad (1) \]
\[ \min_{\tau_t} \sum_t (y_t - \tau_t)^2 + \lambda \sum_t (\tau_{t+1} - 2\tau_t + \tau_{t-1})^2 \quad (2) \]

The data is calculated in \( y_t \), trended into components \( \tau_t \) and cyclical components \( c_t \), such that the distance between the trend and the original data is minimized, and at the same time the curvature of the trend is minimized. The tradeoff between the two goals is determined based on the parameter values \( \lambda \).

ii. CF Filter

*CF Filter* forms de-trending of data into 3 components, i.e., trend, cycle, and irregular components as follows:

\[ y_t = \tau_t + c_t + \epsilon_t \quad (3) \]

To obtain the cycle, the CF Filter is computed using the following model:

\[ c_t = b_0 y_t + b_1 y_{t+1} + \ldots + b_{T-1-t} y_{T-1} + \tilde{b}_{T-t} y_t + b_1 y_{t-1} + \ldots + b_{t-2} y_2 + \tilde{b}_{T-1} y_1 \quad (4) \]

for \( t=3,4,\ldots,T-2 \), where:

\[ b_j = \frac{\sin(j\phi) - \sin(ja)}{\pi j}, j \geq 1; b_0 = \frac{c-a}{\pi}; a = \frac{2\pi}{p_h}; c = \frac{2\pi}{p_l} \quad (5) \]

\[ b_k = -\frac{1}{2} b_0 - \sum_{j=1}^{k-1} b_j \quad (6) \]

iii. Bry-Boschan

In principle, the Bry-Boschan algorithm will determine the turning point of a cycle. This algorithm contains two important steps: (i) identification of local maximum and minimum values for a given period, and (ii) the imposition of certain criteria to ensure the minimum cycle length (distance between two consecutive peaks and troughs) and minimum length of each phase (from peak to trough or trough to peak). This algorithm also requires that peak and trough must occur alternately, and trough (peak) must be lower (higher) than the previous peak (trough). The determination of peak and trough is determined formulas follows:
In this study, the criteria used are a minimum requirement of 5 (five) months to be considered as 1 (one) phase (peak to trough or trough to peak), and a minimum of 15 months to be considered as 1 (one) cycle (peak to peak, or trough to trough). The growth rate cycle is a type of presentation that is formed from the growth of the business cycle. The cycle which will be used in this research is the growth cycle. The movement of the growth cycle from time to time shows changes in the economic cycle which in order words indicate the widening or narrowing of the GDP gap. The resulting change in month to month (mtm) index indicates the GDP growth forecast for the next 6-9 months whether it is above or below the growth trend (see Appendix).

**B.2 Concordance Index Analysis**

In this study, we also calculate the concordance index, originally proposed by Harding and Pagan (1999). According to McDermott and Scott (2000), the correlation statistic is easily affected, particularly by single events in the time series. We use this method as an alternative measure of correlation.

Concordance index is used to show the average time when in the same phase for the two cycles being compared (Harding and Pagan, 2002; 2006). The concordance index value is between 0 and 1. The concordance index is 1 if \( S_{X,t} = S_{Y,t} \) and is valued at 0 if \( S_{X,t} = (1 - S_{Y,t}) \)

A value of 1 represents perfect concordance, i.e., both cycles are in the same direction. A value of 0 represents perfect dis-concordance, i.e., the two cycles are in the opposite direction:

\[
S_{X,t} = \begin{cases} 
1, & \text{if } X \text{ is in the expansion phase in time } t \text{ and} \\ 
0, & \text{otherwise} 
\end{cases}
\]  
(10)

\[
S_{Y,t} = \begin{cases} 
1, & \text{if } Y \text{ is in the expansion phase in time } t \\ 
0, & \text{otherwise} 
\end{cases}
\]

Then the concordance index between the two cycles can be formed using the following formula:

\[
C_{XY} = \frac{1}{T} \sum_{t=1}^{T} [S_{X,t}S_{Y,t} + (1 - S_{X,t})(1 - S_{Y,t})] 
\]  
(11)
Cycle X is said to be pro-cyclical with cycle Y if the concordance index value is between 0.5 and 1, and countercyclical if it is between 0 and 0.5. Values close to 1 indicate perfect pro-cyclicality, while values close to 0 indicate perfect countercyclicality.

After obtaining the concordance index, the next step is to determine the level of significance by comparing the concordance index value to the critical value determined by the response-regression surface. A significance test is needed to see if both cycles are synchronous or asynchronous.

Response surface parameters are arranged using the maximum likelihood formula (see McDermott and Scott, 2000). The formula is calculated as follows:

$$C_k(p) = \left[1 + \exp\left(-\beta_1 \cdot T_k^{1/2} - \beta_2 \cdot \left(\frac{\mu}{\sigma}\right) - \beta_3 \cdot \left(\frac{\mu}{\sigma}\right)^2\right)\right]^{-1} + \varepsilon_t$$ (12)

where response-surface parameters ($\beta$) are derived on the level of significance in Table 1.

<table>
<thead>
<tr>
<th>Sig. Level</th>
<th>$\beta_1$</th>
<th>$\beta_2$</th>
<th>$\beta_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>3.42</td>
<td>0.92</td>
<td>1.02</td>
</tr>
<tr>
<td></td>
<td>(1.16)</td>
<td>(0.41)</td>
<td>(0.60)</td>
</tr>
<tr>
<td>5%</td>
<td>4.78</td>
<td>0.80</td>
<td>1.23</td>
</tr>
<tr>
<td></td>
<td>(0.96)</td>
<td>(0.35)</td>
<td>(0.54)</td>
</tr>
<tr>
<td>1%</td>
<td>7.18</td>
<td>0.67</td>
<td>1.57</td>
</tr>
<tr>
<td></td>
<td>(1.35)</td>
<td>(0.51)</td>
<td>(0.89)</td>
</tr>
</tbody>
</table>

To use the above formula (Equation 12), minimum drift and standard error ($\mu$ and $\sigma$) are required. The residual value of the cycle is constructed based on the random walk model with drift to get the value of $\mu/\sigma$. Next, the value of $\mu/\sigma$ that are obtained can be included in the formula to get the critical value according to the level of significance. Critical value ($C_k$) obtained is compared with the value of CI ($C_{ij}$) for the purpose of testing the null hypothesis of no concordance (Fernandez, 2019).

