

RESEARCH NOTE

# Crude Oil Price Futures and Stock Markets Returns: What Do Their Correlations Tell Us?

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**Abstract:** With the increasing recognition that oil price shocks are just symptoms of more fundamental shocks happening in the global crude oil market, it has become imperative to know what drives oil price changes at a particular time period. This note illustrates how we can use the correlations between stock prices and crude oil futures prices in assessing whether the current oil price movement is driven by supply- or demand-related shocks. This note also offers potential implications of crude oil price shocks on ASEAN economies.

**Keywords:** crudeoil, price shocks, stock market returns

**JEL Classifications:** E31, O13, P42, Q43

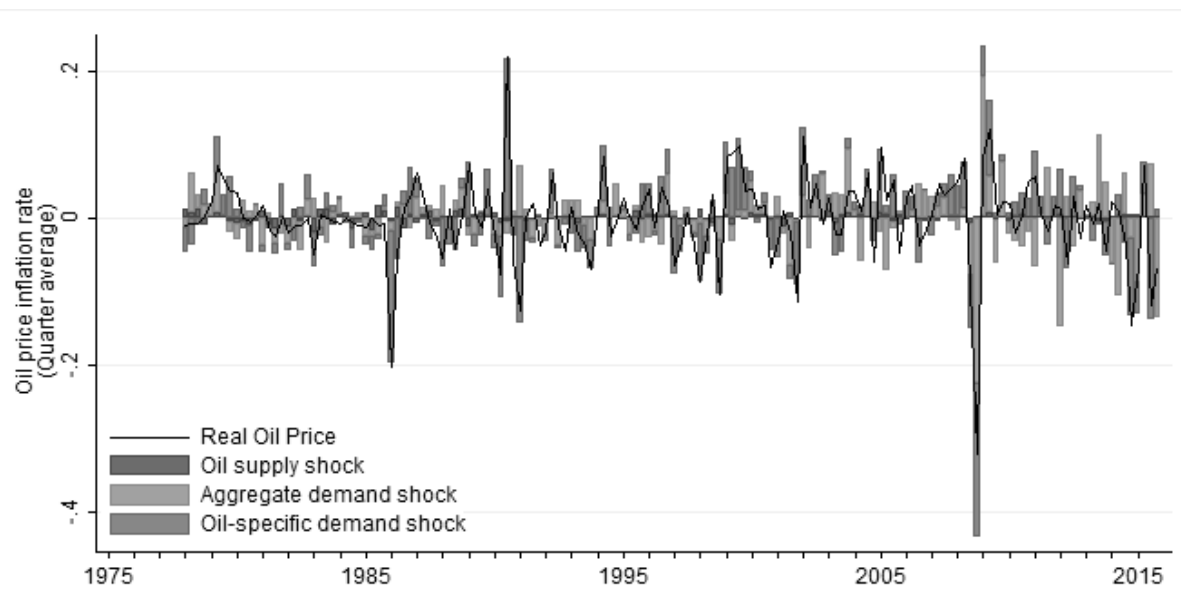
## Overview

For the past three years, oil prices have been volatile. For example, crude oil prices rose to about \$52/barrel in October from \$49.82/barrel in September 2017. These prices are more than twice the 13-year low of about \$27/barrel in January 2016. In June 2015, oil prices were at \$60/barrel. Dramatic oil price movements, such as the ones above, may have huge economic implications on different countries depending on their dependence on oil and related energy sources. It is, therefore, crucial that we all have a good understanding of the dynamics of these price fluctuations with greater emphasis on what causes these oil price movements and on their potential impact on key variables of interest.

