Cyclicality inherent in oil price movement

Present low levels may represent a major medium to long-term shift. Prices may remain weak for the immediate future

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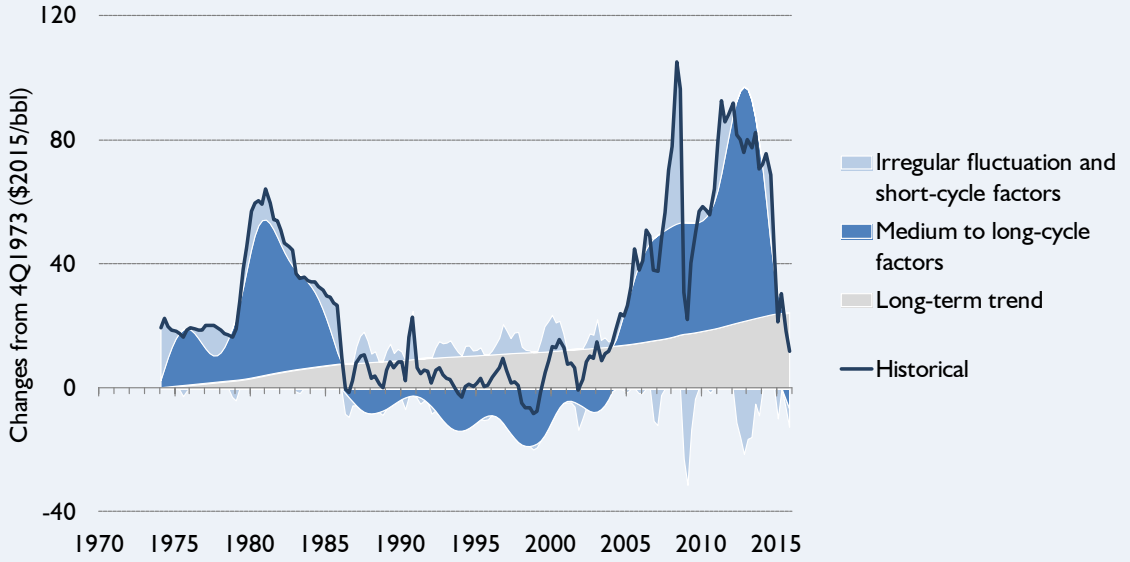
Summary

Many people are interested in the present trend and future course of oil prices. Among them are some people who compare the latest plunge with the rapid falls in the 1980s and in the second half of 2008. They attempt to make some findings by referring to past trends or looking into some cyclical factors. This paper uses a similar approach to analyse the situation facing oil price. This means that this paper analyses whether cyclical factors are behind the present low oil price and projects a broad future trend over the next several years.

The logarithmic rates of change for real oil price between the first oil crisis and 2015 indicate that the present prices' correlation with levels seen six to seven years or 12 years ago are as strong as that with levels several quarters ago. Factors behind such correlation may include oil demand changes accompanying economic changes, cyclical financial and capital changes such as credit cycle changes, and rises and falls of crude oil supply expansion projects.

As real oil price fluctuations are decomposed into several cyclical factors, medium to long-cycle factors with a cycle of four years or more are found to have made great contributions to price fluctuations since the mid-2000s. However, conditions since the mid-2000s have not been constant. The irregular fluctuation and short-cycle factors played great roles in the oil price spike and plunge in 2008. In contrast, the medium and long-cycle factors have made remarkable contributions to the latest oil price plunge. This means that the present weakness of oil prices may represent not only a temporary price adjustment but also a medium to long-term stage shift.

