

The Impact of the Development in Shale Oil Production on Crude Oil Prices and Future Prospects: A Literature Review

Ali Salman Tuama*

University of Misan, School of Economics, Amarah, Iraq

***Corresponding author**

Ali Salman Tuama

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Abstract: Since 2014, the crude oil market has experienced declining oil prices around the globe. Speculations are that there has been over-supply in the market and lower demand than expected. In particular, the oil industry's oil industry in the United States took analysts and experts to surprise and the crude oil supply was not calculated in the forecasts. The production of this resource was preceded by the US, which gained extensive experience in the development of oil shale. Consistent developments in mass oil production coupled with the development of new technologies, which ensured a significant growth in the production of this hydrocarbon resource is believed to have significantly affected the global crude oil market. This article seeks to foster better understanding to the nexus of oil shale production and its impact on crude oil prices, as previous scientists have studied dating from the year 2002 to 2018 streamlined towards articles related to the impact of shale oil production on global crude oil prices. The study findings reveal that while some studies postulate that indeed US shale oil have negative impact on global crude oil prices, other studies also show that current lower crude oil prices could be attributed to several factors other than the mass production of US shale oil. Adversely other studies were indifferent with their findings and attributed the lower crude oil prices to both relatable factors such as the growth of US shale oil production, the slowdown of global oil demand, reduced cohesiveness of the OPEC cartel and production ramp-ups in other non-OPEC countries.

Keywords: Shale Oil Production, Crude Oil Prices, OPEC, Future Prospects.

INTRODUCTION

The use of hydraulic fracturing (or fracking) in conjunction with horizontal drilling and micro-seismic imaging has made it possible to extract crude oil from rock formations characterized by low permeability. Oil extracted by these techniques is commonly referred to as tight oil or shale oil to differentiate it from crude oil extracted by conventional drilling techniques. To date commercial shale oil production has been largely limited to the United States. The U.S. oil fracking boom is an example of a technological change in a single industry in one country affecting international trade worldwide. Increased U.S. shale oil production over time has displaced crude oil exports from Arab oil producing countries, both because the United States no longer relies as heavily on crude oil imports from Arab countries and because U.S. refineries have increasingly exported refined products such as gasoline or diesel made from domestically produced crude oil, causing other countries to cut back on their crude oil imports as well [1]. Much has been written about the United States shale oil revolution. Some sources like the International Energy Agency [2] went as far as to predict that the United States will overtake Saudi Arabia and Russia to become the world's biggest oil producer by 2020 and energy self-sufficient by 2030 [2-4]. Others called it a

game changer with a new emerging balance of power in the global oil market. Yet others were in such a state of euphoria about the success of American shale oil production to say that it may deny OPEC the power to set global oil prices and that the world oil industry won't be the same in the wake of shale. Some also claimed that the idea of peak oil had gone in flames. The above claims aside, given recent increases in U.S. shale oil and gas production, it is now clear that these resources might play some role in non-OPEC supply prospects. Whereas the gains to the U.S. economy of the fracking boom are well understood at this point, little is known to date about the real impacts this development has imposed on foreign oil producers and the global crude oil prices. Understanding the implications of the U.S. fracking boom is important not only for policymakers in Arab economies deciding on how best to respond to the tight oil boom, but it also provides a prime example of a well-identified exogenous shock to the terms of trade of primary commodity exporters. This study sets on to review articles to foster this understanding. As methodology the study adopts a qualitative research approach thus from a literature review stand point with time boundary dating from 2002 to 2018 (most current literature).

RESEARCH METHOD

In the light reviewing the phenomenon of shale oil in the US and its related impact on oil prices amidst prospects and related studies written by scholars, this study aims at aiding the mostly qualitative discussion and hence adopts a literature research approach based on previous review articles [5-7]. Researcher electronically searched the economic journals of oil and gas as well as energy following terms in either in title or body of the paper: shale oil production, impact on crude oil prices and future prospects. It limited the search to articles published from 2002 to 2018, exactly recent 18 years. Each paper was screened to assess whether its content was fundamentally relevant with regards to US shale oil production and its impact on global crude oil prices. For increase the reliability of the review, the individual articles were carefully read and ended up with the most relatable relevant articles.

