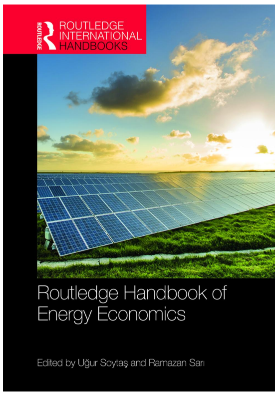

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Uur Soyta, Ramazan Sar

The role of oil price volatility in the real and financial economy

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The role of oil price volatility in the real and financial economy

A survey review

Nicholas Apergis

1 Introduction

Volatility has turned out to be a substantial issue in the energy markets and especially in relevance to oil prices, since oil-based energy consumption still dominates the portfolios of such energy consumption across the globe. Oil prices are the most volatile among all the commodity prices. More specifically, crude oil exhibits significant price fluctuations, which in turn contribute to higher uncertainty in the minds of consumers and producers. Bernanke (1983) and Pindyck (1991) assert that investors and market participants delay investment projects because of the presence of such uncertainty, with this delay in investments resulting in inefficient resource allocation in the long run.

The goal of this chapter is to present as many studies as possible in relevance to how oil price uncertainty/volatility affects various components of real economic activity. Since oil is a salient factor for both households' consumption and firms' production decisions, it is conceivable that changes in oil price uncertainty could have effects on economic fluctuations. In other words, it is plausible that the variability of oil prices could have a significant impact on economic agents' decision-making process.

A great number of empirical studies have demonstrated the significance of oil price uncertainty in various perspectives. In particular, Lee et al. (1995) emphasize the importance of the second moment of oil prices in forecasting economic activity. In that case, oil price shocks reflect both the size and the variability of oil shocks forecast errors, and explain GDP growth with great accuracy. Kellogg (2010) tests for the responsiveness of firms' investment decisions to changes in uncertainty using Texas oil well drilling data and expectations of future oil price volatility. His results provide supportive evidence that oil firms reduce their drilling activity when expected volatility rises. Moreover, Elder and Serletis (2010) and Bredin et al. (2010) use a two-variable Generalized Autoregressive Conditional Heteroskedasticity (GARCH)-in-Mean VAR with oil price and economic activity for the United States and the G7 countries. Their findings document that increases in oil price uncertainty decrease real economic activity, measured by output, investment, and consumption in the United States and four of the G7 countries. Moreover, they illustrate that the 2003–2008 oil price surge has been rather steady and continuous, keeping oil price uncertainty at a very low level. Hence, the overall change in oil price was less disruptive than previous oil price episodes and did not lead to an immediate economic recession. Given the importance of oil price uncertainty, this survey paper will explore how oil price volatility affects not only a number of macroeconomic drivers, but also financial drivers of the economy. Therefore, the structural pattern of this paper will individually report those impacts per category of macroeconomic and financial variables. The paper is organized as follows. Section 2 describes the literature of the nexus between oil price volatility and economic growth, while Section 3 illustrates the relevant literature that links oil price volatility and stock markets. Section 4 reviews the literature between this volatility and exchanges rates, with Section 5 documenting the literature on the empirical aspects in relevance to the econometric modeling of oil price volatility. Section 6 considers the literature on the presence of asymmetric effects of oil price volatility from an empirical perspective, while Section 7 reviews the literature on the impact of oil price volatility on specific economic and institutional variables. Finally, concluding remarks are offered in Section 8.

2 Oil price volatility and economic growth

Due to many potential exogenous supply shocks, oil prices are subject to uncertainty. Even when prices remain relatively stable over an extended period of time, a sudden exogenous event could disrupt the balance, independently of previous events and cause significant upward or downward price changes. When prices are stable, economic agents (i.e. households, firms, and governments) usually overlook the ubiquitous, permanent underlying uncertainty, when making economic decisions. However, in an environment of volatile prices, agents are more likely to take future price uncertainty into account when making investment decisions. Overall, oil price volatility typically results in an increased sense of economic uncertainty, whereas the absence of volatility may instill a false sense of stability. In order to hedge against negative effects of oil price volatility, it is of utmost importance for policy makers to understand how significant the potential dimensions of negative effects are, and which factors determine the level of vulnerability.