In the past, most of the oil price shocks concurred with war-driven oil production shortfalls and geopolitical uncertainties in oil-exporting countries, which prompted researchers to regard oil price shocks

as exogenous (Hamilton, 1983; Guo and Kliesen, 2005; Melichar, 2013; Rahman & Serletis, 2010). However, there is an increasing recognition that oil price shocks are associated not only with shocks to the current physical availability of oil but also with unanticipated changes in the aggregate demand and some (Barsky & Kilian, 2004; Kilian, 2009; Kilian & Murphy, 2014). The different drivers of oil price changes and their relative strengths have implications on how researchers evaluate the influence of crude oil price changes to macroeconomic aggregates, particularly because different shocks have been found to have varying impacts on key macroeconomic variables. It is therefore important to identify the underlying demand and supply shocks in the global crude oil market to help us determine how macroeconomic aggregates are affected by different shocks influencing oil price changes (Kilian, 2009).

More recently, Kilian (2009) proposed a vector autoregression (VAR)-based model to extract the



Source: Brucal and Abrigo (2016).

**Figure 1.** Historical decomposition of global oil price changes, 1976-2015.

underlying structural innovations behind each oil price shock. The model uses monthly data of global crude oil production, an index of real economic activity derived from the bulk dry cargo shipping rate index developed by Kilian (2009) and a proxy to global crude oil price, which can be measured in terms of the US refiner's acquisition cost of imported crude oil. The estimated structural shocks<sup>1</sup> can be multiplied with the estimated average immediate and lagged shock impacts over time to get the relative contribution of each shock to the overall movement of the global crude oil price. Following Burbidge and Harrison (1985), Brucal and Abrigo (2016) provided a recent example of how this method is implemented using global oil production data and prices from the US Energy Information Administration (EIA) and the real economic activity index from Lutz Kilian's database for the period 1976-2015 (see Figure 1). It should be noted that real supply shocks and concerns about the future supply of oil relative to demand (i.e., oil-specific demand shocks) are more relevant in the 1980s to late 1990s, while aggregate demand shocks seem to explain at greater level more recent crude oil price fluctuations.

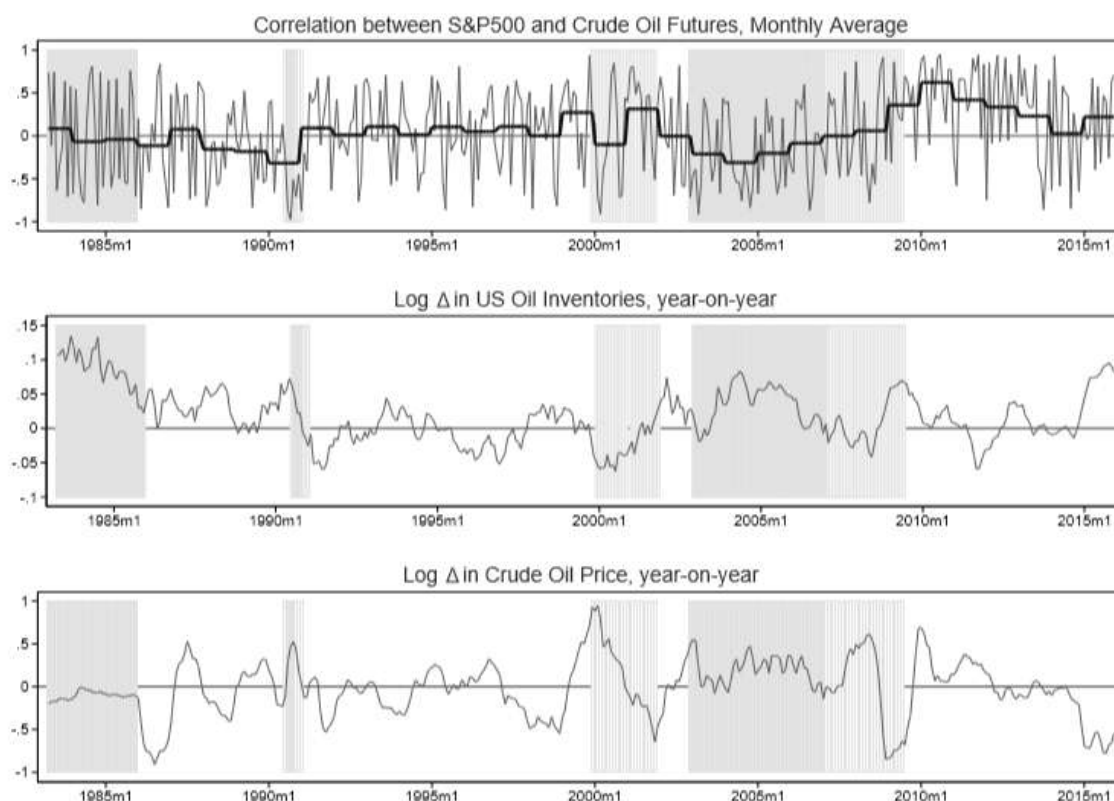
In this note, we make use of a simple method that can identify the relative strength of demand- and supply-related shocks in influencing oil prices. This

