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What do we know about oil prices and stock returns?

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ABSTRACT

This paper is a survey of research on how oil prices affect stock returns. In the last couple of decades there has been an upsurge in such research, suggesting that a stock take is timely. The sheer volume of research on the interaction between oil markets and stock markets has meant that we have lost track of the key findings from the literature. The danger, in the absence of a stock take, is that we will produce a large volume of studies on how oil prices interact with stock returns without them having any real impact on the profession. This paper is a response to this concern. It highlights the key themes researched, main findings and, equally importantly, identifies key challenges and suggests an agenda for future research on the interaction between oil prices and stock returns and oil prices and the financial sector more generally.

1. Introduction

Three-to-four decades ago the only thing we really understood about the oil market was its role in contributing to recessions in the United States (see Hamilton, 1983). In the period since, a large literature has emerged that studies the effect of oil price changes on a range of macroeconomic variables (see e.g. Bachmeier, 2008; Cunado & Perez de Garcia, 2005; Hamilton, 2003; Lee & Chiu, 2011a, 2011b; Lee, Lee, & Ning, 2017). Beginning with Jones and Kaul (1996), who found that oil prices had a negative association with stock returns in Canada, Japan, the United Kingdom and United States, a subset of this literature has examined how changes in oil prices influence stock returns. The 2008 surge in oil prices, when, for the first time in history, oil prices reached the US$100 per barrel mark, ignited massive interest in oil market research.[1] The oil price concern, coupled with the almost simultaneous onset of the global financial crisis (GFC), focused attention on global financial systems (Gkanoutas-Levantis & Nesvetailova, 2015). A specific point of focus was on how the GFC affected the manner in which oil prices influence stock market returns (see, among others, Balcilar, Gupta, & Miller, 2015; Mollick & Assefa, 2013; Mohaddes & Pesaran, 2017; Tsai, 2015). The last decade, in particular, has seen a proliferation in studies examining various aspects of this relationship. In *Energy Economics*, alone, there have been almost 70 articles published since 2008 on the relationship between oil markets and stock markets.[2]

This survey primarily focuses on studies published since the 2008 oil price crisis. We do so for three reasons: first, most of the important studies on the topic have been published in the last decade; second, the oil price crisis increased volatility in oil prices, which provided motivation for empirical studies; and third, as a practical matter, we had to keep the survey manageable. Given the large volume of studies on the interaction between oil prices and stock returns, we thought it important to focus on the most important research. We follow Narayan and Phan (2018), in their survey of Islamic finance research, and primarily focus on journals ranked A or above in the Australian Business Deans Council (ABDC) journal rankings as a filter on journal quality.[3] There are dual reasons for adopting this approach. One is that it recognises quality matters and the other is that articles appearing in lower ranked journals constitute, in large part, applications of methods developed and published in the higher ranked journals.[4]

Our focus journals were the leading journals in energy economics (*Energy Economics*, *Energy Journal*, *Energy Policy*, *Resource and Energy Economics*, *Applied Energy*), important finance journals that regularly

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[1] The fact that the oil price reached US$100 per barrel for the first time in history generated interest in terms of understanding whether US$100 constituted a psychological barrier in the market and how, if at all, investors reacted to this new price (see Narayan & Narayan, 2014; Narayan, Ranjeeni, & Bannigidadmath, 2017).

[2] In addition to the 2008 oil price crisis providing the impetus, a number of other factors have contributed to the surge in studies on this topic, including an increase in availability of data, improved econometric methods for handling financial data and a scale effect generated by the volume of papers published in leading energy and applied economics and finance journals (see Broadstock & Filis, 2014).

[3] A* and A journals on the ABDC list constitute 27.7% of all journals in business and economics see http://www.abdc.edu.au/pages/abdc-journal-quality-list-2013.html.

[4] We emphasise that articles published in ABDC A* and A journals since 2008 was the *primary* focus of articles we collected for review. In the course of reading the literature we identified some articles published before 2008 and published in lower ranked journals that have been influential and we also include these in our review.

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publish research on energy finance (*Emerging Markets Review*, *International Review of Financial Analysis*, *Journal of Banking and Finance*, *Journal of Behavioral Finance*, *Journal of International Financial Markets Institutions and Money*, *Journal of International Money and Finance*, *Pacific Basin Finance Journal*) and important general economics journals that regularly publish research on energy finance (*Applied Economics*, *Economic Modelling*). We searched each of these journals for relevant studies published since 2008. In addition, we did more general searches using the major databases, such as EconLit, to identify relevant articles published in other journals since 2008. This process garnered a large volume of studies. Following this, we identified further important articles published before 2008 and, in a few cases, in lower ranked journals from an initial reading of the articles we had collected. Overall, we identified well in excess of 100 studies concerned with various aspects of how oil prices influence stock returns, with the biggest share of these, and many of the seminal articles, appearing in *Energy Economics*. Our review includes studies either published, or in press but available electronically, up to the end of 2017.

A feature of the literature is its complexity, both in terms of breadth of coverage and, increasingly, range of econometric methods employed. As Koh (2017, p. 2) notes:

"The methods employed in the literature … vary, ranging from regression analysis, linear and non-linear time series analysis, vector autoregression (VAR) models that assume exogenous oil price changes without distinguishing between oil and demand shocks, to VAR models that explicitly account for the source of oil price shocks".[5]

To this, we would add, some studies focus on aggregate stock returns, while others consider the relationship between oil prices and sector-level returns or oil prices and firm-level returns. Moreover, most of the earlier studies failed to distinguish between whether the country in which the stock market was located was an oil importer or oil exporter or whether the firm, or sector in which the firm was located, was an oil consumer or producer, both of which have been the focus of more recent studies. Similarly, more recent studies have considered the effect of the level of competition on the transmission of oil prices to stock returns and how external events, such as terrorism and wars, affect how oil prices affect stock returns.

