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A Survey of Literature on the Interlinkage between Petroleum Prices and Equity Markets

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Abstract: The multifaceted interrelationship between petroleum prices and equity markets has been a subject of immense interest. The current paper offers an extensive review of a plethora of empirical studies in this strand of literature. By scrutinising over 190 papers published from 1983 to 2023, our survey reveals various research themes and points to diverse findings that are sector- and country-specific and contingent on employed methodologies, data frequencies, and time horizons. More precisely, petroleum price changes and shocks exert direct or indirect effects dictated by the level of petroleum dependency across sectors and the country's position as a net petroleum exporter or importer. The interlinkages tend to display a time-varying nature and sensitivity to major market events. In addition, volatility is not solely spilled from petroleum to equity markets; it is also observed to transmit in the reverse direction. The importance of incorporating asymmetries is documented. Lastly, the summarised findings can serve as the basis for further research and reveal valuable insights to market participants.

Keywords: petroleum prices; aggregate equity market returns; equity sector returns; petroleum price shocks; volatility transmission; petroleum exporters; petroleum importers

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1. Introduction

Petroleum is widely regarded as one of the critical components driving the economies of nations that export and import this strategic fossil fuel (Gupta 2008; Korhonen and Ledyaeva 2010; Demirer et al. 2015). Notwithstanding the decline in global primary energy consumption in 2021, petroleum continues to remain the major source of energy, fulfilling more than 30 percent of demand.[1] The prices of petroleum have traditionally been more volatile in comparison to those of other commodities. Any factors that cause considerable petroleum demand and supply imbalances subsequently lead to shocks in the petroleum market (Hamilton 2003; Kilian 2009; Kilian and Park 2009). The recent financialization of commodity markets resulted in a strengthened degree of interrelationship between petroleum and stock markets (Tang and Xiong 2012; Silvennoinen and Thorp 2013). Several incidents of unprecedented petroleum price fluctuations over the past two decades overlapped with analogous shifts in stock markets, thereby pointing to probable financial contagion. It is therefore unsurprising that information arising from the petroleum market is of utmost relevance to market participants.

The literature has documented different theoretical interaction mechanisms between petroleum prices and stock markets. Degiannakis et al. (2018), in their study, discuss five transmission channels, namely stock valuation, monetary, output, fiscal, and uncertainty. The present work's interest lies in the first, as it is widely regarded as a direct and crucial channel that contributes to the elucidation of the rationale for the linkage between the prices of petroleum and stocks. The valuation approaches suggest that stock prices are equal to the present value of expected future cash flows discounted by employing a required rate of return (Huang et al. 1996). Hence, factors that lead to alterations in discount rates and cash flows, as a result, affect stock prices. The cash flows of companies can be influenced positively or negatively by the price of petroleum, which is contingent in their positions as petroleum consumers or producers (Mohanty and Nandha 2011; Basher et al. 2012). Specifically, the petroleum price hikes elevate the costs of producing goods, given the unavailability of full substitution effects, and lessen expected cash flows for companies consuming petroleum (Basher and Sadorsky 2006; Smyth and Narayan 2018). However, they generally increase future cash flows for companies producing petroleum (Basher et al. 2018; Degiannakis et al. 2018). Furthermore, expected discount rates are also impacted by the price of petroleum as they tend to mirror the state of the economy (Mohanty and Nandha 2011), which is in turn sensitive to shocks in the petroleum market (Cunado and Perez de Gracia 2005; Korhonen and Ledyaeva 2010; Cashin et al. 2014; among others). Thus, swings in the price of petroleum may exercise direct and indirect effects on stock prices through their effects on cash flows and discount rates, respectively.

Ever since the studies of Hamilton (1983), Jones and Kaul (1996), and Huang et al. (1996), an extensive body of literature has emerged devoted to the investigation of the impacts of petroleum price swings on macroeconomic variables (see, among others, Burbidge and Harrison 1984; Mork 1989; Hooker 1996; Bjornland 2000; Cunado and Perez de Gracia 2003; Lardic and Mignon 2006; Korhonen and Ledyaeva 2010; Hou et al. 2016; Lorusso and Pieroni 2018) and equity markets (see, among others, Sadorsky 2001; Papapetrou 2001; Basher and Sadorsky 2006; Nandha and Faff 2008; Miller and Ratti 2009; Narayan and Narayan 2010; Lee et al. 2012; Basher et al. 2012; Silvapulle et al. 2017). Others direct their attention towards examining the interactions of volatilities and shocks between petroleum prices and stock markets, focusing on developed markets (Apergis and Miller 2009; Vo 2011; Mensi et al. 2013; Chang et al. 2013; Guntner 2014; Khalfaoui et al. 2015; Salisu and Oloko 2015; Angelidis et al. 2015; Ewing and Malik 2016; among others) and emerging markets (Malik and Hammoudeh 2007; Arouri et al. 2011a; Fang and You 2014; Lin et al. 2014; Koh 2017; Yousaf and Hassan 2019; among others). Furthermore, a subset of the preceding group distinguishes between petroleum exporters and importers (Wang et al. 2013; Wang and Liu 2016; Basher et al. 2018; Ashfaq et al. 2019; Sarwar et al. 2019; Belhassine and Karamti 2021; Enwereuzoh et al. 2021; among others) and accentuates the significance of the sectoral analysis (Kilian and Park 2009; Malik and Ewing 2009; Elyasiani et al. 2011; Arouri et al. 2012; Degiannakis et al. 2014; Broadstock and Filis 2014; Kang et al. 2016; Bouri et al. 2016; Belhassine 2020; Umar et al. 2020; Hwang and Kim 2021; Mishra and Mishra 2021; among others). More recent studies investigate the impact of the COVID-19 outbreak on the nexus between petroleum prices and equity markets (Hung and Vo 2021; Bouri et al. 2021; Zhang et al. 2021; Zhang and Hamori 2021; Benlagha and El Omari 2022; Jebabli et al. 2022; among others).

In light of the foregoing, the present survey strives to synthesise and consolidate an extensive volume of empirical studies that constantly grow, thereby facilitating a holistic comprehension of the interrelation between petroleum prices and stock markets and the identification of new directions for extending research in this strand of literature. To this end, the procedure of obtaining the final list of studies was commenced by identifying leading journals that systematically make publications in the area of interest. The rankings compiled by the Australian Business Deans Council are used for journal quality filtering. All relevant published papers were searched within the selected journals, which are from the A*, A, and B rating categories, without constraining ourselves to any specific period. This approach generated a vast volume of papers. In order to make our list concise and manageable, we focused our attention on the most influential works. It is worth mentioning that some studies with important contributions published in lower-ranked journals were also considered. The final sample includes 194 papers published from 1983 to 2023,[2] out of which 83% have A* and A ratings, while the remaining 12% and 5% have B and lower ratings, respectively, which allows one to observe how research interest has evolved over time. The main differentiation of the current paper from others is that, by reviewing nine research themes, it splits findings across multiple country groups with various levels of market development, thereby uncovering valuable insights that can help academics and market participants develop a deeper comprehension of the petroleum-equity market nexus and pointing out a few directions for expanding the existing research.

In the review, each section is devoted to one prominent theme, where papers are categorised by country groups within paragraphs. This framework provides a complete picture, given that sensitivities to petroleum prices tend to be dissimilar across developed, emerging, and frontier markets. We commence the next section by discussing the effects of petroleum prices on various macroeconomic indicators. Section 3 analyses the impact of changes in petroleum prices on equity returns at the aggregate level, while Section 4 assesses the relationship at the sector level. Section 5 focuses on the role of forces driving petroleum prices in explaining the behaviour of equity returns. Section 6 assesses the time-varying connections between petroleum prices and equity markets. Volatility interactions between petroleum prices and equity markets at the aggregate and sector levels are inspected in Section 7. Section 8 emphasises the importance of distinguishing between petroleum-exporting and importing countries. Section 9 concentrates on the impact of petroleum prices on firm-level equity returns. Section 10 evaluates intraday linkages between petroleum prices and equity markets. The final section concludes the survey and outlines prospective avenues for future research.

2. Petroleum Prices and Economic Variables

The debates in relation to the effects of petroleum price shocks on macroeconomic variables began in the 1970s of the last century.[3] Hamilton's (1983) empirical study, which was one of the earliest works to investigate such interconnections, induced discussions in this area. The author investigated the impact of changes in the price of petroleum on the economy of the United States for the period 1948–1980. Hamilton (1983) found that shocks associated with petroleum prices were a promoting factor in the majority of the post-war United States recessions. Burbidge and Harrison (1984) studied the effects of increases in the petroleum price on the domestic economies of Canada, Germany, Japan, the UK, and the US. The authors used monthly data from 1961 to 1982 and applied the vector autoregression (VAR) model. Their empirical findings suggest that the economic variables of these countries were influenced by petroleum price innovations. However, the effects of the 1973–1974 petroleum price shocks were stronger compared to the 1979–1980 set of shocks, where the effects were minimal in all cases apart from Japan. Gisser and Goodwin (1986) examined the influence of petroleum prices on the US economy for the period 1961–1982. The authors found that macroeconomic indicators were significantly affected by crude petroleum prices. Hooker (1996) analysed the relationship between petroleum prices and US macroeconomic indicators. The author concluded that the effect of the 1973 petroleum price shock on the macro-economy was substantial and measured well. In addition, Hooker (1996) highlighted the significance, but at the same time the insufficiency, of the 1979 petroleum price shock to reflect the 1980–1982 recession's dynamics. The author's investigation of the late 1980s suggests that the simple increases and decreases in price do not fully represent the relationship between the price of petroleum and the macro-economy. Hamilton's (1996) study indicates that the impact of petroleum price increases on GDP was significant from 1948 to 1973, in contrast to the later period from 1973 to 1994. The empirical work of Bjornland (2000) analysed the impacts of petroleum price shocks on the macroeconomic indicators of four European countries, namely Germany, Norway, the United Kingdom, and the United States. The findings indicate that in all cases, except Norway, the effects of petroleum price shocks are significantly negative.

A number of empirical studies, through the application of asymmetric or nonlinear approaches, examined the relationship between petroleum prices and macroeconomic variables. Mork (1989) extended Hamilton's study conducted in 1983 in order to include the petroleum market collapse in 1985–1986. The author particularly paid attention to the probability of asymmetric reactions to both rises and declines in the price of petroleum.

Mork (1989) confirmed that the link between increases in the price of petroleum and economic activity is negative. On the other hand, the findings suggest that the effects of declines in the price of petroleum have no significant impacts but are different from petroleum price increases. Mork et al. (1994) studied the reactions of macroeconomic variables in seven countries, namely Canada, France, Germany, Japan, Norway, the United Kingdom, and the United States, to increases and decreases in the price of petroleum. Their empirical findings indicate a strong asymmetry in the reactions. The responses of the majority of countries to increases in the price of petroleum are significant and negative. The reactions to decreases in the price of petroleum are mainly positive, but significant in the case of Canada and the United States. The findings related to Norway differ in the sense that the effects of petroleum price rises and declines are positive and negative, respectively. Hamilton (2003) investigated the nonlinear relationship between changes in the price of petroleum and the gross domestic product (GDP) of the United States for the period 1949–2001. The author's empirical findings clearly indicate signs of nonlinearity. Hamilton (2003) reports that increases in the price of petroleum have more importance compared to decreases in the price of petroleum.

The more recent empirical works on the macroeconomic effects of petroleum price fluctuations have obtained various outcomes. Some studies consider developed economies. Cunado and Perez de Gracia (2003) analysed the relationship between petroleum prices and macroeconomic variables, such as inflation and industrial production indexes, in fifteen European countries. The authors employed quarterly data covering the period from 1960 to 1999 and used various proxies of petroleum price shocks. Their main findings suggest that the prices of petroleum have a constant impact on inflation. However, the effects on production growth rates are short-term and asymmetric. In addition, the influence is greater when petroleum prices are measured in local currencies. The results also indicate that the reactions of fifteen European countries to shocks significantly differ. Jimenez-Rodriguez and Sanchez (2005) assessed the impacts of shocks arising from petroleum prices on the real economic activity of Canada, France, Germany, Italy, Japan, Norway, the UK, the US, and the Euro area. The authors employed both linear and non-linear models to carry out the multivariate VAR analysis. The authors found that the majority of economies are more negatively influenced by petroleum price increases than by declines, which aligns with previous findings on asymmetric effects. Furthermore, increases in the price of petroleum negatively influence the economic activity of all petroleum-importing countries, apart from Japan. However, reactions between petroleum-exporting countries vary. The impact of petroleum price shocks on the UK is negative, while in the case of Norway, the results demonstrate a positive effect. Lardic and Mignon (2006), using quarterly data from 1970 to 2003, studied the long-term interrelationship between petroleum prices and the GDP of twelve European countries. The authors based their investigation on asymmetric cointegration. They found the existence of asymmetric cointegration between petroleum prices and the GDP in most cases. In addition, the results reject standard cointegration. Lardic and Mignon (2008) extended their work to the economies of the G7, the United States, Europe, and the Euro area. Their empirical findings confirm the presence of asymmetric cointegration between petroleum prices and GDP in all studied countries. Hou et al. (2016) studied the impact of petroleum price shocks on the macroeconomic variables of a petroleum exporting economy, Canada, for the period 1980–2011. Their findings show that the effect of petroleum shocks on the aggregate demand of Canada is stimulative. In addition, shocks appreciate the Canadian national currency and lead to an improvement in terms of trade and a reduction in real wages. Lorusso and Pieroni (2018) assess the influence of fluctuations in the price of petroleum on the economy of the United Kingdom for the period from 1976 to 2014. The outcomes show that the repercussions of petroleum price movements on the macroeconomic variables of the United Kingdom are contingent on various types of petroleum shocks. Wen et al. (2021) concentrate on investigating the responses of inflation in the G7 countries to petroleum demand, supply, and risk shocks over the period from 1997 to 2019. The authors observe that petroleum shocks exert diverse effects on inflation in the studied countries, with the US displaying the largest sensitivity.

Other works utilise a sample of developed and emerging economies. Cunado and Perez de Gracia (2005) investigate the effects of petroleum price shocks on consumer price indexes and the economic activity of Asian countries, namely Japan, Malaysia, the Philippines, Singapore, South Korea, and Thailand. The authors used quarterly data for the period from 1975 to 2002. The results show that both consumer price indexes and economic activity are significantly affected by petroleum price shocks, although the effects are short-term and greater when petroleum prices are represented in local currencies. Furthermore, the authors found the existence of asymmetries in the relationship between petroleum prices and macroeconomic variables for some of the countries. Kim et al. (2017) analyse the effect of positive shocks arising from petroleum prices on the economy of China, where the key focus is on the interest rate reaction to shocks. The authors used monthly data from January 1992 to May 2014 and applied structural vector autoregression (SVAR), time-varying parameter structural vector autoregression (TVP SVAR), and generalised impulse response vector autoregression (GIR VAR) econometric models. They found that the reaction of the country's interest rate to petroleum price shocks varies over time and demonstrates different signs. Specifically, the interest rate response to the shocks between April 1992 and October 2001 is negative, while the reaction between November 2001 and May 2014 is positive. Liu et al. (2020) provide evidence of negative responses of the money supply and economic growth in China to petroleum price shocks, whereas the impact on inflation is found to be positive. Lin et al. (2023) show that the effects of petroleum price shocks on macroeconomic variables in Euro-19, China, Japan, and the US are time-varying and heterogeneous, which amplify over the turbulent period.

A group of studies focuses on petroleum exporters and importers. Korhonen and Ledyaeva (2010) investigate the impact of shocks emerging from petroleum prices on the economies of both petroleum-producing and petroleum-consuming countries. The authors distinguished two types of effects, direct and indirect, of petroleum price shocks in their study. The key results suggest that the direct effects of increases in the price of petroleum are positive for petroleum-exporting countries, but the indirect effects are negative, although minor. The majority of petroleum-importing countries are adversely affected by shocks in the price of petroleum. However, some economies demonstrated persistence in responding to petroleum price changes. Nusair (2016) examines the impact of petroleum price shocks on the economies of the Gulf Cooperation Council (GCC), namely Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE. The author applied the nonlinear cointegrating autoregressive distributed lag model to analyse the short-term and long-term effects. The findings demonstrate the existence of asymmetries in all instances. Precisely, positive movements in the price of petroleum contribute to the growth in real GDP. Conversely, the results show that negative changes in the price of petroleum are only significant for two countries, Kuwait and Qatar, implying that declines depress real GDP. Overall, the empirical outcomes suggest that the impact of positive petroleum price fluctuations on real GDP is considerably greater in contrast to negative movements. Lee et al. (2017) study the interconnection between petroleum price shocks and country risks in petroleum-importing and exporting countries. Their empirical findings indicate that petroleum price shocks significantly influence country risks in petroleum exporting and importing economies, but the effects vary. Smiech et al. (2021) document that the industrial production in petroleum exporting countries, namely Canada, Mexico, Norway, and Russia, is declined by the petroleum price uncertainty shocks. Furthermore, the authors report immediate currency depreciations that are long-lasting for Mexico and Russia. Tan and Uprasen (2023) observe that in petroleum-exporting countries, higher petroleum prices lead to a decline in income inequality, but for petroleum-importing countries, they contribute to an increase in income inequality. Conversely, upsurges in petroleum price volatility are found to increase income inequality in both groups.