Figure | Decomposition of real oil price fluctuations



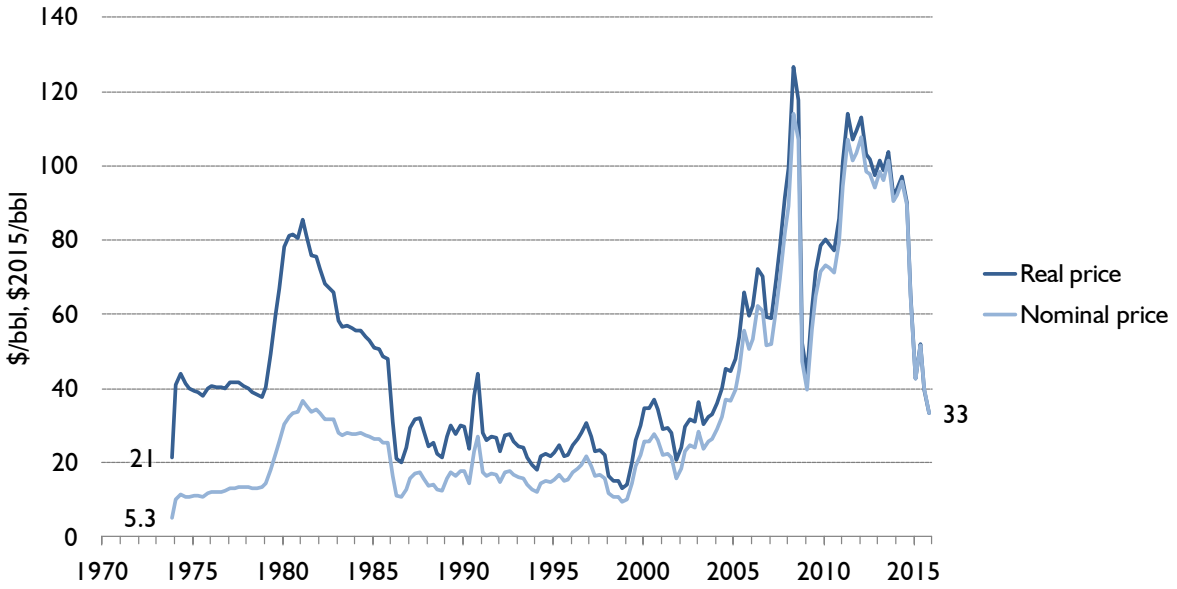
In a projection to anticipate a broad trend, where contributions by the irregular fluctuation factor are eliminated and each cyclical factor's fluctuation is boldly assumed to post no major change from the past one, the oil price is estimated to basically stay unchanged at the 2015 level of $42/bbl or even lower than the level over the next two years.

Keywords: oil price, cyclicality, cycle

As Brent slips below $30/bbl for the first time in 12 years, its future course attracts attention

The benchmark Brent crude oil price plunged from an average $112 per barrel in June 2014 to less than $30/bbl briefly in early 2016 and has remained weak[1]. Some people describe the plunge as a price collapse, while others explain the phenomenon only as representing a setback to levels in the early 2000s. Whichever view is acceptable, many people are now interested in the present and future trends of oil prices. This is because the rapid oil price drop is seen as coupled with a U.S. interest rate hike and a slowdown in emerging economies to bring about instability in financial markets.

Figure 1 | Oil prices



Note: The price represents the import FOB price in the United States. The gross domestic product deflator has been used to convert nominal prices into real ones. The data for 4Q2015 are estimates.
Sources: Computed from data from the Energy Information Administration and Bureau of Economic Analysis

When oil prices remained around $100/bbl until the first half of 2014, some oil analysts reportedly said that oil prices had lost or reduced their cyclicality. At present, however, analysts are looking to the similarity between the rapid drop since the second half of 2014 and the plunge in the 1980s or comparing the latest plunge with the steep decline in the second half of 2008. They are attempting to get some clue to the future course of oil prices by referring to past oil price plunges and looking into the cyclicality of oil prices.

This paper uses such approach to analyse the oil price situation quantitatively based on long-term data. It analyses cyclical factors behind the low oil prices at present and projects a broad trend for the coming several years.

"The past does not repeat itself, but it rhymes"

First, for the real oil price[2] since the first oil crisis, this paper analyses the autocorrelation coefficient and the partial autocorrelation coefficient[3]. The autocorrelation coefficient has a very high value of 0.95 against the price in the previous quarter and gradually reduces the value against prices in earlier quarters (Figure 2). It becomes negative