The main purpose of this survey article is to take stock of what we have learned from this vast, and growing, literature on how oil prices interact with stock returns. Having identified the main research themes in this literature, we seek to highlight the gaps in the literature and point to areas of research in which this literature could be fruitfully moved forward. We organise the balance of the paper as follows. Section 2 provides a review of the literature and identifies the major emerging themes. The main focus of this section is to provide an understanding of what we have learnt from the extant literature. Section 3 discusses key challenges for the literature, Section 4 identifies potential areas of future research and the final section concludes.

2. Existing literature

2.1. Theoretical relationship between oil prices and stock returns

The theoretical relationship between oil prices and stock returns could be positive or negative. Following the theoretical justification proffered by Jones and Kaul (1996), most of the literature has sought to test the cash flow hypothesis, which states that asset values are determined by expected discounted cash flows (Fisher, 1930; Williams, 1938). The cash flow hypothesis suggests that there could be a negative or positive relationship between oil prices and stock returns. Two channels imply a negative relationship. First, because oil is a major input for most firms, higher oil prices increase the cost of production, reducing future cash flows, earnings and dividends and, hence, stock returns. Second, higher oil prices can lead to an overestimation of expected inflation and higher nominal interest rates. Because interest rates are used to discount expected future cash flows, this will depress earnings, dividends and, hence, stock returns. A third channel suggests a positive or negative relationship. Oil price volatility can influence the effect of sensitivity of changes in oil prices on the risk premium component of the discount rate and on cash flow through demand side consequences. Depending on the sign of the risk premium, that may vary widely across firms and time, sensitivity to oil prices can have a positive or negative effect on oil prices.

Another possible reason for a positive association between oil prices and stock returns is, as Kollias et al. (2013, p. 744) note, "investors may well associate increasing oil prices with a booming economy. Thus, higher oil prices could reflect stronger business performance and the concomitant impact on stock markets". Along these lines, Hamilton (2009a) argues that, prior to the GFC, rising oil prices reflected growth in developing markets and high levels of business confidence. Chen, Cheng, and Demirer (2017) suggest that oil price volatility and stock market momentum are positively correlated. Using China as a case study, they suggest that this relationship is driven by time-varying investor sentiment, in which investors respond to oil return volatility associated with uncertainty through putting upward demand pressure on winner stocks,

Kilian and Park (2009) show that the response of stock returns to oil prices can be positive or negative, depending on the nature of the shock: demand shocks, resulting from uncertainty about future oil supply shortfalls, generate a negative relationship between oil prices and stock returns, while higher oil prices, resulting from an unanticipated global expansion, has a positive effect on stock returns. They argue that at the beginning of the business cycle there will be a positive correlation between oil prices and stock returns, reflecting that strong demand for industrial commodities drives up both oil prices and stock returns. However, in the longer-term, the oil-stock price relationship can be expected to turn negative. Using a two-stage Markov-switching approach, Zhu, Su, You, and Ren (2017) also finds that the relative importance of demand and supply shocks varies between low and high-volatility regimes. However, Ciner (2013) argues the positive correlation can be surprisingly persistent. As Ciner (2013, p. 13) writes: "oil price increases do not always suggest negative stock returns. In fact, *prolonged periods* of joint increases in oil and stock markets may be observed" (emphasis ours).

2.2. Oil prices and aggregate stock returns

Most of the earlier literature focused on the effect of oil prices on aggregate stock returns for specific countries or groups of countries. Overall, the majority of such studies have found a negative relationship (see e.g. Basher, Haug, & Sadorsky, 2012; Basher & Sadorsky, 2006; Chen, 2009; Driesprong, Jacobson, & Matt, 2008; Filis, 2010; Gjerde & Saettem, 1999; Jones & Kaul, 1996; Kling, 1985; Papapetrou, 2001; Park & Ratti, 2008; Sadorsky, 1999). However, some studies have found a positive relationship (see eg. Narayan & Narayan, 2010; Silvapulle, Smyth, Zhang, & Fenech, 2017; Zhu, Li, & Li, 2014; Zhu, Li, & Yu, 2011). There are also studies for which results are mixed or found no relationship between oil prices and stock returns (Apergis & Miller, 2009; Cong, Wei, Jiao, & Fan, 2008; Hatemi, Al Shayed, & Roca, 2017; Huang, Masulis, and Stoll, 1996; Miller & Ratti, 2009; Reboredo & Rivero-Castro, 2014).