3. Petroleum Prices and Aggregate Stock Markets

A large volume of empirical work explores the impact of petroleum prices on equity returns at the aggregate level.[4] Some studies have found a negative interrelationship between petroleum prices and stock markets. Jones and Kaul (1996), who made the initial contribution to this field, analyse the effects of changes in petroleum prices on several international equity markets. The authors, through the application of the standard cash flow dividend valuation model, found that the effects of petroleum price changes on current and future corporate cash flows could elucidate the changes in equity returns. Specifically, their findings show that equity market returns are negatively affected by petroleum shocks. Sadorsky (1999) investigates interactions between changes in the price of petroleum and equity returns in the United States. The author applied the vector autoregression model and used monthly data for the period 1947–1996. Sadorsky (1999) found that equity returns are significantly depressed by petroleum price increases. Furthermore, the author's results indicate that the effects of petroleum on equity returns were stronger during the period from 1986 to 1996, when petroleum prices experienced large declines. Papapetrou (2001) studies the interconnections between petroleum prices and stock returns in Greece. The author employed monthly data from 1989 to 1999 and applied the multivariate vector autoregressive model. Papapetrou (2001) obtained similar findings, where positive petroleum price shocks negatively affect stock returns. Driesprong et al. (2008) examine the relationship between movements in petroleum prices and stock returns in 48 developed and emerging countries across the world. Their findings indicate that future stock returns are drastically lowered by increases in the price of petroleum. Chen (2010), by the application of time-varying transition probability Markov-switching models analyse the relationship between petroleum prices and the US stock market, represented by the S&P500 index, for the period from 1957 to 2009. The author focuses on whether an increase in the price of petroleum causes recessions in the US stock market. The empirical findings provide strong evidence that the equity market is pushed into bear territory by increasing petroleum prices. Chen (2010) also found that higher petroleum prices increase the probability of staying in a bear regime, but evidence for such outcomes is weaker. Filis (2010) studies the interconnections between prices of petroleum, which is represented by the Brent grade, industrial production, the consumer price index, and the stock market in Greece. The author applied the vector error correction model (VECM) and VAR models and used data covering the period from 1996 to 2008. Filis (2010) found that the influence of petroleum prices on the stock market in Greece is significantly negative. Basher et al. (2012) examine the dynamic relationship between West Texas Intermediate petroleum prices, emerging market equity prices, represented by the Morgan Stanley Capital International (MSCI) emerging markets index, and exchange rates. The authors employed monthly data for the period of 1988–2008 and estimated the structural vector autoregression model. Their empirical findings indicate that in the short run, exchange rates and emerging market equity prices are depressed by positive shocks to the prices of petroleum. Asteriou and Bashmakova (2013) investigate the interrelationship between the petroleum price risk and equity market returns of ten emerging countries from the central and eastern European regions, namely the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, and Slovenia. The authors employed daily data covering the period from 1999 to 2007 and applied the international multi-factor model. Their findings indicate that equity market returns are sensitive to petroleum price risk. In particular, the petroleum price risk is statistically significant and negative, implying that the price of petroleum is an important element in determining equity returns, and increases in the price level depress equity market returns. A primary explanation of the negative effects caused by petroleum price rises is that the studies have predominantly considered countries with a relatively high level of petroleum dependency.

Other empirical works have identified a positive relationship between the prices of petroleum and stock markets. Narayan and Narayan (2010), through the employment of daily data, investigate the relationship between petroleum prices and equity prices in

Vietnam for the period from 2000 to 2008. The authors found that the impact of petroleum prices on equity prices is positive and statistically significant, which is not in line with the expected theoretical outcome. They suggest that unique factors, among which are an increase in foreign investment inflows and a change in investment preferences towards stocks that occurred during swift upsurges in the price of petroleum, had the dominant impact on the Vietnamese stock market and elucidate the presence of this interlinkage. Zhu et al. (2011) examine the relationship between petroleum prices and stock markets in fourteen OECD and non-OECD countries using monthly data from 1995 to 2009. Their empirical findings indicate the existence of a long-run bidirectional relationship between these variables. In addition, the results show that increases in crude petroleum prices positively affect stock prices. The authors explain the observed positive interrelation by citing the prevailing impact of industrial production and increased leveraged investment in equities as opposed to crude petroleum price rises. Zhu et al. (2014) analyse the dynamic dependence between prices of crude petroleum and equity markets in countries from the Asia-Pacific region, namely Australia, China, Hong Kong, India, Indonesia, Japan, South Korea, Malaysia, Singapore, and Taiwan. The authors use daily data covering the period from 2000 to 2012 and apply both conditional and unconditional copula models. Their empirical outcomes demonstrate that prior to the financial crisis, the dependence between petroleum prices and equity returns in most cases was weak and positive, which could potentially be attributed to the growth of economies in the Asia-Pacific region. However, in the post-crisis period, it strengthened substantially. Silvapulle et al. (2017), using monthly data for the period from 1999 to 2015, studied the relationship between petroleum prices and stock market indices of major petroleum-importing countries, such as China, France, Germany, India, Italy, Japan, Singapore, South Korea, Spain, and the United States. They found that the impact of petroleum prices on stock market indices is significant and positive, with the coefficient being higher during the pre-financial crisis period compared to the post-financial crisis period. The authors provide several elucidations for the detected findings, namely speculative behaviour in the petroleum market, the more dominant impact of alternative energy sources that the studied countries are dependent on, leveraged investment in equities, and the positive and cyclical association of equity market indices and petroleum prices with the global need for industrial resources.

A group of empirical studies have obtained mixed results or found no interrelationships between petroleum prices and stock markets. Huang et al. (1996) investigate the relationship between returns on petroleum futures and US equities. The authors used daily data and applied the VAR model. Their findings suggest that the impact of petroleum futures returns on US stock market returns, represented by the S&P 500 index, is non-existent. On the other hand, the authors found that some individual petroleum equity returns are led by petroleum futures returns. Basher and Sadorsky (2006), through the application of the international multi-factor model, examine the effects of fluctuations in the price of petroleum on stock market returns in emerging economies, namely Argentina, Brazil, Chile, Colombia, India, Indonesia, Israel, Jordan, Korea, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, South Africa, Sri Lanka, Taiwan, Thailand, Turkey, and Venezuela, for the period 1992–2005. The authors found strong evidence indicating that the petroleum price risk affects equity market returns in emerging economies, although the exact interrelation depends on the frequency of employed data. Cong et al. (2008) investigate the effects of changes in the prices of petroleum, represented by the Brent grade, on equity market returns in China for the period from 1996 to 2007. Their empirical results show no evidence of the statistically significant effects on returns of the majority of stock market indices in China, apart from the manufacturing index and some individual petroleum companies. O'Neill et al. (2008) studied interconnections between fluctuations in petroleum prices and equity market indices of Australia, Canada, France, the United Kingdom, and the United States. The authors found that the effects of high petroleum prices vary among the studied countries. The equity market returns of France, the United Kingdom, and the United States are adversely affected by higher petroleum prices, while the impacts are positive for

Australia and Canada. Miller and Ratti (2009) apply the vector error correction model to study the relationship between the price of crude petroleum and the equity markets of six countries, namely France, Germany, Italy, the United Kingdom, Canada, and the United States, over the period 1971–2008. The authors found clear evidence of the interrelationship for the period from 1971 to 1980 and 1988 to 1999 between the price of crude petroleum and the equity markets of all countries. On the other hand, their results show the absence of a statistically significant relationship between these variables during the period from 1980 to 1988. Furthermore, the findings indicate the disintegration of the relationship after 1999. Jammazi and Aloui (2010), through the combination of wavelet analysis and the Markov switching VAR (MS-VAR) model, assess the relationship between changes in petroleum prices and stock market returns in France, Japan, and the UK, for the period 1989–2007. The authors found that the response of the equity market variables to movements in the price of crude petroleum is negative and temporary during the moderate, for France, and expansion, for France and the UK, stock market phases. However, no effects are observed, except for Japan, during the recessionary stock market phase. In addition, their findings show that the negative interrelation was more pronounced prior to 1999. The empirical study of Ajmi et al. (2014) is focused on the investigation of the nonlinear relationships between petroleum prices, which are represented by both the WTI and Brent grades, and the stock markets of eleven countries from the Middle East and North Africa region over the period 2007–2012. The authors found that the interaction between petroleum prices and considered stock markets is nonlinear. In addition, the results suggest that the nonlinear causality is more evident in the case of the Brent grade. Narayan and Gupta (2015) used an extensive range of monthly historical data to study the relationship between petroleum prices and equity returns in the US, represented by the WTI grade and the S&P 500 index, respectively. The authors found evidence of asymmetric effects, that is, negative movements in petroleum prices in comparison to positive changes, are more important in predicting US equity returns. Hatemi et al. (2017) investigate the impact of petroleum prices on equity prices in the G7 countries and the world market for the period from 1975 to 2013. Their empirical findings obtained based on the symmetric causality test provide no evidence of the effects on equity prices in both G7 and world markets. However, when the authors apply the asymmetric test, the results indicate that increases in the price of petroleum induce rises in equity prices in Japan, the US, and the world market, whereas decreases in the price of petroleum depress equity prices in Germany. The reported mixed findings point to the fact that stock markets in the studied countries are heterogeneous in their reactions, given dissimilar levels of dependence on petroleum, and the importance of distinguishing the type of petroleum price movements.

4. Petroleum Prices and Stock Sectors

The aforementioned empirical works investigate the petroleum-stock market relationship using aggregate market indices. Some of the major limitations of aggregation are the following: (i) the weight of each industry in a market index varies, and hence, it tends to be biased towards certain industries (Mateus et al. 2017); (ii) sectors are not identical, and various factors can have dissimilar impacts (Faff and Brailsford 1999); and (iii) movements in the price of petroleum differently influence sectors (Nandha and Brooks 2009), given varying degrees of reliance on petroleum. Thus, one can naturally anticipate that reactions, in terms of magnitude and sign, can be nonuniform.[5] A vast number of studies have conducted sectoral investigations in the context of developed markets. Faff and Brailsford (1999), employing the augmented market model, study the sensitivity of industry stock returns in Australia to petroleum prices for the period from 1983 to 1996. The authors use, in their analysis, monthly data on twenty-four Australian industries. Faff and Brailsford (1999) observe a significant positive sensitivity for industries such as Diversified Resources and Oil and Gas. In the case of the Transport and Paper and Packaging industries, they found significant negative responsiveness. Sadorsky (2001) examines the interrelationship between different risk factors, including crude petroleum prices, and equity prices in the Oil and Gas industry in Canada. The author applied the multifactor market model and employed monthly data that covered the period from 1983 to 1999. The empirical findings indicate that petroleum prices influence the equity returns in the studied industry. Particularly, the hikes in petroleum prices increase equity returns of Canadian Oil and Gas companies. Boyer and Filion (2007) also found that rises in petroleum prices have a positive influence on the equity returns of Oil and Gas firms in Canada. Hammoudeh and Li (2005) investigate the sensitivity of US industry equity indices to petroleum, namely the Transportation and Petroleum industries, represented by the NYSE Transportation Index and Amex Petroleum Index, respectively. The authors found that in the case of the Petroleum industry, the sensitivity is positive but negative for the Transportation industry, with the first industry demonstrating the highest responsiveness. El-Sharif et al. (2005) analyse the relationship between the price of crude petroleum and stock values in the Oil and Gas industry of the United Kingdom. The authors found that Oil and Gas stock returns are affected by changes in crude petroleum prices. In particular, petroleum price upsurges tend to enlarge equity returns in the considered sector of the United Kingdom. Lee et al. (2012) investigate the interrelationship between movements in petroleum prices and sector equity indices of the G7 countries. The authors employed monthly data from 1991 to 2009 and applied the unrestricted VAR model in their study. Their empirical outcomes indicate that sector indices in some markets experience significant impacts. More specifically, one sector index in France, four in Germany, and two in the US are affected by petroleum price fluctuations. Additionally, the equity returns of Consumer Staples and Information Technology sectors are influenced more frequently. In relation to other markets, no significant impacts on sector indices were obtained. Moya-Martinez et al. (2014) examine the responsiveness of fourteen Spanish sectors to fluctuations in petroleum prices, represented by the Brent grade, for the period from 1993 to 2010. The empirical results demonstrate that the effects of movements in petroleum prices on the Spanish sectors are quite limited, although the authors observe considerable variations from one sector to another. Xu (2015), using daily data, investigates the power of petroleum prices in predicting returns of the UK sector stock indices, represented by the FTSE All-Share industry indices, such as Basic Materials, Consumer Goods, Consumer Services, Financials, Health Care, Industrials, Oil and Gas, Technology, Telecom, and Utilities, over the period 1988 to 2013. The author found strong evidence of the relevance between movements in petroleum prices and the UK sector stock indices, where the effects on sector returns are heterogeneous. In particular, the results indicate that petroleum-related sectors are positively influenced, while the impact on petroleum-consuming sectors is adverse. Arouri (2011) utilised weekly data to investigate the reactions of twelve sector equity markets in Europe to petroleum price fluctuations over the period 1998–2010. The author's empirical results point to the existence of significant interconnections between movements in petroleum prices and the majority of sector equity markets. However, the strength of the observed link considerably varies across sectors. Furthermore, Arouri (2011) provides evidence of asymmetries in responses to petroleum price movements for some sectors. Scholtens and Yurtsever (2012) analyse the effects of petroleum prices on thirty-eight industries in the Euro area over the period 1983–2007. The authors applied the vector autoregression model and used various specifications of petroleum prices, such as changes in the price of petroleum, scaled petroleum prices, and net petroleum prices. Scholtens and Yurtsever (2012) documented that the effects considerably vary across sectors. Additionally, the significance of reported findings depends on petroleum price specifications.

Some works utilize a sample of Asian markets. Li et al. (2012) investigate the relationship between prices of petroleum and thirteen stock sector indices in China for the period 2001–2010. The authors obtained clear evidence indicating that, in the long run, the effects of increased real petroleum prices on Chinese sectoral equities are positive. Zhu et al. (2016), in their empirical study, which covers the period from March 1994 to June 2014, use the quantile regression technique to analyse the dependence between fluctuations in crude petroleum prices, represented by the WTI grade, and the equity returns of fourteen

Chinese industries. Their results show that the reactions of stock returns to petroleum price swings differ among industries. Furthermore, the authors found the presence of positive dependence, which is common at the lower quantiles across sectors, and suggest that strong dependence exists during bearish markets or recessions. Broadstock et al. (2014) examine the relationship between petroleum prices and energy-related stocks in the Asia-Pacific region, represented by six indices from four countries. The authors emphasise two channels of effects in their work, such as direct and indirect. The results indicate that the effects on stocks can be not only direct but also indirect through general market risk. They demonstrate that direct effects, although when considered only energy-related stocks, are not always present. However, indirect effects always exist for all indices considered in the study. Additionally, when the effects are significant, they are positive, implying that a sudden increase in the price of petroleum contributes to positive energy-related equity returns.

