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Understanding the Economic Impact of Oil Price Shocks

Erkal Ersoy[1]†, Mark E. Schaffer[1]

[1]Centre for Energy Economics Research and Policy (CEERP), Edinburgh Business School, Heriot-Watt University, Edinburgh EH14 4AS, UK

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Abstract

There is a rich literature on the link between oil price fluctuations and macroeconomic fundamentals that emerged after the oil shocks of the 1970s. This paper reviews this research and provides an overview of key historical developments in the global crude oil market and their implications for the oil price-macroeconomy relationship. We discuss theoretical and empirical studies on this theme with a focus on empirical issues researchers have had to overcome. We speculate that, as the world transitions to a low-carbon economy, oil is likely to continue losing market share to other energy sources and that this will lead to a secular decline in the importance of oil for the macroeconomy. But even in the most optimistic scenarios, this transition will take decades and, in the meantime, understanding oil price shocks will continue to be an area of active research.

†Corresponding author: Erkal Ersoy, Centre for Energy Economics Research and Policy (CEERP), Edinburgh Business School, Heriot-Watt University, Edinburgh EH14 4AS, UK. Email address: E.Ersoy@hw.ac.uk

1 INTRODUCTION

An economy's long-run growth and development critically depend on its resilience and susceptibility to shocks (see [6], [45], [58]). Energy shocks are central to this observation, since growth-inducing activities are highly dependent on access to energy. Further, inexpensive access to energy and economic growth tend to be observed together. Given that oil has been the single most important source of energy in the global fuel mix since World War II, it has enjoyed the limelight for decades. The striking link between oil prices and US business cycles did not escape economists: almost every recession was preceded by a rise in energy prices (Fig. 1). Following oil crises of the 1970s, economists have sought to understand the implications of oil price shocks on the macroeconomy.

Oil has gradually lost market share to other fuels over the past several decades, but today it still maintains its significance as the fuel with the largest share. As Fig. 2 shows, oil accounted for over a third of global primary energy consumption in 2018 (see [15]). Early contributions to understanding how oil prices relate to economic activity and growth include Nordhaus [50] and Nordhaus, Houthakker, and Sachs [51]. More recently, Kümmel, Henn, and Lindenberger [43], Ayres and Warr [5], Allen [2], and Stern and Kander [63] among others have investigated the role energy plays in inducing or preventing growth.

In basic terms, a rise in the price of oil raises the cost of energy which, with a price-inelastic demand, increases expenditure on energy. Oil products enter households' consumption functions as well. Jointly, the impact is typically reduced production and consumption of goods and services. In oil-importing countries, this also hurts the balance of payments and places an upward pressure on prices.

Using post-World War II data through the early 1980s, Hamilton [25] found an economically important and statistically robust relationship between oil price increases and recessions in the US. Since then, researchers have observed shifts in the relationship in terms of its statistical robustness, the magnitude of the impact, and the characteristics of shocks. One major avenue of further investigation has been to ask what makes economies more capable of absorbing shocks and returning to their original growth paths. There is, for example, some evidence that economic development itself enables countries to adjust to new economic conditions and bounce back more quickly.

Blanchard and Gali [14] have argued that declining reliance on energy in production processes, more flexible labour markets, and better monetary policies can help ameliorate the detrimental effects of oil price hikes, and Dhawan and Kesje [20] found that developed economies have become more resilient to oil shocks since 1986. More generally, Kilian [39] argues that the nature of shocks matters, and Ersoy [21] suggests the observed relationship is linked to underlying oil price volatility and modelling this explicitly helps explain the true nature of the oil price-macroeconomy relationship.

This paper reviews the research on

the link between oil price fluctuations and macroeconomic fundamentals that emerged after the oil shocks of the 1970s. In the next section, we discuss key historical developments in the global crude oil market. In section 3, we provide an overview of theoretical and empirical studies on the oil price-macroeconomy theme. Sections 4 and 5 discuss how oil price changes translate into the macroeconomic outcomes observed in practice, while section 6 focuses on obstacles researchers have had to overcome in empirical studies. Section 7 concludes.

