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Oil price shocks and uncertainty: How stable is their relationship over time?

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ABSTRACT

This paper investigates the time-varying relationship between economic/financial uncertainty and oil price shocks in the US. A structural VAR (SVAR) model and a time-varying parameter VAR (TVP-VAR) model are estimated, using six indicators that reflect economic and financial uncertainty. The findings of the study reveal that static frameworks (SVAR) do not show the full dynamics of the oil price shocks effects to the US economic/financial uncertainty. This is owing to the evidence provided by the time-varying framework (TVP-VAR), which convincingly shows that uncertainty responses to the three oil price shocks are heterogeneous both over time and over the different oil price shocks. In particular, uncertainty responses seem to experience a shift in the post global financial crisis period. Thus, the conventional findings that economic fundamentals response marginally, positively or negatively to supply-side, aggregate demand and oil specific demand shocks, respectively, do not necessarily hold at all periods. Rather, they are impacted by the prevailing economic conditions at each time period. The findings are important to policy makers and investors, as they provide new insights on the said relationships.

1. Introduction

Focusing on the US economy, the aim of this paper is to investigate the time-varying effects of oil price shocks, namely supply-side, aggregate demand and oil specific demand shocks, on economic uncertainty. The study focuses on different types of economic-wide uncertainty, which capture the different sectors of an economy, namely macroeconomic-related, policy-related, commodity-related and financial-related uncertainty. In the context of this paper we define economic-wide uncertainty as the unknown outcome in the future economic, policy and financial markets conditions of the country, when these are confronted with unanticipated shocks in oil prices.

The interest on the drivers of economic uncertainty has reemerged since the last financial crisis of 2007–09, the ongoing European debt crisis, the oil price collapse since 2014 and more recently the Trump's victory in the US elections and the Brexit vote in the 2016 UK's referendum (see, *inter alia*, Bloom, 2009; Baum et al., 2010; Bachmann et al., 2010; Popescu and Smets, 2010; Antonakakis et al., 2013; New York Times, 2016; Bloomberg, 2017; Caggiano et al., 2017).

Interestingly enough, though, the literature has remained relatively silent on the effects of oil prices on economic-wide uncertainty, despite the ample evidence on the effects of oil prices (i) on the economy since the 1980s and the seminal paper by Hamilton (1983), as well as (ii) on the financial markets, since the seminar paper by Jones and Kaul (1996).[1] The wealth of literature has established that oil prices affect the wider economy, via their influence on productivity, inflation or unemployment.[2]

Nevertheless, examining the effects of oil prices on economic uncertainty is rather important, given the effects of the latter to the wider economy, as established by Bernanke (1983), Marcus (1981) and Rodrik (1991) among others. More specifically, examining the sources of economic uncertainty is of major importance as the latter affects the business cycle through its influence on economic activity (Pindyck, 1990; Bloom, 2009; Kang et al., 2014; Visco, 2017), either via household consumption decisions or firm investments decisions. Put it simply, the higher the economic uncertainty the lower the household consumption and the

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[1] See, Sadorsky (1999), Park and Ratti (2008), Filis (2010), Cunado and de Gracia (2014), Angelidis et al. (2015), Boldanov et al. (2016) and Antonakakis et al. (2017), among many others.

[2] See, *inter alia*, Hamilton (1988, 1996), Hooker (1996), Abel and Bernanke (2001), Lee and Ni (2002), Hooker (2002), Bernanke (2006), Hamilton (2008, 2009), Lippi and Nobili (2012).

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higher the delays in capital investments. The impact of oil price shocks on investment uncertainty is also documents by more recent studies, such as those by Elder and Serletis (2010), Ratti et al. (2011) and Rahman and Serletis (2011). Although the focus on this paper is to identify the direct effects of oil price shocks on economic-wide uncertainty, we should not lose sight of the fact that these effects might propagate indirectly via the inflation, production or even the size of the public sector channels.[3] The examination of these indirect channels, though, falls beyond the scope of the current paper.

Turning our attention to the linkages between oil prices and financial-related uncertainty, the literature is extremely scarce. It is only Degiannakis et al. (2014) who provide evidence that oil price shocks exercise an effect on stock market volatility. The channel by which these effects are materialized is based on the fact that unanticipated changes in the prices of oil lead to abrupt fluctuations in the future firms' cash flows, which then lead to higher uncertainty about the firms' stock prices. Under the valid assumption that most listed firms will be impacted by such unanticipated oil price changes, we maintain that oil price shocks lead to higher stock market volatility.

Finally, there is an emerging strand in the energy finance literature which is motivated by Filis et al. (2011), Degiannakis et al. (2013), Broadstock and Filis (2014), Bekiros et al. (2015) and Aloui et al. (2016), among other, that show time-varying spillover effects between the aforementioned oil price shocks and economic policy uncertainty. For instance, Antonakakis et al. (2014) report that the aggregate demand oil price shocks mainly lead to a reduction in economic policy uncertainty, whereas oil specific demand shocks and supply-side shocks do not exhibit any strong spillover effects.

Against this backdrop, we maintain that it is important to extend the studies by Kang and Ratti (2013), Bekiros et al. (2015), Aloui et al. (2016), and Kang et al. (2017) and to assess how oil price shocks could also trigger changes in other sources of economic-wide uncertainty, such as commodity-related and macroeconomic-related, rather than solely on economic policy and financial uncertainty, which is the main focus of the existing literature. This paper aims to fill this void.