There are several reasons for these mixed results, which we explore in more detail below. One is that most of these studies do not explicitly consider heterogeneity in the extent to which firms captured in the aggregate index stand to gain or lose from oil price changes. As Mollick and Assefa (2013, p. 2) put it, "there is no reason why oil prices should impact aggregate indexes uniformly since a stock index is a combination of firms that may profit or lose in response to oil price fluctuations". Second, the mixed results can be explained, in part, by

[5] References omitted from the quotation.

heterogeneity in the level of oil dependence among firms on stock markets across countries. A major reason why the majority of studies that have looked at the relationship between oil prices and aggregate stock returns have found them to be negatively related is that most have focused on the United States and other major oil importing countries, such as Canada, Japan and most of the European countries in which one would expect the cash flow hypothesis to be more supported. Third, many of the studies, and all of them before Kilian and Park (2009), fail to consider the nature of the shock. Fourth, most of these studies fail to consider that the oil price-stock return relationship exhibits time variation and those studies that do (e.g. Jammazi & Aloui, 2010; Miller & Ratti, 2009) tend to find a negative relationship between oil prices and stock returns before 1999, that either becomes unstable and disappears or becomes less pronounced in the new millennium, possibly reflecting bubbles in the market.

2.3. Do oil price shocks have asymmetric effects on stock returns?

Several studies have found that increases/decreases in oil prices have asymmetric effects on macroeconomic variables (Mork, 1989) and fuel prices (Bacon, 1991). Most of the earlier studies on the relationship between oil prices and stock returns assumed that the underlying variables exhibited a linear and symmetrical adjustment process (Zhu et al., 2011).

Wan (2005) provides a theoretical justification for why oil prices may have asymmetric effects on stock returns. He suggests that the optimal decision for listed companies is to only pay their shareholders a dividend when their expected present value is above a certain threshold. An increase/decrease in oil prices could either push the expected present value of future cash flows below the threshold or let the firm pay a higher dividend. If an increase in the oil price pushes the expected present value below the threshold, the firm will elect not to pay dividends and face a decline in stock prices, while if the oil price falls, the firm will pay a higher dividend, which will likely lead to a higher stock price. Wan (2005) suggests that the negative impact of the former will be greater than the positive impact of the stock price rise. There is also the possibility of an indirect asymmetric effect through the discount rate if the monetary authority responds differently to oil price rises and falls in managing interest rates (Salisu & Isah, 2017).

There is mixed empirical evidence that oil prices have asymmetric effects on stock returns. Some studies have found that price rises have larger effects on oil returns than price rises (see e.g. Aggarwal, Akhigbe, & Mohanty, 2012; Arouri, 2011; Asteriou & Bashmakova, 2013; Basher & Sadorsky, 2006; Kang, Ratti, & Vespignaniet, 2016; Kilian, 2008; Kilian & Park, 2009; Li, Cheng, & Yang, 2017; Narayan & Gupta, 2015; Phan, Sharma, & Narayan, 2015; Sadorsky, 1999). However, other studies fail to find evidence of asymmetric effects (Asalman & Herrera, 2015; Bachmeier, 2008; Cong et al., 2008; Mollick & Assefa, 2013; Nandha & Faff, 2008; Reboredo & Rivero-Castro, 2014; Reboredo & Ugolini, 2016). Tsai (2015) finds no evidence of asymmetry prior to the GFC, but finds asymmetric effects during, and after, the GFC. Ramos and Veiga (2013) find evidence of asymmetric effects in oil importing countries, but not oil exporting countries. Overall, the preferable view is that oil prices do have asymmetric effects on stock returns. Most of the studies that find to fail asymmetric effects have used aggregate stock returns. As Tsai (2015, p. 49) notes, “the aggregate stock index might mix the heterogeneous effects of positive and negative oil price shocks on individual stock returns”. There is also much evidence that the oil price-stock return relationship is characterized by nonlinearities (see Section 2.4 below), which is consistent with there being asymmetric effects between oil prices and stock returns.

2.4. How do stock returns respond to different types of oil price shocks?

Building on the seminal work of Kilian (2009), who shows that demand and supply shocks have different implications for the US economy, Kilian and Park (2009) demonstrate that an increase in the oil price has different effects for US stock returns, depending on the nature of the structural shock. They distinguish between three types of structural shocks. *Oil supply shocks* reflect unexpected changes in petroleum production. *Aggregate demand shocks* reflect changes in global demand for oil associated with the global business cycle. *Oil specific demand shocks* refer to an increase in precautionary demand due to concerns about future oil shortfalls. Kilian and Park (2009) argue that studies which do not distinguish between these demand and supply shocks will be picking up the response of stock returns to the average oil price effect and, hence, their estimates will either be biased toward finding no effect or be unstable.

Kilian and Park (2009) find that aggregate demand shocks and oil specific demand shocks are much more important than global oil supply shocks in explaining US stock returns, with oil specific demand shocks having a negative effect on US stock returns and aggregate demand shocks having a positive effect on US stock returns. The finding for oil supply shocks was consistent with Hamilton's (2009a, 2009b) work suggesting that oil supply shocks are no longer important for macroeconomic developments more generally. Kang et al. (2016) extend Kilian and Park's (2009) analysis by distinguishing between US and non-US oil production. When they do this, they find that positive US oil supply shocks associated with an increase in production since 2009 have a positive effect on US stock returns, while, in contrast to the Kilian and Park (2009) result, non-US oil supply shocks are comparable to demand shocks. Kang et al. (2016) show that the contribution of oil supply shocks and aggregate demand shocks to explaining variation in US stock returns has changed over time with aggregate demand shocks becoming more important, and oil supply shocks less important, after the GFC.