simple method exploits variations in the correlation between crude oil price futures and stock market prices over time. We validate our findings by verifying its consistency with notable historical events characterizing global crude oil market since the 1980s. We find that our findings are consistent with these events. Contrary to common belief, we find that more recent crude oil price shocks are driven by innovations in aggregate demand.

## Crude Oil Price Futures and Stock Markets Returns

In general, crude oil futures and stock prices are negatively correlated because of their opposite exposure to unexpected inflation. Gorton and Rouwenhorst (2006) explained that unexpected inflation is associated with supply shocks, which is bad news for stocks. In contrast, commodity futures represent a bet on future price as well as foreseeable trends in commodity prices. Unexpected inflation causes market participants to revise their estimates of future expected inflation. This can raise crude oil futures, causing them to move in opposite direction with stock prices.

In a 2016 post by Ben Bernanke at Brookings Institute, he found that the correlation between stock



*Note: The gray vertical bars represent oil supply shocks while the bluish vertical bars are oil demand shocks. The shocks are a collection of historical accounts collected from Kilian (2009), Hamilton (2013) and National Bureau of Economic Research (NBER) list of US Economic Recessions. All prices are in current USD. Crude Oil Futures are based on Cushing, OK Crude Oil Future Contract, expressed in US\$/barrel.*

*Data Sources: Energy Information Administration, 2017; Yahoo Finance, 2017 and Author's calculations.*

**Figure 2.** Correlations between S&P 500 and crude oil futures, changes in US oil inventories and crude oil price, 1983-2015.

price and oil over the past five years, although volatile, is positive on the average. He postulated that the positive relationship might arise because both variables respond to underlying shifts in global aggregate demand. Since stock prices are positively correlated with expectations about future economic growth and crude oil prices are determined by prospects about aggregate demand and news about future oil output, we can only expect a positive stocks-oil price relation when these variables respond to a common factor (i.e., aggregate demand). Moreover, crude oil futures are a combination of expectations about future prices as well as the risk premium that investors want to earn. Hence, futures prices can all the more move negatively with stock prices when there are increased uncertainties (and risk aversion) in the future.

To verify that this relationship is not just a recent phenomenon, we look at the monthly correlation between S&P 500 and crude oil futures between 1983 and 2015, the period in which a number of oil price shocks were identified by Hamilton (2013) and US recessions occurred as recorded in the National Bureau of Economic Research (NBER). We combine year-on-year changes in US oil inventories and imported crude oil prices to see if these variables can give more information on what drives oil inventories. The top panel of Figure 2 summarizes the relationship between S&P 500 prices and crude oil futures prices from 1983 to 2015. The gray line corresponds to monthly correlation, while the blue line denotes the annual average correlation. The middle and bottom panels illustrate year-on-year log-transformed differences

in US oil inventories and imported crude oil prices, respectively. The gray vertical bars represent oil supply shocks while the bluish vertical bars are oil demand shocks.