2 HISTORICAL DEVELOPMENTS

There have been major changes in the global oil market over the last sever-

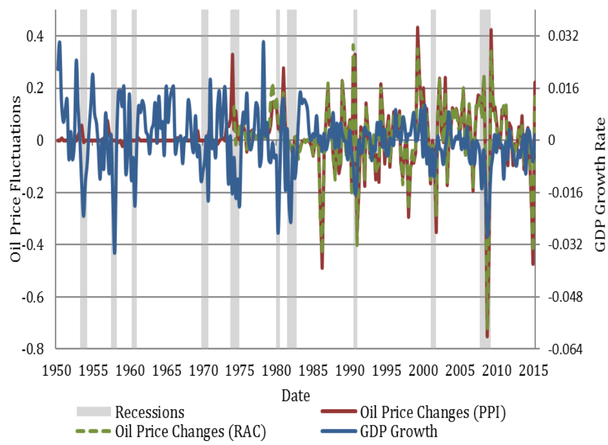

Fig. 1 Recessions and oil prices in the US. Oil prices measured by refiners' acquisition cost (RAC) and producer price index in crude petroleum (PPI). *Source: National Bureau of Economic Research, US Bureau of Economic Analysis, US Bureau of Labor Statistics, US Department of Energy.*

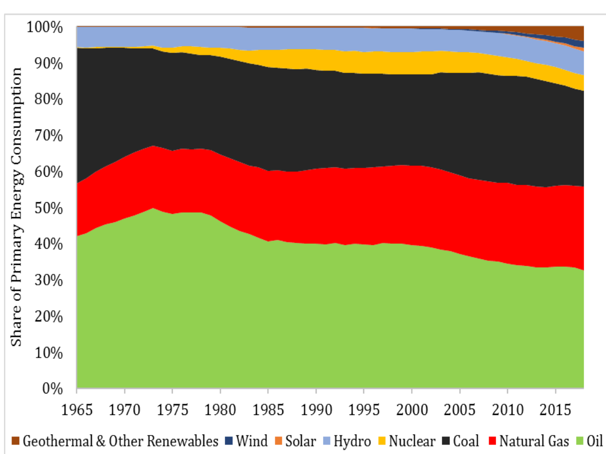

Fig. 2 Share of world primary energy consumption % by fuel
Source: BP Statistical Review of World Energy 2019.

al decades. The establishment of OPEC in 1960 and the 1970s price shocks signalled a fundamental change in the way the global oil market operated. Although there is ongoing debate about the true underlying nature of these shocks, researchers agree that the events marked the emergence of a new regime in the market for crude oil. The balance of power has shifted from the Seven Sisters (multinational oil companies of the Consortium for Iran oligopoly, which dominated the global petroleum industry from 1940s to 1970s) to OPEC, and OPEC were not afraid to use their influence. Price controls used during this period in response to the sharp rise in oil prices exacerbated the impact and disrupted the day-to-day running of the economy. Fig. 3 plots global crude oil production by region to demonstrate the overall increasing trend in production hence the size of the global oil market and the role Middle Eastern producers play relative to the rest of the world. The dip in Middle Eastern production in 1974-75 corresponds to the OPEC oil embargo, and the shrinking contribution by the region's producers observed in mid-1980s was short-lived given the trend that followed. These are examples of large dynamics in the global oil market that have had profound economic impacts across the globe. In more recent years, North American producers have brought about a key change in the market yet again. Partly due to the differences in technology required for hydraulic fracturing (fracking), these producers have been able to enter and exit the market at different oil price levels. This has not only reduced OPEC's potential influence on the global market but also placed a ceiling on the price of oil: if oil price increased beyond a certain threshold, these producers enter the market, increasing global production and putting a downward pressure on price. Fig. 4 hints at this change with the increasing share of non-OPEC crude oil production.