The literature exploring the link between oil price volatility and economic activity strongly suggests that such volatility negatively affects economic output in the short to medium term (Sadorsky, 1999; Kuper and Soest, 2006, Rahman and Serletis, 2012). Adverse short-term economic impacts largely reflect the deterioration of aggregate demand as volatility intensifies. While industrial production has been found to decline in the short run (Lorde et al., 2009), production declines are more likely to be a response to downward trends in aggregate demand than to production cost uncertainty. This is because industrial producers respond to production/input cost uncertainty by raising product prices to incorporate an uncertainty premium, rather than by reducing production levels. In the medium term, aggregate supply is more responsive than aggregate demand to the effects of volatility. This is foremost the product of decreasing investment in the short term, which results in constrained production capacity and increased supply-side inelasticity in the medium term. Other negative economic effects of oil price volatility in the medium-term such as inflation (Lorde et al., 2009), are also likely to stem from supply-side responses to volatility changes.

Guo and Kliesen (2005) construct the ‘realized volatility’ (RV) variable suggested by Andersen et al. (2004), rather than employing the standard method of considering oil price shocks directly, while Rafiq et al. (2009) extend Cunado and Gracia’s (2005) study by analyzing the effects of oil price volatility for various macro-indicators in the Thai economy. In a vector auto-regression (VAR) and vector error correction model, they show that the realized volatility of oil prices Granger causes GDP growth, investment, unemployment, and inflation. Their results support Bernanke’s (1983) theoretical explanation of postponed investments due to expected oil price volatility and the associated uncertainty.

The literature has first identified the linear/symmetric relationship theory of growth which postulates that GDP volatility can be driven by oil price volatility. These authors base their theory on what happened in the oil market between 1948 and 1972 and its impact on the economies of oil-exporting and importing countries, respectively. Hooker (1996) documents that between 1948 and 1972, oil prices and its changes exerted a substantial influence on GDP growth. Mork et al. (1994) confirm the asymmetry in effect of oil price volatility on economic growth. Ferderer (1996) explains the asymmetric mechanism between the influence of oil price volatility and economic growth by focusing on three potential channels: counter-inflationary monetary policy, sectoral shocks, and uncertainty. He finds a significant relationship between oil price increases and counter-inflationary policy responses. Balke et al. (2002) supports Federer's position/submission by positing that monetary policy alone cannot sufficiently explain real effects of oil price volatility on real GDP. The renaissance growth theory is considered as an offshoot of the symmetric and asymmetry in effect theoretical approaches. Lee (1998) focuses on attempting to distinguish between oil price changes and oil price volatility, while he defines volatility as the standard deviation in a given period. She provides evidence that both have a negative impact on economic growth, but in different ways: in particular, volatility has a negative and significant impact on economic growth immediately, while the impact of oil price changes delays until after a year.

Various empirical studies illustrate that oil price increases have a clear negative impact on economic growth, while oil price declines do not affect economic activity significantly. Mork et al. (1994) confirms the asymmetry in effects for a number of OECD countries. Oil price increases seem to slow down economic growth in the United States to a great extent, even if this country is less dependent on imported oil than countries such as Germany, France, and Japan. Lee et al. (1995) also reveal the stability of asymmetric effects in the period before and after 1985. In order to explain the presence of the 'asymmetry puzzle', the asymmetric mechanism between oil price changes and economic activity, Ferderer (1996) focuses on three possible mechanisms: counter-inflationary monetary policy, sectoral shocks, and uncertainty and establishes that oil price falls increase oil price volatility.

Jiménez-Rodríguez and Marcelo Sánchez (2004) assess empirically the effects of oil price uncertainty on the real economic activity for the case of the main industrialized OECD countries, i.e. individual G7 countries, Norway and the euro area as a whole. Their analysis carries out multivariate vector autoregressions by considering both linear and nonlinear models. The consideration of non-linear transformations re-establishes the negative relationship between increases in oil prices and economic downturns. Their findings show that Granger causality tests allow to conclude that the interaction between oil prices and macroeconomic variables is found to be significant, with the direction of causality going in at least one direction in all countries, and in both directions in most countries. The effects of oil price increases on real GDP growth are found to differ substantially from those of an oil price decrease, providing evidence against the linear approach that assumes that oil prices have symmetric effects on the real economy.