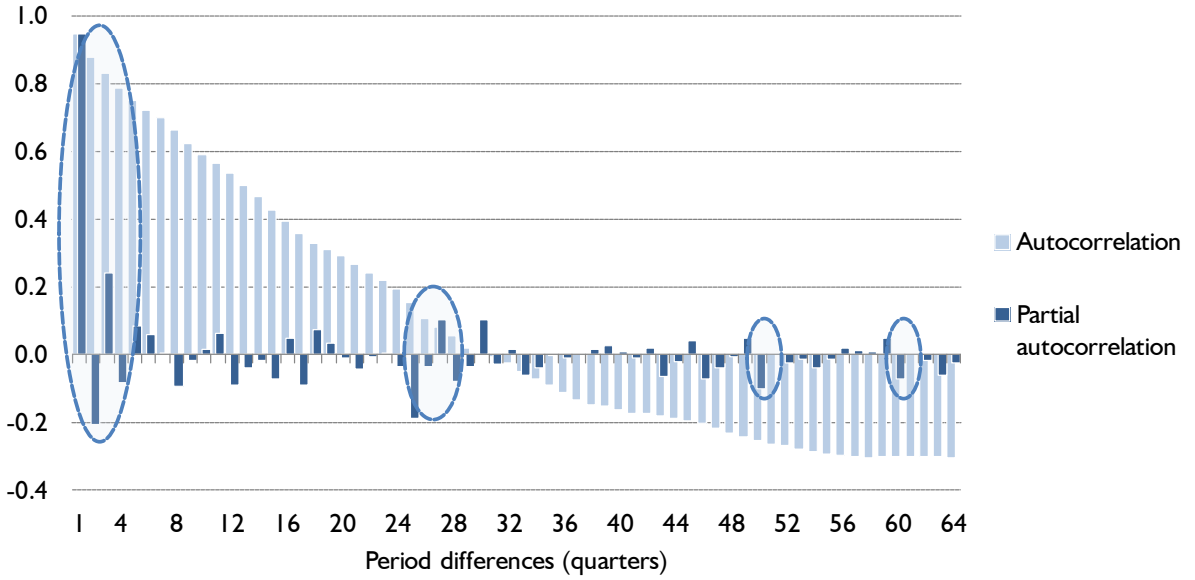
[1] Representing oil prices at present are the front-month futures contracts for West Texas Intermediate and Brent crude oil. As this paper analyses a long term since the first oil crisis, however, the following part uses the U.S. FOB import price for oil for which persistent data are available for the long term.

[2] The price represents the quarterly average. The U.S. GDP deflator (seasonally adjusted) was used to convert nominal data into real ones. Data for 4Q2015 represent estimates.

[3] The autocorrelation represents the correlation between X_T in a quarter and X_{T-t} t quarters ago. The partial autocorrelation is the correlation excluding the influence of X_{T-1}, X_{T-2}, ..., X_{T-t+1} between the two time points.

against the price level 31 quarters (seven years and three quarters) ago or earlier. The partial autocorrelation coefficient, which is used to assess a change between two time points while excluding the influences of the period between the two points, has statistically significant values against prices up to only two or three quarters ago. However, the partial autocorrelation coefficient indicates some correlation against prices 25 quarters (six years and one quarter), 27 quarters (six years and three quarters), 50 quarters (12 years and a half) and 60 quarters (15 years) ago.

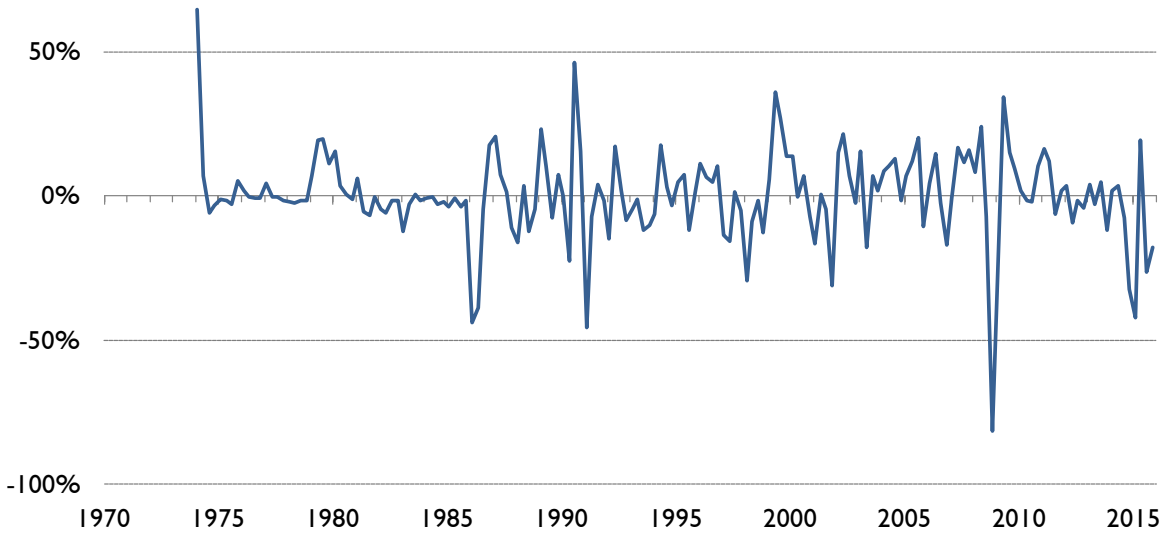
Figure 2 | Autocorrelation and partial autocorrelation coefficients of real oil prices (correlogram)