### III. RESULTS

#### A. Growth Cycle Analysis

Based on the GDP growth cycle, the aggregate GDP as well as the six main sectors, which were also in the acceleration phase, have shown signs of economic recovery. This is in line with the ongoing economic recovery process.
Figure 1. Growth Cycle of Aggregate GDP and Six Main Sectors

This figure plots growth cycle of the aggregate GDP and six main sectors, which are (i) manufacturing industry; (ii) agriculture, forestry, and fisheries; (iii) wholesale and retail trade, repair of motor vehicles and motorcycles; (iv) transportation and storage; (v) construction; and (vi) mining and quarrying. Value represented in index is processed using CACIS-OECD software. Light grey-shaded area means the growth cycle is in acceleration phase, dark grey-shaded area means the growth cycle is in deceleration phase.
Figure 1.
Growth Cycle of Aggregate GDP and Six Main Sectors (Continued)

GDP Growth Cycle: Agriculture, Forestry & Fisheries

GDP Growth Cycle: Wholesales & Retail Trade
Figure 1.
Growth Cycle of Aggregate GDP and Six Main Sectors (Continued)

Transportation & Storage

Index  GDP Growth Cycle: Transportation & Storage

115
110
105
100
95
90
85

2011 I II III IV I II III IV I II III IV I II III IV I II III IV I II III IV I II III IV I II III IV I II III IV I II III IV I


Construction

Index  GDP Growth Cycle: Construction

115
110
105
100
95
90
85

2011 I II III IV I II III IV I II III IV I II III IV I II III IV I II III IV I II III IV I II III IV I II III IV I II III IV I

In the next step, we document the informative statistics of the phases. A comparison of time plots of the series and their peaks ($P$) and troughs ($T$) allows us to quickly assess whether recent cycles are in some way unusual, or whether there is a pattern in the evolution of the cycles (McDermott and Scott, 2000). From 2011Q1 to 2021Q2, there are two full cycles of the aggregate GDP. On average, a full cycle of the aggregate GDP ($P$ to $T$ and $T$ to $P$) took around 21 quarters or approximately 5 years. During the cycle, duration of the deceleration phase ($P$ to $T$) was relatively shorter than the acceleration phase ($T$ to $P$). Based on this result, we can conclude that recovery of the aggregate GDP can occur in a relatively short period. Comparing to an earlier study by Perrotti (2021) which used GDP growth cycle of Argentina from 1980Q1 to 2018Q2, duration of the deceleration phases were also shorter than the acceleration phases. This finding is also in line with the study conducted by Hall and McDermott (2013) which used GDP growth cycle of New Zealand. Their study shows that the GDP growth cycles have an average expansion phase of almost 6.5 years, longer compared to the average contraction phase which is just over one year. Similar conclusion with regards to the duration between acceleration and deceleration phase is found in the study by Lopes et al. (2017) where they GDP growth cycle of Brazil. Their findings reveal that the acceleration phases generally being much longer in duration than the deceleration phases.

We also use the GDP growth cycle graph to show the results of turning points analysis. Growth cycle has four phases: expansion, peak, contraction, and trough. Expansion is the phase when the economy experiences relatively higher and increasing GDP growth. Then, at the peak, the economy reaches the highest level of the output before experiencing a slowdown. The contraction phase has the characteristic of a continuous deceleration in economic growth and therefore,
decreases in the level of output. Finally, the trough point is the lowest part of the cycle, or the lowest turning point. This phase is known as a recession.

Based on the aggregate GDP growth cycle, it indicates that Indonesia experienced deceleration or contraction phase over the period 2011Q1 to 2015Q2, and finally it reached the trough point. After reaching the lowest point, Indonesia started to experience acceleration or expansion phase until 2019Q3 or just before the beginning of the COVID-19 pandemic. Indonesia entered the contraction phase from 2019Q4 to 2020Q3. This was in line with the economic condition that was declining at that time due to the COVID-19 pandemic. Going forward, along with the economic recoveries, Indonesia shows a V-shaped expansion phases since the 2020Q4. The wholesale and retail trade sector, the manufacturing industry sector, the construction sector as well as the transportation and storage sector GDP growth cycle phases during the period 2019Q4 to 2020Q3 experienced same phase as the aggregate GDP growth cycle and also showed V-shape expansion phases. Based on these results, we conclude that the aggregate GDP growth cycle recovery is mainly supported by recoveries in these sectors.

Table 2.
Phase Duration of Aggregate GDP and Six Main Sectors’ GDP Growth Cycle
This table reports the informative statistics of phase duration of the aggregate GDP and six main sectors, which are (i) manufacturing industry; (ii) agriculture, forestry, and fisheries; (iii) wholesale and retail trade, repair of motor vehicles and motorcycles; (iv) transportation and storage; (v) construction; and (vi) mining and quarrying. The statistics include the minimum, maximum and average duration of the growth cycle phase. Data analysed using CACIS-OECD software.