Other studies provide evidence from a global perspective. Nandha and Faff (2008) investigate the impact of fluctuations in the price of petroleum, represented by the WTI grade, on thirty-five global industry indices over the period 1983–2005. Their empirical results show that stock returns in all industries, with the exception of Mining and Oil and Gas, are negatively affected by movements in the price of petroleum. Furthermore, the authors suggest that interest rates and consumer confidence might be affected and depressed by higher petroleum prices, which consequently creates indirect channels to reflect elevated petroleum prices in stock prices. In addition, their findings demonstrate that increases and decreases in the price of petroleum exert a symmetric influence on the stock markets. Henriques and Sadorsky (2008) study interlinkages between petroleum prices, interest rates, technology, and alternative energy equity prices. The authors applied the four-variable vector autoregression model and employed weekly data for the period 2001–2007. Their empirical results show that petroleum prices have some power to explain the changes in equity prices of alternative energy firms. Additionally, the simulation findings demonstrate that a shock to petroleum prices has a little influence on alternative energy equity prices compared to a shock to technology equity prices. Ramos and Veiga (2011), using monthly data, studied the exposure of Oil and Gas sector indices from thirty-four countries to different factors, including movements in the price of petroleum, for the period 1998–2009. The authors found that the response of the Oil and Gas industry to petroleum price fluctuations in developed markets is much stronger than in their emerging counterparts. Furthermore, the reaction of Oil and Gas sector returns is asymmetric; that is, the impact of petroleum price increases in comparison to petroleum price decreases is greater. Kumar et al. (2012), through the application of the VAR model, examine the interconnection between petroleum prices and clean energy indices represented by the Wilder Hill New Energy Global Innovation Index, Wilder Hill Clean Energy Index, and S&P Global Clean Energy Index. The authors' empirical results indicate that the equity prices of clean energy companies are affected by petroleum prices. In particular, the effects of rising petroleum prices are positive. Cameron and Schnusenberg (2009) examine the relationship between petroleum prices and equity prices of automobile producers, namely General Motors (Detroit, MI, USA), Ford Motor Corp. (Dearborn, MI, USA), Daimler/Chrysler (Stuttgart, Germany), Toyota Motor Corp. (Toyota, Aichi, Japan), Honda Motor Co. (Minato, Tokyo, Japan), and Nissan Motors (Yokohama, Kanagawa, Japan), over the period 2001 to 2008. Their results show the existence of an inverse relationship between increasing prices of petroleum and automobile manufacturers' equity returns, where manufacturers of sport SUVs experience most of the impact. Nandha and Brooks (2009) investigate the role of petroleum prices in explaining the stock returns of transport sectors. Their analysis has a global perspective and includes thirty-eight countries. The authors used monthly data until July 2006, where start dates depended on the stock market history of each country. Nandha and Brooks (2009) classify countries into geographic and economic regions, namely Latin America, Europe, Asia Pacific, Developed, G7, and Emerging. Their empirical findings support the role of petroleum prices in determining equity returns in the transport sectors of countries within the Europe, G7, and Developed groupings, while no such evidence is observed in countries falling within the remaining groupings. The empirical study of Kristjanpoller and Concha (2016) is concentrated on the analysis of the effects of fuel price movements, represented by the WTI grades of petroleum and Jet Fuel, on the stock returns of fifty-six airlines, which are part of the International Air Transport Association, for the period from 2008 to 2013. The results of their work show that airline equity prices are positively influenced by rises in fuel prices. The authors explain such findings in terms of asset prices, mainly commodities and equities, being positively associated with the bullish market and rising petroleum prices being a signal of higher economic growth.

5. Petroleum Price Shocks and Stock Markets

The empirical studies that have been reviewed in the previous sub-sections are mostly focused on the movements of petroleum prices when analysing the petroleum-equity market nexus. However, the identification of different sources that affect the price of petroleum is also crucial in order to better comprehend the interconnections between petroleum and stock markets.[6] The price of petroleum, as with any commodity's price, is determined by market fundamentals, that is, by supply and demand (Kilian 2009). Kilian (2009) identified different types of supply and demand shocks in the crude petroleum market that explain changes in the price of petroleum, namely petroleum supply shocks, aggregate demand shocks, and petroleum-specific demand shocks. Additionally, Kilian and Park (2009) emphasise the importance of distinguishing between supply and demand shocks, as the empirical findings of studies that do not make such distinctions could be biased towards obtaining insignificant effects or not stable over time. Kilian and Park (2009), using monthly data, studied the effects of petroleum price shocks on aggregate and industry equity returns in the US over the period from 1973 to 2006. The authors show that the response of equity returns in the US to petroleum price shocks varies considerably, depending on the nature of movements in petroleum prices. In comparison to petroleum supply shocks, petroleum-specific demand and aggregate demand shocks are more important for explaining changes in US equity prices. Particularly, the effect of petroleum-specific demand shocks on equity returns is negative, whereas aggregate demand shocks positively influence equity returns. At the aggregate level, their findings demonstrate that, in the long run, nearly one-fifth of the variation in equity returns in the US is attributed to supply and demand shocks. At the industry level, the authors also document more significant reactions to petroleum demand shocks than to petroleum supply shocks, where the effects vary across sectors. In particular, equity returns in Precious Metals and Petroleum and Natural Gas industries positively react to aggregate demand shocks, but Automobile and Trucks and Retails industry returns respond negatively to petroleum-specific demand shocks. The empirical study of Kilian and Park (2009) is extended by Kang et al. (2016) through the distinction between shocks generated from US and non-US petroleum production and the analysis of their effects on both the US aggregate and sector equity returns for the period from 1973 to 2014. The authors found a positive association between equity returns and US petroleum production shocks. In addition, the findings indicate that petroleum supply and demand shocks, when the US and non-US petroleum production shocks are separated, have comparable importance in explaining equity returns. Furthermore, Kang et al. (2016) emphasise the importance of such disaggregation in order to understand the effects of petroleum supply shocks on the equity returns of sectors.

A large body of studies considers developed markets in their analyses. Apergis and Miller (2009) employ monthly data that cover the period from 1981 to 2007 to investigate the effects of structural petroleum market shocks on the equity markets of eight countries, namely Canada, the United States, France, the United Kingdom, Germany, Italy, Australia, and Japan. The authors construct three types of structural shocks, such as petroleum supply, global aggregate demand, and global petroleum demand. Their empirical findings indicate that the equity market returns of the studied countries do not significantly respond to shocks in the petroleum market; that is, the observed effects are small in magnitude. Kang and Ratti (2013) study the interrelationship between petroleum shocks, economic policy uncertainty, and equity returns in the US at both aggregate and sectoral levels. The authors used monthly data for the period 1985–2011 and applied the structural VAR model. The impulse response function outputs demonstrate that the effects of petroleum supply shocks are not statistically significant for most of the period. Aggregate demand shocks positively affect US equity returns, while the impact of petroleum-specific demand shocks is negative. Additionally, the variance decomposition results demonstrate that, in the long term, approximately 32% of the variation in real equity returns is accounted for by structural petroleum shocks. With regard to responses from different sectors, the authors found that petroleum supply shocks positively influence returns of Automobiles and Trucks and Retail equities but depress equity returns in the Precious Metals industry. Aggregate demand shocks lead to statistically significant and persistent increases in equity returns in the Petroleum and Natural Gas sector, and petroleum-specific demand shocks negatively affect equity returns in the Automobiles and Trucks sector. The empirical work of Abhyankar et al. (2013) is focused on the analysis of the relationship between shocks that arise from petroleum prices and the Japanese equity market, represented by the Datastream Japan stock index. The authors applied the structural vector autoregressive model and employed monthly data covering the period from 1988 to 2009. Abhyankar et al. (2013) found that Japanese equity returns are positively, albeit not in a large magnitude, affected by petroleum supply shocks. Their results in relation to demand shocks confirm those of Kilian and Park (2009). The effect of aggregate demand shocks on stock market returns in Japan is positive. However, the reaction of the stock market to petroleum-specific demand shocks is negative. Guntner (2014) applies the methodology of Kilian and Park (2009) to analyse the effects of petroleum demand and supply shocks on the national equity markets of six OECD member countries, such as Canada, France, Germany, Japan, Norway, and the United States, for the period 1974–2011. The author found that petroleum supply shocks exercise little impact on the equity markets of all considered countries. Aggregate demand shocks cause increases in petroleum prices and equity returns, where the more persistent effect is reported for petroleum exporters, particularly for Norway. In addition, the results indicate that the effects of petroleum-specific demand shocks are positive for Norway and insignificant for Canada, while the impact on the stock markets of petroleum-importing countries is detrimental.

A group of more recent studies also focuses on advanced markets. Angelidis et al. (2015) investigate the ability of petroleum price shocks and volatility to forecast the state of equity market returns in the US over the period from 1989 to 2011. The authors follow the methodology of Kilian and Park (2009) in order to identify petroleum price shocks. Their empirical findings indicate that petroleum price shocks possess incremental power to predict the state of equity market volatility and returns in the US. More precisely, only petroleum-specific demand shocks have the power to forecast the state of equity market volatility. With regard to equity market returns regimes, only petroleum supply and aggregate demand shocks exercise significant effects. Bastianin et al. (2016) direct their attention towards examining the impact of three petroleum shocks on the level of stock market volatility in the G7 economies. The authors observe significant impacts of aggregate demand and petroleum-specific demand shocks on stock market volatility, albeit with differences in magnitude. On the contrary, responses to supply shocks are found to be insignificant. Sakaki (2019) studies the sensitivities of ten S&P 500 sector indices to petroleum shocks. The results indicate that equity returns in the majority of sectors are dampened by petroleum market-specific demand shocks, with the exception of the Energy and Utilities sectors, where the effects are positive. Petroleum supply shocks measured using shifts in US petroleum production in lieu of global petroleum production and aggregate demand shocks are found to induce positive reactions in stock sector returns. Utilising the nonlinear smooth transition VAR (STVAR) model, Hwang and Kim (2021) examine the influence of petroleum shocks on the US aggregate equity market and sector returns across the different business cycle stages. The authors observe that petroleum shocks exercise significant asymmetric effects on aggregate and sector equity returns over periods of economic contraction, where demand-side-driven petroleum shocks have larger impacts in contrast to supply-side-driven petroleum shocks. In addition, the intensity and course of reactions are contingent on the nature of shocks and substantially differ among sectors.

Other works conduct investigations in the context of developing markets. Gupta and Modise (2013), applying the structural VAR model, studied the relationship between various petroleum price shocks and the stock market in South Africa for the period 1973–2011. The authors show that South African stock returns respond positively to aggregate demand shocks, whereas speculative demand shocks lead to declines in equity returns, which supports the findings of Kilian and Park (2009). However, the reaction of stock returns in South Africa to petroleum supply shocks is negative. The variance decomposition findings demonstrate that the contribution of petroleum supply shocks to the variability of South African equity returns is larger in contrast to other shocks. Fang and You (2014) investigate the impact of petroleum price shocks on the stock markets of three large emerging economies, namely China, India, and Russia, over the period from January 2001 to May 2012. The authors found mixed evidence of the effects of petroleum price shocks on equity prices. In particular, Indian equity returns respond positively to their own petroleum-specific demand shocks only in the first month, whereas global petroleum demand shocks negatively affect equity returns. In the case of Russia, stock returns are significantly decreased by global petroleum demand shocks, but Russian petroleum-specific supply shocks positively influence local stock returns. The impact of Chinese petroleum-specific demand shocks on regional equity returns is negative during some of the periods, while global demand shocks have no significant effects. Li et al. (2017) apply the structural vector autoregression model to investigate the impact of petroleum price shocks on the equity returns of listed firms in the petroleum industrial chain in China over the period from 2009 to 2014. The authors distinguish between four types of shocks: petroleum supply shocks, domestic demand shocks, global demand shocks and precautionary demand shocks. Their empirical findings indicate that the effects of petroleum supply shocks and precautionary demand shocks, compared to other shocks considered, are the most significant. Koh (2017), using the structural VAR model and monthly data, examines the relationship between various types of shocks and equity prices in fifteen Asian countries for the period from 1994 to 2014. The author confirms that the underlying causes of increases in the price of petroleum do matter. The empirical findings indicate that petroleum price increases caused by petroleum-specific demand shocks depress equity prices in the majority of cases, except for Malaysia, Korea, China, and Hong Kong. On the other hand, aggregate demand shocks lead to real equity return rises in most countries.

Other studies apply the innovative method of Ready (2018) for decomposing petroleum shocks that allows the utilisation of high-frequency data. Demirer et al. (2020) analyse the effects of petroleum shocks on equity market returns in twenty-one advanced and emerging economies using the daily frequency of data over the period from January 2000 to October 2018. The authors found that, regardless of countries' categorisation, equity market returns are positively impacted by petroleum demand shocks, while the consequences of petroleum supply shocks are more diverse. Wong (2020) investigates the sensitivities of Chinese sector equity returns to diverse types of petroleum shocks. The findings indicate that supply-driven shocks trigger positive equity returns in sectors, which can help ease concerns associated with supply constraints. On the other hand, the effects of demand shocks are found to be heterogeneous. Mishra and Mishra (2021) examine the responses of ten sector indices in India to petroleum demand, supply, and risk shocks for the period from 2010 to 2019. The authors document the positive and negative effects of demand and risk shocks, respectively, on all sector indices. With regard to supply shocks, only the reaction of the Metal sector index is observed to be significantly positive. Umar et al. (2020) focus on studying the static and dynamic connectedness between eight stock sector indices in Spain and three petroleum shocks. The static analysis revealed that the contribution of demand and risk shocks to fluctuations in sector stock returns is significant, whereas supply shocks exhibit negligible effects. Furthermore, the time-varying connectedness of demand and risk shocks with Spanish sector indices is greater, particularly during the global financial crisis. Employing a sample of GCC and BRICS countries, Umar et al. (2021) explore the interrelationship between equity markets and petroleum shocks. Their findings indicate that the reactions of stock markets to shocks are country-specific, with demand and risk shocks also exerting a stronger impact on the level of connectedness.

Overall, the findings of the aforementioned studies can be summarised as follows: Petroleum demand shocks, irrespective of the methodology used to derive them, serve as an indicator of an economic expansion that, despite causing elevated petroleum prices, is viewed favourably by financial markets (Kilian and Park 2009; Ready 2018; Degiannakis et al. 2018), thereby credibly explaining positive reactions. The adverse impact of petroleum supply shocks and precautionary demand shocks is explained by the fact that the first generally leads to heightened inflationary pressures and economic contraction (Peersman and Van Robays 2012; Cashin et al. 2014), while the second transmits uncertainty in the petroleum market, caused by potential petroleum supply shortages as a result of various factors, to others (Degiannakis et al. 2018).

6. Time-Varying Linkages between Petroleum Prices and Stock Markets

Some recent empirical studies have documented the fact that the interrelationship between petroleum prices and stock markets changes over time and tends to be sensitive to major global events.[7] A group of works focuses on single or multiple countries with developed markets. Reboredo (2010) uses the Markov-switching models to investigate the nonlinear effects of petroleum price shocks on stock markets in Germany, the Netherlands, the United Kingdom, and the United States over the period 1985–2006. The author provides evidence that equity market prices are differently affected by movements in petroleum prices. Specifically, the empirical findings indicate the presence of significant negative correlations at times of high uncertainty in equity markets, while at times of low uncertainty, the impact is null or minimal. Mollick and Assefa (2013) investigate the relationship between petroleum prices and equity returns in the US. The authors use daily data from 1999 to 2011 and consider three indices, such as the S&P 500, Nasdaq, Dow Jones, and Russell 2000. Their empirical findings indicate that the response of US equity returns to petroleum prices varies before, during, and after the global financial crisis. The association of equity returns with petroleum prices prior to and during the crisis is low. However, the effect on equity returns becomes statistically significant and positive during the latter period. Chang and Yu (2013), through the application of the MS-ARJI-GJR-GARCH-X model, examine the impact of crude petroleum price shocks, represented by the WTI grade, on equity returns in the US for the period 2001–2012. Their empirical outcomes show that petroleum price shocks exercise regime-dependent impacts, and behaviour differs during stable and turbulent periods. Ciner (2013) studied the impact of changes in the price of petroleum on the returns of aggregate stock markets and individual companies' equities from various industries in the US over the period 1986–2010. The author considers the time variation in the relationship and applies the frequency domain methods. The findings indicate that the linkage between petroleum and stocks is time-varying. Equity returns respond negatively to petroleum price shocks with a persistency of less than twelve months and greater than thirty-six months, while shocks with a persistency of twelve to thirty-six months cause positive reactions. Furthermore, the results are mostly robust when individual equity returns are employed, with the exception of petroleum firms' equities that have positive associations with increases in petroleum prices. Degiannakis et al. (2013) examined the time-varying relationship between fluctuations in the price of petroleum and the returns of ten European sector indices for the period 1992–2010. The authors considered various origins of petroleum price shocks in their study. Their empirical findings indicate that the interrelationship between petroleum price movements and sector indices changes over time and differs among industries. In addition, precautionary demand shocks result in nearly zero correlation levels, petroleum supply shocks generate positive correlations with low to moderate levels, and aggregate demand shocks lead to substantial variations, either positive or negative, in correlation levels. Reboredo and Rivera-Castro (2014), through the wavelet multi-resolution analysis, study the intrarelationship between petroleum and equity markets in the US and Europe for the period from June 2000 to July 2011. The authors conduct both market- and sectoral-level analyses. They found that aggregate and sector equity market returns were not affected by the petroleum price movements, except for stocks of oil and gas firms, in the period preceding the financial crisis. However, with the commencement of the financial crisis, the positive interdependence and contagion between petroleum and equity markets are evident at both aggregate and sectoral levels. The empirical work of Martin-Barragan et al. (2015) focuses on the analysis of the influences of equity market crashes and petroleum shocks on correlations between petroleum and equity markets in the United States, Germany, the United Kingdom, and Japan for the period from February 1990 to November 2011. The obtained findings show that in non-crisis periods, the correlation between equity and petroleum markets has a tendency to be stable. On the contrary, during financial and petroleum shocks, this correlation fluctuates at lower and higher frequencies.