Do the autocorrelation and the partial autocorrelation coefficients indicate the cyclicality of oil price? The answer is no from the statistical viewpoint. This is because real oil price may not be stationary. These coefficients' failure to represent a real structure cannot be rejected.

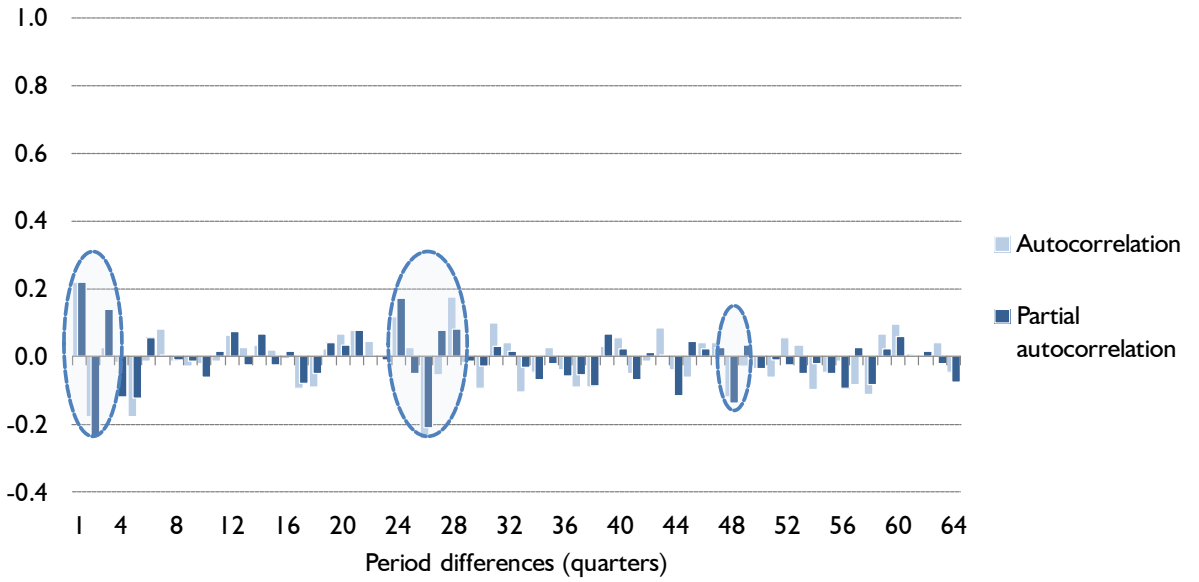
Therefore, real oil prices are converted into logs to find the difference between logs, or the logarithmic rate of change. As indicated by differences for economic data series generally, the logarithmic rates of change for oil price fluctuate very wildly (Figure 3). It is difficult to use the graph alone for determining the extent to which cyclical factors influence oil price.

Figure 3 | Logarithmic rates of change for real oil price



As done for real oil prices, the autocorrelation coefficient and the partial autocorrelation coefficient are computed for the logarithmic rates of change. As imagined easily, the two coefficients have lower absolute values than prices and indicate a lower extent of correlation (Figure 4). Not only the partial autocorrelation coefficient but also the autocorrelation coefficient approaches close to zero early.