<table>
<thead>
<tr>
<th>No.</th>
<th>Sectors</th>
<th>Growth Cycle Phase</th>
<th>Current Phase and Duration of Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Acceleration (Q)</td>
<td>Deceleration (Q)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>1</td>
<td>Manufacturing Industry</td>
<td>3</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>Agriculture, Forestry &amp; Fisheries</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>Wholesale &amp; Retail Trade</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>Transportation &amp; Storage</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>5</td>
<td>Construction</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>6</td>
<td>Mining &amp; Quarrying</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Aggregate GDP</td>
<td>4</td>
<td>17</td>
</tr>
</tbody>
</table>

Using the cross-correlation method, we can forecast the next phase of the aggregate GDP growth cycle. Based on the cross-correlation, we can categorize the main sectors into three groups, namely: (i) the sectors that will recover earlier than the aggregate GDP (lead); (ii) the sectors that will recover simultaneously with the aggregate GDP (co-movement); and (iii) the sectors that will recover later than the aggregate GDP (lag). Besides indicating recovery, the value of cross-correlation also indicates a decline in the aggregate GDP.

Based on the calculation of the cross-correlation, most of the main sectors had a high value of correlation, mainly at $t=0$, indicating that these sectors are strongly correlated and co-moved with the aggregate GDP growth cycle. The GDP growth cycle of the mining and quarrying sector also co-moved with the aggregate GDP.
GDP growth cycle, though it had a relatively lower correlation value compared to other sectors. Furthermore, the GDP growth cycle of the construction sector is highly correlated with the aggregate GDP growth cycle at $t+1$ (lead), suggesting that the sector could be an early indicator of possible recovery or decline of the aggregate GDP in the future. Meanwhile, the GDP growth cycle of the agriculture, forestry, and fishery sector reports lowest correlation value with the aggregate GDP growth cycle. Overall, from these above findings, we conclude that there is no sector that will recover later than the aggregate GDP (lag) in the economy. Comparing to studies in other countries, Craigwell and Maurin (2007) examines the correlation between the cyclical component of GDP and 11 series of production indicator that represent each of its main economic sectors. Based on the cross-correlation calculation, the production series representing the construction, tourism, wholesale, and retail sectors, as well as the business and other services sectors, are strongly co-incident or co-move with the total GDP growth cycle.

Table 3. Cross-correlation between Aggregate GDP and Six Main Sectors’ GDP Growth Cycle

This table reports cross-correlation of growth cycle index between the aggregate GDP and six main sectors, which are (i) manufacturing industry; (ii) agriculture, forestry, and fisheries; (iii) wholesale and retail trade, repair of motor vehicles and motorcycles; (iv) transportation and storage; (v) construction; and (vi) mining and quarrying. Possible value of the correlation ranges between -1 to +1. -1 indicates a perfect negative correlation, 0 indicates no linear relationship, and +1 indicates a perfect positive correlation. $t$ means time (quarter).

<table>
<thead>
<tr>
<th>No.</th>
<th>Sectors</th>
<th>t,-3</th>
<th>t,-2</th>
<th>t,-1</th>
<th>t</th>
<th>t-1,t</th>
<th>t-2,t</th>
<th>t-3,t</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Manufacturing Industry</td>
<td>0.69</td>
<td>0.85</td>
<td>0.95</td>
<td>0.97</td>
<td>0.92</td>
<td>0.80</td>
<td>0.63</td>
</tr>
<tr>
<td>2</td>
<td>Agriculture, Forestry &amp; Fisheries</td>
<td>0.30</td>
<td>0.26</td>
<td>0.18</td>
<td>0.08</td>
<td>0.07</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>3</td>
<td>Wholesales &amp; Retail Trade</td>
<td>0.66</td>
<td>0.78</td>
<td>0.87</td>
<td>0.89</td>
<td>0.84</td>
<td>0.73</td>
<td>0.58</td>
</tr>
<tr>
<td>4</td>
<td>Transportation &amp; Storage</td>
<td>0.73</td>
<td>0.88</td>
<td>0.96</td>
<td>0.96</td>
<td>0.88</td>
<td>0.74</td>
<td>0.55</td>
</tr>
<tr>
<td>5</td>
<td>Construction</td>
<td>0.58</td>
<td>0.74</td>
<td>0.86</td>
<td>0.92</td>
<td>0.93</td>
<td>0.86</td>
<td>0.74</td>
</tr>
<tr>
<td>6</td>
<td>Mining &amp; Quarrying</td>
<td>0.41</td>
<td>0.50</td>
<td>0.58</td>
<td>0.63</td>
<td>0.61</td>
<td>0.55</td>
<td>0.45</td>
</tr>
</tbody>
</table>

In addition to the cross-correlation method, we also calculate the concordance index which is originally proposed by Harding and Pagan (1999) as an alternative measure of correlation. Based on the value of the concordance index between the growth cycles of the aggregate GDP and the six main sectors, we can see that the concordance indices for all main sectors are in the high category. The wholesale and retail trade sector, the manufacturing industry sector as well as the transportation and storage sector report the highest concordance indices, with indices of 0.824, 0.776, and 0.768, respectively. This implies that around 82.4% of the time, the GDP growth cycle of the wholesale and retail trade sector is in the same phase as the aggregate GDP growth cycle. Similarly, around 77.6% and 76.8% of the time, the GDP growth cycles of the manufacturing industry sector and the transportation and storage are in the same phase as the aggregate GDP growth cycle, respectively. A high concordance index value indicates that the aggregate GDP growth cycle is in the same or pro-cyclical direction as the sectors’ GDP growth cycle throughout the period.
The concordance index can also be used to assess the degree of growth cycle co-movement or synchronization between the aggregate GDP and its six main sectors. According to Prabheesh et al. (2021), the concordance index value between 0.5 and 1 reveals weak to perfect synchronization, and the value between 0 to 0.5 reveals perfect to weak concordance (asynchronous). Based on the concordance index value, all of Indonesia’s main economic sectors have concordance index values between 0.5 and 1, indicating that these sectors are in perfect synchronization or synchronous with the aggregate GDP. After having calculated the concordance index, the level of significance is tested by comparing the concordance index value to the critical value, which is determined by the response-regression surface. According to the significance test, the concordance indices of the manufacturing industry sector, the wholesale and retail trade sector, and the transportation and storage sectors are statistically significant at the 1% significance level, while the construction sector is statistically significant at the 10% significance level. A high and significant concordance index indicates that the phase of the sectoral GDP cycle can adjust with the change in aggregate GDP cycle within a relatively short period of time (0-2 months lag). Meanwhile for the sector which reports high concordance index but statistically insignificant, the phase of the sectoral GDP cycle can also adjust with the change in aggregate GDP cycle, but within the longer period (more than 2 months lag).