Understanding the oil market: Crude oil

Although there are differences in the formation of fossil fuels, most scientists agree that this is due to the decay of dead bodies of millions of years. Due to the long breakdown before the conversion of crude oil, the commodity is defined as a non-renewable commodity. Economic value that cannot easily be replaced [8]. Crude oil can be divided into several categories according to its properties, mixture and extraction site. Tanks around the world differ from the oil type. The most important measurement of oil quality is viscosity, which ranges from light to medium, heavy, and particularly heavy. The American Petroleum Institute introduced a standard for separating various oils by comparing their weight with water. The measure is known as API gravity, and more than ten readings mean that the oil is lighter and floats in water, with less than ten digits indicating it is heavier than water and it is sinking [9].

The most widely used reference to European oil is the Brent alloy, which is used as a reference to about 65 percent of world crude oil contracts [10]. Brent refers to the North Sea oil extracted from four different fields. They are easy to transport because they are delivered over the sea and are therefore fast and easy to deliver to the whole world. West Texas Intermediate (WTI) is an oil from the United States that is transported by pipelines, which makes it much more expensive. However, it is the most important benchmark for oil sold in the United States. The Middle East uses the most oil comparison in Dubai / Oman. The reference has been the most important market price for Middle East crude oil. Also, OPEC reference basket is an important reference, although it is not an oil blend as mentioned above. This is the weighted average of the prices of oil blends produced by OPEC countries. There is also a difference between conventional and unconventional oil, where different types of extraction methods exist for pumping the oil. Traditional oil means oil that lies between rock formations and is free

flowing. A rig can drill a well down to the oil pool and the only pressure needed to pump the oil is the natural pressure that occurs from drilling a well. On the other hand, unconventional oil cannot be extracted by this method. Oil is often located in layers and instead of a large basin, often in small quantities. Horizontal drilling is used to achieve deposition and instead of having hook hooks and wells; is often referred to as fracking. This creates fractures in the surrounding layers and stones, so that oil flows more freely and facilitates extraction [11]. It is important to understand that the oil is not homogeneous and that it produces a variety of extraction methods. In particular, the difference between conventional and unconventional oil is important in this work as OPEC production is defined as normal and returns by extraction of oils and is defined as abnormal. Because we have two different production methods, we have also seen differences in marginal costs.

Evolution of Shale Oil: Historical Perspective

After a steady decline in the three decades, US oil production was the biggest contributor to the global supply chain growth in 2012-2014, and its current competition is Saudi Arabia and Russia's share of world oil production. Initially, oil shale was essentially a US phenomenon, because both technical and regulatory issues limit its global impact. In particular, oil streams in the US, Canada and Mexico pipeline systems were only able to absorb currents from the perimeter to the internal US states and US crude oil exports were banned by a law introduced for national security reasons. Shale oil has been known as an oil opportunity since the 10th century, but did not get much attention before the last decade. The technology was missing, so the oil removal was not effective. In addition, oil prices were historically too low in order to make investments worthwhile, so it did not get much attention before oil prices rose. Shale oil consists of sediment layers of tightly packed stones. In 1981 George P. Mitchell began to drill Barnett Shale and over the next 20 years an efficient drilling method called fracking was developed, which made it cheaper to produce shale oil [12]. Since then, bran oil has received much attention as well as investments, and at least 137 shale fields in 42 countries have now been found. Approximately 67% of the bushes are located in six countries, namely the United States, Argentina, Australia, China, Libya and Russia. Of these countries only Libya is an OPEC Member [12]. The United States has been a forerunner in oil production in oil production. Between 2013 and 2015, North American slate production increased by approximately EUR 1.5 million. Bbl / d per year [13]. In 2007, the EIA estimated that oil production in the US would be roughly standard by 2030, but we have actually seen much larger volumes. Production levels have increased by about 80 percent from 2008 to 2015 [14]. The development of the steel sector was not anticipated on the world market, and it was the surest one. It had long been known that large stocks existed,