Figure 4 | Autocorrelation and partial autocorrelation coefficients for logarithmic rates of change in real oil price (correlogram)



Even attracting more attention than such change is a finding that the present prices' correlation with levels seen 24 to 28 quarters (six to seven years) or 48 quarters (12 years) ago are as strong as that with levels several quarters ago. Factors behind such correlation may include oil demand changes accompanying economic changes, cyclical financial and capital changes such as credit cycle changes, and rises and falls of crude oil supply expansion projects consuming massive time between investment decisions and production[4]. Oil prices can be conceived as having medium to long cycles that fall short of regular repetition.

Oil price repeats wild short-term fluctuations but indicates medium to long-term cycles

What kind of cyclical factors does oil price have? How strong are such cyclical factors? The application of a frequency domain analysis as well as a time domain analysis is suitable for considering these points[5]. This is because a frequency domain analysis can decompose past oil price fluctuations into some cyclical factors. Furthermore, the results of the frequency domain analysis may pave the way for estimating how far oil price would drop or when they would turn upward. This chapter applies the band-pass filter (Box 1) to decompose oil price fluctuations into several cyclical factors while retaining the concept of time points.

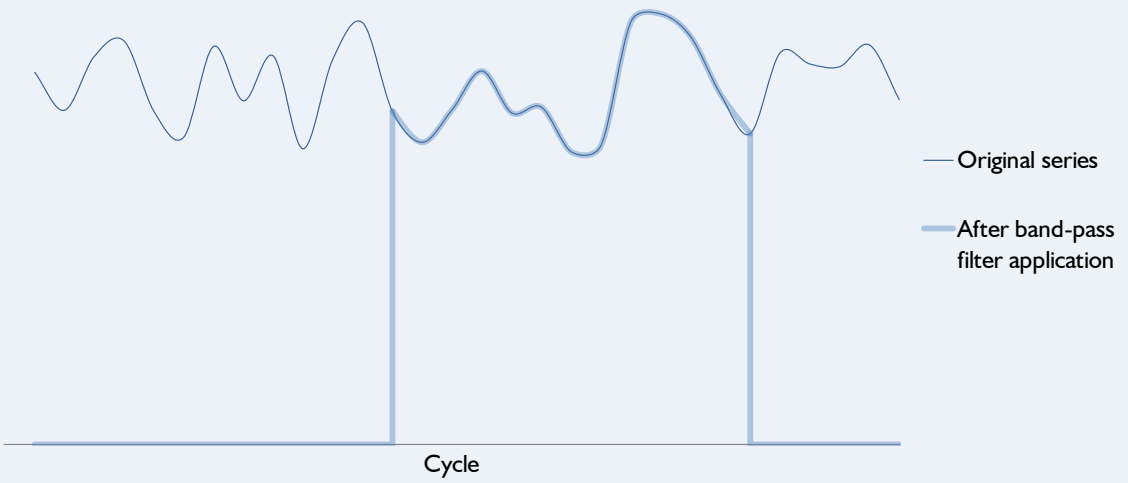
[4] For example, Koyama 2015 on "Oil supply investment under low prices and its impacts" (http://eneken.ieej.or.jp/data/6422.pdf) discusses oil prices and the supply side's investment cycle.

[5] The time domain analysis explicitly links time series data to time points. For example, the analysis is based on an economic growth rate of x% for 2015 and a rate of y% for 2016. In contrast, the frequency domain analysis considers time series fluctuations as synthesising cyclical components. In the frequency domain analysis, for example, the economic cycle is viewed as influenced by the around 40-month Kitchin Cycle, the 7-to-10-year Juglar Cycle, the 15-to-25-year Kuznets Cycle and the about 50-year Kondratiev Cycle.

Box 1 | Band-pass filter

The band-pass (band-stop) filter passes (stops) frequency components within a band and stops (passes) other components. The filter can be used for time series data to extract cyclical factors that have some specific cycles. The application of the band-pass filter is illustrated in Figure 5.