For purposes of comparison with the growth cycles generated using the HP filter method, we also established growth cycles using the CF Filter method. In terms of growth cycle indices, the results obtained suggest that the growth cycles generated by the HP filter method are relatively in line with the growth cycles generated by the CF filter method.

### Table 4.

#### Concordance Index of Six Main Sectors’ GDP Growth Cycle

The table reports the estimated concordance index between the growth cycles of the aggregate GDP and the main sectors. The concordance index value lies between 0 and 1, where the index value of 1 would indicate perfect concordance or pro-cyclicality (high category) and an index value of 0 would indicate perfect dis-concordance or countercyclicality (low category). This explains the number of times the GDP growth cycle of the main sectors are in the same phase as the aggregate GDP growth cycle. ***, *, and * represents significance at 1%, 5%, and 10%, respectively. Critical values are determined by the methodology described in McDermott and Scott (2000).

<table>
<thead>
<tr>
<th>No.</th>
<th>Sectors</th>
<th>Concordance Index</th>
<th>Critical Value</th>
<th>Proportion of time in the same phase as aggregate GDP</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Manufacturing Industry</td>
<td>0.776</td>
<td></td>
<td>77.6%</td>
<td>High***</td>
</tr>
<tr>
<td>2</td>
<td>Agriculture, Forestry &amp; Fisheries</td>
<td>0.536</td>
<td></td>
<td>53.6%</td>
<td>High</td>
</tr>
<tr>
<td>3</td>
<td>Wholesales &amp; Retail Trade</td>
<td>0.824</td>
<td>0.688</td>
<td>0.643</td>
<td>0.618</td>
</tr>
<tr>
<td>4</td>
<td>Transportation &amp; Storage</td>
<td>0.768</td>
<td></td>
<td>76.8%</td>
<td>High***</td>
</tr>
<tr>
<td>5</td>
<td>Construction</td>
<td>0.624</td>
<td></td>
<td>62.4%</td>
<td>High*</td>
</tr>
<tr>
<td>6</td>
<td>Mining &amp; Quarrying</td>
<td>0.568</td>
<td></td>
<td>56.8%</td>
<td>High</td>
</tr>
</tbody>
</table>
Figure 2. Comparison of GDP Growth Cycle using HP Filter and CF Filter Method

This figure provides a comparison between the aggregate GDP and six main sectors’ GDP growth cycle, which are (i) manufacturing industry; (ii) agriculture, forestry, and fisheries; (iii) wholesale and retail trade, repair of motor vehicles and motorcycles; (iv) transportation and storage; (v) construction; and (vi) mining and quarrying using HP filter and CF filter method. Value represented in index is processed using CACIS-OECD software.
Figure 2.
Comparison of GDP Growth Cycle using HP Filter and CF Filter Method
(Continued)
Figure 2.
Comparison of GDP Growth Cycle using HP Filter and CF Filter Method
(Continued)

GDP Growth Cycle: Transportation & Storage

Index

HP Filter  CF Filter

GDP Growth Cycle: Construction

Index
We also compare different phases of the growth cycles. Our findings reveal that there are differences between the growth cycles processed using the HP filter and the growth cycles produced by the CF filter method at several periods, as indicated by the blank/white color on the phase indicator bar. The average duration of the deceleration phase on the growth cycles generated using the CF filter method is longer than the average duration of the acceleration phase and it is also longer compared to the average duration of the deceleration phase of the growth cycles generated using the HP filter method. However, for most periods of study, the phases of growth cycles that are generated using the HP filter method are relatively the same as the phases of growth cycle processed using the CF filter method, as indicated by the black color on the phase indicator bar. Based on these findings, the growth cycles produced using the HP filter method are relatively consistent with those generated using the CF filter method. As a result, we used the HP filter method for this study, considering that the HP filter method is more commonly used and suitable for analysis with a relatively short period of study. However, it should be noted that the HP Filter method also has weaknesses, particularly with regard to the end-point bias, and as a consequence, the results obtained still need to be observed.
Figure 3. Comparison of Phase of Six Main Sectors’ GDP Growth Cycle using HP Filter and CF Filter Method

This figure plots phases of the six main sectors’ GDP growth cycle, which are (i) manufacturing industry; (ii) agriculture, forestry, and fisheries; (iii) wholesale and retail trade, repair of motor vehicles and motorcycles; (iv) transportation and storage; (v) construction; and (vi) mining and quarrying using HP filter and CF filter method. Value represented in index is processed using CACIS-OECD software. Light grey-shaded area means the growth cycle is in acceleration phase, dark grey-shaded area means the growth cycle is in deceleration phase. The “phase indicator” at the bottom of the figure shows when the two series are in the same phase according to the dating—that is, when the two series are in acceleration or deceleration at the same time, the phase indicator is solid, and blank when out of phase. This presentation has been used by McDermott and Scott (2000).
In terms of future prospects, the aggregate GDP and the six main sectors’ GDP growth cycle are predicted to continue with the acceleration phase. This is based on the duration of the acceleration phase, which is currently still below the historical average. This is in line with the ongoing recovery process for the six main sectors, mainly driven by external and domestic demand recovery. As a robustness check, the results of the growth cycle with data up to 2021Q2 are also compared with the growth cycle with data up to 2021Q1. In general, the results of the GDP growth cycle for most of the sectors are relatively consistent compared with the data up to the period 2021Q1 and continued to accelerate in 2021Q2, with the exception of agriculture, forestry, and fisheries, which experienced a decline in indexes despite remaining in the accelerated phase. Such a decline in performance is due to the decline in plantation commodity prices caused by the limited global demand.
Figure 4. 
Comparison of GDP Growth Cycle Using Data as of Q1-2021 and Q2-2021