For net importers of oil, the nature of the relationship between oil prices and macroeconomic activity seems obvious: an oil price hike should, ceteris paribus, slow down economic growth through more expensive imports and other channels. However, despite numerous theoretical predictions and empirical studies, debates continue, and many researchers believe that the negative correlation between oil price rises and output growth dissipated after the 1980s. This can be explained partly by the continued decline in the market share of oil in total primary energy, which is visible in Fig. 2, as renewable sources of energy are adopted more widely.

3 THE OIL PRICE-MACROECONOMY RELATIONSHIP

The literature on the relationship between oil prices and GDP, inspired by Hamilton [25], consistently identifies negative impacts of oil price hikes on GDP in industrialised, industrialising, oil importing, and oil exporting economies (see [22], [36], [44], [46], [47], [52]). Numerous studies find that the impact of oil prices on GDP declined over time. For example, Hamilton [25, 27] estimated a larger impact coefficient for pre-1973 than post-1973. Similarly, Baumeister and Peersman ([10], [11]), Blanchard and Gali [14], and Kilian [38] found a smaller and declining effect in the early 1980s. More recently, oil price dynamics appear to be getting more complex: thus Hamilton [30] and Kilian and Murphy [40] concluded that price speculation played a role in the 2007-08 oil price fluctuations. For the US economy, most studies found a negative impact on GDP growth of an oil price increase too large to explain given the share of oil expenditures in GDP. Economic theory has struggled to describe this empirical finding (see [4], [59]).

In an effort to disentangle the underlying mechanisms, Kilian [38] breaks down the transmission mechanisms into roughly two categories. The first category is concerned with energy as an input into economic activity. An oil price hike causes the operating costs of durables that rely on oil as an input to rise, which in turn restricts their use. In ad-

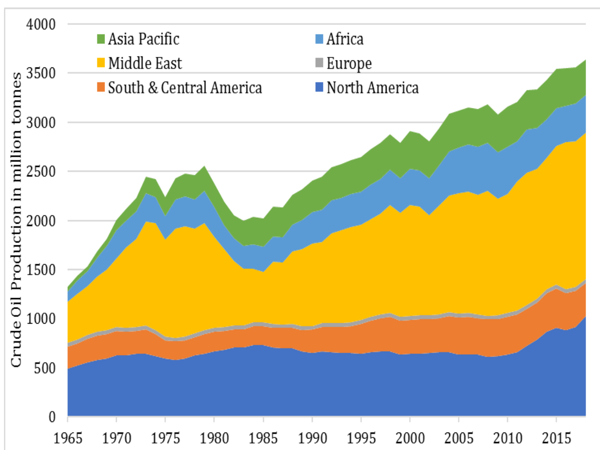

Fig. 3 Global crude oil production by region in million tonnes (MT). *Source: BP Statistical Review of World Energy 2019.*

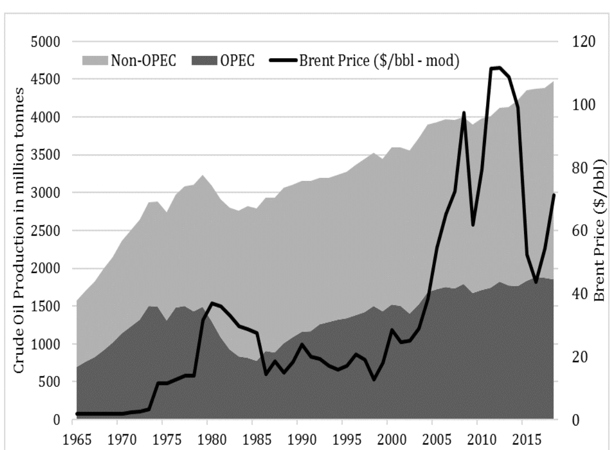

Fig. 4 Global crude oil production by region in million tonnes (MT). *Source: BP Statistical Review of World Energy 2019.*

dition, because demand for energy is typically price inelastic, rising costs decrease overall disposable income and reduce the consumption of other goods. On this basis, Finn [23] argued that energy price shocks could act like technology shocks and hypothetically cause GDP fluctuations more than twice the magnitude that would be expected given the share of energy in GDP.