Subsequent studies for other countries have found mixed results for oil supply shocks. Some studies have found oil supply shocks have a positive effect on stock returns (Abhyankar, Xu, & Wang, 2013; Basher et al., 2012). Other studies have found that oil supply shocks have a negative effect on stock returns (Cunado & de Gracia, 2014; Gupta & Modise, 2013). Apergis and Miller (2009) find that oil supply shocks have small effects on stock returns across eight developed countries. Among the demand shocks, most of the subsequent literature has generally confirmed the Kilian and Park (2009) finding that aggregate demand shocks have a positive, and oil specific demand shocks have a negative, effect on stock returns (see e.g. Abhyankar et al., 2013; Basher et al., 2012; Filis, Degiannakis, & Floros, 2011; Gupta & Modise, 2013; Koh, 2017). Güntner (2014) applies the Kilian and Park (2009) framework to examine the effect of oil demand and supply shocks on stock returns in six OECD countries. He finds that oil supply shocks have little effect, aggregate demand shocks increase oil prices and stock returns, while the effects of oil specific demand shocks have a negative effect in net oil importing countries and a positive effect in Norway (a net oil exporter). Broadstock and Filis (2014) find that the effect of the three types of shocks on stock returns vary considerably across sectors.

2.5. The oil price-stock return relationship varies over time

Nonlinearities in the oil price-stock return relationship occur when stock returns respond to oil prices differently in periods of low and high economic volatility associated with recessions or booms. Such volatility can be caused by financial crises or external events, such as geopolitical tension or wars that alter the behavior of oil prices or stock returns (Ajmi, El-montasser, Hammoudeh, & Nguyen, 2014). Mohaddes and Pesaran (2017) find that there is no stable relationship between oil prices and stock returns in the US over the period 1946–2017. Mollick and Assefa (2013) and Tsai (2015) find that US stock returns responded differently to oil price shocks before, during and after the GFC. Miller and Ratti (2009) find that the negative long-run link between oil prices and stock returns disappears after September 1999 in international stock markets.

More generally, using primarily one of frequency domain, Markov-switching VARs, regime switching models or wavelet decomposition, several studies have found that the oil price-stock returns relationship is time-varying and non-linear and that it differs following financial and oil shocks (see e.g. Aloui & Jimmazi, 2009; Broadstock & Filis, 2014; Chang & Yu, 2013; Chen, 2009; Ciner, 2013; Daskalaki & Skiadopolous, 2011; Filis et al., 2011; Jammazi & Aloui, 2010; Kang, Ratti, & Yoon, 2015a, 2015b; Martin-Barragan, Ramos, & Veiga, 2015; Mohanty, Nandha, & Bota, 2010; Reboredo, 2010; Reboredo & Rivero-Castro, 2014; Xu, 2015; Zhang, 2017; Zhang & Li, 2014; Zhu et al., 2017). Silvapulle et al. (2017) find evidence of significant nonlinear effects in the oil-stock price relationship in oil importing countries using non-parametric panel data modelling.

Apart from financial shocks, some studies have examined the effect of other external shocks on the oil price-stock return relationship using non-linear models. Kollias et al. (2013) find that in the US and major European markets, the correlation between oil prices and stock returns was reduced, and volatility increased, following the initial stages of the two Iraq wars, but one-off terrorist incidents had little effect. Bouri, Awartani, and Maghyereh (2016) find that the effect of oil price shocks on financial and services stocks on the Jordanian stock market intensified following the Arab Spring that started in 2010. Zhang (2017) finds that the positive correlation between oil prices and stock returns on the Chinese market changed from positive to negative following the first Iraq war. In a similar vein, Bharn and Nikolovann (2010) find that following the September 11, 2001 terrorist attack, first Iraq war and civil unrest in Iraq in 2006, the relationship between oil prices and stock returns on the Russian market became negative. Cameron and Schnusenberg (2009) find that the negative association observed between oil prices and stock returns of US automobile manufacturers grew stronger following the first Iraq war.

Overall, these studies suggest that external events increase volatility in oil prices and/or stock markets, which, in turn, generate non-linearities in the oil price-stock return relationship. The market may be more efficient at absorbing the information from one-off terrorist incidents than wars (Kollias et al., 2013), although, in general, geopolitical and civil unrest intensifies the effect of oil prices on stock returns and generates a negative relationship between the two variables. One channel through this might occur is through geopolitical unrest increasing uncertainty about the future supply of oil, in which case there is a link with the literature suggesting that oil specific demand shocks tend to have a negative effect on stock returns.

A few studies have examined how large positive or negative oil price movements affect different stock return quantiles (Ding, Kim, & Park, 2016; Lee & Zeng, 2011; Peng, Zhu, Jia, and You, 2017; Reboredo & Ugolini, 2016; Sim & Zhou, 2015; Zhu, Guo, & You, 2015; Zhu, Guo, You, & Xu, 2016). These studies generally find that large positive or negative oil price movements have asymmetric effects on stock returns with a larger effect observable in the lower, compared with upper, quartiles (Peng et al., 2017; Reboredo & Ugolini, 2016; Sim & Zhou, 2015; Zhu et al., 2015). Such effects are also time dependent and influenced by financial crises and the state of the stock market. Analyzing data for three developed markets and five BRICS markets, Reboredo and Ugolini (2016) find that the asymmetric effects existed, but were limited, before the GFC, while they became much more pronounced after the GFC. Meanwhile, Lee and Zeng (2011), for the G7 markets, and Zhu et al. (2016), for China, find that the asymmetric effects of large oil price swings on lower and upper quantiles of stock returns vary across bull and bear markets.