Other works report evidence in the context of emerging markets. Bhar and Nikolova (2010) study the relationship between petroleum price changes and the Russian stock market, represented by the AK&M Composite index, for the period 1995–2007. The authors found that Russian stock market returns and volatility are significantly affected by movements in petroleum prices. In addition, the empirical results indicate that the conditional correlation between petroleum prices and stock returns in Russia is negative after the unstable global events that took place in 2001, 2003, and 2006. Mohanty et al. (2010) analyse the relationship between the prices of petroleum and the equity returns of oil and gas companies from Central and Eastern European countries for the period from 1998 to 2010. Their overall empirical findings indicate the absence of a significant association between petroleum prices and the stock values of oil and gas firms. In contrast, the results obtained from the sub-period analysis suggest that the equity returns of some oil and gas firms are affected by petroleum prices, where the levels of exposure vary across companies and over time. Broadstock et al. (2012), through the employment of weekly data, examine the relationship between prices of petroleum and equities in the Chinese energy sector over the period from 2000 to 2011. Their results suggest that the correlation between changes in petroleum prices and energy-related equity returns is time-varying. In particular, the interrelation between these variables strengthened following the global financial crisis.

Several studies consider a combination of developed and emerging markets. Broadstock and Filis (2014) use monthly data to examine time-varying correlations between three types of petroleum price shocks and equity market returns for the period 1995–2013. The authors employ a sample of both aggregate stock market and sector indices from China and the US. The empirical findings indicate that stock market responses to petroleum price shocks fluctuate over time. Specifically, the Chinese equity market demonstrates more resilience to petroleum price shocks as opposed to the equity market in the US. Furthermore, the authors report that shocks, depending on their origin, exercise diverse effects on stock markets, which substantially vary across sectors. Reboredo and Ugolini (2016) examine the effects of petroleum price fluctuations on various equity return quantiles in three developed and BRICS countries for the period from 2000 to 2014. Their empirical results indicate the existence of asymmetric effects that are limited in the period prior to the financial crisis but strengthen after the commencement of the financial crisis. Zhang (2017) investigates the time-varying correlations between the price of petroleum and equity markets in China and the US, represented by the CSI 300 and S&P 500 indices, respectively. The author used daily data for the period from 2002 to 2013 and applied the mixed asymmetry dynamic conditional correlation model in their study. They found that the correlation structure was significantly changed by the great shocks that occurred in 2003 and 2008. For the US, the correlation between the equity market and petroleum prices changes from positive to negative after the great shock of 2003, while the correlation increases in the case of China. Furthermore, the global financial crisis causes upsurges in correlations between petroleum prices and the equity markets of both countries. Zhu et al. (2017) apply the two-stage Markov regime-switching approach to study the influence of petroleum demand and supply shocks on equity returns in ten countries for the period 1997–2015. Their empirical outcomes show that in the low-volatility regime, equity returns are minimally impacted by structural petroleum shocks. However, the effects in the high-volatility regime are statistically significant. Furthermore, the authors observe that aggregate demand and petroleum-specific demand shocks significantly influence equity returns in comparison to petroleum supply shocks. More specifically, equity returns are increased by positive aggregate demand shocks, while positive petroleum-specific demand shocks lead to decreases in equity returns.

7. Petroleum Price and Stock Market Volatility

The strengthened financialisaton of commodity markets along with advancements in technology contributed to the spread of announcements, news, speculative rumours, and investors' sentiment between petroleum and stock markets across the world, particularly given the nearly continuous operation of the former. In this connection, a number of empirical studies have examined the interrelationship between the volatility of the petroleum and equity markets.[8] Some of these works concentrate on developed markets. Aloui and Jammazi (2009) apply the two-regime MS-EGARCH model to study the effects of crude petroleum volatility shocks on the behaviour of equity markets in France, Japan, and the UK. The authors use monthly data from the CAC 40, Nikkei 225, and FTSE 100 indices over the period from 1989 to 2007. Their empirical findings provide evidence of the significant role of petroleum price increases in determining equity return volatility and the likelihood of transition between regimes. Vo (2011) utilises the multivariate stochastic volatility framework to investigate the association between volatilities in the petroleum and US equity markets. The author documented the presence of volatility interdependencies between two markets. Mensi et al. (2013) employ the VAR-GARCH model to study the volatility linkages between the S&P 500 index and different types of commodity indices, such as gold, wheat, beverage, and petroleum, represented by both the WTI and Brent grades, over the period from 2000 to 2011. Their empirical findings provide evidence of the bidirectional volatility transmission between the S&P 500 index and the WTI grade of petroleum. However, the results differ in the case of the Brent grade. More precisely, equity market volatility is significantly affected by Brent crude petroleum volatility and not the reverse. The empirical study of Chang et al. (2013) is focused on the analysis of volatility spillovers between petroleum returns, represented by spot, futures, and forward prices of the WTI and Brent grades, and returns of the NYSE, Dow Jones, FTSE 100, and S&P 500 indices for the period 1998–2009. The authors used daily data and applied different types of multivariate GARCH models. Surprisingly, they found little evidence of volatility transmissions between the prices of petroleum and equities. Kang et al. (2015) apply the structural VAR model to examine the influence of petroleum price shocks on US equity market volatility for the period from 1973 to 2013. The authors also focus on three volatility measures, namely realised, conditional, and implied volatility. Their empirical results show that petroleum aggregate demand shocks negatively affect all measures of volatility. Furthermore, the association of petroleum-specific demand shocks with each of the volatility measures has been negative over the first several months. The effects of petroleum supply shocks are associated with significant increases in implied volatility, whereas the effects on conditional and realised volatility are not significant. Salisu and Oloko (2015) investigate interactions between the Brent and WTI grades of petroleum and the US stock market, represented by the S&P 500 index, over the period 2002 to 2014. The authors account for structural breaks in their study, the dates of which coincided with the global financial crisis period. Their findings indicate that during the period preceding the structural break, the volatility spillover from the petroleum market to the US equity market was significant for WTI. However, the volatility transmission from the petroleum market to the stock market heightened after the global financial crisis in the case of both the Brent and WTI grades. Khalfaoui et al. (2015) use multivariate GARCH models and wavelet analysis to study the volatility spillover effects between petroleum prices and equity markets of the G7 countries, namely Canada (S&P/TSX), France (CAC 40), Germany (DAX), Italy (FTSE MIB), Japan (Nikkei 225), the United Kingdom (FTSE 100), and the United States (S&P 500), for the period from 2003 to 2012. The authors provide evidence of significant volatility transmissions between the petroleum and equity markets. Ewing and Malik (2016) employ bivariate and univariate GARCH models to investigate spillovers of volatility between the WTI grade of petroleum and the US equity market over the period from 1996 to 2013. The authors incorporate structural breaks into their study. They found no evidence of volatility transmissions between two markets when structural breaks were disregarded. However, after incorporating structural breaks, the authors detect evidence of volatility spillovers between petroleum prices and the US equity market. Utilising daily data over the period from 21 January 2020 to 2 July 2020, Adekoya and Oliyide (2021) examine the role of COVID-19 in driving the connectedness between commodities (crude petroleum and gold) and financial markets (the S&P 500 index, dollar exchange rate, and bitcoin). Their findings indicate that the total time-varying volatility connectedness remained high during the first half of the estimation period and subsequently descended to a lower level. Among the studied assets, crude petroleum acts as the major net transmitter for others.

Other studies consider both developed and emerging markets. Malik and Hammoudeh (2007) study the volatility transmission interrelationship between petroleum market and equity markets in the US, Bahrain, Kuwait, and Saudi Arabia over the period 1994–2001. Their empirical results indicate that volatility spills over from the petroleum market to the equity markets of Bahrain, Kuwait, and Saudi Arabia. However, the authors found that the petroleum market is affected by the equity market volatility in the case of Saudi Arabia, thereby underscoring the important role of the country in the global petroleum market. Maghyereh et al. (2016) examined interconnections between implied volatilities of petroleum and stock market indices of eleven countries, namely Canada, Germany, India, Japan, Mexico, Russia, South Africa, Sweden, Switzerland, the UK, and the US, for the period 2008–2015. Their findings show that the interrelationship between the volatilities of markets is established by bidirectional information transmissions. More specifically, the information spillover is greater from petroleum to stock markets than in the opposite direction. Moreover, the authors detect large transmissions during the period of global recovery, from the middle of 2009 to 2012. Tiwari et al. (2021) analyse the connectedness of volatility between petroleum, represented by Brent and WTI grades, and stock markets in a set of developed and emerging economies. They found that petroleum, irrespective of the grade, is the net recipient of volatility spillovers. Furthermore, volatility interactions are dynamic in nature and have been observed to be impacted by major global events. Utilising a sample of seven advanced and five emerging economies, Mensi et al. (2021) investigate volatility transmissions between stock markets and strategic commodities such as petroleum and gold. The authors document evidence of the dynamic volatility spillovers that strengthen during major events. The stock markets transmit a greater level of volatility to petroleum than they receive on the short-term horizon. The comparable results are detected over intermediate- and long-term horizons, aside from the stock markets of China, Japan, and Russia, where more spillovers in the reverse direction are observed.

A collection of studies considers emerging markets. Arouri et al. (2011a) examine the transmission of volatility between petroleum prices, represented by the Brent grade, and the equity markets of the Gulf Cooperation Council countries, namely Bahrain, Kuwait, Oman, Saudi Arabia, Qatar, and the UAE. The authors applied the VAR-GARCH model and used daily data covering the period from June 2005 to February 2010. Overall, the authors provide evidence of the existence of significant volatility spillovers, particularly during the crisis sub-period, between the prices of petroleum and the equity markets of the studied countries. Awartani and Maghyereh (2013) also examine the volatility spillover effects between the petroleum market and equity markets of the Gulf Cooperation Council countries, but for the period from 2004 to 2012. Their empirical results demonstrate that bidirectional volatility transmissions, although asymmetric, exist between the petroleum market and equity markets. More specifically, volatility spillovers are more pronounced from the petroleum market to equity markets than in the reverse direction. Furthermore, such trends were evident during the financial crisis in 2008 and strengthened afterwards. The study by Lin et al. (2014) focuses on developing markets in the African region. The authors applied DCC-GARCH, VAR-GARCH, and VAR-AGARCH models to examine volatility transmissions between the petroleum market and equity markets in Ghana and Nigeria, represented by the GSE All-Share and NSE All-Share indices, for the period 2000–2010. Their empirical findings provide evidence of significant volatility spillovers between petroleum and equity market returns. The documented effects are stronger in the case of Nigeria, while for Ghana, the volatility transmission is more evident from the petroleum market to the equity market. Yousaf and Hassan (2019) investigate volatility interactions between petroleum stock markets in nine Asian emerging economies. The authors found that volatility spillovers are contingent on study periods and differ across stock markets. Specifically, throughout the full sample and the subprime meltdown in the United States, volatility transmissions are predominantly unilateral from petroleum to stock markets, while during the turbulent period in the Chinese stock market, volatility spillovers are bilateral between petroleum and Indian and Korean stock markets. Focusing on the GCC stock markets, energy, and precision metal commodities, Al-Yahyaee et al. (2019) observe that petroleum, represented by the WTI grade, is the net contributor of volatility. Furthermore, the total volatility spillover index is found to intensify at times of economic turmoil and geopolitical tensions. Sarwar et al. (2020) study the spillover of volatility between petroleum and equity market returns in China, India, and Pakistan. Their findings, which vary across three subperiods and frequencies of data, indicate that volatility transmissions are mixed for India, bilateral for Pakistan, and unilateral for China.

Several works stress the importance of a sectoral examination. Hammoudeh et al. (2004), using daily data, analysed the effects of crude petroleum spot and futures prices on five equity indices of the US petroleum sector for the period from July 1995 to October 2001. The authors report bidirectional volatility interactions between petroleum sector indices and petroleum spot and futures prices. Employing weekly data for the period from 1992 to 2008 and the bivariate BEKK-GARCH model, Malik and Ewing (2009) investigate the volatility transmission mechanism between prices of petroleum and five sector indices in the US. Their findings provide evidence of the substantial transmission of volatility between petroleum prices and sector indices. Nevertheless, such effects are not detected in the Financial and Industrial sectors. Elyasiani et al. (2011) study the effects of shifts in petroleum futures returns and volatility on the equity returns of the thirteen US sectors for the period 1998–2006. The authors categorise these sectors into four groups: petroleum-substitute, petroleum-related, petroleum-users, and financials. Their empirical findings indicate that the excess returns of petroleum-user sectors are influenced by variations in the volatility of petroleum futures returns. On the other hand, sectors in the petroleum-related and petroleum-substitute groups are more affected by fluctuations in petroleum futures returns. Sectors in the financial group are impacted by both movements in petroleum futures returns and volatility. Arouri et al. (2011b) provide evidence of bidirectional volatility spillovers between stock sectors of the United States and petroleum and mostly unidirectional volatility spillovers from petroleum to European stock sectors.

Following the same line, Arouri et al. (2012) apply the VAR-GARCH model to investigate volatility spillover effects between prices of Brent crude petroleum and European equity markets, represented by the DJ Stoxx Europe 600 aggregate index and seven sector indices, over the period 1998 to 2009. Their empirical findings demonstrate the significant transmission of volatility between prices of petroleum and sector equity returns in Europe, where the effects are more apparent from petroleum to sector equity markets. Furthermore, the results indicate that volatility interactions differ across sectors. Sadorsky (2012) examines volatility spillovers and correlations between prices of petroleum and equity prices of technology and clean energy firms for the period 2001–2010. The authors applied multivariate GARCH models and used daily data from the NYSE Arca Technology and WilderHill

Clean Energy indices. The findings indicate that the dynamic conditional correlation between the equity prices of clean energy and technology firms is higher than between clean energy equity prices and petroleum prices. In addition, the results obtained from the DCC type of model show the presence of statistically significant volatility transmission from petroleum prices to equity prices of clean energy firms. Degiannakis et al. (2014) investigate the effects of petroleum price shocks on the volatility of equity markets, represented by the Euro Stoxx 50 and ten Dow Jones sector indices, over the period 1999 to 2010. The authors in their study consider the realised, conditional, and implied volatility measures. Their empirical findings show that volatilities of the aggregate equity market and sectors are not influenced by petroleum supply and petroleum-specific demand shocks, while aggregate demand petroleum shocks result in a reduction of volatilities. Alsalman (2016) examines the effects of petroleum price uncertainty on equity returns in the US at both aggregate and sector levels. The author applied the bivariate GARCH-in-mean VAR model and used monthly data covering the period from 1973 to 2014. The author's results show no evidence of statistically significant impacts of petroleum price volatility on stock returns in the US. Alsalman (2016) suggests that the application of hedging strategies in order to minimise risks arising from petroleum price fluctuations might explain such findings. Applying the VAR-BEKK-GARCH model, Belhassine (2020) documents the non-uniform and dynamic nature of volatility transmissions between petroleum and most of the Eurozone equity sector indices. Costola and Lorusso (2022) scrutinise volatility interactions between energy commodities and six Russian sector indices over the period from January 2005 to December 2020. The authors detect that the magnitude of volatility spillovers is greater from sector indices to petroleum than in the opposite course. Among sectors, Oil and Gas and Metals and Mining are the largest contributors of volatility to petroleum. Furthermore, the total dynamic volatility connectedness is found to be sensitive to global events, particularly the financial crisis and the recent pandemic.