The second category identified by Kilian relates to behaviour and expectations. Capturing these effects in traditional economic models is complicated and an asymmetric response of GDP to energy price variation is likely, as these effects tend to be stronger when energy prices rise than when they fall. An uncertainty effect underlies this. Changing energy prices often create uncertainty about the future path of energy prices and cause consumers and producers to delay irreversible investments (see [12], [53]). Additionally, rises in energy prices could induce precautionary savings for consumption smoothing, whereas a fall in prices would not provide as strong an incentive to spend existing savings. Evidence of an asymmetric response of GDP to oil prices as documented by Hamilton [27, 28], Lee et al. [44], Mork [46,47], and Mory [48] suggests that this mechanism may play a substantial role in determining the GDP response to an oil price shock.

Hamilton [29] pointed out that an OLS regression of GDP growth on its lags and the lags of logarithmic changes in nominal oil prices would be a simple but effective approach to determine the correlation, if any, between oil price fluctuations and GDP growth. This is shown in equation 1 below.

$$\begin{aligned} y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \beta_3 y_{t-3} \\ + \beta_4 y_{t-4} + \beta_5 o_{t-1} + \beta_6 o_{t-2} \\ + \beta_7 o_{t-3} + \beta_8 o_{t-4} + \varepsilon_t \end{aligned} \tag{1}$$

where, y_t denotes changes in real GDP in period t, o_t changes in nominal oil prices in period t, and ϵ_t is the error term such that $\epsilon_t \sim N(0, \sigma_\epsilon^2)$

Hamilton's [29] analysis found a negative relationship between the real GDP growth rate and lagged logarithmic changes in nominal oil prices using a dataset spanning 1949:2 through 1980:4. An F-test on the joint significance of the coefficients on oil prices supported the rejection of the null hypothesis that all coefficients on the lags of oil price changes are zero. Having observed this, Hamilton [29] discussed two further findings: the impact of period considered and the transmission mechanism of oil price shocks. For the former, the model in equation 1 was re-estimated using data through 2005. This led to a fall in not only the size of the coefficients of interest but also the precision of the estimates. As for the latter, through an output elasticity analysis, Hamilton [29] deduced that "if these oil shocks did contribute to economic downturns, it would have to be attributed to the movements they induced in other factors of production rather than the value of the lost energy per se."

Many researchers have opted for VAR (vector autoregression) and structural VAR models capable of capturing more complex relationships than OLS (see [1, 18, 25, 27–29, 32, 33, 36]). Further analyses extended to macroeconomic variables other than GDP growth have still concluded that oil prices have a negative impact on the macroeconomy in general, e.g., Carruth et al. [17]; Hamilton [25, 27–29]; Raymond and Rich [57]. In their estimations, many researchers use nominal prices and argue that real prices can bias empirical results: by definition, real prices incorporate inflation, which is endogenous to the economy at any given time.

A number of researchers further argue that the transmission mechanism between oil prices and macroeconomic variables is indirect and that the observed relationship between, for instance, GDP growth and oil price fluctuations is mostly due to the two variables' correlation with a third one (see [7], [8], [33], [34]). Implemented and popularised by Hamilton [25], one approach to ruling this possibility out is to confirm that oil price fluctuations cannot be predicted by other variables in the model and their lags.

A key point of debate is the exogeneity of oil price shocks. Within this discussion, we can differentiate between two types of exogeneity: macroeconomic and econometric. In a macroeconomic modelling sense, it would be difficult to argue for the strict exogeneity of oil price fluctuations since oil is an input to many production processes and has been the dominant source of energy for decades. However, this does not automatically imply econometric endogeneity of oil price fluctuations in a GDP growth equation of a VAR system. In fact, most oil price changes in history have been driven by exogenous factors such as military conflicts, which provides evidence for the price shocks being exogenous (see [25], [29]). For much of the period since 1950, US production and consumption were small enough relative to their global counterparts that exogeneity assumptions are plausible. Nevertheless, Hamilton's exogeneity claims have been criticised in the literature. For instance, Hooker [34] argued that oil price shocks acted through unemployment and that much of the impact of price hikes on output is indirect. More specifically, Hooker concluded that oil price increases lead to a heightened natural level of unemployment and impede output growth as a by-product. Another perspective was offered by Barsky and Kilian [7, 8], who argued that monetary policy sometimes in response to oil price changes themselves is the cause of some large drops in GDP growth.