The effect of oil price uncertainty on real economic activity depends on the impact of the oil price on investments, but also on how firms face the uncertainty regarding their investment decision plans. Indeed, depending on the sectors, the delay from the investment decision to the beginning of the production can differ, and short-run uncertainty can thus have no impact on long-run investment strategies. All in all, accounting for the effect of maturity when investigating the impact of uncertainty is thus of crucial importance.

3 Oil price volatility and stock markets

Although numerous studies have explored the effect of oil price shocks on real economic activity, only a few have focused on investigating how oil price volatility has influenced stock market returns. The most known works in this field remain those of Kilian (2009), Kilian and Park

(2009) and Güntner (2013). Sadorsky (1999), Malik and Ewing (2009) and Oberndorfer (2009) also argue that apart from oil prices, oil price volatility also can impact on stock market returns. They provide evidence that higher oil price volatility causes a negative effect on stock market returns. Chiou and Lee (2009) document that oil price volatility exerts a negative impact on the S&P 500 index.

Park and Ratti (2008) examine the effects of oil price shocks and oil price volatility on US real stock returns and 13 European countries, spanning the period January 1986 to December 2005. Using a multivariate VAR model, they find that oil price shocks exert a statistically significant impact on real stock returns in the same month or within one month. Their findings remain robust to changes in the VAR model in terms of the variable order and the inclusion of additional variables. Naifar and Al Dohaiman (2013) investigate the nature of the relationship between crude oil prices, stock market return, and macroeconomic variables. Their analysis first examines the impact of oil price changes and volatility on stock market returns under regime shifts using a sample from the Gulf Cooperation Council (GCC) countries. To generate regime probabilities for oil market variables they employ a Markov regime-switching model. Moreover, they investigate the non-linear connections between oil price, interest rates, and inflation rates before and during the subprime crisis. They consider various Archimedean copula models with different tail dependence structures. Their findings document a regime dependent relationship between GCC stock market returns and OPEC oil market volatility, with exception to the case of Oman. Their results also illustrate the presence of an asymmetric dependence structure between inflation rates and crude oil prices, with this structure orienting toward the upper side during the financial crisis. Moreover, they find a significant symmetric dependence between crude oil prices and short-term interest rates during the same crisis.

The negative reaction of real stock prices to the increase in oil price is primarily attributed to the direct effects of such changes on cash flows and inflation. In fact, oil price can corporate cash flows, since oil prices constitute a substantial input in production. Moreover, oil price changes can significantly influence the supply and the demand for output across industrial sectors, as well as the entire economy. Therefore, oil price changes can impact firms' performance through their effect on the discount rate for cash flows, as well as through the direct effect that may exert on both the expected inflation and the expected real interest rate. These direct and indirect effects of the high volatility in oil prices seem likely to increase uncertainty for firms and for the economy as well. In this line, Bernanke (1983) and Pindyck (1991) document that higher volatility in energy prices leads to higher uncertainty about future energy prices and incites firms to postpone irreversible investment decisions in reaction to their profit prospects. Other studies provide important evidence on the association between oil prices and stock returns. The analysis of the relationship between oil price risks and stock returns has been also the subject of the study by El-Sharif et al. (2005) for a sample composed of the UK-listed oil and gas firms. They find that changes in oil prices enhance stock market and exchange rate risks which in turn exert a significant impact on both oil and gas stock returns. Agren (2006) employs weekly stock market data for Germany, Japan, Sweden, the United Kingdom, and the United States from 1989 to 2005 and finds strong evidence in favor of volatility spillovers running from oil price volatility to the equity markets in Germany, Japan, and the United Kingdom. Both German and UK equity markets seem to display an asymmetric volatility-response to oil shocks, implying that positive shocks affect stock market volatility more than negative ones do. Evidence of volatility spillovers running from oil prices to US stocks is detected, but is considered rather weak since it does not hold under some intuitively appealing parameter restrictions. No support for oil price volatility spillovers in the Swedish stock market is observed. Furthermore, empirical evidence is found that oil price changes have an impact on US stock returns, while some evidence is provided that supports the presence of asymmetric oil price volatility. Aloui and Jammazi (2009) develop a two-regime Markov-switching EGARCH model to explore the interdependence between oil shocks and stock returns. Using data for France, the United Kingdom, and Japan spanning the period January 1987 to December 2007, they illustrate that net oil prices play a pivotal role in determining not only the volatility of real returns, but also the probability of transition across regimes. Ramos and Veiga (2013) examine 43 stock markets and find that for the case of developed countries' stock markets, the volatility of oil prices has a negative impact on international stock market returns. In the case of emerging market returns, they appear not to be sensitive to oil price variations. In addition, the asymmetry of oil price changes impacts oil volatility: when oil prices soar, oil volatility also increases, while negative oil price changes dampen that volatility. Hammaa et al. (2014) the interaction between oil and stock markets in Tunisia in terms of volatility at the sector level, as well as they determine the best hedging strategy for oil-stock portfolios against the risk of negative variation in stock market prices. Through a bivariate GARCH model their empirical results indicate that the majority of relationships are unidirectional running from the oil market to the Tunisian stock market, while the conditional variance of stock sector returns is affected not only by the volatility surprises of the stock market, but also by those of the oil market.