This figure compares the GDP growth cycle of the aggregate GDP with the six main sectors, which are (i) manufacturing industry; (ii) agriculture, forestry, and fisheries; (iii) wholesale and retail trade, repair of motor vehicles and motorcycles; (iv) transportation and storage; (v) construction; and (vi) mining and quarrying. Value represented in index is processed using CACIS-OECD software.
Figure 4.
Comparison of GDP Growth Cycle Using Data as of Q1-2021 and Q2-2021
(Continued)

GDP Growth Cycle: Agriculture, Forestry & Fisheries

GDP Growth Cycle: Wholesales & Retail Trade
Figure 4.
Comparison of GDP Growth Cycle Using Data as of Q1-2021 and Q2-2021
(Continued)

GDP Growth Cycle: Transportation & Storage

GDP Growth Cycle: Construction
B. Event Analysis

The event analysis of the six main sectors’ GDP growth cycles are as follows:

### Table 5. Event Analysis of the Six Main Sectors’ GDP Growth Cycle

This table reports event analysis of the six main sectors’ GDP growth cycle, which are (i) manufacturing industry; (ii) agriculture, forestry, and fisheries; (iii) wholesale and retail trade, repair of motor vehicles and motorcycles; (iv) transportation and storage; (v) construction; and (vi) mining and quarrying. The figures of event analysis are provided in Appendix.

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Event-Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing Industry</td>
<td>Most of its deceleration phases were caused by external shocks, primarily shocks in trade and financial activity. To accelerate the change of phase from deceleration to acceleration, need to be supported by government policies, particularly policies to boost the domestic demand side. During the COVID-19 pandemic, the change of phase was mainly supported by government policies that support industry recovery.</td>
</tr>
<tr>
<td>Agriculture, Forestry, and Fisheries</td>
<td>Shocks were from internal and external, Main driving factors were the improvement in weather conditions and the improvement in commodity prices for agricultural commodities. Development of infrastructure that supports the facilitation of agricultural production during weather anomalies such as irrigation projects, greenhouses, or the development of high-yielding varieties.</td>
</tr>
<tr>
<td>Wholesale and Retail Trade</td>
<td>Most of its deceleration phases were caused by external shocks, primarily shocks in trade and financial activity. During the COVID-19 pandemic, the acceleration phase was maintained.</td>
</tr>
<tr>
<td>Transportation and Storage</td>
<td>From external shocks, especially from the increase in world oil prices. Deceleration in the performance of the transportation and storage.</td>
</tr>
</tbody>
</table>
Based on the event analysis, we can draw a common thread. To accelerate the change of phase from deceleration to acceleration, particularly in the manufacturing industry sector and the wholesale and retail trade sector, we need policies that support consumer purchasing power and public demand, such as the distribution of social assistance, an increase in the value of the minimum wage, and tax incentives. In the transportation and storage sector, government policies are substantial to boost consumer purchasing power, such as the imposition of transportation tariff limits, fuel subsidies for public transportation, and the provision of public transportation or opening travel routes to remote areas. During the COVID-19 pandemic period, the cyclical change from deceleration back to acceleration was supported with policies from both health and economic perspective. Furthermore, in order to increase demand in the transportation sector, strict health protocols are important so that travel activities can continue without restrictions.

Moreover, to expedite the change in the phase of the growth cycle from deceleration to acceleration, particularly in the construction sector, government policies are needed to boost the infrastructure development, such as increasing the realization of government project budgets, issued the Job Creation Law and implementing the regulation effectively and efficiently, alongside with continuous support for the Indonesia Investment Authority (INA).1,2 Furthermore, the change of phases from deceleration to acceleration in mining and quarrying sector historically are mostly supported by the commodity price recovery. In this sector, external factors, particularly the commodity price fluctuations, has a greater influence on the change of phases rather than government policies.

### IV. CONCLUSION AND POLICY IMPLICATION

This study examines the dynamics of Indonesia’s economic cycles for six main sectors using GDP data over the period 2011Q1 to 2021Q2. We obtained the cycles for each of the six main sectors by using the HP filter and the CF filter methods, followed by the correlation analysis. Our findings are further supported by event analysis to identify countercyclical policies taken to drive the cycles into the expansion phase.

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1. Job Creation Law (Act Number 11 of 2020) aims to increase foreign and domestic investment and create jobs by improving the ease of doing business.
2. The Indonesia Investment Authority is Indonesia’s sovereign wealth fund.

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<table>
<thead>
<tr>
<th>Sectors</th>
<th>Event-Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>From external shocks which then have an impact on domestic demand, such as the global crisis. Contribution of the declining realization of the government budget for infrastructure projects and fiscal consolidation.</td>
</tr>
<tr>
<td>Mining and Quarrying</td>
<td>The change of phases were mostly caused by commodity price fluctuation. External factors, particularly commodity price fluctuations, have a greater influence on the change of phases rather than Government policies.</td>
</tr>
</tbody>
</table>
We document that the economic recovery is apparent in the aggregate GDP as well as in the six main sectors’ GDP growth cycles, which are currently in the acceleration phase. Furthermore, five of the six main sectors which are manufacturing and industry, agriculture, forestry, and fisheries, wholesale and retail trade, transportation and storage, and construction show relatively stronger correlation with the aggregate GDP growth cycle. Additionally, by using the concordance index, we reach a more solid conclusion that three main sectors are pro-cyclical with the GDP growth cycle. In terms of future cycle phases, the growth cycles of the aggregate GDP and the six main sectors are expected to continue with their acceleration phase, mainly driven by domestic and external demand recoveries.