Another theoretical view with its origin dating back to late 1980s is the asymmetric impact of oil price shocks on output: an oil price increase may have a greater absolute effect on output than a fall in price. Several researchers found strong evidence for this. See Lee, Ni, and Ratti [44], and Mork [46] for early examples. Ersoy [21] has also found evidence towards this using US data from 1950 through 2015.

4 TRANSMISSION MECHANISMS

The main channels through which changes in oil prices affect macroeconomic variables are largely agreed upon: supply side, demand side, and terms of trade. Even though the contribution of each channel can be case-specific, all three matter in most cases. To see how an oil price shock may propagate through the economy, suppose there is a rise in the price of oil. The immediate supply-side impact is increased production costs. Although firms can adopt streamlined and energy-efficient processes in the long run, frictions prevent these efficiency gains in the short run. This translates into a negative impact on supply in the short term, and the long-run impact is expected to be less pronounced. Even so, implementing changes in production processes comes at a cost. Firms need to pay fixed costs for training and infrastructure (see [61]). Given these additional costs, which may be affected by oil prices themselves, firms need to solve a new profit maximisation problem: is it optimal to continue an energy-intensive production process in the new price environment or is investment to improve energy efficiency warranted? Depending on which side of the threshold firms find themselves, this decision may lead to a bias in what we observe. If most firms opt to continue production as is, the effect of an oil price increase on GDP growth may appear negligible.

On the demand side, the impact of the price increase is two-fold. First, since consumers demand oil products directly, the shock feeds into inflation and drives the general price level up. Considering US transport sector has accounted for over two-thirds of oil demand in the past few decades, the price increase also affects individual goods. This decreases real disposable incomes across the economy and reduces aggregate demand (see [61]). Second, falling real wages put pressure on downward rigid nominal wages, lower the level of employment, and lead to a fall in output.

Since oil is a globally traded commodity, fluctuations in its price can affect nations through channels outside of their domestic economies. For an oil importing country, a rise in price is equivalent to an increase in import prices. This causes a deterioration in the terms of trade and, in many cases, reduces welfare in importers' domestic markets. Unsurprisingly, the magnitude of this impact depends on what fraction of import value oil accounts for: the greater the share of oil in total expenditure, the larger the impact of the shock (see [56]).

In addition to the supply, demand, and trade channels, oil price shocks can have a substantial impact on the financial sector and, by extension, on macroeconomic fundamentals. One main message from this rich and developing part of the literature is that investor and consumer confidence play a key role in their respective behaviours in the economy and the stock market. If such loss of confidence due to fluctuations in oil prices is reflected in stock markets, the overall impact could be amplified (see [61]).

Researchers unanimously acknowledge that policy responses to oil price fluctuations can influence the final impact of the shock. For instance, in response to an oil price increase, an oil-importing country's central bank could attempt to mitigate the negative implications by manipulating the policy tools available. The extent to which policy affects the outcome can vary and is a point of debate. On one extreme, Bernanke, Gertler, and Watson [13] argued that most of the impact of price shocks were caused by tighter monetary policy responses as opposed to the price fluctuations themselves. On the other end of the spectrum, Hamilton and Herrera [31] claimed that restrictive monetary policy could not explain all of the impact of the shocks and that the direct effects were greater than those caused by policy responses. Since there are often many moving parts, it is difficult to disentangle the impact into its components. For instance, the monetary authority faces a trade-off between inflation dampening and output stabilisation and objectives can vary across countries. Similarly, each shock occurs under different circumstances and policy may be implemented differently for what appears to be the same type of shock.