2.6. The oil price-stock return relationship across sectors

One of the limitations of using aggregate stock return data is that it potentially masks heterogeneity in the oil price-stock return relationship across sectors (Arouri, Jouini, & Nguyen, 2012). Mature markets are more diversified so aggregate stock indices reflect the average across many sectors, while other markets are concentrated in a few industries. Hence, the overall relationship between oil prices and stock returns in studies that use aggregate stock returns is likely to depend on the sectorial composition of the market (Arouri, 2011; Asalman, 2016; Narayan & Sharma, 2011). In response, several studies now exist which examine the oil price-stock returns relationship at the sector level. Most of these are for the United States (see e.g. Elyasiani, Mansur, & Odusami, 2011, 2013; Narayan & Sharma, 2011), Europe (see e.g.; Arouri & Nguyen, 2010; Moya-Martinez, Ferrer-Lapena, & Escribano-Sotos, 2014; Xu, 2015) or the G7 economies (Lee, Yang, & Huang, 2012). Apart from China, for which there are multiple studies at the sector level (see e.g. Caporale, Ali, & Spagnolo, 2015; Cong et al., 2008; Li et al., 2017; Li, Zhu, & Yu, 2012; Peng et al., 2017; Zhu et al., 2016), there are few studies for emerging or transition markets. Perhaps the most comprehensive study, in terms of geographical breadth, is Nandha and Faff (2008), who investigated the relationship between oil prices and 35 global industry indices.

One major conclusion from these studies is that oil price rises have a positive effect on the stock returns of firms in the oil and gas sector (Boyer & Filion, 2007; Cong et al., 2008; Gupta, 2016; Li et al., 2017; Nandha & Faff, 2008; Sadorsky, 2001). El-Sharif, Brown, Nixon, and Russell (2005) finds a positive, but weak, effect of oil prices on oil and gas returns in the UK. Kang, de Gracia, and Ratti (2017) distinguish between oil supply shocks and aggregate demand shocks in the Kilian and Park (2009) framework, on oil and gas firms. Disentangling the different shocks, they find that oil supply shocks, which generate disruptions to supply, tend to have a negative effect, while aggregate demand shocks have a positive effect, on oil and gas stock returns.

A second major finding is that in industries in which oil is a major cost of production – manufacturing and transport – oil price rises generally have a negative effect on stock returns. Nandha and Faff (2008) find that oil prices are negatively correlated with the returns of manufacturing firms. In a dedicated study of the issue, Aggarwal et al. (2012) document that transportation firm returns are influenced negatively by oil price rises. Aggarwal et al.'s (2012) results are consistent with Cameron and Schnusenberg (2009), who find an inverse relationship between rising oil prices and stock returns of automobile manufacturers with most of the impact concentrated on manufacturers of SUVs. One study that reaches a different conclusion is Kristjanpoller and Concha (2016) who find that oil price rises have a positive effect on airline stock returns. While fuel represents a major cost for airlines, these authors explain their result in terms of increasing oil prices being correlated with higher economic growth and more demand for air travel. The implicit assumption is that aggregate demand shocks dominate, but it is difficult to know if this is so because the authors do not separate out the type of shock.

A third main finding is that oil prices explain movements in the stock returns of alternative energy companies (Henriques & Sadorsky, 2008) and that rising oil prices have a positive effect on the stock returns of alternative energy firms (Kumar, Managi, & Matsuda, 2012). There is some evidence that this relationship is nonlinear (Reboredo, Rivero-Castro, & Ugolini, 2017) and that it has strengthened over time (Managi & Okimoto, 2013), in particular, since the GFC (Broadstock, Cao, & Zhang, 2012).

2.7. The oil price-stock return relationship across firms

A few studies have examined the relationship between oil prices and stock returns using firm-level data (Demirer, Jategaonkar, & Khalifa, 2015; Gupta, 2016; Narayan & Narayan, 2014; Narayan & Sharma, 2011; Phan et al., 2015; Sadorsky, 2008; Tsai, 2015). Firm level data has the advantage that it allows for a higher level of disaggregation than examining across sectors and may pick up heterogeneity within sector stocks. Narayan and Sharma (2011) find that the manner in

which individual firm returns on the NYSE respond to oil price changes reflect the sector to which they belong with the results generally similar to those found in sector-level studies. Narayan and Narayan (2014) find that when the oil price reached US$100 per barrel, this had a negative effect on firm returns on the NYSE for their fall sample of almost 1600 stocks and several subsamples of stocks cut different ways. Phan et al. (2015) examine how oil process affect stock returns of oil consumers differently to oil producers at the firm level.

Several these studies take advantage of having firm-level data to examine how firm size affects the oil price-stock return relationship (Narayan & Sharma, 2011, 2014; Sadorsky, 2008; Tsai, 2015). These studies find that oil prices were more likely to be negatively related with stock returns in medium (Sadorsky, 2008) or large firms before the GFC (Narayan & Narayan, 2014; Narayan & Sharma, 2011, 2014; Phan et al., 2015). Tsai (2015), however, finds that the negative size-effect in large firms may have weakened since the GFC.

Gupta (2016) uses firm-level data from 70 countries to examine how the level of competition affects the relationship between oil prices and stock returns. He finds that oil and gas firms that are more protected from competition are less sensitive to oil price shocks. This result suggests that market power dampens the volatility of the firm-level stock return.