4 Oil price volatility and exchange rates

Only a few empirical studies have focused on the impact of oil price volatility on exchange rates. Rickne (2009) documents that the co-movements between oil price and real exchange rates in a sample of 33 oil-exporting countries are conditional on political and legal institutions. Specifically, currencies in countries with strong bureaucracies are less affected by oil price variation. Englama et al. (2010) examine the relationship between oil price and exchange rate volatility in Nigeria. Their findings illustrate that exchange rate volatility is positively influenced by oil price volatility. Ghosh (2011) also indicates that positive and negative shocks have similar effects on exchange rate volatility.

5 Empirical volatility methodologies for oil prices

In general, a number of studies (Sadorsky, 2006; Narayan and Narayan, 2007 for a survey of literature) impose a particular structure of volatility models to analyze oil price volatility. In particular, in the case of linear modeling, these studies make use of the Engle (1982) approach to determine the choice of volatility model and also to validate the choice of the preferred model over other competing models. In addition, the volatility could be time varying and therefore, the choice of appropriate model for oil price volatility may change over time based on the significance of variations over time. Thus, generalizing with a particular model over the entire available data may be misleading.

Overall, the studies in oil price volatility cover a number of different areas and issues and examine the characteristics of these markets in various respects. More specifically, certain studies document that oil prices are characterized by fat-tail distribution, volatility clustering, asymmetry and mean reversion (Morana, 2001; Bina and Vo, 2007). Oil price dynamics during 2002–2006 have been characterized by high volatility, high intensity jumps, and strong upward drift and was concomitant with underlying fundamentals of oil markets and world economy (Askari and Krichene, 2008). Standard GARCH modeling is used by Yang et al. (2002) for the US oil market and by Oberndorfer (2009) for the case of the oil market of the Eurozone, and by Hwang et al. (2004) for the case of major industrialized countries. Fong and See (2002) make use of a Markov regime-switching approach allowing for GARCH dynamics, and sudden changes in both mean and variance to model the conditional volatility of daily returns on crude oil futures prices. They document that the regime-switching model performs better non-switching models, regardless of evaluation criteria in out-of-sample forecast analysis. A similar approach has been followed by Vo (2009), who explains the behavior of crude oil prices of the WTI market. Duffie and Gray (1995) construct in-sample and out-of-sample forecasts for volatility in the crude oil, heating oil, and natural gas markets. Their forecasts from GARCH, EGARCH, bi-variate GARCH, regime switching, implied volatility, and historical volatility modeling are compared with the realized volatility to compute the criterion RMSE for forecast accuracy. Their findings highlight that implied volatility yields the best forecasts in both the in-sample and out-of-sample cases. Sadorsky (2006) has also modeled and forecasted the oil volatility by using a five-year rolling window. The daily ex post variance is measured by squared daily return which is consistent with the approach of Brailsford and Faff (1996) and Brooks and Persand (2002). He applies the random walk, historical mean, moving average, exponentially smoothing, linear regression, autoregressive, GARCH, threshold GARCH, GARCH in mean, and bivariate GARCH modeling approaches. The out-of-sample forecasts are evaluated using forecast accuracy tests and market timing tests. No one model fits the best for each series considered. Most models outperform the random walk model, while parametric and nonparametric value at risk measures are calculated and compared. Non-parametric models outperform the parametric models in terms of number of exceedances in back tests. Narayan and Narayan (2007) use the Exponential Generalized Conditional Heteroskedasticity (EGARCH) model with the intention of checking for evidence of asymmetry and persistence of shocks. They document an inconsistent evidence of asymmetry and persistence of shocks, indicating the presence of strong permanent and asymmetric effects on volatility. Their findings imply that oil prices change over short periods of time. Kang et al. (2009) focus on investigating the efficacy