8. Petroleum Prices and Stock Markets in Petroleum Exporting and Importing Countries

It is generally expected that petroleum price changes would have different effects on stock markets in net petroleum exporting countries compared to net petroleum-importing countries (Smyth and Narayan 2018). More specifically, in the case of petroleum-importing countries, a surge in the petroleum price generally leads to higher levels of production costs, given that crude petroleum and petroleum-related products are among the fundamental components in the manufacturing process, while for petroleum exporting countries, it triggers an influx of wealth.[9] Several empirical studies have analysed how the relationship between petroleum prices and equity returns differs across petroleum exporting and importing countries. Park and Ratti (2008) examine the effects of petroleum price shocks and volatility on the equity returns of the United States and thirteen European countries over the period from 1986 to 2005. Their empirical findings indicate that the impact of petroleum price shocks on equity returns in the studied countries is statistically significant. More precisely, the effects of shocks are positive in the case of Norway, a petroleum exporter, and negative for the remaining European countries and the United States. Furthermore, equity returns in most European countries are significantly depressed by the amplified volatility of petroleum prices. Ramos and Veiga (2013) use a sample of thirteen petroleum-importing and five petroleum-exporting countries covering the period 1988–2009 to investigate the impact of petroleum prices on stock markets. Their results show that the effects of petroleum price changes for petroleum exporters and importers run on different routes. Specifically, petroleum price hikes positively affect stock markets in petroleum-exporting countries, while the impact on the stock markets of petroleum-importing countries is negative. Petroleum price drops negatively influence the stock markets of two country groups, while the effect is larger for petroleum exporters. Furthermore, the results show that the impact of petroleum price volatility on the stock markets of petroleum exporting countries is positive and on those of petroleum-importing countries is negative. The empirical study of Wang et al. (2013) is focused on the analysis of the effects of petroleum price shocks on stock market returns in seven petroleum exporting and nine petroleum importing countries for the period 1999–2011. The authors employ the structural VAR model in their work. The main findings indicate that the sign, magnitude, and duration of reactions of equity market returns to petroleum price shocks are contingent on the origin of shocks and the position of countries in the petroleum market, that is, whether they are net exporters or importers. In addition, the results show that petroleum price shocks have more power to explain variations in stock markets for petroleum-exporting countries in comparison to petroleum-importing countries.

More recently, Le and Chang (2015) examined the effects of fluctuations in Dubai crude petroleum prices on equity returns for the period from January 1997 to July 2013. The authors focus on petroleum exporting, importing, and refining economies represented by Malaysia, Japan, and Singapore, respectively. The main estimation period in their study is split into three sub-periods. Overall, the empirical findings indicate that the responses of stock markets to petroleum price hikes vary across different countries and periods. In the first sub-period, the immediate effect of petroleum price shocks on the Malaysian stock market is positive but turns negative in the long run. The impact in the case of Singapore is positive and gradually becomes insignificant. The Japanese stock market generally has positive reactions. In the second sub-period, the instant responses of stock markets in all nations are positive. The Japanese and Singaporean stock markets experience unfavourable influences in the third sub-period, while for Malaysia, the impact is positive only for a short duration and then changes to negative. Employing a sample of nine exporters and seven importers, Wang and Liu (2016) provide evidence of country-specific volatility spillovers. More precisely, volatility spills over from the stock markets of three importers, Germany, the UK, and the US, to the petroleum market, while in the case of exporters, the stock market volatility of Canada, Norway, Russia, and Venezuela is affected by the petroleum market volatility. Employing the nonlinear Panel ARDL approach, Salisu and Isah (2017) examine the asymmetric responses of stock prices to petroleum price changes in five net petroleum exporting and eight net petroleum importing countries over the period from 2000 to 2015. Their empirical findings indicate that the reactions of stock prices in petroleum exporting and importing countries to movements in the price of petroleum are asymmetric, although stronger responses were detected in the former group. Ashfaq et al. (2019) observe volatility spillovers between the petroleum and equity markets of one importer (South Korea) and two exporters (Saudi Arabia and Iraq). The authors found no evidence of significant effects in the cases of India and Japan (importers) and the United Arab Emirates (exporter). Belhassine and Karamti (2021) report the presence of significant volatility transmissions between the petroleum and stock markets of exporters and importers, which vary across considered markets and time scales. Enwereuzoh et al. (2021) focus on equity markets in African exporting and importing economies in order to examine their sensitivities to petroleum shocks for the period 2000–2018. Their findings demonstrate precautionary demand shocks exert significant effects on most of the studied equity markets, and aggregate demand shocks predominantly impact the equity markets of exporting countries. However, the authors obtain scant evidence that petroleum supply shocks affect the stock markets of exporting and importing countries. The study of Akyildirim et al. (2022), which focuses on examining the connectedness between MSCI energy stock indices of petroleum exporters and importers, shows that the first group of countries are mainly transmitters of shocks, while the latter act as receivers of shocks.

Several studies centre around dynamic correlations. Filis et al. (2011), in their work, utilise the sample of three petroleum exporting and importing countries to study time-varying correlations between prices of petroleum and stock markets for the period from 1987 to 2009 based on the DCC-GARCH-GJR model. The authors observe that while time-varying correlations of petroleum and equity prices do not differ for petroleum exporters and importers, they depend on sources of petroleum price shocks. Thus, aggregate demand-side shocks cause positive and precautionary demand shocks negative correlations between markets, but supply-side shocks have no influence on the relationship. Antonakakis and Filis (2013) use the DCC-GARCH model to examine the effects of changes in petroleum prices on the time-varying correlation between stock markets. The authors consider in their study stock market indices from two petroleum-exporting and three petroleum-importing nations. Their findings show that petroleum price movements influence correlations between the stock markets of petroleum-importing countries, while no significant effects on correlations are detected in the case of petroleum-exporting economies. Applying the GJR-DCC-GARCH model, Guesmi and Fattoum (2014) investigate co-movements between Brent crude petroleum prices and stock market indices of four petroleum-exporting economies and five petroleum importing economies over the period from 2000 to 2010. The authors' findings show no differences in dynamic correlations for petroleum-exporting and importing countries. Petroleum demand shocks significantly affect the relationship between petroleum prices and stock markets, particularly in exporting economies. Petroleum supply shocks exert an impact on a correlation only in exporting countries. Boldanov et al. (2016) investigate the relationship between petroleum price and equity market volatilities in petroleum exporting, Canada, Norway, and Russia, and importing, China, Japan, and the US, countries for the period from 2000 to 2014. Their findings indicate that correlations between volatilities are country-specific and vary over time. Particularly, the relationship between petroleum and stock market volatilities is mostly positive in the case of petroleum-importing nations, while more negative correlations are reported for petroleum-exporting nations. In addition, the authors show that correlations are sensitive to different global events. Mokni (2020) analyses the dynamic responses of stock markets in exporting and importing countries to aggregate demand, petroleum supply, and petroleum-specific demand shocks. The author observes that the impact of aggregate demand shocks is positive in most cases, while the effects of petroleum supply shocks are minimal and negative. In addition, the stock markets of exporting countries react positively to petroleum-specific demand shocks, but their counterparts from importing countries react negatively, except for China.

Some works focus exclusively on petroleum-importing nations. The study by Masih et al. (2011), which considers South Korea, one of the largest petroleum importers, shows that movements in petroleum prices significantly affect the country's stock market. Specifically, reactions of the South Korean stock market to petroleum price shock and volatility are negative, with a more profound effect in the latter case. Cunado and Perez de Gracia (2014) analyse the impact of petroleum price shocks on equity returns in twelve petroleum-importing European countries. The authors employed monthly data covering the period from 1973 to 2011. Their empirical results indicate that the effects of fluctuations in petroleum prices on stock market returns in the majority of countries are significant and negative. Furthermore, the authors found that petroleum supply shocks, in comparison to petroleum demand shocks, have larger negative impacts on equity market returns when both world and local petroleum prices are employed. Petroleum demand shocks negatively influence the returns of stock markets only in five countries and positively affect equity returns in France and Denmark when national petroleum prices are used. Bouri (2015) investigates the transmission of petroleum price volatility to the equity markets of four petroleum-importing countries from the MENA region, namely Jordan, Lebanon, Morocco, and Tunisia, for the period 2003–2013. In the pre-crisis period, the author found no evidence of volatility transmissions between the global petroleum market and stock markets in all countries. However, different findings are reported for the post-crisis period. While stock markets show no responses to the petroleum price volatility in the case of Lebanon and Morocco, the bidirectional volatility spillover effects are detected between the world petroleum market and the equity market in Jordan. Additionally, for Tunisia, the unidirectional transmission, although weak, of petroleum volatility to the stock market is present. Silvapulle et al. (2017) applied the nonparametric and parametric panel data approaches to study the relationship between prices of petroleum and stock market indices of large petroleum-importing nations, namely China, France, Germany, India, Italy, Japan, Singapore, South Korea, Spain, and the United States, for the period 1999 to 2015. The reported findings of both methods indicate that the effects of petroleum prices on stock market indices are mostly positive, although they vary during different periods. Overall, the authors conclude that the nonparametric method better captures the dynamic petroleum-stock market relationship in comparison to the parametric method. Sarwar et al. (2019) investigate volatility spillovers between the petroleum market and equity markets of the largest petroleum importers in Asia (China, Japan, and India) over the period from 2000 to 2016. Their results indicate that volatility spillovers are bidirectional between petroleum and the Japanese stock market and unidirectional from the Indian stock market to petroleum, but absent in the case of the Chinese stock market.

Other studies consider petroleum-exporting nations. Employing the structural VAR model, Bjornland (2009) analyses the influence of petroleum price shocks on equity returns in Norway, a net petroleum exporting country. The author's findings suggest that higher petroleum prices increase equity returns in the country. More specifically, the results demonstrate that following an increase of 10% in the petroleum price, equity returns rise instantly by 2.5%. The highest effect is detected after 14–15 months, which gradually fades. Mohanty et al. (2011) investigate the relationship between petroleum price fluctuations and stock market returns in Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE for the period 2005–2009. Their empirical results show that declines in the price of petroleum negatively impact equity market returns in all the studied countries. In contrast, petroleum price increases have significant and positive effects on the stock market returns of only two countries: Saudi Arabia and the UAE. Furthermore, the industry-level analysis conducted for four countries demonstrates that reactions to petroleum price shocks considerably vary across considered industries. Arouri and Rault (2012) examine long-term links between the prices of petroleum and the stock markets of the four Gulf Cooperation Council countries, namely Bahrain, Kuwait, Oman, and Saudi Arabia. The authors applied seemingly unrelated regression methods, bootstrap panel cointegration techniques, and employed monthly data for the period from 1996 to 2007. Their results provide evidence for cointegration between petroleum prices and equity markets. In addition, the empirical findings indicate that rises in the price of petroleum positively affect stock markets in all countries, except for Saudi Arabia. Demirer et al. (2015) explore the effects of petroleum price risk exposure on equity returns in net petroleum-exporting nations. The authors focus on the Gulf Cooperation Council countries and use firm-level data covering the period from 2004 to 2013. The results demonstrate that equities that are more responsive to movements in the price of petroleum produce notably higher returns. Thus, the obtained findings suggest that exposure to petroleum prices can act as a forecaster of equity returns in the studied countries. Gil-Alana and Yaya (2014) analysed the relationship between monthly Brent crude petroleum prices and the Nigerian stock market based on fractional integration and cointegration approaches over the period from 2000 to 2011. The authors document evidence of the positive relationship between the studied variables, although with a short-term effect that remains significant only for the first three months. Basher et al. (2018) use monthly data to study the impact of different petroleum shocks on the performance of stock markets in eight petroleum exporting nations, namely Canada, Mexico, the UK, Norway, Russia, Saudi Arabia, Kuwait, and the UAE. Their results show that magnitudes and signs of petroleum shocks vary among the studied countries. The impacts of petroleum demand shocks on equity returns in all countries, with the exception of Mexico and the UK, are statistically significant. Petroleum supply shocks exert statistically significant effects in the case of Kuwait, the UAE, and the UK. The stock returns in Russia, Norway, Saudi Arabia, Kuwait, and the UAE are influenced by idiosyncratic petroleum market shocks. Petroleum inventory shocks affect equity returns in Russia, Canada, Kuwait, and the UAE. Lastly, petroleum market shocks have no effect on equity returns in Mexico. The authors explain the findings obtained by the absence of large publicly traded oil and gas corporations in the country.

A few studies conduct sectoral investigations. Bouri et al. (2016) examine the association between petroleum prices and returns of Financials, Industrials, and Services stock sectors in Jordan, a small petroleum-importing country from the MENA region. Their findings show that the returns of the Financials and Services sectors are significantly influenced by petroleum shocks, whereas the effect is insignificant in the case of the Industrial sector. The reported impact is more noticeable during the period that follows the Uprising in the region. Furthermore, the authors found evidence of risk transmission from the petroleum market to the Industrial sector only. Bagirov and Mateus (2022) scrutinise volatility transmissions between petroleum prices and manually constructed stock sector indices of Mexico (net exporter) and the United Kingdom (net importer) over the period from January 2005 to September 2018. The authors document the presence of significant bilateral volatility spillovers, which are more evident for sectors of Mexico. In the case of the United Kingdom, the volatility cross-effects are observed between petroleum and only two sectors.

9. Petroleum Prices and Firm-Level Stock Returns

A group of studies have analysed the relationship between petroleum prices and equity returns employing firm-level data.[10] Sadorsky (2008) investigates the relationship between fluctuations in petroleum prices, equity prices, and firm size using data on 1483 companies from the S&P 1500 index, which comprises small, medium, and large companies, covering a period of seventeen years. The author observes that the effects of movements in the price of petroleum on equity returns are asymmetric and vary with the size of companies, which are stronger in the case of medium-sized companies. Petroleum price rises exercise a greater impact on equity returns in comparison to petroleum price decreases. Furthermore, the findings indicate that increases in petroleum prices lead to drops in company-level equity returns. Narayan and Sharma (2011) use daily data to examine the impact of petroleum prices on the stock returns of 560 US companies from fourteen sectors listed on the New York Stock Exchange for the period 2000–2008. Their main results suggest that the responses of companies to petroleum price movements depend on their size and sectoral belonging. More specifically, petroleum price increases lead to rises in returns for companies in the energy and transportation sectors, while corporations in the remaining sectors experience decreases in returns, which could be attributed to different degrees of dependence on petroleum. In addition, the authors found that the relationship between petroleum prices and returns of small-sized companies in the majority of instances is positive and statistically significant, but it turns out to be negative as firms' sizes grow, thereby pointing to a greater flexibility that small-sized companies may have in terms of efficiently adapting to changing market conditions. Dayanandan and Donker (2011) explore the interrelationship between petroleum prices, firm size, financial performance, and capital structure of oil and gas companies in the North American region over the period from 1990 to 2008. The authors used in their study data on 200 large corporations listed on the US stock exchange. Dayanandan and Donker (2011) found that the impact of petroleum prices on measures of the financial performance of oil and gas companies is significant and positive. In addition, their empirical findings indicate that the global financial crisis negatively affects the prices of petroleum and the performance of companies.

Aggarwal et al. (2012) analysed the influence of changes in petroleum prices on various firm characteristics of seventy-one companies from the S&P Transportation sector index over the period 1986–2008. The authors found asymmetrical exposures to petroleum price shifts. In addition, their results indicate that petroleum price upsurges negatively influence the returns of transportation companies, while declines in petroleum prices increase risks. The divergence in findings of Narayan and Sharma (2011) and Aggarwal et al. (2012) related to transportation stocks could be attributed to different empirical methodologies employed. Mohanty et al. (2013) study the effects of petroleum price fluctuations on equity returns and other firm-specific characteristics of fifty-four companies from the US oil and gas industry for the period from 1986 to 2008. Their results show that both petroleum price increases and decreases influence the returns of oil and gas companies. However, the reactions of equity returns associated with negative petroleum price movements are significantly greater, and equity risks are more affected by declines in the price of petroleum. In addition, the authors found that responses to fluctuations in petroleum prices are contingent on the characteristics of companies and differ across sub-sectors. Phan et al. (2015) examined the impact of movements in petroleum prices on the equity returns of petroleum-consuming and producing companies in the US over the period from 1986 to 2010. The authors found evidence indicating that the influence of petroleum price increases on the equity returns of petroleum producers is positive, whereas for petroleum consumers, the negative impact is documented. In addition, their results show that the magnitude of observed effects differs across sub-sectors of petroleum producers and consumers. Gupta (2016) used company-level monthly data covering seventy countries to examine the effects of petroleum price shocks, competition, and country-level determinants on the equity returns of oil and gas companies over the period from 1983 to 2014. The author's findings indicate that petroleum price shocks positively affect company-level returns. Oil and gas firms from petroleum-producing countries showed higher sensitivity to market stress and petroleum price fluctuations. Furthermore, companies located in a non-competitive environment are less influenced by decreases in the price of petroleum. The empirical work of Bagirov and Mateus (2019) is focused on the analysis of the effects of crude petroleum price movements on the financial performance of 137 listed and 531 unlisted oil and gas corporations from the Western European region for the period from 2005 to 2014. Their results demonstrate that the performance of listed oil and gas corporations is positively affected by crude petroleum prices. Furthermore, the recent geopolitical crisis exerted negative effects on listed and unlisted corporations, while the global financial crisis adversely affected only listed corporations.