but not that it would be produced on a large scale. The Shale industry has seen enormous technical innovations, especially in hydraulic fracturing, geological visualization and calculation [14]. The IEA suggests that global glutinous oil is 8 million barrels of oil a day by 2040. This growth analysis by [12] is the same as adding a US producer to global supply. Traditionally, as prices are high, some fields have now hit \$ 40. Both factors led to an overwhelming inventory, which threw oil prices in the United States. Quality differences delivered at dive sites in the archipelago such as the West Texas Intermediate (WTI) benchmark³² (the most important benchmark in the US) are priced at a reduced discount. Energy product prices are cheaper in the US than in the rest of the world. However, the subsequent reversal of oil flows in pipelines and the creation of extra rail capacity in 2014 coupled with a repeal of the export ban one year later helped to close the gap between US and international oil prices and bring US oil shale oil to the global arena. At this point, the US EIA had made a number of positive re-evaluations of oil shale oil for both future volumes and life expectancy, suggesting permanent changes in the global oil market.

Global Impact of increased U.S. production (Shale oil Production)

The recent projections of the EIA and the International Energy Agency (IEA) [2-4] suggest both global oil production and real oil prices rise sharply by 2035, due in particular to the growing demand for China, India and other fast-growing emerging economies. The IEA predicts that world oil production will grow by 19 percent by 2035 compared to the estimated EIA's 28 percent growth [2-4] (which is not such a large deviation, given the uncertainties in such long-term forecasts). The average global oil price projections of the EIA and the IEA are in line with the tighter line, and the IEA predicts sharply short-term growth, which will gradually fall to \$ 127 a barrel by 2035 in the long run, and the EIA is forecast to reach a steeper price increase of \$ 133 per barrel by 2035 (both estimates are in real terms in accordance with the general US standard of prices, which also applies to all oil price changes mentioned in this report). In analyzing these oil price forecasts, both agencies expect a relatively low growth in refined oil compared to global production. Their forecasts are probably conservative because they are based only on resources that are already very certain. Past experience of combustible oils suggests that these resources are likely to have significantly increased significantly over time as they function as new ones in the United States and globally. The extrapolation of the available data (and the experiences of combustion of US flame gases) has helped create a number of scenarios that see cellulite production both in the US and in the rest of the world. The successful development of slate development resources depends on globally distributed, large-scale and high-quality resources with overall technical and economic outlook for the US oil stocks. Significant

studies and assessments will have to be made in the coming years to show the quantity and quality of resources. Another key aspect is the timing of the large-scale development of oil shale oils. Evolution of shale gas outside the United States has undoubtedly been a disappointment, and the same things (including regulatory barriers, infrastructure, logistics and skill challenges) may also affect the unrest in the report with several key assumptions. Successful development of pulp and oil resources depends on the distribution of global, large-scale, high-quality resources with a general technical and economic utilization that is largely consistent with US oil shale. Significant studies and evaluations will have to be undertaken in the coming years to show the amount and quality of resources. Another important aspect is the timing of the large-scale development of oil shale oils. Outbreaks of US shale gas have so far been disappointing, and the same issues (including regulatory barriers, infrastructure, logistics, and skill balances) may also affect how light oil opportunities are run outside the United States. We assume that the production of oil tapes outside the United States will be phased in stages from a small scale by 2015 and will increase one million barrels per day by 2018 and will continue to grow. The third important requirement that oil recovery must be effectively exploited has a sound regulatory framework. In addition, local environmental issues need to be taken into account and in line with national governments' CO₂ emissions and energy security objectives. Different countries have probably found a different balance, and this is reflected, for example, in our assumption that oil shale is produced slower in the EU than in the US and other regions

Macroeconomic Impact of lower oil prices in relation to Shale oil Production

Lower global oil prices of the magnitude indicated by our analysis suggest a major impact on the future evolution of global economy, given the key role that oil prices still play. These effects are not as great now as in the 1970s when oil price hikes had severe negative impacts on major oil importing economies, helping to push the UK and many other countries into prolonged periods of 'stagflation', but are nevertheless very significant. PwC [15] used the National Institute Global Econometric Model (NiGEM) to foster clarity to explore the consequences of a lower oil price across the global economy and for selected major national economies covered by the model (in particular the US, Japan, Germany, the UK and the BRICs – Brazil, Russia, India and China). Their study findings indicate that Oil prices play three key roles within the NiGEM model, thus: Energy combines with labor and capital to produce economic output (as measured by GDP), Import and export prices are modelled as a weighted average of commodity and non-commodity prices. A decrease in the price of oil will improve the terms of trade for a net oil importer, and conversely see them deteriorate for a net oil exporter. Oil prices are directly

and indirectly linked to consumer prices. Lower oil prices will generally boost consumer spending power, especially in net oil importing economies.