of a volatility model for three crude oil markets (Brent, Dubai and West Texas Intermediate (WTI)). They used different competitive GARCH volatility (CGARCH, FIGARCH, GARCH and IGARCH) to assess the persistence in the volatility of the three oil prices. They document that the estimated value of the persistence coefficient is quite close to one in the standard GARCH model, a fact that favors the IGARCH specification. Arouri et al. (2010) investigate whether structural breaks and long memory are relevant features in modeling and forecasting the conditional volatility of oil spot and futures prices using three GARCH-type models (i.e. linear GARCH, GARCH with structural breaks and FIGARCH). They provide evidence of parameter instability in 5 out of 12 GARCH-based conditional volatility processes, while long memory is effectively present across all series considered and a FIGARCH model seems to better fit the data, but the degree of volatility persistence diminishes significantly after adjusting for structural breaks. Finally, out-of-sample forecasting findings indicate that forecasting models accommodating for structural break characteristics of the data often outperform the commonly used short-memory linear volatility models. Yaziz et al. (2011) use the Box-Jenkins methodology and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) approach in analyzing the crude oil prices. GARCH modeling is found to be the appropriate model under model identification, parameter estimation, diagnostic checking, and forecasting future prices. Hou and Suardi (2012) consider an alternative approach in relevance to nonparametric methodologies to model and forecast oil price volatility. They focus on two crude oil markets, Brents and West Texas Intermediate (WTI), and they show that the out-of-sample volatility forecast of the nonparametric GARCH model yields superior performance relative to an extensive class of parametric GARCH models.

6 Asymmetric effects of oil price volatility: an empirical perspective

The presence of potential asymmetries in oil price volatility documents that positive and negative news have a different impact on the future volatility of oil prices. Acknowledging and explicitly considering the presence of asymmetries in oil price volatility seems to be imperative for correctly estimating the volatility of oil prices, forecasting future oil price volatility, and understanding the broader financial markets and the overall economy. Nevertheless, there have been a few empirical attempts in explicitly considering the presence of asymmetries in relevance to oil price volatility. In particular, oil price volatility implies that this volatility seems to react more to positive shocks than to negative shocks. Narayan and Narayan (2007) employs an exponential GARCH modeling approach to evaluate time-varying effects of positive and negative shocks on oil price volatility, while Cheong (2009) illustrates the asymmetric effects on two crude oil prices: WTI and Brent crude oil. The findings clearly document that volatility seems to react more to negative shocks than to positive shocks. However, such results are evident only for the case of Brent crude prices and not for the case of WTI crude oil prices. Furthermore, Hasan et al. (2013) estimate and compare the presence of asymmetry in relevance to the volatility of crude oil prices. Their methodological approach evaluates the effect of the recent global financial crisis on the returns and volatility of such oil prices. Both threshold GARCH (TGARCH) and fractionally integrated GARCH (FIGARCH) models are employed to facilitate the empirical analysis. The results confirm that the volatility of crude oil prices increases after positive shocks in these prices.

In terms of the oil price volatility and economic growth link, Huang et al. (2005) apply a multivariate threshold model to explore the impact of oil price changes and their volatility on economic activity. Using monthly data of the United States, Canada, and Japan spanning the period 1970 to 2002, their findings show that changes in oil prices, along with their volatility only above a threshold level can help explain output changes. Moreover, Cologni and Manera (2009) use a Markov-switching analysis for the case of the G7 countries and highlight that positive oil price changes, net oil price increases, and oil price volatility tend to have a greater impact on output growth. In addition, their analysis suggests that the role of oil shocks in explaining recessionary episodes have decreased over time. Finally, they conclude that oil shocks tend to be asymmetric.