2.8. The oil price-stock return relationship in net oil importers vs net oil exporters

One would expect oil prices to have a different effect on stock returns in countries that are net oil exporters versus net oil importers. Oil price rises might be expected to have a positive effect on stock returns in oil exporting countries because an increase in oil prices will increase the country's income. Meanwhile, an increase in oil prices can be expected to have a negative effect on stock returns in oil importing countries, given that oil is one of the most important factors of production. Several studies have explicitly examined the oil price-stock return relationship in sets of oil importing and exporting countries (Filis et al., 2011; Park & Ratti, 2008; Ramos & Veiga, 2013; Salisu & Isah, 2017; Wang, Wu, & Yang, 2013). Other studies have focused on one or more net oil importing countries (Bouri, 2015; Cunado & de Gracia, 2014; Masih, Peters, & De Mello, 2011; Silvapulle et al., 2017) or one or more net oil exporting countries (Arouri & Rault, 2012; Bjornland, 2009; Demirer et al., 2015; Gil-Alana & Yaya, 2014; Mohanty, Nandha, Turkistani, & Alaitani, 2011; Ramos & Veiga, 2013). Consistent with expectations, these studies generally find that oil price rises affect stock returns positively in oil exporting countries and negatively in oil importering countries (Arouri & Rault, 2012; Bjornland, 2009; Demirer et al., 2015; Gil-Alana & Yaya, 2014; Mohanty et al., 2011; Park & Ratti, 2008).

A few studies have examined the effect of the different types of shocks proposed by Kilian and Park (2009) across oil importing and exporting countries (Cunado & de Gracia, 2014; Filis et al., 2011; Wang et al., 2013). The results have been varied. Focusing on just oil importing countries, Cunado and de Gracia (2014) find that oil supply shocks have a negative effect on stock prices. Filis et al. (2011) find that aggregate demand shocks have a positive effect, and oil specific demand shocks have a negative effect, while oil supply shocks have no effect, on stock prices across oil importers and oil exporters. Wang et al. (2013) find that oil supply shocks that increase petroleum production increase stock prices in oil importing countries because increased production lowers prices, while in oil exporting countries the relationship is nonlinear – stock prices initially fall, but then increase in the longer run reflecting the difference between the short-term and long-term price elasticity of oil demand. Wang et al. (2013) also find that aggregate demand shocks generally have positive effects on stock markets in oil importing and oil exporting countries and that the effects are more persistent in oil exporters.

2.9. Role of volatility in shaping the oil price—Stock returns relationship

A number of studies have attempted to understand how volatility influences the effect of oil prices on stock returns. Choi and Hammoudeh (2010) investigate whether oil price volatility affects the S &P500 index. They discover high and low volatility regimes, which they use to draw implications for investors. Using European data, Arouri and Nguyen (2010) examine volatility spillovers between oil and stock markets. Their analysis reveals strong evidence of volatility spillovers with the spillover from oil to stock markets strongest. Interestingly, their analysis shows that spillovers of volatilities among the two markets are irrelevant. The authors use this information to draw implications for hedging. These findings for Europe and the US also hold for a developing market, Ghana. Lin, Wesseh, and Appiah (2014) find strong evidence of volatility spillover and hedging effectiveness. Overall, using different methods, these findings of strong spillover effects are also found by Kang et al. (2015a, 2015b), who use a structural VAR model as opposed to the GARCH-type models used in Choi and Hammoudeh (2010), Arouri and Nguyen (2010) and Lin et al. (2014). Methodologically, Salisu and Oloko (2015) complement these studies through the introduction of structural break analysis. These authors show that structural breaks significantly influence the effect of volatility spillover on the stock market.

The role of oil price volatility on stock returns has also been documented. Elyasiani et al. (2011) show, using US sectoral data, that oil futures return volatility influences excess returns of oil user industries. Narayan and Sharma (2014) examine whether oil prices contribute to stock return volatility. They find a heterogeneous effect of oil prices on stock return volatility and show that such statistical outcomes have economic significance for investor trading behavior.

3. Key challenges

For any area of research, understanding, acknowledging and accepting the key challenges is imperative before directions for future research can be considered. The challenges that we identify are not only based on our survey of the literature, but also our experience as editors, or associate editors, of, between us, multiple social science journals, including special issues relevant directly to the theme of this survey. Therefore, in this section we seek to offer a fresh perspective on not only on the type of issues we, as a profession, face on the theme of this survey paper, but also the types of mistakes, in many cases repeatedly, committed by researchers. We associate the oil price—stock returns literature with four common types of mistakes. We argue that addressing these issues constitute the main challenges for researchers.

First, there is a general lack of attention devoted to developing the theory, or meaning, behind most empirical analyses. Most studies do not consider the economic importance of understanding how the statistical relationship between oil prices and stock returns translates into practical implications. Second, most articles, while recognising the importance of an economic story, end up speculating about the potential implications. The limitation is that these studies do not empirically show those implications. In the absence of this type of analysis, it is unclear whether or not the data used in those studies contain economic benefits for investors or policy makers. Third, there is a tendency to use new econometric techniques without understanding why those techniques are important and how those techniques connect to economic theory. These attempts have created a large body of empirical papers that add little, or nothing, to what we already know about the oil price-stock returns relationship.[6] When applying new econometric methods, it would be useful for authors to point out how their results differ from those of previous studies and to what extent

[6] See also Smyth and Narayan (2015), in which we make this point more generally for energy economics research.

those differences reflect the benefits of the new method being applied. Doing so allows the reader to ascertain the value added in the new method. Fourth, often little space is given to examining the robustness of both the economic and statistical relationship between oil prices and stock returns. This is an important part of the empirical analysis because almost the entire literature is empirical. This demands an analysis of the sensitivity of the relationship with respect to issues around data and methods.