We also check the robustness of our findings by comparing the results of the growth cycle using the HP filter and CF filter methods. Our results suggest that HP filter produces GDP growth cycles that are in line with the GDP growth cycles produced by the CF filter method in terms of index, though they have differences in terms of cycle phase. Aside from that, we also compare the results of the GDP growth cycle using data as of 2021Q1 and 2021Q2. The findings indicate that the GDP growth cycles are relatively consistent, except for the agriculture, forestry, and fisheries sector in 2021Q2, which experienced a decline in indices in the last period despite remaining in the acceleration phase. This is due to agricultural commodity prices falling in this period.

Furthermore, we conducted event analysis to identify countercyclical policies taken to drive the cycles into the expansion phase. According to that, the expansion phases are primarily driven by the implementation of policies to boost the demand side, such as the provision of social assistance and acceleration of infrastructure project development. Aside from that, policies to support production side, such as business incentives, ease of licensing and acceleration of vaccination during the COVID-19 pandemic are required to drive the cycles into the expansion phase. In contrast, the deceleration phases are primarily caused by external shocks, such as trade or financial activity.

In conclusion, demand-side policies are important to bolster consumer purchasing power, particularly during the economic downturn. These policies must be put as priorities in order to maintain the acceleration phase of the main sectors, particularly the manufacturing industry sector, the wholesale and retail trade sector, and the transportation and storage sector. This is based on the event analysis, which shows that the duration of the deceleration phase is relatively shorter than the acceleration phase, implying that those policies are effective. However, demand-side policies such as the provision of social assistance are not sustainable in the long run because they put the Government’ fiscal sustainability at risk. Hence, more structural policies need to be formulated in order to keep the inflation rate at a low and stable level and also to support consumer purchasing power.

In the mining and quarrying sector, consistent policies to support the downstream industry is needed to be maintained, in order to reduce its dependency on the global commodity price. Furthermore, strengthening the supply side and increasing productivity, including the development of high yielding varieties, can be prioritized to support the agriculture, forestry, and fisheries sector. Other than
that, developing higher value-added products should be prioritized in order to reduce its sensitivity to the global commodity price movement. Meanwhile, for the construction sector, policies need to be directed to support infrastructure development and national strategic projects.

REFERENCES


APPENDIX

Figure A.1. Event Analysis of Six Main Sectors’ GDP Growth Cycle

This figure shows event analysis of the six main sectors’ GDP growth cycle, which are (i) manufacturing industry; (ii) agriculture, forestry, and fisheries; (iii) wholesale and retail trade, repair of motor vehicles and motorcycles; (iv) transportation and storage; (v) construction; and (vi) mining and quarrying. Value represented in index, processed using CACIS-OECD software. Light grey-shaded area means the growth cycle is in acceleration phase, dark grey-shaded area means the growth cycle is in deceleration phase. Event analysis compiled from various source (i.e. reports, articles, news). Light grey-shaded box means event-analysis during acceleration phase, dark grey-shaded box means event-analysis during deceleration phase.

GDP Growth Cycle: Manufacturing Industry

Q1-Q3’2001: The impact of the 1997/98 crisis. Domestic consumption is still slow, so manufacturing is still in a contraction phase.

Q4’2004-Q1’2006: Economic growth slowed again in line with solid pressure on economic stability and rising oil prices, thus increasing production costs. Fuel prices increase which leads to inflation and reduces the purchasing power.

Q1’2006-Q2’2008: Consumption supported growth as people’s purchasing power improved, supported by the policy of providing direct cash assistance (BLT) and low inflation. Export demand remains high during this period.

Q2’2008-Q2’2009: The global financial crisis (GFC) impacted the domestic market through trade channels (commodity prices slowed), and the exchange rate depreciated quite profoundly. During this period, inflation increased significantly export-import activities slowed in line with declining global demand (and lower demand for industrial raw materials).

Q3’2010-Q3’2013: The global economic crisis occurred in line with the moderation of the US economy and the European debt crisis, thereby reducing the demand for manufactured products. The current account began to run into a deficit, and the exchange rate depreciated quite profoundly. The increase in world oil prices prompted the adjustment of fuel prices. Inflation has increased which impacted the people’s purchasing power.

Q4’2013-Q1’2019: The improvement in the economic conditions of trading partner countries after the global economic crisis has again boosted demand for industrial exports. Domestic demand remains robust, driven by the policy of providing social assistance. Infrastructure development is directed towards being more effective, and various policies are issued to support industrial performance, including a tax holiday (Minister of Finance Regulation PMK 35/2018) to encourage industrial investment.

Q4’2019-Q2’2020: The COVID-19 pandemic was responded to by restricting mobility and suppressing demand and production activity. Non-conventional recovery policies are taken by the Government and related authorities to reduce the impact of the COVID-19 pandemic.

Q3’2019-Q4’2021: The impact of the policy is focused on social assistance, which supports the smooth running of production activities as the main factor for the recovery. Policies to encourage industrial recovery, a relaxation of restrictions on community mobility, granting of Industrial Mobility and Activity Operational Permits (OMAKI), and initiation of vaccinations.
Figure A.1.
Event Analysis of Six Main Sectors’ GDP Growth Cycle (Continued)

Agriculture, Forestry & Fisheries

Q1’2003-Q3’2005: Increased rice production in line with land expansion, use of technology, and favorable weather.

Q1’2001-Q3’2003: The El Nino phenomenon causes a drought. This impacts that agricultural land cannot be processed in food crop production centers on the islands of Java, Bali, and Lombok.

Q1’2006-Q4’2006: The occurrence of weather anomalies where the dry season period in 2006 was longer than in previous years.