The Impact of Shale Oil Production on Crude Oil Prices: A Review of Literature

Even though this phenomenon stands distinct in academia, very few studies are focused in this direction. Significant among them (See, for instance, [16, 17, 7, 18, 19]) are critically evaluated in this section. Many suggest that supply-side factors have been important in the oil price crash deciphering the impacts [20]. Shows how the combination of low supply and demand on the oil market flexibility cannot reply to the previous level of oil price volatility without any role in enhancing any of the volatility of financial speculation. Highlighting on the phenomenon of shale oil production and its impact on crude oil prices [7, 5], elaborates that much interest in the causes of the steep decline in the Brent price of oil between June and December 2014. Their study shows that more than half of this decline was predictable in real time as of June 2014 attributing \$11 of this predictable decline to the cumulative effects of negative demand shocks prior to July 2014 which can be traced to a slowing global economy. The remaining \$16 of the predictable decline is due to positive shocks to current and expected oil production prior to July 2014. The rest of the \$49 cumulative decline was unpredictable and reflected a shock to oil price expectations in July 2014 which lowered the demand for oil inventories and a negative demand shock caused by an unexpected weakening of the global economy in December 2014. These two shocks lowered the price by an additional \$9 and \$13, respectively. Furthermore [21] examines how the shale oil revolution has shaped the evolution of U.S. crude oil and gasoline prices. Kilian explains why the shale oil revolution unlike the shale gas revolution is unlikely to stimulate a U.S. boom in oil-intensive manufacturing industries, and it explores more generally the implications of the shale oil revolution for the U.S. economy. Furthermore [22], examines the global flows and strategic refinery adjustments in a spatial, game-theoretic partial-equilibrium model. The study consider detailed supply chain infrastructure with multiple crude oil qualities (supply), distinct oil products (demand), as well as specific refinery configurations and modes of transport (mid-stream). The study finds while US producers gain, the profits of US refiners decrease, due to reduced market distortions and a more efficient resource allocation. Countries importing US sweet crude benefit from higher product output, while avoiding costly refinery investments. Producers of heavy sour crude (e.g. the Middle East) are incentivized to climb up the value chain to defend their market share and maintain their dominant position. Following the variant of [23, 24] investigates on the phenomenon. The study adopts mostly qualitative discussion with quantitative evidence from computing quarterly partial market equilibria Q4 2011 – Q4 2015 under present short-term profit

maximization and different competition setups as methodology to address the phenomenon. Although the model performs reasonably well in explaining pre-2014 prices, all setups fail to capture low prices, which fall even beyond perfect competition outcomes. The research findings exhibits a robust effect with respect to large variations in cost parameters. Rejecting present short-term profit maximization, as well as a qualitative discussion of Saudi Arabian politics and the shale oil revolution, lead to the conclusion that the price drop of 2014-16 was most plausibly the result of an attempt to defend market shares and to test for shale oil resilience, besides being fueled by other factors such as rising competitiveness of alternative technologies. Although shale oil might have increased competition permanently (as supported by model results), the agreement of December 2016 should not be misunderstood as an OPEC defeat. In another study [23] sets to analyze the impact of shale oil revolution on oil prices and economic growth. Their study employs a general equilibrium model as methodology to investigate the nexus. The research results suggest that most of the expected increase in US oil supply due to the shale oil revolution has already been incorporated into oil prices and that it will produce an additional increase of 0.2 percent in the GDP of oil importers in the period 2010-2018. We also employ the model to analyze the collapse in oil prices in the second half of 2014 and conclude that it was mainly due to positive unanticipated supply shocks.

In line with [25, 24, 26] also presents a simple equilibrium model as methodology to explain the fundamental market factors that can rationalize such a regime switch by OPEC given factors such as the growth of US shale oil production, the slowdown of global oil demand, reduced cohesiveness of the OPEC cartel and production ramp-ups in other non-OPEC countries [26]. show that these qualitative predictions are broadly consistent with oil market developments during 2014-15. The model is calibrated to oil market data; it predicts accommodation up to 2014 and a market-share strategy thereafter, and explains large oil-price swings as well as realistically high levels of OPEC output. Also [27] show that changes in the US production alone is not expected to have a large impact on overall global oil prices.