With respect to the volatility type of the oil price–stock returns nexus, Dhaoui and Khraief (2014) investigate the effect of oil price shocks on stock market returns for eight developed countries, over the period 1991–2013. Their findings indicate that there is a strong negative relationship across all countries under consideration, except in the case of Singapore. Moreover, on the volatility front, changes in oil prices turn out to be significant in the case of six markets. Their results receive statistical support by a study for the case of developed countries (i.e. the G7 countries) carried out by Diaz and Gracia (2016) who confirm the negative reaction of these G7 stock markets to an increase in oil price volatility. In the case of emerging economies, the study by Masih and Mello (2010) for South Korea represents a good example on the role of the volatility of oil prices. In particular, it investigates the impact of oil price fluctuations and their associated oil price volatility on equity stock market returns, using a vector error correction model which includes interest rates, economic activity, real stock returns, real oil prices and oil prices volatility. They provide robust evidence in support of the dominance of oil price volatility on real stock returns, which increases over time. Finally, Gomez and Chaibi (2014) provide further evidence on the volatility transmission mechanism across frontier markets (i.e. 21 stock markets). A bivariate BEKK-GARCH (1,1) model has been employed using data for the period 2008–2013. Their results suggest significant transmissions of shocks and volatility between oil prices and some of the markets under examination. They also find that the second highest coefficient measuring the volatility spillover from oil prices to stock markets is that of Jordan, following Qatar, Nigeria, and the United Arab Emirates.

7 Oil price volatility and other variables

7.1 Oil price volatility and inflation

The final section of this survey reviews the studies that have explored how oil price volatility can affect inflation, as well as inflationary expectations. Given that in many incidents in the past oil price shocks had different implications on both the economic activity and inflation, while if we further explore the link between oil price volatility and both average inflation and output, the findings indicate that larger oil price volatility has been associated with high inflation rates. Such statistical evidence poses questions regarding the link between oil price volatility and inflation. The literature has attempted to address questions like whether oil price volatility does matter for inflation or what is the associated role of monetary policy. Blanchard and Gali (2008) address the above questions using a log-linear New Keynesian model that includes the role of oil as both a production factor and a component of the consumer price index. The authors document that a monetary policy improvement, more flexible labor markets and smaller shares of oil in production have all had an important role in explaining the different macroeconomic performance of the global economy in the past and especially between the 1970s and 2000s. However, their approach has received certain negative critical points on the grounds that their log-linear solution misses crucial channels through which oil prices can affect inflation, such as its own volatility, the precautionary behavior of price setters and the convexity of the Phillips curve.

7.2 Oil price volatility and fiscal policy

According to Alley (2016), oil price volatility could be transmitted to the economy event rough the fiscal channel. In particular, this may happen because oil revenues accrue to governments, while such revenues can affect the economy mainly through government spending decisions. However, optimal decisions on current government expenditures take explicitly into account information about current and future revenues (Collier et al., 2009). However, very few studies have paid attention onto the implications of oil price volatility on fiscal policies. Anshashy and Bradley (2012) focus on the responses of government expenditure to oil price volatility. Fiscal policies are can be characterized as the transmission channel through which oil price movements and their volatility can affect the entire economy. As oil revenues are usually large and accrue to governments, the volatility in oil prices often poses serious challenges to macroeconomic stabilization policies, especially in the short run. It undermines intergenerational equity and fiscal sustainability in the long run (Sturm et al., 2009), especially in economies which lack appropriate countercyclical fiscal measures to deal with oil revenue fluctuations (Frankel, 2010). Whether or not appropriate fiscal policies would be deployed to contain the effects of oil price volatility on the economy depends on the quality of the institutions in effect (Collier et al., 2009). Moreover, Mehlum et al. (2006) document that countries with good institutions have had oil price booms positively affect the economy, while those with poor institutions have experienced a resource curse (Collier et al., 2009). The countries with weak fiscal institutions would have their fiscal instruments or strategies rendered ineffective (IMF, 2008), as resources allocation and government expenditures on projects would be inefficient (Budina and Wijnbergen, 2008). Finally, unexpected increases in oil price volatility adversely affects government budgets (Rutten, 2001).