Narayan and Sharma (2014) analyse the impact of petroleum prices on the equity return volatility of 560 companies from fourteen sectors listed on the New York Stock Exchange over the period from 2000 to 2008. The authors' results indicate that the effects of petroleum prices vary depending on the sectors and sizes of companies. In particular, petroleum price rises lead to equity return volatility increases for the banking sector and decreases in equity return volatility for all other sectors. Tsai (2015) investigates the reactions of equity returns in the US to petroleum price shocks for the period from 1990 to 2012. The author employs the daily data of 682 companies. The empirical findings indicate that the equity returns of companies were negatively influenced prior to the global financial crisis. However, the effects are positive during and after the crisis periods. In addition, the author observes heterogeneous responses across industries. Particularly, the reactions of some energy-intensive manufacturing sectors are positive to petroleum price shocks compared to other sectors that are less energy-intensive. Furthermore, the effects of shocks on large companies were strong and negative in the period preceding the crisis, while medium-sized companies experienced bigger impacts after the financial crisis. Kang et al. (2017) study the relationship between petroleum price shocks and equity returns of the aggregate oil and gas sector index and seven individual companies, namely BP, Chevron, ConocoPhillips, Exxon Mobil, TransCanada Corporation, Royal Dutch Shell, and Valero Energy Corporation, for the period 1985–2015. Their empirical results show that the effects of demand-side shocks on the equity returns of oil and gas companies are significant and positive. In addition, the authors analyse three oil and gas sector components, such as upstream, midstream, and downstream, represented by ConocoPhillips, TransCanada Corporation, and Valero Energy Corporation, respectively. They found that in all three cases, responses to demand-side shocks are positive, whereas petroleum supply shocks cause negative effects. Antonakakis et al. (2018) investigate volatility spillovers between petroleum prices, represented by the WTI sort, and the equity prices of twelve oil and gas companies. The authors employed daily firm-level data from June 2001 to February 2016. Their results demonstrate the significant volatility spillover effects between petroleum and equity prices. In particular, the transmission of volatility is mostly unidirectional, from the equity prices of corporations to petroleum prices. The companies that exerted the largest impact are British Petroleum, Chevron, Exxon Mobil, Royal Dutch Shell, and Total SA. Furthermore, the authors detect higher dynamic conditional correlations between volatilities during the global financial crisis, while correlation figures are lower during 2005.

10. Intraday Linkages between Petroleum Prices and Stock Markets

Considering the accelerated exchange of information among markets, some studies are devoted to the analysis of the petroleum-stock market nexus utilising intraday data.[11] Xu et al. (2019) make use of 5 min data to examine volatility interconnections between the equity markets of China, the United States, and WTI futures prices over the period from 2007 to 2016. Their findings reveal that the volatility connectedness between petroleum and equity markets is stronger for the United States. The dynamic figures of volatility transmissions indicate that the stock market of China and petroleum are the net-recipients throughout the financial crisis, whereas the stock market of the United States is found to be the net-contributor. In addition, the authors observe the prevalence of bad volatility spillovers for most of the study period. Employing a 5 min frequency of data, Suleman et al. (2021) examine asymmetric volatility interactions between the Dow Jones Islamic Market Index and three commodities (gold, silver, and the Brend grade of crude petroleum) for the period from January 2010 to November 2020. The authors document that the Dow Jones Islamic Market Index acts as a major transmitter of volatility for commodities. The dynamic volatility interactions intensify throughout the Eurozone debt crisis and the global health crisis, with Brent crude petroleum and silver being the net-recipients of volatility over the latter event. Furthermore, they found that the intensity of volatility transmissions induced by negative shocks is greater in contrast to positive shocks. Farid et al. (2021) focus on the more recent period from January 2019 to May 2020 to investigate intraday volatility connectedness between equities and commodities employing 5 min trading data on US ETFs. Their results point to the role of the equity market as the major source of volatility transmission to commodities during the entire study period. In addition, the authors observe that the recent pandemic exerted a substantial impact on the total dynamic volatility connectedness, which amplified in the first half of 2020. Heinlein et al. (2021), utilising 5 min data and a contagion test grounded on the local Gaussian correlation approach, report significantly stronger correlations between Brent crude petroleum and equity markets of both petroleum exporting and importing countries during the COVID-19 outbreak. Adekoya et al. (2022) focus on the intraday connectedness between prominent assets, such as Brent crude petroleum, gold, bitcoin, S&P stocks, US bonds, and the dollar index. The authors observe that Brent crude petroleum is the net contributor of spillovers during periods of market instability caused by geopolitical tensions. Applying the GARCH-type model, Mensi et al. (2022) document substantial upsurges in intraday dynamic correlations between returns of the US stock market and Brent crude petroleum throughout the spread of COVID-19.

11. Conclusions

Understanding the interaction mechanisms between petroleum prices and equity markets continues to garner the interest of industry professionals and scholars globally, particularly in view of the unprecedented swings driven by demand-side, supply-side, and speculative factors that petroleum prices experienced over the preceding two decades. By identifying 194 studies published from 1983 to 2023, mostly in top-ranked journals, the current paper delivers a comprehensive review of a broad array of the existing literature by focusing on the following themes: (i) the effects of petroleum prices on macroeconomic variables; (ii) the relationship between petroleum prices and equity returns at the aggregate and sector levels; (iii) the role of petroleum price shocks in elucidating equity returns; (iv) time-varying linkages between petroleum prices and equity markets; (v) volatility spillovers between petroleum prices and equity markets; (vi) the role of a country as a net petroleum exporter or net petroleum importer in the petroleum-equity market nexus; (vii) responses of firm-level equity returns to petroleum price changes; and (viii) intraday connections between petroleum prices and equity markets. The synthesis and consolidation of an extensive number of empirical works enable researchers and professionals to gain an in-depth understanding of the interaction mechanisms between markets of interest.

The inferences derived from the current survey can be summarised as follows: The effects of petroleum prices and shocks, as well as volatility interactions, are mixed depending on the utilised methodologies, estimation periods, and data frequencies, yet it is evident that, in general, the sensitivities of equity returns are negative for petroleum importers, whereas the opposite trend is valid for petroleum exporters. Negative and positive petroleum price fluctuations are prone to exerting asymmetric effects on equity returns. Furthermore, the nexus between petroleum and equity markets exhibits a dynamic nature and tends to be affected by global events.

Having conducted the comprehensive analysis, it is worth highlighting several avenues that we hope will offer the scope necessary for extending research in this diverse line of literature. Given the growing significance of managing environmental, social, and governance (ESG) risks, it would certainly be interesting to assess the role that sector- and company-specific ESG ratings play when investigating the effects of petroleum price shocks and volatility transmissions. Prior to moving to the next area for extension, it is necessary to walk through the potential effects of petroleum prices on stock markets in petroleum exporting and importing countries. An increase in the price of petroleum induces the relocation of capital to petroleum-exporting nations and generates greater investment opportunities, but for petroleum-importing nations, it results in high manufacturing costs and the amplification of inflationary pressures (Bjornland 2009; Wang et al. 2013; Filis and Chatziantoniou 2014). Thus, not only aggregate markets but also sectors are anticipated to experience different reactions. The utilisation of aggregate market indices in the analysis will not produce a full picture since the level of petroleum dependency is dissimilar among sectors and, hence, the intensity of responses may demonstrate heterogeneous behaviour (Gogineni 2010; Elyasiani et al. 2011). Taking the aforesaid into account, as suggested by Degiannakis et al. (2018), the effects of shocks representing the speculative behaviour in the petroleum market on the petroleum-stock sector nexus across exporters and importers can also be incorporated. However, the existing approach developed by Kilian and Murphy (2014) for detecting speculative shocks based on petroleum inventories data, although useful, is constrained to a monthly frequency. Therefore, it would be beneficial to produce shocks associated with speculative activity by employing high-frequency data, which permits the capture of valuable short-term movements amid the interlinked global financial landscape and, in particular, the enhanced financialization of the petroleum market. Furthermore, another important avenue is associated with quantifying minute-per-minute good and bad volatilities, where a method of decomposing realised variances of assets into realised semivariances proposed by Barndorff-Nielsen et al. (2010) can be applied to scrutinise the intraday volatility interconnectedness at the sector level across petroleum exporters and importers. This will allow us to assess the instant impact of actions taken by OPEC+ countries towards the voluntary reduction of production levels in order to control petroleum prices and the recently increased geopolitical risks, given the accelerated spread of information among financial markets.

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Appendix A

Table A1. Summary of considered studies.

Authors	Countries and Study Periods	Methodology	Variables
Panel A: Petroleum prices and economic variables			
Hamilton (1983)	US 1948–1980	VAR	Petroleum price, real GNP, unemployment, US prices, wages, money, and import prices.
Burbidge and Harrison (1984)	US, Japan, Germany, UK, Canada 1961–1982	VAR	Petroleum price, total industrial production in OECD and domestic countries, short-term interest rate, currency and demand deposits, wages, and CPI.
Gisser and Goodwin (1986)	US 1961–1982	St. Louis-type equations	Petroleum price, money stock, fiscal activity, real GNP, price level, real investment, and unemployment.
Mork (1989)	US 1949–1988	VAR	Petroleum price, real GNP, inflation, 3-month Treasury bill, unemployment, import price, and wages.
Mork et al. (1994)	Canada, France, Germany, Japan, Norway, UK, US 1967–1992	VAR, Seemingly Unrelated Regression	Petroleum price, real GDP, unemployment, wages, and interest rates.
Hooker (1996)	US 1948–1994	VAR	Petroleum prices, 3-month Treasury bill rate, inflation, import prices, unemployment, GDP, industrial production, and employment in goods and services producing sectors.
Hamilton (1996)	US 1948–1994	VAR, Granger causality	Petroleum prices, GDP, Treasury bill, inflation, and import prices.
Bjornland (2000)	US, Germany, UK, Norway 1960–1994	VAR	Petroleum prices, real GDP, and unemployment.
Hamilton (2003)	US 1949–2001	Flexible approach to nonlinear modelling	Petroleum price, GDP.
Cunado and Perez de Gracia (2003)	Germany, Belgium, Austria, Spain, Finland, France, Ireland, Italy, Luxembourg, Portugal, UK, Netherlands, Denmark, Greece, Sweden 1960–1999	VAR	Petroleum price, inflation, and industrial production indices.
Jimenez-Rodriguez and Sanchez (2005)	Canada, France, Germany, Italy, Japan, Norway, UK, US, Euro Area 1972–2001	VAR	Petroleum price, real GDP, exchange rate, wage, inflation, and short and long-term interest rates.
Lardic and Mignon (2006)	Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Norway, Portugal, Spain, Sweden, UK 1970–2003	OLS	Petroleum price, GDP.

Table A1. *Cont.*

Authors	Countries and Study Periods	Methodology	Variables
Lardic and Mignon (2008)	G7, US, Europe, Euro Area 1970–2004	OLS	Petroleum price, GDP.
Hou et al. (2016)	Canada 1980–2011	SVAR	Petroleum price, GDP, inflation, wage, and exchange rate.
Lorusso and Pieroni (2018)	UK 1976–2014	SVAR	Brent, real GDP, output gap, inflation, and short-term interest rate.
Wen et al. (2021)	G7 1997–2019	Diebold and Yilmaz	NYMEX Crude-Light Sweet Oil, VIX, the world integrated oil and gas producer index, and CPI.
Cunado and Perez de Gracia (2005)	Japan, Singapore, South Korea, Malaysia, Thailand, Philippines 1975–2002	Cointegration, Granger causality, VAR	Petroleum price, CPI, Industrial Production Index (Japan, South Korea), Manufacturing Production Index (Singapore), and real GDP (Malaysia, Thailand, and Philippines).
Kim et al. (2017)	China 1992–2014	TVP SVAR, SVAR, GIR VAR	Petroleum price, petroleum production, industrial production, CPI, exchange rate, and interest rate.
Liu et al. (2020)	China 1999–2018	SVAR	WTI, industrial added value growth rate, money supply, and CPI.
Lin et al. (2023)	Euro-19, China, Japan, US 1990–2021	BVARSV	WTI, Brent, exchange rate, interest rate, consumer price index, industrial production index (Euro-19, Japan), industrial added value (China), and gross industrial output (US).
Korhonen and Ledyaeva (2010)	Russia, Germany, Italy, Netherlands, China, US, UK, Switzerland, Finland, Belgium, Canada, France, Japan 1995–2006	VAR	WTI, Brant, Dubai, and GDP.
Nusair (2016)	Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, UAE 1968–2014	NARDL	Dubai, real GDP.
Lee et al. (2017)	Canada, UK, Germany, France, Italy, Japan, US 1994–2014	SVAR	World petroleum production, real global economic activity, Brent, and risk ratings.
Smiech et al. (2021)	Canada, Mexico, Norway, Russia 2006–2019	BSVAR	WTI, industrial production, and exchange rate.
Tan and Uprasen (2023)	Brunei, Indonesia, Malaysia, Vietnam, Myanmar, Philippines, Singapore, Thailand 2000–2021	Panel NARDL	Petroleum price, Gini index, CPI, GDP, unemployment, human development, and trade openness.

Table A1. *Cont.*

Authors	Countries and Study Periods	Methodology	Variables
	Panel B: Petroleum prices and aggregate stock markets		
Jones and Kaul (1996)	US, Canada, Japan, UK 1947–1991	Standard cash-flow dividend valuation model	Petroleum price, index of industrial production, inflation, equity returns, dividend yield, corporate bond yield, government bond yield, default spread, and term spread.
Sadorsky (1999)	US 1947–1996	VAR	Petroleum price, S&P 500, industrial production, and interest rate.
Papapetrou (2001)	Greece 1989–1999	VAR	Petroleum price, equity returns, interest rate, industrial production, and employment.
Driesprong et al. (2008)	48 countries 1973–2003	Basic regression model	Brent, WTI, Dubai, Arab Light, IPE Brent futures, NYMEX Light futures, and MSCI reinvestment indices.
Chen (2010)	US 1957–2009	TVTP-MS	Petroleum price, S&P500.
Filis (2010)	Greece 1996–2008	VECM, VAR	Brent, ATHEX General Composite Index, industrial production, and CPI.
Basher et al. (2012)	Emerging markets 1988–2008	SVAR	Petroleum price, petroleum production, global real economic activity, MSCI emerging stock market index. exchange rate, and interest rate.
Asteriou and Bashmakova (2013)	Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, Slovenia 1997–2007	International multi-factor model	WTI, stock markets, exchange rate, and MSCI World Index.
Narayan and Narayan (2010)	Vietnam 2000–2008	OLS, DOLS, GARCH	WTI, stock market, and exchange rate.
Zhu et al. (2011)	14 OECD and Non-OECD markets 1995–2009	Panel threshold cointegration, TVECM, Granger causality	WTI, stock prices, industrial production, and short-term interest rate.
Zhu et al. (2014)	Australia, China, Hong Kong, India, Indonesia, Japan, South Korea, Malaysia, Singapore, Taiwan 2000–2012	AR-GARCH, Constant and time-varying copulas	WTI, S&P/ASX 200, Shanghai composite, Hang Seng, BSE National, Jakarta SE Composite, Nikkei 225, Kospi, Kuala Lumpur Composite, Strait Times, and SE Weighted.
Silvapulle et al. (2017)	China, France, Germany, India, Italy, Japan, Singapore, South Korea, Spain, US 1995–2015	Nonparametric panel data model	WTI, S&P500, Nikkei 225, Shanghai SE Composite, KOSPI 200, S&P BSE 30, DAX 30, CAC 40, Straits Times, FTSE MIB, and IBEX 35.
Huang et al. (1996)	US 1979–1990	VAR	NYMEX petroleum futures, S&P 500.
Basher and Sadorsky (2006)	21 emerging markets 1992–2005	OLS, Unconditional and conditional cross section regressions	WTI, MSCI World Index, and exchange rate.