In the figure, the periods 1991, 2003-2005, and 2009 experienced increases in oil inventories, and are associated with periods of oil price shocks or during a major US recession. More interesting is that while these events have the same effect on demand for oil inventories, the correlation between stock prices and crude oil futures are different, which might suggest the relative dominance of factors influencing expectations on future demand and future supply of oil. For instance, in July 1990, US entered into a recession, but this coincides with the start of the first Gulf War in August that lasted until October. This event brings strong negative correlation, even before the collapse in the supply of oil in Iraq and Kuwait and as tensions rise about the potential spill-over effect to Saudi Arabia. Oil inventories went up as traders respond to future uncertainties. Crude oil spot price spikes as a result of the Iraqi invasion of Kuwait in early 1990. The sudden shift of correlation towards the end of 1990 is in line with the short lived oil supply crisis, as Saudi Arabia uses its excess capacity to restore production to the levels prior to the conflict, while the effect of 1990 US recession started to wind down.

The period between 2003 to end of 2007 is characterized by an increasingly negative correlation between stock and futures prices. This period coincides with a series of political turmoil that may have brought uncertainties in the future supply of oil, starting from Venezuelan unrest in late 2002 and the second Gulf War in mid-2003. While Hamilton (2013) argued that the disruptions only influence a very small portion of global oil supplies, the uncertainties in future supply prompted traders to increase oil inventories, while prices remain generally stable except for the short uptake in the beginning of 2003. Starting in February 2007, stock-oil futures correlation becomes positive, in line with increasing demand and stagnant oil supply (Hamilton, 2013). This period coincides with declining inventories and increasing oil price. Then the US went into a recession in December 2007. During this time, there is an unusually high positive correlation between crude oil futures and price, suggesting that they are responding to a common factor—declining aggregate demand, as Ben Bernanke put it. Correlation remains positive until 2014 when it is almost zero. This is

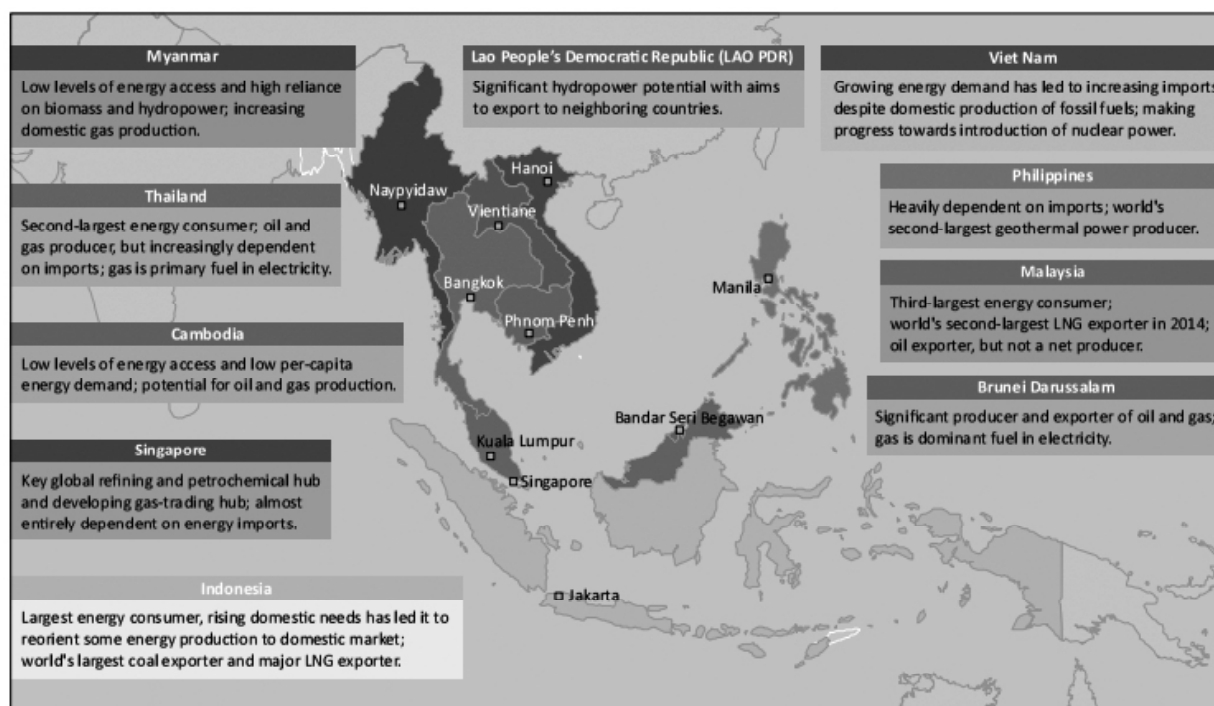
the period when the US had unprecedented high oil production and demand for oil remained low. These stylized facts confirm that the correlation between stock prices and crude oil futures can be used to determine if increases in inventories are driven mostly by expectations about future oil demand or foreseeable conditions in the supply of oil.