Q1’2009-Q3’2010: The occurrence of forest fires in Sumatra (Riau). In addition, there are also weather disturbances that cause crop failure.

Q1’2003-Q4’2003: The weather returned to normal with the start of increasing rainfall again. However, the price of CPO decreased in line with the increase in soybean production in Brazil.

Q1’2007-Q4’2008: Great harvest caused by shifting harvest schedule in 2007 due to the dry season in the previous year.

Q3’2010-Q4’2016: Food crop commodity prices drove the increase in agricultural commodity prices. This increase was due to restrictions on wheat exports from Russia in August 2010.

Q1’2018-Q2’2019: Export performance of plantation commodities (CPO, rubber) improved, driven by demand and prices.

Q3’2019-Q4’2019: The decline of commodity prices due to the trade war and the occurrence of forest fires in 2019, with a total area of up to 900 thousand hectares.

Q1’2017-Q4’2017: The occurrence of rice harvest failure due to pests and drought in the Java Island area.

Q1’2020-Q2’2021: Increased prices and demand for plantation and fishery commodities. Improved weather conditions after the dry season in 2019.
Figure A.1.
Event Analysis of Six Main Sectors’ GDP Growth Cycle (Continued)

GDP Growth Cycle: Wholesales & Retail Trade, Repair of Motor Vehicles & Motorcycles

Q1 2001-Q4 2001: Public consumption was still limited as a result of the crisis in 98/99.
Q1 2003-Q4 2003: Trade growth was slightly restrained due to a decline in foreign tourists due to the travel warning.
Q1 2005-Q4 2005: The impact of the increase in fuel prices in 2004 which pushed up inflation and suppressed people’s purchasing power.
Q3’2017-Q2’2019: The global financial crisis (GFC) impacted the domestic market through trade channels (commodity prices slowed down). Inflation increased significantly while export import activity slowed down as global demand declined.
Q3’2011-Q4’2012: The increase in world oil prices prompted the adjustment of fuel prices. Inflation has increased which impacted people’s purchasing power.
Q1 2014-Q2 2015: The adjustment of fuel prices follows the increasing world oil prices, which impacts people’s purchasing power.
Q3’2019-Q2’2020: The COVID-19 pandemic was responded to by restricting mobility and suppressing demand and production activity. Non-conventional recovery policies are taken by the Government and related authorities to reduce the impact of the COVID-19 pandemic.
Q3’2020-Q2’2021: Relaxation of mobility restrictions, distribution of social assistance, distribution of VAT incentives for vehicles, and relaxation of restrictions on shopping center operations.
Q1 2002-Q4 2002: Improvement in consumption driven by demand for goods from the manufacturing industry and controlled inflation as an impact of political stability.
Q1 2004-Q4 2004: Increase in public consumption driven by an increase in minimum fares and demand for vehicles.
Q1’2006-Q4’2006: Distribution of direct cash assistance (BLT) to poor households with distribution for 12 months as compensation for the increase in fuel prices.
Q3’2009-Q2’2011: Distribution of direct cash assistance (BLT) to increase people’s purchasing power as a result of the financial crisis in the US.
Q1’2013-Q4’2013: Policy for direct distribution of assistance (BLSM) in response to the re-escalation of fuel prices.
Q3’2015-Q3’2019: Improved economic conditions are driven by improved retail performance and improved production of agricultural products and the processing industry.

Q1’2001-Q4’2001: Public consumption was still limited as a result of the crisis in 98/99.
The Dynamic of Indonesia’s Sectoral Economic Cycles

Figure A.1.
Event Analysis of Six Main Sectors’ GDP Growth Cycle (Continued)

GDP Growth Cycle: Transportation & Storage

Index


Q1’2005-Q4’2007: The increase in the number of passengers was in line with improving people’s purchasing power and high competition in air freight rates.

Q1’2008-Q4’2011: The high opening of flight routes drove the increase in transportation passengers to remote areas.

Q1’2008-Q’2009: There was an increase in fuel prices in 2013 to reduce subsidies to reduce the government’s budget deficit.

Q1’2014-Q2’2015: The decrease in the number of passengers was due to the decline in public consumption because of commodity prices such as coal and crude oil.

Q1’2015-Q3’2019: Stable growth in the number of passengers was driven by positive public consumption. There is an upper limit tariff set as stated in the ministerial decree KM.72/2019

Q2’2012-Q3’2014: The increase in global commodity prices boosted business travel and people’s income.

Q2’2015-Q3’2019: Stable growth in the number of passengers was driven by positive public consumption. There is an upper limit tariff set as stated in the ministerial decree KM.72/2019

Q3’2019-Q2’2020: Long-distance travel restrictions by closing flight routes and adding health documents for travel requirements to mitigate the impact of the Covid pandemic.

Q4’2008-Q1’2011: The high opening of flight routes drove the increase in transportation passengers to remote areas.

Q1’2001-Q4’2002: Increasing the number of low-cost carriers (LCC) that can reduce operating costs and absorb more passengers.

Q2’2012-Q3’2014: The increase in global commodity prices boosted business travel and people’s income.

Q3’2020-Q2’2021: Travel relaxation was in line with the decline in cases encourages the return of mobility from the community.