Table A1. *Cont.*

Authors	Countries and Study Periods	Methodology	Variables
Cong et al. (2008)	China 1996–2007	VAR	Brent, industrial production, CPI, short term interest rate, and stock market prices.
O'Neill et al. (2008)	Australia, Canada, France, UK, US 2003–2006	ARX	WTI, DJ Industrial Average, TSX, FTSE 100, and CAC 40.
Miller and Ratti (2009)	France, Germany, Italy, UK, Canada, US 1971–2008	VECM	Brent, CPI, producer price index, CPI, industrial production index, short-term interest rate, and stock market prices.
Jammazi and Aloui (2010)	France, Japan, UK 1989–2007	MS-VAR	WTI, Brent, FTSE 100, CAC 40, and Nikkei 225.
Ajmi et al. (2014)	Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, UAE 2007–2012	Granger causality, Mackey-Glass process, and Kyrtsou-Labys causality	WTI, Brent, and stock market prices.
Narayan and Gupta (2015)	US 1859–2013	Predictive regression model	WTI, S&P 500.
Hatemi et al. (2017)	US, UK, France, Germany, Italy, Canada, Japan, World 1975–2013	Granger causality, Asymmetric causality of Hatemi-J	Petroleum prices, stock market prices.
Panel C: Petroleum prices and stock sectors			
Faff and Brailsford (1999)	Australia 1983–1996	Two-factor APT	Petroleum prices, 24 ASX sectors.
Sadorsky (2001)	Canada 1983–1999	Multifactor market model	WTI, TSE oil and gas index.
Boyer and Filion (2007)	Canada 1995–2002	GLS	WTI, NYMEX Natural Gas, stock market, interest rate, exchange rate, cash flows, debt, petroleum production, proven reserves, and drilling success.
Hammoudeh and Li (2005)	US 1986–2003	VECM	WTI, NYSE Transportation Index, Amex Oil Index, and MSCPI Index.
El-Sharif et al. (2005)	United Kingdom 1989–2001	Two-factor model	Brent, oil and gas sector index, exchange rate, FTSE All Share Index, and interest rate.
Lee et al. (2012)	Canada, France, Germany, Italy Japan, UK, US 1991–2009	VAR	Petroleum price, industrial production, interest rate, Composite, Consumer discretionary, Consumer staples, Energy, Financial, Health care, Industrials, Information technology, Materials, Utilities, Transportation, and Telecommunications sector indices.

Table A1. *Cont.*

Authors	Countries and Study Periods	Methodology	Variables
Moya-Martinez et al. (2014)	Spain 1993–2010	Multifactor market model	Brent, aggregate market index, interest rate, Banking, Basic Resources, Chemicals and Paper, Construction, Consumer Goods, Consumer Services, Energy, Financial, Food and Beverages, Health Care, Industrials, Real Estate, Services, Technology and Telecommunications, and Utilities sectors.
Xu (2015)	UK 1988–2013	One- and two-factor models, Diebold-Mariano	Brent, Basic Materials, Consumer Goods, Consumer Services, Financials, Health Care, Industrials, Oil and Gas, Technology, and Telecom and Utilities FTSE All-Share industry indices.
Arouri (2011)	Europe 1998–2010	Linear and asymmetric models	Brent, DJ Stoxx 600, Automobile and Parts, Financials, Food and Beverages, Oil and Gas, Health Care, Industrials, Basic Materials, Personal and Household Goods, Consumer Services, Technology, Telecommunications, and Utilities DJ Stoxx sector indices.
Scholtens and Yurtsever (2012)	Euro Area 1983–2007	VAR, MLRM	Brent, short-term interest rate, industrial production, and 38 industries.
Li et al. (2012)	China 2001–2010	Panel cointegration, Granger causality	WTI, Agriculture, Conglomerates, Construction, Financials, IT, Manufacturing, Media, Mining, Real Estate, Social services, Transportation, Utilities, and Wholesale and Retail sectors.
Zhu et al. (2016)	China 1994–2014	Quantile regression approach	WTI, 16 sectors (Accommodation and Catering; Agriculture; Complex; Construction; Culture, Sports and Entertainment; Financial; IT; Manufacturing; Mining; Production and Supply of Power, Heat, Gas and Water; Realty; Transportation; Water, environment and public facilities management; Wholesale and retail trade).
Broadstock et al. (2014)	Japan, India, Korea, Taiwan 1984–2012	Simple empirical asset pricing model	WTI, KOSPI, KOSPI 200 Energy and Chemical, NKY, SENSEX, SENSEX Oil and Coal, SENSEX Power, TOPIX, TOPIX Oil, Nikkei 225, Nikkei 500 Oil, TWSE, and Taiwan Taiex Oil.
Nandha and Faff (2008)	Global 1983–2005	Standard market model	WTI, 35 DataStream Global Industry indices

Table A1. *Cont.*

Authors	Countries and Study Periods	Methodology	Variables
Ramos and Veiga (2011)	34 countries 1998–2009	Multifactor panel model	Brent, world market index, oil and gas industry indices, currency rates, and interest rates.
Henriques and Sadorsky (2008)	US 2001–2007	VAR	WTI, WilderHill Clean Energy Index, and Arca Tech 100 index.
Kumar et al. (2012)	Global 2005–2008	VAR	WTI, Brent, Wilder Hill New Energy Global Innovation Index, Wilder Hill Clean Energy Index, S&P Global Clean Energy Index, S&P 500 Index, carbon price, and interest rate.
Cameron and Schnusenberg (2009)	Global 2001–2008	Four-factor regression model	WTI, Energy Select Sector SPDR (XLE) ETF, stock prices of General Motors, Ford Motor Corp., Daimler/Chrysler, Toyota Motor Corp., Honda Motor Co., and Nissan Motors.
Nandha and Brooks (2009)	38 countries 1983–2006	Standard market model	WTI, transport sector indices, and world market index.
Kristjanpoller and Concha (2016)	Global 2008–2013	CAPM, GARCH	WTI, Jet Fuel, and 56 airlines' stock prices.
Panel D: Petroleum price shocks and stock markets			
Kilian and Park (2009)	US 1973–2006	SVAR	US aggregate and 4 sector (Petroleum and Natural Gas, Automobiles and Trucks, Retail, Precious Metals) stock returns, oil supply shock, aggregate demand shock, and oil-specific demand shock.
Kang et al. (2016)	1973–2014	SVAR	US aggregate and 4 sector (Petroleum & Natural Gas, Automobiles and Trucks, Retail, Precious Metals) stock returns, US oil supply shock, non-US oil supply shock, aggregate demand shock, and oil-specific demand shock.
Apergis and Miller (2009)	Canada, US, France, UK, Germany, Italy, Australia, Japan 1981–2007	VEC	Australian General Market Index, C.L. Toronto Index, DAX Index, CAC Industrial Index, MIB 30 Index, Nikkei Index, FT 30 Index, NYSE Index, oil supply shock, global aggregate demand shock, and global oil demand.
Kang and Ratti (2013)	US 1985–2011	SVAR	US aggregate and 4 sector stock returns, US economic policy uncertainty, oil supply shock, aggregate demand shock, and oil market specific demand shock.
Abhyankar et al. (2013)	Japan 1988–2009	SVAR	Datastream Japan country equity index, oil supply shock, aggregate demand shock, and oil market specific demand shock.

Table A1. *Cont.*

Authors	Countries and Study Periods	Methodology	Variables
Guntner (2014)	Canada, France, Germany, Japan, Norway, US 1974–2011	SVAR	S&P 500, CDAX, NIKKEI 225, S&P/TSX, CAC40, OBX, oil supply shock, aggregate demand shock, and other oil demand shock.
Angelidis et al. (2015)	US 1989–2011	SVAR	Dow Jones returns, Dow Jones realised volatility, dividend yield, interest rate, unemployment, default spread, inflation, petroleum production, petroleum price returns, global economic activity, and petroleum price volatility.
Bastianin et al. (2016)	Canada, US, France, UK, Germany, Italy, Japan 1973–2015	SVAR	MSCI country indices, oil supply shock, aggregate demand shock, and oil specific demand shock.
Sakaki (2019)	US 1990–2015	SVAR	10 S&P 500 sector indices (Consumer Discretionary, Consumer Staples, Energy, Financials, Heath Care, Industrials, Information Technology, Materials, Telecommunication Services, Utilities), oil supply shock, aggregate demand shock, and oil market specific demand shock.
Hwang and Kim (2021)	US 1973–2008	Smooth Transition VAR	S&P 500, 4 industries (Petroleum and Natural Gas, Chemicals, Automobile and Truck, Retail) oil supply shock, aggregate demand shock, and oil specific demand shock.
Gupta and Modise (2013)	South Africa 1973–2011	SVAR	Johannesburg Securities Exchange All Share Index, oil supply shock, global demand shock, and speculative demand shock.
Fang and You (2014)	China, India, Russia 2001–2012	SVAR	Aggregate market indices, oil supply shock, global demand shock, and oil specific demand shocks.
Li et al. (2017)	China 1994–2014	SVAR	Listed firms from the petroleum industrial chain in China, oil supply shock, global demand shock, precautionary demand shock, and domestic demand shock.
Koh (2017)	Bangladesh, China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand 1994–2014	SVAR	Stock markets, oil supply shock, aggregate demand shock, and oil market specific demand shock.
Demirer et al. (2020)	21 countries 2000–2018	Multifactor linear model, Diebold and Yilmaz	Stock markets, MSCI world stock index, FTSE world government bond index, oil demand shock, oil supply shock, and risk shock.

Table A1. *Cont.*

Authors	Countries and Study Periods	Methodology	Variables
Wong (2020)	China 2000–2019	Multifactor model, Three-factor model	Forms from 11 sectors and 60 industries, oil demand shock, oil supply shock, and risk shock.
Mishra and Mishra (2021)	India 2010–2019	Linear regression, Rolling window regression, DCC GARCH, and MRS	10 NSE sector indices (Auto, Bank, Consumer Durables, FMCG, Financial Services, Information Technology, Media, Metal, Pharma and Realty), oil demand shock, oil supply shock, and risk shock.
Umar et al. (2020)	Spain 2000–2019	Diebold and Yilmaz	8 sectors (Basic Materials, Industrials, Consumer Goods, Telecommunications, Utilities, Financials, Technology and Retail), oil demand shock, oil supply shock, and risk shock.
Umar et al. (2021)	Bahrain, Brazil, China, India, Kuwait, Oman, Qatar, Russia, South Africa, Saudi Arabia, UAE 2005–2020	Diebold and Yilmaz	MSCI total return stock indices, oil demand shock, oil supply shock, and risk shock.
Panel E: Time-varying linkages between petroleum prices and stock markets			
Reboredo (2010)	Germany, Netherlands, UK, US 1985–2006	MS models	Brent, WTI, Dubai, S&P 500, DAX, FTSE 100, and AEX.
Mollick and Assefa (2013)	US 1999–2011	GARCH, MGARCH-DCC	WTI, gold, exchange rate, VIX, inflation, interest rates, Russell 2000, NASDAQ, Dow Jones, and S&P 500.
Chang and Yu (2013)	US 2001–2012	MS-ARJI-GJR-GARCH-X	WTI, S&P 500.
Ciner (2013)	US 1986–2010	Frequency domain method	WTI, NASDAQ, S&P 500, and 20 stocks from the DJIA.
Degiannakis et al. (2013)	Europe 1992–2010	Diag-VECH GARCH	Brent, 10 Dow Jones sector indices (Basic Materials, Consumption Goods, Financials, Health, Industrial, Oil and Gas, Retail, Technology, Telecommunications, and Utilities).
Reboredo and Rivera-Castro (2014)	2000–2011	Wavelet multi-resolution analysis	Brent, S&P 500, DJ Stoxx Europe 600, 8 sector indices (Automobile and Parts, Banks, Chemical, Oil and Gas, Industrial Good, Utilities, Telecommunications, and Technologies).
Martin-Barragan et al. (2015)	US, Germany, UK, Japan 1990–2011	Wavelet-based approach	WTI, aggregate market indices.
Bhar and Nikolova (2010)	Russia 1995–2007	EGARCH	WTI, AK&M Composite index
Mohanty et al. (2010)	Hungary, Czech Republic, Romania, Poland, Slovenia, Austria 1998–2010	Two-factor model	WTI, major oil and gas companies, and aggregate market.

Table A1. *Cont.*

Authors	Countries and Study Periods	Methodology	Variables
Broadstock et al. (2012)	China 2000–2011	BEKK-GARCH, Three-factor model	Brent, energy sector index.
Broadstock and Filis (2014)	China, US 1995–2013	SVAR, Scalar-BEKK	NYSE, Shanghai Composite, 5 sector indices (Banks, Retail, Oil and Gas, Metals and Mining, Technology), oil supply shock, aggregate demand shock, and oil market specific demand shock.
Reboredo and Ugolini (2016)	US, UK, European Monetary Union, Brazil, Russia, India, China, South Africa 2000–2014	Unconditional and conditional quantiles, TGARCH, and Copula models	Brent, aggregate market indices.
Zhang (2017)	China, US 2002–2014	MADCC	WTI, CSI 300, and S&P 500.
Zhu et al. (2017)	China, India, Japan, South Korea, US, Canada, Mexico, Russia, UK 1997–2015	SVAR, Two-stage Markov regime-switching	Shanghai Composite, BSE 30, Nikkei 225, Seoul Composite, S&P 500, BOVESPA, S&P TSX Composite, MX-MEXBOL, RTS, FTSE 100, oil supply shock, aggregate demand shock, and oil demand shock.
Panel F: Petroleum price and stock market volatility			
Aloui and Jammazi (2009)	France, UK, Japan 1989–2007	Two-regime MS-EGARCH	WTI, Brent, CAC 40, FTSE 100, and Nikkei 225.
Vo (2011)	US 1999–2008	CC-MSV, DC-MSV	WTI futures, S&P 500.
Mensi et al. (2013)	US 2000–2011	VAR-GARCH	WTI, Brent, S&P 500, gold, wheat, and beverage price indices.
Chang et al. (2013)	UK, US 1998–2009	Multivariate GARCH (CCC, VARMA-GARCH, VARMA-AGARCH, and DCC)	Brent and WTI spot prices, Brent and WTI one-month forward prices, Brent one-month futures prices, NYMEX one-month futures prices. S&P 500, NYSE, Dow Jones, and FTSE 100.
Kang et al. (2015)	US 1973–2013	SVAR	AMEX, NYSE, Nasdaq, VIX, oil supply shock, aggregate demand shock, and oil market specific demand shock.
Salisu and Oloko (2015)	US 2002–2014	VARMA–BEKK–AGARCH	WTI, Brent, and S&P 500.
Khalfaoui et al. (2015)	Canada, France, Germany, Japan, UK, US 2003–2012	Wavelet-based MGARCH	WTI, S&P/TSX, CAC 40, DAX, FTSE MIB, Nikkei 225, FTSE 100, and S&P 500.
Ewing and Malik (2016)	US 1996–2013	Univariate GARCH, BEKK-GARCH	WTI, S&P 500.
Adekoya and Oliyide (2021)	US January 2020-July 2020	TVP-VAR	Crude petroleum S&P 500, bitcoin, gold, and exchange rate.
Malik and Hammoudeh (2007)	US, Bahrain, Kuwait and Saudi Arabia 1994–2001	BEKK-GARCH	WTI, S&P 500, BSE, KSE, and Tadawul.