Overall, the results presented above confirm that real oil supply-related shocks have been relatively less relevant in explaining more recent oil price fluctuations. This is consistent with previous studies employing more sophisticated methods and contrary to widely accepted view that the recent oil price declines have been driven largely by the glut attributed to the surge in US shale gas production. In particular, we find another evidence to support that the recent price decline is due to slowing global demand for industrial commodities.

### Implications for the ASEAN Economies

The fact that global crude oil price shocks are driven by different structural innovations in the global crude oil market implies that ASEAN policymakers in these economies must carefully take into account the underlying causes of the shocks in devising a monetary or fiscal response. As Kilian (2009) has postulated, the economic consequence of supply-driven shocks is different from those that are primarily driven by fluctuations in the global aggregate demand. In general, an unanticipated disruption in global crude oil production can cause a cost push, which may entail inflationary pressures and output stagnation. Unanticipated increases in aggregate demand, on the contrary, have a positive income-growth effect and a negative effect due to inflationary pressures (Kilian, 2009). Thus, whether a monetary policy is tightened in ASEAN economies in response to higher oil price should depend on each source of oil shock.

Moreover, ASEAN countries are heterogeneous in terms of their reliance on crude oil, principally due to the differences in economic makeup, amount of oil reserves, and presence of alternative energy sources (see Figure 3). The difference in the extent of reliance of these economies to crude oil has implications on how different structural shocks (which drive global crude oil prices) can influence each ASEAN economy. For example, a negative shock in oil may contract



Source: Fatih, B. (2015).

**Figure 3.** Energy overview of Southeast Asian Nations.

net-importing economies such as the Philippines and Singapore but may spur economic growth to oil exporters such as Brunei Darussalam.

Furthermore, the increasingly integrated economies of ASEAN bring in both opportunities and challenges in dealing with global crude oil price shocks.<sup>2</sup> With states interacting with each other through factor mobility (e.g., capital movement or labor migration) and cross-border trade, it is likely that an oil-price-driven economic shock to an ASEAN economy may have a spill-over effect on another. This means that the direct effect of an oil price shock may be attenuated or amplified depending on the economy and its neighbors' relative reliance on oil. The situation becomes more complex with the ASEAN being a signatory to five Free Trade Areas (FTAs) - one each with China, Korea, Japan, Australia and New Zealand, and India. In 2016, China held its position as ASEAN's largest external trade partner. This means that the effect of oil price shock on China may also have an indirect economic effect on ASEAN economies through changes in demand for ASEAN exports (and vice-versa).

Overall, this note raises some issues for further research from which policymakers can draw meaningful policy implications. Future studies should look into how these structural shocks are influencing ASEAN economies while taking into account differences in economic structure as well as the interaction amongst ASEAN economies and between ASEAN and its external trade partners. If warranted, ASEAN may need a more concerted and coordinated economic policy response to support continued growth amidst global crude oil price shocks.

## NOTES

<sup>1</sup> For a more detailed discussion on these structural shocks, see Kilian (2009).

<sup>2</sup> Total trade in ASEAN stood at US\$2.22 trillion in 2016, of which 23.48% constitutes an intra-regional trade. Meanwhile, Foreign direct investment inflows amounted to US\$96.72 billion of which intra-ASEAN FDI inflows make up for 24.76%.

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