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Figure A.1: Event Analysis of Six Main Sectors' GDP Growth Cycle (Continued)

GDP Growth Cycle: Construction

Q1’2001-Q1’2002: The impact of the 1997/98 crisis so that domestic demand is still slow.
Q1’2002-Q3’2004: The government increased the development of regional infrastructure. On the private side, development is supported by retail trade.
Q3’2004-Q4’2005: The realization of government projects is declining due to administrative processes.
Q4’2005-Q4’2007: The number of industrial land areas and apartments was increasing, and the ongoing development of government infrastructure projects.
Q1’2009-Q3’2011: Formation of a state-owned company by the government that helps explicitly provide funds for various infrastructure projects.
Q4’2011-Q2’2013: Weakening global economic and financial conditions also affected the demand for the construction sector.
Q2’2013-Q2’2015: The government’s strategic infrastructure project developments were accelerated to maintain future economic stability.
Q4’2015-Q4’2016: Performance slightly decreased, especially in the second semester of 2016, influenced by the fiscal consolidation process pursued by the Government.
Q4’2016-Q4’2019: The construction sector increased, driven by the growth of the domestic property market and the realization of government spending on infrastructure projects.
Q3’2020-Q2’2021: Improved domestic demand, including the construction sector.
Q4’2019-Q2’2021: Improved domestic demand, including the construction sector.
Q1’2007-Q1’2009: People’s purchasing power weakened as a result of the global financial crisis (GFC).
Q1’2009-Q3’2011: Formation of a state-owned company by the government that helps explicitly provide funds for various infrastructure projects.
Q1’2013-Q2’2015: The government’s strategic infrastructure project developments were accelerated to maintain future economic stability.
Q4’2015-Q4’2016: Performance slightly decreased, especially in the second semester of 2016, influenced by the fiscal consolidation process pursued by the Government.
Q4’2016-Q4’2019: The construction sector increased, driven by the growth of the domestic property market and the realization of government spending on infrastructure projects.
Q3’2020-Q2’2021: Improved domestic demand, including the construction sector.
Figure A.1. Event Analysis of Six Main Sectors’ GDP Growth Cycle (Continued)

GDP Growth Cycle: Mining & Quarrying

Q1'2001-Q1'2004: The decline in oil prices despite a temporary increase in 2002. The impact of Law no. 22 of 2001 concerning Oil and Gas with technical regulations that are not strict and transparent caused a decline in oil and gas production due to insufficiency in governance and national energy security.

Q1'2005-Q1'2008: The issuance of Law no. 32 of 2004 concerning Regional Governments, which decentralizes the affairs of mining, energy, and mineral resources to the regions, was still not in sync with the regulation regarding mining because it still refers to Law no. 11 of 1967 concerning Basic Mining Provisions. Oil prices fell amid increasing oil production from non-OPEC countries and rising oil reserves in OPEC countries.

Q1'2004-Q1'2005: Oil prices increased throughout 2004 due to the impact of the prolonged crisis in the Middle East, especially Iraq, which affected oil production amid high demand from the US.

Q1'2008-Q1'2012: The issuance of Article no. 4 of 2009 concerning Mineral and Coal Mining in January 2009 requires mining business holders to process and purify mining products. However, implementation has not been strict, and entrepreneurs are still exporting raw minerals. The law also imposes export duties on the export of non-processed mineral goods.

Q1'2012-Q1'2015: The global economic crisis occurred as the US economy moderated, and the European debt crisis led to a decline in commodity prices such as aluminum, nickel, and tin, and a decline in export demand.

Q2'2010-Q2'2011: The decline in prices and demand for Indonesian mining commodities, especially from China and other developing countries. Oil prices fell in line with falling world oil prices and demand after Iran increased its production and over-supplied oil.

Q1'2015-Q2'2018: The recovery in commodity prices, including world oil and coal, and the emergence of global demand for commodities, has led to an increase in the mining sector’s performance.

Q3'2015-Q3'2018: Domestic mining commodity prices are still fluctuating amid declining world commodity prices, the risk of the end of the commodity supercycle period, and the impact of the Fed’s reduced monetary stimulus, which has also dominated commodity price movements.

Q4'2014-Q2'2015: The recovery in commodity prices, including world oil and coal, and the emergence of global demand for commodities, has led to an increase in the mining sector’s performance.

Q3'2018-Q3'2020: Decreased production at oil refineries that are still operating (while waiting for the refinery revitalization program with an operation target in 2021). The implementation of the coal conservation policy, which is the mandate of the 2015-2019 Medium-Term Development Plan (RPJM) and is regulated in Presidential Regulation No. 22 of 2017 (concerning the General National Energy Plan (RUEN)) so that coal production decreases. Implementing the ban on the export of low-grade nickel ore began on January 1, 2020. The COVID-19 pandemic was responded to by restricting mobility, thereby suppressing demand and production activity.

Q1'2012-Q4'2012: The global economic crisis occurred as the US economy moderated, and the European debt crisis led to a decline in commodity prices such as aluminum, nickel, and tin, and a decline in export demand.

Q1'2001-Q1'2004: The decline in oil prices despite a temporary increase in 2002. The impact of Law no. 22 of 2001 concerning Oil and Gas with technical regulations that are not strict and transparent caused a decline in oil and gas production due to insufficiency in governance and national energy security.

Q1'2005-Q1'2008: The issuance of Law no. 32 of 2004 concerning Regional Governments, which decentralizes the affairs of mining, energy, and mineral resources to the regions, was still not in sync with the regulation regarding mining because it still refers to Law no. 11 of 1967 concerning Basic Mining Provisions. Oil prices fell amid increasing oil production from non-OPEC countries and rising oil reserves in OPEC countries.

Q1'2004-Q1'2005: Oil prices increased throughout 2004 due to the impact of the prolonged crisis in the Middle East, especially Iraq, which affected oil production amid high demand from the US.
Table A.1. Phase Duration of Aggregate GDP and Six Main Sectors’ GDP Growth Cycle

This table reports duration of the growth cycle phase of the aggregate GDP and six main sectors, which are (i) manufacturing industry; (ii) agriculture, forestry, and fisheries; (iii) wholesale and retail trade, repair of motor vehicles and motorcycles; (iv) transportation and storage; (v) construction; and (vi) mining and quarrying. Value represented in quarter, processed using CACIS-OECD software.

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Peak and Trough (Month)</th>
<th>Duration (Quarter)</th>
<th>Current Phase and Duration of Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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