The contribution of this paper can be described succinctly. First, it adds to the limited empirical findings on the linkages between oil price shocks and several economic-wide uncertainties. Second, we investigate for the first time in the literature whether the responses of these economic-wide uncertainty indicators to the three oil price shocks are time-varying. Put it simply, this paper analyses the effects of the different oil price shocks on a wide range of uncertainty measures in a Structural VAR framework, both constant and time-varying. To do so, this study concentrates on six key US economic uncertainty indicators for the period January 1994 to March 2015 and uses a structural VAR (SVAR) model, as well as, a Time-Varying Parameter VAR (TVP-VAR).

Our results can be outlined as follows. The responses of the uncertainty indicators to the three oil price shocks, as these were estimated by the SVAR model, reveal that oil supply shocks do not exercise any significant impact on uncertainty indicators. Furthermore, we find that the two demand-side oil shocks trigger lower uncertainty. More importantly, though, through the TVP-VAR model we show that impulse responses of the uncertainty indices to the three oil price shocks are not constant over time, but rather they vary over time. The time-varying impulse responses show that uncertainty indices exhibit heterogeneous responses to all three shocks, as well as, during different time periods. More specifically, we show that the behaviour of responses changes in the post global financial crisis period, suggesting a shift in the relationship between oil shocks and uncertainty indicators.

The rest of the paper is structured as follows. Section 2 describes the data employed in this study, whereas Section 3 details the methodology. The empirical findings of the research are presented in Section 4, whereas Section 5 summarizes the results and concludes the paper.

2. Data description

In this study we employ world oil production (in thousand barrels, PROD), Lutz Kilian's global real economic activity index (GEA)[4] and Brent crude oil price returns (ROIL), which are used for the construction of the three oil price shocks (supply-side, aggregate demand and oil specific demand shocks). We also use six measures of economic and financial uncertainty in the US, which capture macroeconomic-related (JMU), policy-related (EPU), commodity-related (OCV and ORV) and financial-related (EMU and VIX) uncertainty.

More specifically, we use (i) Jurado's et al. (2015) *macroeconomic uncertainty index* (JMU), which expresses the common volatility of the unforecastable components of 132 macroeconomic indicators; (ii) The *Economic Policy Uncertainty Index* (EPU), which is constructed based on three components, i.e. newspaper articles of the ten largest newspapers of the US, the temporary provisions of the tax code expiration of the US and the factor of disagreement between the opinions of economic forecasters. Thus, EPU combines the different sources of uncertainty which are linked to the policy making and political conditions in an economy, without explicitly considering the country's macroeconomic fundamentals; (iii) The *Equity Market Uncertainty Index* (EMU), which is based on an automated text-search process from Access World News's NewsBank service news articles that contain terms related to “uncertainty”, “economy”, “stock price” and “equity market”; (iv) The *Implied Volatility Index of S&P500* (VIX), which is often characterized as the “fear index” and it is the leading measure of market expectations of the implied volatility of S&P500 index options over the upcoming 30-day period; and (v) the *Conditional Oil Price Volatility* (OCV), which is a measure of commodity uncertainty. We approximate commodity-related uncertainty with the oil price volatility, given that oil is one of the most important traded commodities in the world and one of the most important production inputs. For this particular uncertainty indicator, we construct an additional oil price volatility series (vi), namely the *Realized Oil Price Volatility* (denoted as ORV) for robustness purposes.[5] The usage of these two volatility series is justified by the fact that realized volatility is a more precise and less noisy estimator, according to the literature (e.g. Andersen and Bollerslev, 1998), but it requires no-freely available data for its construction, which are not always available to researchers. On the other hand, the conditional volatility is a widely applied and accepted volatility estimator and requires daily data.

All data span from January 1994 to March 2015 and they are in monthly frequency, with only exception the data used for the OCV and ORV. The EPU and EMU have been extracted from Baker et al. (2016).[6] In addition, Brent crude oil prices and the world oil production are obtained

[3] For instance, recent literature shows that when there is an increase in the price of oil, this causes inflationary pressures and lower household consumption in an oil-importing country, which forces the monetary authority to face a trade-off of either stabilizing inflation or output gap, leading to higher uncertainty (Natal, 2012; Montoro, 2012). In addition, El Anshasy and Bradley (2012) claim that higher oil prices lead to greater government size for the oil-exporting countries. Nevertheless, an increased size of the public sector raised issues in terms of the efficient operation of the government, as also emphasized by Antonakakis et al. (2014), leading to further economic uncertainty. Along a similar vein, Kang and Ratti (2013), Antonakakis et al. (2014) and Kang et al. (2017) maintain that policy-related uncertainty is also affected by oil price shocks. This is rather expected based on the aforementioned transmission channels. For instance, the trade-off that the monetary policy is faced with in the case of oil price increases, leads to both uncertainty in terms of the outcome in the real economy, as well as uncertainty as to whether policy decisions will be successful in stabilizing the economy.

[4] The Kilian's index became popular selection for the real economic activity worldwide as it captures business cycle fluctuations in global base about commodity markets of industrial sector and is used by many authors such as; Apergis and Miller (2009), Baumeister and Kilian (2014) and Alquist and Kilian (2010), among others.

[5] We have also considered the volatility of the CRB Commodity index and the results remain qualitatively similar.

[6] In more details, the US policy uncertainty index appears at http://www.policyuncertainty.com/us_monthly.html and the equity market uncertainty index appears at http://www.policyuncertainty.com/equity_uncert.html.