Oil price volatility is key as well. Frequent large oil price fluctuations increase uncertainty in the general economic environment and can affect consumer behaviour. Durable goods purchases, including real estate and cars, subside and can have economy-wide trickle-down implications (see [29]). Stock markets respond to volatility the same way. Periods of volatile oil prices are generally associated with lower investor confidence, which can lead to cautious trading. This effect has been demonstrated through a number of country-specific studies on the link between oil price volatility and stock market returns (see e.g. [3], [60], [21]). Ersoy [21] argues that GARCH models are effective in this context, as they allow explicit modelling of unexpected shocks that surprise economic agents whose expectations are determined by historical trends.

More generally, increased uncertainty often leads to precautionary savings, slowing down economic activity and, if sustained over a longer period, dampen economic growth. Pindyck [55] pointed out that persistent volatility has wide-reaching implications. Within the oil and gas sector, it can expose producers and industrial consumers to risk and influence their investment decisions. In turn, these have an impact on oil inventories and production and transportation facilities (see [55]). Outwith the oil and gas industry, volatility has an impact on commodity-based contingent claims and, therefore, derivative valuation and hedging decisions. Furthermore, firm may revise their investment decisions in physical capital linked to production and consumption of oil and natural gas (see [55]). According to Pindyck [54], there are even wider implications. The author argued that volatility can affect the total marginal cost of production, which is reflected in firms' operating options and the opportunity cost of current production. Generally, the higher the oil price volatility, the more uncertainty it creates and the more likely economic instability becomes in both oil-exporting and oil-importing countries. If the volatility is linked to increasing oil prices, rising inflation follows threatening a recession in oil-dependent countries.

5 RESPONSES TO SHOCKS

Earlier we mentioned the idea that the negative impact on GDP growth of a positive price shock may not have the same absolute size as the positive impact an equivalent negative price shock. A number of empirical studies have investigated and in fact found evidence for a non-linear relationship between oil price fluctuations and output growth (see [24], [27], [44], [46], [48]). The leading explanation for this phenomenon is the dispersion hypothesis, which states that frictions in reallocating factors of production across sectors exacerbate the detrimental effect of price fluctuations. In the context of oil price analysis, consumer behaviour in fuel-inefficient automobile industry is a good example of this. One of the immediate effects of an oil price hike is a fall in demand for fuel-inefficient vehicles. Since labour and capital are immobile in the short-run, factors of production cannot move freely from fuel-inefficient automobile industry to other sectors (see [29]). This may lead to extended idle periods for labour and capital in this part of the economy following the sudden fall in demand, causing a potentially sizeable fall in output.

Following a decrease in oil prices of the same size, however, demand for fuel-inefficient cars does not increase substantially. According to Atkeson and Kehoe's [4] and Hamilton's [26] theoretical models, technological costs of adjusting capital and labour to be adopted by other sectors could magnify the effects of oil price fluctuations on macroeconomic variables. In some cases, oil price decreases could reduce output growth in the short-run as capital and labour are reallocated to other industries (see [29]). Further, these models found that demand side output responses to oil price shocks are not log-linear. Returning to the example above, consumers may postpone purchasing (fuel-inefficient) vehicles when oil prices increase but do not buy a second car when they decrease (see [29]).

Downward nominal wage rigidities also play a role in this asymmetric relationship between GDP growth and changes in the oil price. An increase in price reduces workers' purchasing power and puts an upward pressure on wages as workers press for higher pay. Increased wages can, in turn, have implications for the level of employment, inflation, and more generally, aggregate demand and supply. On the contrary, nominal wages are largely unaffected (i.e., not adjusted downwards) if the oil price shock is a negative one and real wages rise.