Using a quantitative analysis of how the recent boom in US oil production as methodology [28], provides insight that largely a result of shale oil production has impacted the domestic petroleum refining industry. The findings suggest that since 2011 independent refiners' profitability rose by 3 per cent for a domestic crude oil price decrease of 1 per cent, while they were not associated with domestic crude prices before 2011. The relation between refinery profitability and domestic oil prices is consistent with the results of pass-through of relative domestic crude prices to relative refined product prices in the United States

before and since the dramatic rise in shale oil production. Again [29, 30], examines whether the recent low crude oil price is attributable to this shale revolution in the U.S., using a SVAR model with structural breaks. Their results reveal that U.S. supply shocks are important drivers of real oil price and, for example, explain approximately a quarter of the 73% decline between June 2014-February 2016. Failure to consider statistically significant structural changes results in underestimating the role played by global

supply shocks, while overestimating the role of the demand shocks [25]. Adopts a two-country DSGE model with a rich representation of crude oil and refined products and a crude oil export ban in the U.S to examines the U.S. shale oil boom and its impact on crude oil prices. Their model shows that the shale boom leads to a decline in oil and fuel prices, and a dramatic fall in U.S. imports of light oil.

Table-1: Summary of Literature Review on Shale Oil Production and Its Impact on Crude Oil Prices

Author/s	Year	Methodology	Findings
Baumeister, Christiane, and Lutz Kilian	2016	Content Analysis Method	More than half of the decline in the price of oil was predicted in real times as of June 2014 and attribute it to the cumulative effects of adverse demand shocks while remaining decline was due to supply shocks associated with an unexpectedly weakling economy
Kilian, Lutz	2015	Content Analysis Method	Shale oil producers remain competitive even at the current much lower prices of oil but it is likely to be more of a temporary acquittal for another decade than a permanent solution
Kilian, Lutz.	2017	Review Analysis	
Langer, Lissy, Daniel Huppmann, and Franziska Holz	2016	Game-theoretic partial-equilibrium model	While US producers gain, the profits of US refiners decrease, due to reduced market distortions and a more efficient resource allocation
Mănescu, Cristiana Belu, and Galo Nuño.	2016	General Equilibrium Model	Most of the expected increase in US oil supply due to the shale oil revolution has already been incorporated into oil prices and that it will produce an additional increase of 0.2 percent in the GDP of oil importers in the period 2010-2018. Also the collapse in oil prices in the second half of 2014 was mainly due to positive unanticipated supply shocks.
Ansari, Dawud	2017	General Equilibrium Model	The price drop of 2014-16 was most plausibly the result of an attempt to defend market shares and to test for shale oil resilience, besides being fueled by other factors such as rising competitiveness of alternative technologies. Although shale oil might have increased competition permanently (as supported by model results), the agreement of December 2016 should not be misunderstood as an OPEC defeat.
Bataa, Erdenebat, and Cheolbeom Park	2017	SVAR model with structural breaks	U.S. supply shocks are important drivers of real oil price and, for example, explain approximately a quarter of the 73% decline between June 2014 and February 2016. Failure to consider statistically significant structural changes results in underestimating the role played by global supply shocks, while overestimating the role of the demand shocks.
Cakir, Nida, Michael Plante, and Mine Yücel	2017	DSGE model (General Equilibrium Model)	Shale boom leads to a decline in oil and fuel prices, and a dramatic fall in U.S. imports of light oil. On the other hand, the shale boom leads to a 1 percent increase in U.S. GDP and a significant improvement in the oil trade balance.
Vaitilingam, Romesh	2016	Literature Review Analysis	US Shale boom does not leads to a decline in oil and fuel prices as lower crude oil prices can be attributed to other factors
Ron Alquist and Justin-Damien Guénette	2014	Structural Model	Changes in US oil production alone is not expected to have a large impact on global oil prices
Arezki, Rabah, and Olivier Blanchard	2014	Content Analysis Method	the co-movement of crude oil prices and metal prices is a respond to global slowdown activity in the oil market, however metals declining in prices were less significantly than oil

Source: Authors own Conceptualization from literature review

Additionally, the shale boom leads to a 1 percent increase in U.S. GDP and a significant improvement in the oil trade balance. We show that the export ban was a binding constraint, primarily from 2014 to 2015, and would likely have remained a binding constraint thereafter had the policy not been removed at the end of 2015. While the ban distorted oil prices, the refining sector and trade balances, we find that it had a negligible impact on fuel prices and the macroeconomy [16]. Points out that the co-movement of crude oil prices and metal prices is a respond to global slowdown activity in the oil market, however metals declining in prices were less significantly than oil.