Table A1. *Cont.*

Authors	Countries and Study Periods	Methodology	Variables
Maghyereh et al. (2016)	Canada, Germany, India, Japan, Mexico, Russia, South Africa, Sweden, Switzerland, UK, US 2008–2015	Diebold and Yilmaz	OVX, AEXVOLI, VIXCVOLI, VFTSEIX, NIFVIXI, VIMEXVI, VXJINDX, SIXVXVL, RTSVXVL, JSAVIVI, VDAXNEW, and VSMI01M.
Tiwari et al. (2021)	Developed and emerging markets 2000–2017	Diebold and Yilmaz	Brent, WTI, NYK, DAX, SPX, UKK, CAC40, FTSEMIB, SPTSX, MICEX, IBOV, SENSEX, Shanghai, and TOP40.
Mensi et al. (2021)	Brazil, Russia, India, China, South Africa, US, Japan, Australia, Canada, France, Germany 2000–2018	Baruník and Krehlík connectedness approach, Wavelet-based approach, and DCC-GARCH	WTI futures, gold futures, IBOV, RTS, SENSEX, SHCOMP, JALSH, SPX, Nikkei, All Ords, TSX, FTSE, CAC, and DAX.
Arouri et al. (2011a)	Bahrain, Kuwait, Oman, Saudi Arabia, Qatar, UAE 2005–2010	VAR-GARCH	Brent, stock market indices.
Awartani and Maghyereh (2013)	Bahrain, Kuwait, Oman, Saudi Arabia, Qatar, UAE 2004–2012	Diebold and Yilmaz	WTI, stock market indices
Lin et al. (2014)	Nigeria, Ghana 2000–2010	DCC-GARCH, VAR-GARCH, and VAR-AGARCH	Brent, GSE All-Share Index, and NSE All-Share Index.
Yousaf and Hassan (2019)	India, China, Indonesia, Korea, Malaysia, Pakistan, Philippines, Taiwan, Thailand 2000–2018	VAR-GARCH, VAR-AGARCH	Petroleum price, aggregate market indices.
Al-Yahyaee et al. (2019)	Bahrain, Kuwait, Oman, Saudi Arabia, Qatar, UAE 2005–2016	DECO-FIAPARCH, Diebold and Yilmaz	WTI, gasoline, heating oil, gold, palladium, platinum, silver, and aggregate market indices.
Sarwar et al. (2020)	China, India, Pakistan 1997–2015	BEKK-GARCH	WTI, Shanghai, and Karachi and Bombay stock markets.
Hammoudeh et al. (2004)	US 1995–2001	VAR, VECM, univariate GARCH, and multivariate GARCH	WTI, S&P Oil Composite index, S&P Oil Domestic Integrated index, Oil and Gas Exploration index, S&P Oil and Gas (Refining and Marketing) index, and S&P Oil-International Integrated index.
Malik and Ewing (2009)	US 1992–2008	BEKK-GARCH	WTI, DJ sector indices (financials, technology, consumer services, health care, and industrials).
Elyasiani et al. (2011)	US 1998–2006	AR-GARCH	NYMEX petroleum futures, 13 US sectors.
Arouri et al. (2011b)	US, Europe 1998–2009	CCC-GARCH, BEKK-GARCH, DCC-GARCH, and VAR-GARCH	Brent, S&P 500, DJ Stoxx Europe 600, and 7 sector indices (Automobile and Parts, Basic Materials, Financials, Industrials, Telecommunications, Technology, and Utilities).

Table A1. *Cont.*

Authors	Countries and Study Periods	Methodology	Variables
Arouri et al. (2012)	Europe 1998–2009	VAR-GARCH	Brent, DJ Stoxx Europe 600, 7 sector indices (Automobile and Parts, Basic Materials, Financials, Industrials, Telecommunications, Technology, and Utilities).
Sadorsky (2012)	US 2001–2010	Multivariate GARCH (BEKK, diagonal, CCC, and DCC)	WTI, WilderHill Clean Energy Index, and Arca Technology Index.
Degiannakis et al. (2014)	Europe 1999–2010	SVAR	Euro Stoxx 50, 10 DJ sector indices (Basic Materials, Consumption Goods, Financials, Health, Industrial, Oil and Gas, Retail, Technology, Telecommunications, Utilities), supply-side oil shock, aggregate demand shock, oil specific demand shock, and volatility shock.
Alsalman (2016)	US 1973–2014	Bivariate GARCH-in-mean VAR	Petroleum price, aggregate market index, and 18 sectors.
Belhassine (2020)	Europe 2004–2015	VAR-BEKK-GARCH	Brent, Euro STOXX 50, and 19 Eurozone supersector indices.
Costola and Lorusso (2022)	Russia 2005–2020	Diebold and Yilmaz	Brent, natural gas, gold, MSCI aggregate market indices, MOEX, six sector indices (Telecommunications, Financials, Oil and Gas, Metals and Mining, Electric Utilities, and Consumers Goods and Services).
Panel G: Petroleum prices and stock markets in petroleum exporting and importing countries			
Park and Ratti (2008)	US, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Norway, Spain, Sweden, UK (importers) 1986–2005	VAR	Petroleum price, stock markets, interest rate, industrial production, and CPI.
Ramos and Veiga (2013)	Austria, Belgium, Finland, France, Germany, Greece, Ireland, Japan, the Netherlands, Portugal, Spain, Sweden, Switzerland (importers); Colombia, Canada, Mexico, Norway, Russia (exporters) 1988–2009	Fixed effects, GARCH	NYMEX petroleum futures, stock markets, world market index, and exchange rate.
Wang et al. (2013)	China, France, Germany, India, Italy, Japan, Korea, UK, US (importers); Canada, Saudi Arabia, Kuwait, Mexico, Norway, Russia, Venezuela (exporters) 1999–2011	SVAR	S&P 500, NIKKEI 225, DAX, CAC 40, FTSE 100, FTSE MIB, Shanghai Composite, KOSPI Composite, BSE Sensex, Tadawul All Share, Kuwait Stock Exchange Index, Bolsa IPC, OSEAX, MICEX, IBVC, S&P/TSX Composite, oil supply shock, aggregate demand shock, oil specific shock, and stock specific shock.

Table A1. *Cont.*

Authors	Countries and Study Periods	Methodology	Variables
Le and Chang (2015)	Malaysia (exporter), Japan (importer), Singapore (refinery) 1997–2013	VAR, Toda and Yamamoto causality approach	Dubai crude petroleum, stock markets, interest rate, and industrial production.
Wang and Liu (2016)	China, France, Germany, India, Japan, Korea, UK, US, Spain (importers); Canada, Saudi Arabia, Kuwait, Mexico, Norway, Russia, Venezuela (exporters) 2000–2011	BEKK-GARCH, CCC-GARCH, DCC-GARCH, and RS-DCC	WTI, SSEC, FCHI, GDAXI, BSESN, NIKKEI 225, KS11, FTSE, S&P 500, TSX, TASI, SEWI, MXX, OSEAX, MICEX, SMSI, and IBVC.
Salisu and Isah (2017)	Argentina, Australia, France, Germany, Japan, South Korea, UK, US (importers); Kuwait, Indonesia, Nigeria, Qatar, Saudi Arabia (exporters) 2000–2015	Nonlinear Panel ARDL	Brent, WTI, and stock markets.
Ashfaq et al. (2019)	China, Japan, India, South Korea (importers); Saudi Arabia, United Arab Emirates, Iraq (exporters) 2009–2018	BEKK-GARCH, DCC-GARCH, ABEKK-GARCH, and ADCC-GARCH	Petroleum price, stock exchanges.
Belhassine and Karamti (2021)	China, India, US (importers); Canada, Russia, Saudi Arabia (exporters) 2001–2017	Wavelet-based multivariate GARCH	Petroleum price, SZSE Component index, BSE Sensex index, S&P 500 index, TSXSP, RTSI, and TASI.
Enwereuzoh et al. (2021)	Botswana, Kenya, Mauritius, South Africa (importers); Egypt, Tunisia, Nigeria (exporters) 2000–2018	SVAR, Two-state regime smooth transition regression framework	Botswana Gaborone Index, Nairobi Securities Exchange Index, Mauritius Stock Exchange Index, Johannesburg All Share Index, Egyptian Exchange Index, Tunisian Stock Exchange Index, Nigerian Stock Exchange Index, oil supply shock, aggregate demand shock, and oil specific demand shock.
Akyildirim et al. (2022)	29 exporters and importers 2006–2021	TVP-VAR, Quantile regression approach	MSCI energy stock indices, Twitter-based economic uncertainty index, News Sentiment Index, Infectious Disease Equity Market Volatility Tracker, CBOE Energy Sector ETF Volatility Index, and lockdown index indicator.
Filis et al. (2011)	Netherlands, Germany, US (importers); Brazil, Mexico, Canada (exporters) 1987–2009	DCC-GARCH-GJR	Brent, AEX General Index, DAX 30, Dow Jones Industrial, Bovespa Index, MXICP 35, and S&P/TSX 60.
Antonakakis and Filis (2013)	Germany, UK, US (importers); Norway, Canada (exporters) 1988–2011	DCC-GARCH	Brent, DAX 30, FTSE 100, Dow Jones, OBX, and TSX.

Table A1. *Cont.*

Authors	Countries and Study Periods	Methodology	Variables
Guesmi and Fattoum (2014)	France, Netherlands, Germany, Italy, US (importers); Venezuela, Saudi Arabia, Kuwait, UAE (exporters) 2000–2010	GJR-DCC-GARCH model	Brent, stock market indices.
Boldanov et al. (2016)	China, Japan, US (importers); Canada, Norway, Russia (exporters) 2000–2014	Diag-BEKK	Brent, TSX, RTS, OSEAX, S&P 500, SSE, and Nikkei 225.
Mokni (2020)	China, Japan, India, South Korea (importers); Russia, Norway, Venezuela, Mexico (exporters) 1999–2018	SVAR, OLS, and TVP models	SSE, NIKKEI225, BSE, KSE, RTSI, OBX, AAPL, IPC, oil supply shock, aggregate demand shock, and oil specific demand shock.
Masih et al. (2011)	South Korea (importer) 1988–2005	VEC	Petroleum price, Korean stock market index, industrial production, and interest rate.
Cunado and Perez de Gracia (2014)	Austria, Belgium, Denmark, Finland, France, Germany, Italy, Luxembourg, Netherlands, Spain, Portugal, UK (importers) 1973–2011	VAR, VECM	Brent, stock markets, industrial production, and interest rate.
Bouri (2015)	Jordan, Lebanon, Morocco, Tunisia (importers) 2003–2013	ARMAX–GARCH	Brent, stock market indices, and MSCI world index.
Silvapulle et al. (2017)	China, France, Germany, India, Italy, Japan, Singapore, South Korea, Spain, US (importers) 1999–2015	Fixed effects with time-varying trend, Parametric panel data model	WTI, S&P500, Nikkei 225, Shanghai SE, KOSPI 200, S&P BSE 30, DAX 30, CAC 40, Strait Times, FTSE MIB, IBEX 35, unemployment rate, bond rate, market capitalisation, dividend yield, and price earnings ratio.
Sarwar et al. (2019)	China, Japan, India (importers) 2000–2016	GO-GARCH, DCC-GARCH, cDCC-GARCH, and BEKK-GARCH	WTI, Bombay stock exchange, Nikkei stock exchange, and Shanghai stock exchange.
Bjornland (2009)	Norway (exporter) 1993–2005	SVAR	OSEBX, unemployment, interest rate, exchange rate, and oil price shocks.
Mohanty et al. (2011)	Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, UAE (exporters) 2005–2009	Two-factor model	WTI, world stock market index, andf aggregate stock markets and sectors.
Arouri and Rault (2012)	Bahrain, Kuwait, Oman, Saudi Arabia (exporters) 1996–2007	Bootstrap panel cointegration, seemingly unrelated regression	OPEC spot prices, stock markets.
Demirer et al. (2015)	Kuwait, Qatar, UAE, Saudi Arabia (exporters) 2004–2013	Multifactor model	Brent, stock exchanges.
Gil-Alana and Yaya (2014)	Nigeria (exporter) 2000–2011	Fractionally cointegrated framework	Petroleum prices, Nigerian All Share Index.

Table A1. *Cont.*

Authors	Countries and Study Periods	Methodology	Variables
Basher et al. (2018)	Canada, Mexico, UK, Norway, Russia, Saudi Arabia, Kuwait UAE (exporters) 1974–2015	SVAR, Multifactor model, and Multifactor Markov-switching model	Stock market indices, oil supply shock, global demand shock, oil specific demand shock, and oil inventory shock.
Bouri et al. (2016)	Jordan (importer) 2004–2013	ARMAX-EGARCH, ARMAX-GARCH, and VARMA–BEKK–AGARCH	Brent, Amman stock exchange, and 3 sector indices (Industrials, Financials, and Services).
Bagirov and Mateus (2022)	Mexico (exporter); UK (importer) 2005–2018	VAR-GARCH	Brent, S&P BMV IPC, FTSE 100, and 5 sector indices (Basic Materials, Consumer Cyclicals, Consumer Non-Cyclicals, Financials, and Industrials).
Panel H: Petroleum prices and firm-level stock returns			
Sadorsky (2008)	US 1990–2006	Multifactor market model	WTI (price and volatility), S&P 1500 index and stocks, size, and spread.
Narayan and Sharma (2011)	US 2000–2008	GARCH, Multiple threshold regression	Petroleum, 560 firms from 14 sectors listed on the NYSE, exchange rate, and turnover rate.
Dayanandan and Donker (2011)	US 1990–2008	GMM	WTI, 200 large oil and gas firms listed on the US Stock Exchange, ROE, size, and gearing.
Aggarwal et al. (2012)	US 1986–2008	Cross-sectional regression, Two-factor model	WTI, constituents of the S&P Transportation industry index, profitability, investment growth, leverage, size, runup, and industry concentration.
Mohanty et al. (2013)	US 1986–2008	Two-factor model	WTI, 54 companies from the US oil and gas sector, size, financial leverage, profitability, growth potential, runup, and industry concentration,
Phan et al. (2015)	US 1986–2010	GARCH	WTI, top 20 companies from air transport, chemical manufacturing, construction, chemical manufacturing, petroleum sub-sectors, top 60 companies in CONGEP sub-sector, and aggregate stock market.
Gupta (2016)	Global 1983–2014		NYMEX petroleum futures, 2136 stocks from 70 countries, Market Dislocation Index, aggregate market, firm riskiness, illiquidity, market value, price to book value, leverage, risk-free rate, foreign sales percentage, and GPD growth rate.
Bagirov and Mateus (2019)	Western Europe 2005–2014	GMM, Panel least squares, Fixed effects, and Random effects	Brent, 137 listed firms and 531 unlisted oil and gas firms, size, and gearing profitability.
Narayan and Sharma (2014)	US 2000–2008	GARCH	Crude petroleum price growth rate, 560 firms from 14 sectors listed on the NYSE, and size.

Table A1. *Cont.*

Authors	Countries and Study Periods	Methodology	Variables
Tsai (2015)	US 1990–2012	OLS with panel-corrected standard errors	WTI, 682 firms, exchange rate, gold, federal funds rate, yield rate, aggregate stock market, and size.
Kang et al. (2017)	Global 1985–2015	SVAR	Aggregate oil and gas sector index, BP, Chevron, ConocoPhillips, Exxon Mobil, TransCanada Corporation, Royal Dutch Shell, Valero Energy Corporation, policy uncertainty index, oil supply shock, aggregate demand shock, and oil-specific demand shock.
Antonakakis et al. (2018)	Global 2001–2016	DCC GARCH, Diebold and Yilmaz	WTI, BP, Chevron, CNCP, Eni, Exxon Mobil, Lukoil, Petrobras, Royal Dutch Shell, Sinopec, Statoil, Total, and Valero Energy Corporation.
Panel I: Intraday linkages between petroleum prices and stock markets			
Xu et al. (2019)	China, US 2007–2016, 5 min data	Diebold and Yilmaz	WTI futures, Shanghai Stock Exchange Composite Index, and S&P 500 Index.
Suleman et al. (2021)	Middle East 2010–2020, 5 min data	Diebold and Yilmaz	Brent, gold, silver, and Dow Jones Islamic Market Index.
Farid et al. (2021)	US January 2019–May 2020, 5 min data	MCS GARCH, Diebold and Yilmaz	SPDR S&P 500 trust ETF, US oil fund ETF, US natural gas fund ETF, SPDR gold shares trust ETF, and iShares silver trust ETF.
Heinlein et al. (2021)	Japan, China, Sweden, Canada, Russia, Norway August 2019–April 2020, 5 min data	Local Gaussian correlation	Brent, SPTSX60, NKY, IMOEX, SHCOMP, OSEAX, and OMX.
Adekoya et al. (2022)	US January 2022–March 2022, 30 min data	TVP-VAR	Brent, gold, bitcoin, US bonds, US dollar index, and S&P stocks.
Mensi et al. (2022)	US April 2018–April 2020, 15 min data	FIAPARCH-DCC	Brent futures, gold futures, and S&P 500.

Notes

1. British Petroleum (2022).
2. We acknowledge that the applied approach could potentially be improved by giving more emphasis to recent papers published in the last 5 years, given unprecedented petroleum price swings, to broadly reflect the current state of knowledge.
3. Panel A of Table A1 in Appendix A summarises the studies analysed in this section.
4. Panel B of Table A1 in Appendix A summarises the papers reviewed in this section.
5. Panel C of Table A1 in Appendix A summarises the works scrutinised in this section.
6. Panel D of Table A1 in Appendix A summarises the studies analysed in this section.
7. Panel E of Table A1 in Appendix A summarises the papers analysed in this section.
8. Panel F of Table A1 in Appendix A summarises the works reviewed in this section.
9. Panel G of Table A1 in Appendix A summarises the papers scrutinised in this section.
10. Panel H of Table A1 in Appendix A summarises the studies analysed in this section.
11. Panel I of Table A1 in Appendix A summarises the papers reviewed in this section.

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