Empirically, the nature of the hypothesised effect of oil price fluctuations on macroeconomic variables appears to depend on a number of factors. For instance, sample period has been a key point of discussion in this context, and Lee et al. [44] find that the results of statistical tests of the asymmetry hypothesis depends on sample period. Through pairwise equality tests of oil price increases and decreases, the authors conclude that the null hypothesis of equal positive and negative effects could not be rejected for the sample from 1949:1 through 1986:1. However, the same hypothesis was rejected for 1949:1-1988:2 and 1949:1-1992:3 samples, leading to the final conclusion that output growth appears to respond asymmetrically to oil price disturbances in recent samples and not in earlier ones. In their original analysis, Kilian and Vigfusson [41] used a Monte Carlo integration method to argue that GDP, consumption, and unemployment respond symmetrically to positive and negative oil price innovations. However, with a dataset updated to the fourth quarter of 2009, the authors rejected the null hypothesis of symmetry in response to a 2-standard deviation price shock (see [42]). Recently, Karaki [37] repeated Kilian and Vigfusson's [41] analysis with data through 2016 and found that asymmetry could not be rejected for a 2-standard deviation innovations and could only be rejected for small price shocks.

On a sectoral and firm level, the extent to which an oil price shock affects industry and firm output depends critically on the production processes: firms with capital intensive production processes, those with a high capital to labour ratio, and those that produce durable goods are affected most due to their energy requirements and hence susceptibility to price fluctuations in the energy sector (see [19]).

6 EMPIRICAL ISSUES

As with most empirical work, model specification and variable choice have been key points of discussion for the estimation of the theoretical relationship at hand. An issue that received particular attention is the choice of oil price variable. Bernanke et al. [13] noted that "it is surprisingly difficult to find an indicator of oil price shocks that produces the expected responses of macroeconomic and policy variables in a VAR setting". Various attempts have been made to capture the true nature of oil price shocks using different oil price measures and introduction of non-linear oil price specifications. Along this vein, Hamilton [28] provided evidence for the non-linear nature of the oil price-macro relationship, Hooker [33] investigated the stability of the relationship, and Kilian [39] argued that the underlying causes of oil price shocks change over time and that this matters for the relationship in question. Further, others observed that the relationship between oil price shocks and macroeconomic fundamentals has evolved over the years (see e.g. [14], [21]).

Model specification and choice of oil price variable have been key elements of modelling decisions in this theme. Using Sims' [62] 6-variable quarterly VAR model for GDP equation as a basis, Hamilton [25] found a strong causal relationship between oil price fluctuations and output growth based on U.S. data from 1948 to 1980. Mork [46] repeated the analysis with data through the second quarter of 1988 and observed only a marginally significant relationship between oil price changes and real GDP growth. Hooker [33] further extended the dataset and claimed that the relationship between oil price changes and output growth was no longer supported by the data by the early 1990s.

Furthermore, Mork [46] illustrated that oil price fluctuations only marginally improve the goodness of fit of Sims' GDP equation when the sample period is extended into the 1980s. The author suggested that the findings differed from those made by Hamilton [25] due to three main reasons: how oil prices are modelled, what oil price measure is used, and how monetary policy is controlled for. These three factors had an influence on the direction of the literature as econometricians attempted to model these accurately.

The VAR implementations have become larger as longer time series became available. As a part of this, Mork [46] proposed extending the 7-variable system into an 8-variable one in order to allow for an asymmetric oil price impact, which was achieved by splitting oil price fluctuations into their positive and negative counterparts. Mork also proposed two further fundamental changes to Hamilton's [25] approach. First, he argued that refiner's acquisition cost of crude oil is a better proxy for oil price than the traditionally-used producer price index in crude petroleum. The biggest justification for this was the bias in what PPI measured in the 1970s, as it reflected only the controlled prices of domestically produced oil (see [46]). Second, he suggested replacing M1 with 3-month TB rate to capture the behaviour of monetary policy makers. Through these changes, Mork improved the accuracy of the test and observed an asymmetric relationship between oil price fluctuations and GDP growth. In general terms, looser monetary policy in response to an oil price rise could potentially outweigh the effects of the original shock itself. Given the established relationship between interest rates and GDP growth, the a priori expectation is a negative coefficient on the 3-month TB rate.