4. Areas for future research

4.1. Combining strands of literature

The literature has developed different strands. Some studies focus on the effect of different types of oil shocks in the Kilian and Park (2009) framework; other studies examine asymmetries and nonlinearities in the oil price stock returns relationship or how it varies across sectors or between oil importing and oil exporting firms. The state-of-the-art in the literature are those relatively few studies that are attempting to marry these diverse strands.

Examples are those studies that have examined how demand and supply shocks differ across oil importers and exporters (Cunado & de Gracia, 2014; Filis et al., 2011; Wang et al., 2013); studies that have examined nonlinearities and time-varying correlation in the oil price-stock return relationship across sectors (see eg. Degiannakis, Filis, & Floros, 2013; Narayan & Sharma, 2011); studies that have linked oil demand and supply shocks with time-varying correlation in the oil price-stock return relationship (Broadstock & Filis, 2014); studies that have linked oil demand and supply shocks with asymmetries in the oil price-stock return relationship (Zhu et al., 2017); and studies that examine how the effect of oil demand and supply shocks on stock returns differ across sectors (see eg. Degiannakis et al., 2013; Elyasiani et al., 2011; Kilian & Park, 2009).

An important direction for future research are further studies that marry different strands of the literature. It has been almost a decade since Kilian (2009) and Kilian and Park (2009) pointed to the differential effects of different types of oil shocks. Yet many studies continue to be published that do not separate out these shocks, let along look at the effect of different types of shocks across different forms of markets. Ideally, future research should be looking to link three or more of the strands of literature, taking into account that (a) not all shocks are alike, (b) that the oil price stock return relationship is time-varying and (c) that the effects of oil price shocks on stock returns differ across firms and sectors. One study that does this is Degiannakis et al. (2013) who examine demand and supply shocks across sectors in a time-varying environment. The lack of conclusive evidence among those studies that do attempt to marry different strands of the literature suggest that more research is needed.

4.2. Greater use of panel data

Most studies focus on individual countries and the US in particular. There are relatively few studies that examine large numbers of countries – exceptions include Ramos and Veiga (2013) (34 countries) and Gupta (2016) (70 countries). Park and Ratti (2008), who use a sample that include the US and 13 European countries, suggest, “it is important to consider the effects of oil prices on stock prices in a number of countries in order to better identify effects that may be systematic across countries rather than country specific” (Park & Ratti, 2008, p. 2588). Yet, as Westerlund and Sharma (2018) argue, a country-by-country approach using just the time series variation for each country, without taking advantage of the cross-sectional variance across countries, is wasteful. Analyses that just focus on the time series of several countries potentially result in lower power tests and small sample bias (Li et al., 2012). There are very few panel studies (Arouri & Rault, 2012; Asteriou & Bashmakova, 2013; Jouini, 2013; Li et al., 2012; Westerlund & Sharma, 2018; Zhu et al., 2011). Each of these use parametric modelling techniques. Silvapulle et al. (2017) use a nonparametric panel data model. In future research, there is much potential to apply different types of panel data models, including nonparametric panel data models that allow for a more flexible underpinning structure.

A final point on this subject is about combining firms across countries and regions. Forming panels of firms by have greater a number of countries spanning different regions will allow the researcher to account for the different costs/revenue structures of firms in testing some of the traditional hypotheses in energy finance. Forming such panels will also be helpful in understanding how different cultures and ways of doing business (such as Islamic vs non-Islamic) impact on the manner in which stock markets behave.

4.3. Oil importers and oil exporters

The literature comparing oil importers and oil exporters can be extended in at least a couple of directions. One way to extend this literature would be to extend the net oil import/export distinction to consider oil refiners, such as Singapore. Few studies consider Singapore (Le & Chang, 2015; Silvapulle et al., 2017; Zhu et al., 2014). Yet, one would expect that in oil refining economies the intensity of oil in GDP would be higher (see Le & Chang, 2015).

Another way to extend this literature would be to consider small oil importing countries (Bouri et al., 2016). Most studies have focused on large oil importing countries. But, as Bouri et al. (2016) point out many small oil-importing countries, particularly those in the Middle East and North Africa, are more vulnerable to oil price shocks than the major industrialized countries because they are highly energy intensive and this is coupled with rapid economic growth.

4.4. Developing and transition economies

With the exception of China, for which there are many studies, there is a dearth of studies for developing countries and transition countries, in which stock markets are more embryonic. Notable exceptions focused on one or a few countries include Ghosh and Kanjilal (2016) (India); Narayan and Narayan (2010) (Vietnam); Bharn and Nikolovann (2010) (Russia); Asteriou and Bashmakova (2013) (Central and Eastern Europe (CEE)) and Mohanty et al. (2010) (CEE). There are also a few multi-country studies that have examined the effect of oil prices on stock returns for large samples of emerging markets (Aloui, Nguyen, & Njeh, 2012; Basher & Sadorsky, 2006; Gupta, 2016; Ramos & Veiga, 2013). But there remains a lack of studies for large chunks of the developing world including Africa (exceptions include Gupta & Modise, 2013; Gil-Alana & Yaya, 2014, Lin et al., 2014); Asia, other than China (exceptions include Narayan & Narayan, 2010; Zhu et al., 2014; Koh, 2017) and South America.