Figure 5 | Image of band-pass filter application



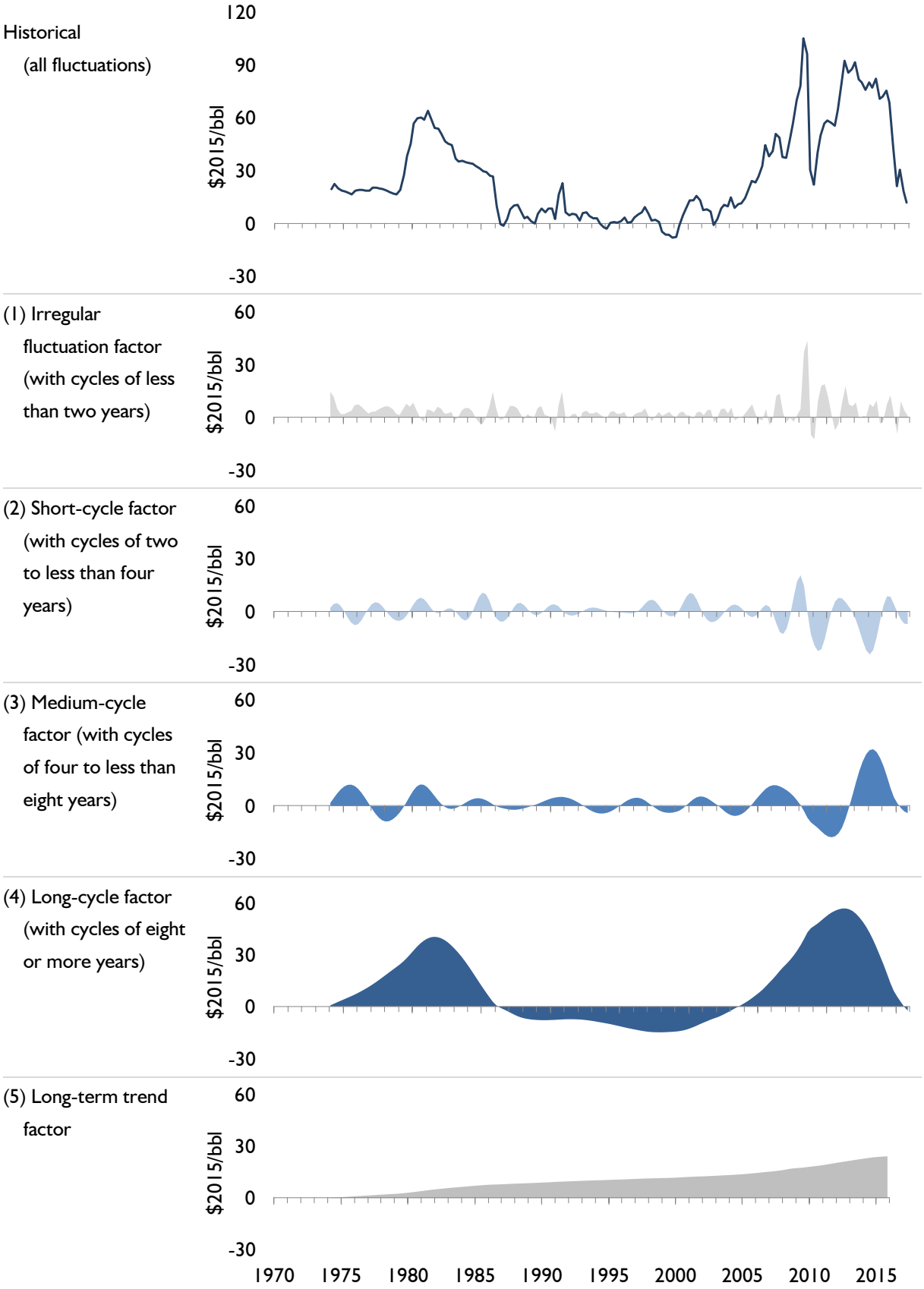
The role of the band-pass (band-stop) filter can be analogised when vuvuzela sounds (with a frequency of 233 Hz or its overtone) are eliminated for live television or radio coverage of football games or when the blue light (with a wavelength of 380 to 500 nm) for a liquid crystal display is cut.

Here, the logarithmic rates of change for real oil price between 1974 just after the first oil crisis and 2015 are decomposed into several factors. Specifically, the rates are decomposed into five factors – (1) the irregular fluctuation factor with cycles of less than two years, (2) the short-cycle factor with cycles of two to less than four years, (3) the medium-cycle factor with cycles of four to less than eight years, (4) the long-cycle factor with cycles of eight or more years and (5) the long-term trend factor given in a linear trend.