Lee et al. [44] proposed building upon Mork's [46] analysis by modelling the volatility of oil prices. The authors argued that, ceteris paribus, unexpected oil shocks have a larger impact on GDP growth than expected ones. Further, the authors observed that this find was more robust for surprise shocks. To establish this, the authors re-estimated Mork's [46] 7-variable VAR model using real GDP growth, GDP deflator inflation, 3-month TB rate, unemployment rate, wage inflation measured as the average hourly earnings for production workers in manufacturing, import price inflation, and oil price changes. The extended model added a new oil price variable that captured the "unanticipated component of real oil price movement and the time-varying conditional variance of oil price change forecasts"(see [44]). This variable evaluates how different the current shock is from the prior distribution of oil prices in an attempt to capture the effect of unexpected price shocks. Although the sets of results from the two studies could not be compared directly due to data source and format differences, Lee et al. [44] found this variable to be highly correlated with GDP growth in various sample periods. This was also observed by Ersoy [21] using an updated dataset.

Lee et al. [44] has been a stepping stone for introducing normalised oil price shock variables into VAR systems to account for the surprise element of a shock. This has been a critical step forward in understanding the impact of unexpected shocks on macroeconomic fundamentals as well as how, if at all, they differ from their expected counterparts. Unsurprisingly, this approach requires us to categorise oil price fluctuations and define which ones are unexpected. In practice, this could be modelled in various forms. A robust and relatively uncomplicated approach implemented by Lee et al. [44] used a univariate generalised autoregressive conditional heteroskedasticity error process to compute the unexpected part and conditional variance of the oil price shock.

In contrast, others have argued that the robust relationship between oil prices and macroeconomic variables broke down after the highly volatile oil price movements of the 1980s. From the middle of 1990s onwards, a number of analyses emerged empirically testing this claim. As an example, Hooker [33–35] observed that mainstream model specifications led to considerably different outcomes when differing sample periods were considered. The author argued, therefore, that oil price fluctuations affect macroeconomic fundamentals indirectly; they propagate through interest rates, unemployment, and inflation such that an oil price shock may induce a departure from Okun's Law. Using a univariate GARCH model to normalise oil price shocks, Ersoy [21] observed that Granger-causality between oil price shocks and US GDP growth continues to be important. In fact, using impulse response functions, the author concludes that a negative oil price shock has a larger overall negative impact in after 1986 data than in pre-1986 data.

Most recently, Baumeister and Hamilton [9] have reinvigorated the debate on the oil price-macroeconomy theme by adopting a different econometric approach. The authors argue that traditional assumptions of structural VAR models can be relaxed in a Bayesian inference framework. By formulating informative priors for structural parameters, the authors conclude that oil supply disruptions play a more significant role in oil price movements than inventories. Further, the authors argue that supply shocks reduce global economic activity, while demand shocks do not.

7 CONCLUSIONS

Despite oil's declining market share in global energy consumption, researchers' interest in the link between oil price fluctuations and economic activity has yet to subside. Following Baumeister and Hamilton [9], a new strand of empirical analysis is emerging. The focus is now on Bayesian inference and relaxing structural assumptions that were previously necessary in structural VAR models

A secondary focal point has been oil price volatility. In particular, Mumtaz [49] introduces a VAR system with stochastic volatility in mean that removes the need to assume exogeneity of volatility shocks. Future research is likely to focus on time-varying parameters. Ersoy's [21] findings, which are based on a rolling-window application of VARs and impulse responses, highlight that oil price volatility plays a key role in the oil price-macroeconomy relationship. Further, Byrne et al. [16], who adopt a time-varying VAR approach, find that both oil fundamentals and forward-looking expectations matter for oil prices.

The secular decline in the importance of oil for the macroeconomy is likely to continue, as the world transitions to a low-carbon economy. But even in the most optimistic scenario this transition will take decades, and in the meantime understanding oil price shocks will continue to be an area of active research.

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