There also needs to be more sector-based studies across a broad sample of countries. Most such studies are country or region specific or focus on a limited set of high income countries (e.g. Lee et al., 2012). Apart from China, we know little about how oil prices affect stocks in different sectors in developing or transition countries. Exceptions are Mohanty et al. (2010) who examine the effect of oil prices on gas and oil stocks in CEE and Gupta (2016) who does likewise for a sample of emerging markets as part of his multi-country study. But beyond this, *a fortiori* the points made in Section 4.1 apply to research on the oil price-stock returns relationship in developing countries. We need more studies that bring together different strands of the literature for developing and transition countries other than China. In this respect, it is particularly important to incorporate the effect of different types of oil shocks.

4.5. Examine if results are robust to other proxies

Few studies have used other financial proxies for stock prices or

investor sentiment. Studies using such proxies can act as useful robustness check on the findings for stock prices. Related studies examine the impact of movements in oil prices on an investor sentiment index (Ding, Liu, Zhang, & Long, 2017), a financial stress index (Nazlioglu, Soytas, & Gupta, 2015; Wan & Kao, 2015) and sovereign credit ratings (Breunig & Tse, 2015). Some of these studies incorporate advancements from the oil price-stock return literature. For example, Wan and Kao (2015) allow for nonlinearities. There is much scope for more of such studies and further incorporation of insights from modelling the oil price and stock returns, including most of the points made in Section 4.1. Narayan and Narayan (2017) examine the impact news headlines concerning the oil price on stock returns. Another area for further research is to use different proxies for the oil price.

4.6. Country risk, oil prices, policy uncertainty and stock returns

The importance of policy uncertainty has recently emerged in the economic literature. One strand of this literature deals with the interrelationship between oil price, policy uncertainty and stock returns (e.g., Antonakakis, Chatziantoniou, & Filis, 2013; Kang et al., 2017; Kang & Ratti, 2013; Kang & Ratti, 2015; Naifar & Hammoudeh, 2016). As stated in Kang and Ratti (2013), oil prices and policy uncertainty are interrelated and influence stock prices through affecting expected cash flows and the discount rate. However, other important external factors, such as country risk, have not yet received attention in studies on oil price, policy uncertainty and stock returns. There are only a few studies discuss the relationship between oil price, country risk and stock returns (e.g., Mensi, Hammoudeh, Yoon, & Balcilar, 2017; Mensi, Hammoudeh, Yoon, & Nguyen, 2016) and these do not also consider policy uncertainty. Marrying these emerging strands in the literature could be an area for future research.

4.7. The role of higher order moments of oil prices

The oil price-stock returns relationship has been studied almost exclusively using the first moment of oil prices; one exception is those studies noted in Section 2.8. Those studies, however, focus on only the second moment of either stock returns or oil prices. Higher order odd or even moments (kurtosis, skewness, hyper-kurtosis and hyper-skewness) have not been considered in this literature. This constitutes an important gap in the literature, particularly so when one realizes that there are higher order moments (beyond the second order) that can matter to stock returns. This said, two caveats are in order when considering the effect of higher order moments of oil prices on stock returns. The first point is that high order moments are best modelled when using intraday data. Second, there are likely to be computational challenges in modelling the role of higher order moments. Using one-minute data on oil prices to extract higher order moments, for instance, can be computationally challenging, although it is not impossible to do so.

4.8. Oil prices and other financial instruments

The focus of the literature examining the effect of oil prices on financial markets has almost entirely been on stock returns. Kang, Ratti, and Yoon (2014) examine the impact of oil price shocks on US bond market returns, but the effect of oil prices on other components of the financial system are relatively less understood. In this regard, three different directions of research could be interesting. The first of these research areas is the role of oil prices in influencing capital structure decisions. Firm leverage (debt), and how well it is managed, is at the heart of corporate finance research. Naturally, oil prices—because they impact the cost of production and therefore influence sales and profits/losses—have implications for target leverage of firms. Yet, nothing is known about how, if at all, oil prices impact leverage.

The second literature, in which the role of oil prices is less understood is the determinants of corporate investment. In corporate finance, an attempt has been made to understand what determines corporate investment within a Tobin's Q investment model. Typically, in this model, Tobin's Q proxies for the incentive to invest and it is easy to see conceptually how oil prices (which impacts on costs of production) can affect either corporate investment directly, or indirectly, through its effects on the incentive to invest. Yet, whether or not oil prices do, in fact, influence corporate investment in this way is not understood.

The third literature relates to credit risk profiles of firms. Credit risks, reflected, for instance, in the credit default swap (CDS) spread is an important hedging instrument. There is an active literature that examines the relation between CDS and financial markets, and one missing link in this story is about the role of oil prices. Indeed, oil prices influence firms costs and revenue structures. This, in turn, changes the risk profile of firms accordingly. As risk profiles change because of oil prices, this change is reflected in the CDS spread. Oil prices, through influencing the CDS spread, can potentially effect the financial system; yet, this relation is less understood.

5. Concluding remarks

Literature surveys are important because they provide researchers with a synthesis of what has been done, and provide signposts for future research, on a topic. This survey piece articulates a stock take of studies on a popular subject of research in energy finance; namely, the oil price-stock returns nexus. We review the main streams of research on this theme, highlight the main findings and messages, identify the key challenges and propose an agenda for future directions in research on this topic. We hope that our agenda for future research will both further draw together the diverse strands of the oil price-stock returns literature and broaden the scope of the current focus on effects on the stock market to encourage further research on the relationship between the oil price and financial systems more generally.

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