UNDERSTANDING CYCLICAL BEHAVIOR OF CRUDE OIL CONSUMPTION AND PRODUCTION AND THEIR EFFECT ON CRUDE OIL PRICES

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Overview

Heavy disruptions of the global oil market occur with considerable regularity. Among the manifold examples are the two oil crises, the OPEC collapse, the 1990/1991 oil price hike, the 2008 oil price surge and, finally, the currently observed oil price collapse. Every one of these disruptions has led to heated debates in both the public and academic arenas. Considerable effort has been made to understand both the macroeconomics and the behavior of oil prices, and this work is well justified for at least two reasons. First, crude oil is still an important economic input factor and there is a widespread notion that virtually all economic recessions are associated with increases in oil prices. Second, crude oil is a fossil resource, the combustion of which is one of the main drivers of climate change.

A striking feature of data on crude oil production, consumption and prices is that changes in crude oil prices are considerably larger than changes in both crude oil production and consumption. Among the most prominent explanations for this behavior are certainly low short-run demand and supply elasticities, as well as political influences (see, e.g., Smith, 2009; Hamilton, 2009).

This paper empirically analyses cyclical behavior of crude oil production and crude oil consumption and attempts to explain their influence on crude oil prices. Preliminary results suggest that a stronger correlation between long-run components of these two variables exists in certain periods only: during the early 2000s as well as between 2008 and 2013. Those periods are characterised by a relatively high degree of crude oil-price stability.

Methods

This paper employs univariate and multivariate frequency domain techniques in order to study the relationship between crude oil production and consumption; for a detailed introduction into these methods, see e.g. Chatfield (2003). The spectral density function of a stationary process is defined as the Fourier-transform of the autocovariance function of the process. A consistent estimate of the spectral density is obtained by calculating the periodogram which is defined as the finite Fourier transform of the autocovariance coefficient and, then, applying the Daniell smoother. In order to avoid discontinuity at the end of the data, often a certain percentage of data is tapered. Spectral densities are evaluated at frequencies which can be translated into cycyle lengths in months. The coherency is a frequency-domain correlation measure based on the cross-covariance function of two stationary stochastic processes. The cross-spectrum of this process is then defined as the Fourier transform of the cross-covariance function.
This complex function consists of a real part referred to as co-spectrum, and a complex part referred to as quadrature spectrum. The coherency is a function of the elements of the cross-spectrum and the spectra of the individual processes.
The data used in this paper is from EIA. Period of observation is 1996-2015, data frequency is monthly, and all variables have been de-trended.

Results

Preliminary results clearly indicate that the correlation between crude oil production and consumption varies across frequencies. A particularly strong correlation is found to exist for frequencies up to 20 only. This corresponds to cycle lengths of 6 months and longer. In order to investigate if this relationship is changing over time, rolling samples are used: The full sample is split into a large number of subsamples each consisting of 50 observations. It is evident that higher correlation between the long-run components is only found to exist in subsamples ending between 2004 and 2007 as well as between 2010 and 2013. These periods are characterised by a relatively high degree of crude oil-price stability.

Conclusions

The results indicate that there is a drifting-apart of crude oil production and consumption which leads to extreme oil price reactions. Due to very long planning horizons it should be assumed that these factors together will have long-run consequences. Recent micro level research suggests that there is a relationship between oil price increases and exploration activity - and not crude oil production (Mauritzen, 2015; Anderson et al., 2014). In addition to that, research dating back to the 1990s by Miller and Zhang even shows that there is an effect even if an oil price increase is only temporary. High oil prices in a certain period are likely to result in higher crude oil production in the future; the opposite holds if oil prices are low. Unexpected changes in demand for crude oil will in consequence lead to extreme reactions of crude oil prices. There seems to be a fundamental change in the global crude oil market and it is not unlikely that we will observe some extraordinary oil price episodes in the future as well.

References

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