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Volatile oil and the U.S. economy

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ABSTRACT

Volatile oil prices have been an interesting topic for both market participants and policy makers. While several studies have attempted to test the interaction between oil price shocks and the economy, there is limited research evaluating the impact of oil price volatility on the U.S. economy. This study attempts to provide a relatively complete picture through testing for the interactions between oil prices, macroeconomic variables and other shock variables commonly used in the literature. In addition, we show that Brent oil prices contain more information in predicting macroeconomic variables than the West Texas Intermediate oil prices. Econometric methods utilized here help evaluate the interactions from the short-run, long-run and volatility transmission perspectives. Our results show that not only oil prices significantly impact the U.S. economy, but the volatility of those prices also spillover to a significant portion of the macroeconomic variables.

1. Introduction

Between 2007 and 2009, during one of the worst recessions since the Great Depression, the US GDP went down three percent, unemployment rate went up to almost 10%, and S&P500 went from 1500s to low 600s. While the USD/EUR exchange rate went up to $1.50, Brent oil price jumped to $140 from $70 in a 14 month period and then came down to low $40s at the beginning of 2009. In late 2014, oil prices plummeted again to a 6-year low which had detrimental effects on some of the largest capitalization firms in the stock market.

Although there is a significant move towards alternative energy sources (Nelson et al., 2014), oil prices are expected to dominate the markets for a long time. The annual amount of oil needed by United States is almost 7 billion barrels (US Energy Information Administration, 2015) of which 28% is imported from Canada and 13% is from Saudi Arabia. While the reliance on foreign oil declined since peaking in 2005, for the time being, the United States still relies on foreign sources for oil. Although it might seem that a reduced reliance on oil imports could dampen its effects on the economy, most economists agree that not to be the case (Brown and Huntington, 2015).

Several studies have found significant relationships between oil prices, international economies and equity markets (Uri and Boyd, 1997; Ugur et al., 2009; Oladosu, 2009; Gormus et al., 2014; Abbas et al., 2014). In 2008, using Hamilton's (2003) model, which is originally based on Hamilton's 1983 study, Kliesen tested the relationship between changes in oil prices and GDP growth. Using the Chicago Fed National Activity Index, a forecasting exercise was conducted to assess the potential impact of oil prices on future economic activity. While the findings were promising, which we discuss below, a more

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complete further extension of that study would definitely contribute to the ongoing debate about the relationship between oil and economic activity. In our paper, we aim to do that by testing the variables through methodologies which allow for short-run and long-run interactions as well as volatility transmissions. We also use a more comprehensive approach in variables which include additional macroeconomic and asset market shock variables commonly used in the literature today. We believe that, our findings will shed light on these economically and politically important relationships.

There are several reasons why an increase in oil prices may actually be detrimental to an economy. First, oil being the major energy source, has low short-run price elasticity. In other words, people cannot easily switch from oil to other energy sources due to price changes. Although the elasticity may change over the long-run, the definite fact is that economies cannot get away from oil in the near future. This brings out potential for either direct or indirect effects of oil prices on the economy. Second, dramatic increases in the oil prices actually may raise uncertainty about the future. We know that future expectations is part of the IS/LM model and has direct effect on investment activities. In addition, higher oil prices can push market players, who rely on oil as the main energy source, to allocate more resources for oil to compensate for this price increase. Thus, they have to cut from something else in order to maintain buying the amount of oil they need. Several studies in the past were able to show the impact of oil price changes on economic activity including financial market performance.

Financial markets, being significant players in the economy, are heavily tested against oil-price shocks. Sadorsky (2001) used a multifactor model to evaluate the impacts of oil prices, the exchange rate and interest rates against the expected returns of Canadian oil and gas industry stocks. The tests suggested that the oil and gas industry were significantly impacted by the shock variables. Evaluating the impacts of oil prices on the US stock market, Chiou et al. (2008) found an asymmetric/unidirectional relationship between oil prices and the S&P 500 Index. A multi-national study (including Canada, England, Japan and United States) conducted by Jones and Gautam (1996) showed that oil price volatility and price shocks have a significant impact on the real stock returns. Testing the oil, unleaded gasoline, and heating oil futures prices against the US trade-weighted exchange rate, Li (2011) found mixed results. While co-integration among most of the variables were detected, impulse responses and Granger causality test suggested that the US exchange rate does not have a relationship with energy prices. Mohanty (2011) tested the relationship between oil prices and the US transportation sector. The Fama–French–Carhart four-factor model showed that oil price exposure is not identical for all firms. In particular, their financial policies, diversification activities, hedging strategies and cost structures are critical factors in their response to oil prices.

Oil-price related studies have been an important niche in academic research; dating back to at least 1974 (Brown and Yücel, 2002). While many researchers made important attempts in modeling oil-price behavior, Hamilton received some of the most attention. In a highly regarded article, Hamilton (1983) found that oil shocks were a contributing factor to some of the US recessions prior to 1972. In that article, Hamilton, using Granger causality tests, not only looked at the relationship between oil price shocks and aggregate economy, but specifically the impact on unemployment, prices, wages, money and import prices as well. Several responses to Hamilton's study were written throughout the years. In particular, Lee et al. (1996) showed that during times when the oil prices are erratic and volatile, oil price returns have a greater impact on real GNP. Furthermore, they showed that adjustment costs can cause asymmetric responses to oil price shocks. In another response, Darrat et al. (1996) showed that the variables used in Hamilton's study were not stationary and suggested unit-root tests before employing any variable in the model. They also highlighted the need for adding the interest rates and the use of a more comprehensive methodology. Using a Vector Autoregression (VAR) model to account for the methodological problems they identified in Hamilton's study, Darrat et al. (1996) found that oil price shocks are not a major cause of US business cycles. Kliesen (2008) extended the study conducted by Hamilton (2003) and found that the oil price changes have effects on GDP growth and inflation. In addition, the author also attempted to forecast the potential impact of oil prices in the future and showed that the effects of oil-price shocks are short-term and have significant impacts on consumer expenditures and inflation. Emphasizing the difference between the demand and supply-side shocks for oil, Kilian (2008, 2009) showed not only the source of the shock to be important, but also demonstrated external economic shocks (in comparison to domestic ones) to be the main drivers of prices.

While the literature has a significant component related to oil prices, it is important to note that there are two oil price benchmarks commonly used: WTI (West Texas Intermediate) and Brent prices. Typically, oil consumption in the US is thought to correspond with WTI; however, it is the overseas crude which gets utilized for most of the gasoline produced in the US Although one could assume that due to limits to arbitrage, oil prices around the world should be similar to each other, a persistent difference between Brent and WTI has emerged in recent years (Borenstein and Kellogg, 2014). In addition to stronger linkages found between Brent prices, interest rates and default cycles in the US, most of the major trading partners to the US peg their oil imports to Brent-related benchmarks (Hammoudeh et al., 2010). From the perspective of individual dynamics, Brent prices typically are known to be more volatile and converge faster to long-run equilibrium then its WTI counterpart (Choi and Hammoudeh, 2010). For these reasons, it is important to see the impact of Brent and WTI prices on the macroeconomic variables separately for our tests.

In order to reassess oil's impact on the US economy, we attempt to extend the above mentioned studies through testing the impacts of oil shocks on the economy in the short-run, long-run and from a volatility transmission perspective. We use a VAR approach and Generalized Impulse Responses for short-term tests, Granger Causality (Granger, 1969) approach for long-run tests and the Hafner and Herwartz (2006) approach for volatility spillover studies.