While some studies postulate that indeed US shale oil have negative impact on global crude oil prices (see for instance [23], other studies also show that current lower crude oil prices could be attributed to several factors other than the mass production of US shale oil [31, 5, 7, 22, 24]. Meanwhile other studies were indifferent with their findings and attributed the lower crude oil prices to both relatable factors such as the growth of US shale oil production, the slowdown of global oil demand, reduced cohesiveness of the OPEC cartel and production ramp-ups in other non-OPEC countries.

In the Table-1 below, the author summarizes the conclusions drawn by the respective authors regarding shale oil production and its impact on crude oil prices across over from the selected journals.

General Future Prospects

To what extent are the low oil prices reflecting the slow global economy, the question of the stage is will Europe, Japan and the emerging Asia recover? A fast and sustainable economic recovery, which is unlikely at this stage, would quickly remove the state of crude oil. However, all the signs indicate that there are still significant negative risks to the world economy and that recovery is likely to slow down and gradually increase. This suggests that demand for oil will not go in the near future. A final remedy would be coordinated oil supply cuts, similar to those that helped to alleviate the glut of crude oil when the oil price dropped to \$11 in 1998 [32]. But taking the theory of cartels as a guide, that solution seems unlikely in the current environment of low demand for oil. Oil cartels are inherently pro-cyclical and tend to fall apart during economic slumps [33].

Even though negotiations have taken place between Russia, Saudi Arabia, Venezuela and other oil producers on a coordinated supply limit, all the indications are that these producers are likely to halt high production levels in recent times as they are in agreement with the actual production volumes. In addition, Iran, Iraq and the United States are unlikely to be aware of such agreements. There is still little doubt

that oil prices will recover in the longer term, but the question is whether the Saudi net currency can maintain the economy so far. It is more likely that the Saudi economy will face another three or four lean years. At this stage, the premature savings of the Saudi state fund will probably end, while the potential for the new external debt will be reduced. Saudi credit rating has already fallen

CONCLUSION

Over the past decade, the strong crude oil demand in emerging markets has raised oil prices higher than the historical inflation-adjusted average. These rising price levels are masked clothing in the United States. Although high oil prices may have affected the US recovery after a major downturn, it has also produced stricter oil reserves that are commercially viable. Although oil from these sources poses challenges, there has been rapid and rapid delivery, suggesting that rising prices have helped ease the adjustment to new balances where abnormal oil resources are profitable and show a positive turning point in the United States. However, many factors suggest that oil production in the US oil shale has led to lower global oil production in oil-producing countries. It is common that most of the fall in oil prices since June 2014 is a collapse of the US. However, the analysis of Christiane Baumeister and Lutz Kilian shows that global oil production, global economic slowdown, oil price expectations and changes in storage requirements have all contributed to the decline [5; 34]. In a comparative study, Kilian compares it with the outbreak of the Iranian and Iraqi war in 1980, after which the decline in oil production was roughly the same as US oil shale oil [21].

This supply shock was followed by an increase in the US price of imported crude oil of about 10%. After reversing the sign that would correspond to a decrease in the oil price of about \$10 in today's market. In his latest research, Kilian measures how much global oil production would have been lower if the fracking boom had never taken place [1]. While [21] believes that considering the most striking pattern in crude oil prices it may be tempting to think that this decline is caused primarily by the tight oil boom, but this is not the case according to the most study findings. However, it is safe to conclude that long-lasting low oil prices are likely to result in far-reaching economic changes in arable oil producing countries and changes in the social fabric, whether these changes have been progressively anticipating growing financial difficulties or eventually forced on external events. It is indicative to note that the great concern is that if this shift is not well controlled, the geopolitical risks in the Middle East, which have not played a significant role since 1990, may again be more important. This would increase oil prices in the long run.

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