The analysis results indicate that each factor made great contributions to the spikes and plunges in oil price since the mid-2000s (Figure 6). While the indication looks like an ordinary one at glance, attention must be paid to the great contributions of the medium to long-cycle factors.

Conditions since the mid-2000s have not been constant. The irregular fluctuation and short-cycle factors played great roles in the oil price spike and plunge in 2008. In contrast, the latest oil price plunge, though being a short-term phenomenon like the previous one, is attributable to not only the irregular fluctuation and short-cycle factors but also the medium and long-cycle factors. This means that the present weakness of oil prices may represent not only a temporary price adjustment but also a medium to long-term stage shift.

Figure 6 | Decomposition of real oil price fluctuations (changes from 4Q1973)

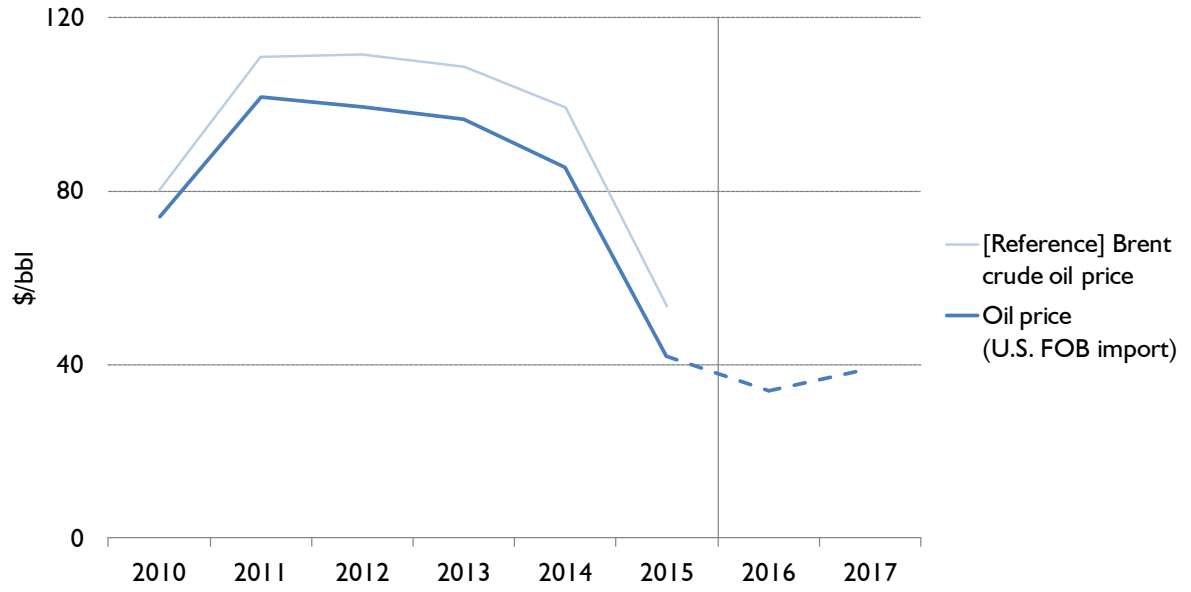


Note: Each factor projected with the logarithmic rate of change is converted into a price level. The real oil price for 4Q1973 is $21/bbl.

There is no crystal ball to predict oil price, but…

It is difficult to predict oil price. If medium to long-term moves are making considerable contributions to the latest plunge and unless any new event dramatically changes the situation, however, it may be natural to expect oil price to remain weak rather than staging any rapid rally in the immediate future. In a projection to anticipate a broad trend, where contributions by the irregular fluctuation factor are eliminated and each cyclical factor's fluctuation is boldly assumed to post no major change from the past one[6], the oil price is estimated to basically stay unchanged at the 2015 level of $42/bbl or even lower than the level over the next two years.

Figure 7 | Future trend of oil price



Note: The future trend is projected on an annual basis, with contributions by the irregular fluctuation factor eliminated.

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[6] Given the preconditions for the frequency domain analysis used for this paper, the assumption is rather bold.