7.3 Oil price volatility and institutions

Finally, according to the resource curse hypothesis, abundance of oil resources tends to be an important determinant of economic failure. This section reviews the literature that has explicitly documented whether the poor performance of resource-rich countries comes from the abundance of oil or whether it is associated with price volatility in global oil markets. This literature explores whether there is a role for institutions and the government in offsetting certain parts of the negative growth effects due to the curse.

The relevant literature provides different explanations for why resource-rich economies might be subject to a curse. Dutch disease (Neary and van Wijnbergen, 1986; Krugman, 1987) is one of the channels: increases in natural resource revenues lead to an appreciation of the real exchange rate, which raises the cost of exports, making them less competitive with possible negative effects on economic activity. Economic growth might also be adversely affected by the resulting reallocation of resources from the high-tech and high-skill manufacturing sector to the low-tech and low-skill natural resource sector. Another explanation for the resource curse paradox focuses on the political economy considerations and argues that large windfalls from oil and other resources create incentives for the rent-seeking activities that involve corruption (Mauro, 1995; Leite and Weidmann, 1999), voracity (Lane and Tornell, 1996; Tornell and Lane, 1999), and possibly civil conflicts (Collier and Hoeffler, 2004). A number of empirical works have also focused explicitly on the role of institutions. More specifically, Mehlum et al. (2006) and Beland and Tiagi (2009) use a cross-sectional approach and illustrate that the impact of natural resources on growth and development depends primarily on institutions, while Boschini et al. (2007) illustrate that the type of natural resources possessed is also an important factor. They also argue that when we control for institutional quality and include an interaction term between institutional quality and resource abundance, a threshold effect arises, implying that there are levels of institutional quality above of which resource abundance becomes growth enhancing.

The empirical support for the resource curse hypothesis has been provided by Sachs and Warner (1995), who show the presence of a negative relationship between real GDP growth per capita. However, the empirical evidence on the resource curse paradox is rather mixed. The majority of papers follow Sachs and Warner's cross-sectional specification, while others derive theoretical models that are loosely related to their empirical specification (Rodriguez and Sachs, 1999; Gylfason et al., 1999; Bulte et al., 2005). An important drawback of these studies is in relevance to the measure of resource abundance. Brunnschweiler and Bulte (2008) argue that the so-called resource curse does not exist when one uses the correct measure of resource abundance, while they confirm that resource dependence, when instrumented in growth regressions, does not affect growth.

Moreover, the literature has provided alternative mechanisms through which institutions can mitigate the effect of oil rent volatility on economic growth. These mechanisms are associated with the types of institutions which are likely to dampen such an effect. According to economic theory, the most relevant and key institutions that mitigate the effects of volatility on an economy are the institutions of finance. This is due to the well-known role of finance in risk diversification (Levine, 1997; Leong and Mohaddes, 2011) may be driven by financial depth. The empirical findings do confirm that the financial measures do mitigate the effects of oil price volatility, since these measures reduce or completely eliminate the negative effects of oil volatility on growth.

8 Final remarks

Given that the role of oil price volatility seems to be very important for both the real economy and financial markets, this survey paper intended to contribute to the relevant literature by shedding more light on the arguments, notions, and definitions underlying the existing literature on the issue.

This review documented the general consensus among economists that the economic significance of oil price volatility can affect both the real economy and the financial markets. Stock prices are shown to be very sensitive to oil price volatility, while methodological challenges, such as causality and endogeneity, can affect the validity of the empirical findings. The results provided in the relevant literature call for further empirical analysis, based on more advanced econometric techniques some of which are introduced in Chapter 22 of this handbook. However, the rise of shale gas and substantial progress on renewable energy technologies could signify the mitigating impact of such volatility on the economy, as well as on financial markets. Furthermore, carbon markets, such as the European Union Emission Trading Scheme (EU ETS) could also contribute to such diminishing role (Chevallier, 2011). In terms of the empirical approach, the studies reviewed in this paper documented a lack of consensus on the role of the forecasting capability of the modeling approaches for clarifying the role of oil price volatility in an economy, indicating an inherent need for alternative approaches, such as artificial intelligence, which has not been thoroughly explored for oil price volatility. It is expected that this area of research will form the core of a new future research agenda on this issue.

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