

On Recent Trends in Crude Oil Prices

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Abstract

The price of crude oil is of great importance to the stability and growth prospects of the world economy. Since the year 2000, oil prices have been on a sharp upwards trend, prompting concerns over the effects of a resulting oil-price shock. In this paper we examine the different factors affecting the price of crude oil, and possible explanations of the recent price surge. The factors we consider include world demand-supply trends, recent industry changes in inventory management, political uncertainty in the OPEC zone, the increasing influence of speculators in the futures markets, and the possibility of resource depletion. The relative importance of each of these factors is a subject for empirical study, and we summarize some recent findings on the subject.

1 Introduction

The recent surge in crude oil prices since the year 2000, preceded by a price collapse around 1998, have attracted considerable interest both in the academic research community and in the popular media. Due to the crucial importance of crude oil to the global economy, several theories have been proposed to explain the increased volatility observed recently. Volatility implies uncertainty, and this is accepted as a bad thing economically, therefore reducing uncertainty is an important policy goal. However a proper understanding of the different factors affecting crude oil price levels and volatility is necessary, in order to analyse policy alternatives. In this paper, we present a survey of recent research into crude oil price trends.

Some facts about the oil industry are well-known and widely accepted by researchers.

- The short-term demand and supply of crude oil is extremely inelastic to price changes. Oil prices have historically been both highly volatile, and subject to exogenous supply shocks from natural disasters, political events etc.
- The demand for oil products is expected to increase for the foreseeable future, driven by demand from emerging economies. The world aggregate

oil demand in the year 2004 was 82.3 mb/d (million barrels per day), compared to 79.4 mb/d in 2003 [1].

- Information on crude oil demand, supply and inventory levels are neither timely, nor reliable. Furthermore, reported figures for demand, supply and inventory can be, and often are revised subsequently, sometimes more than a year after the fact. Also the quality of data varies considerably across regions [2].
- Crude oil is not a fungible quantity. There is significant variation of quality (and therefore price) among the standard baskets. The West Texas Intermediate (WTI) is considered as the highest quality basket, followed by the Brent Blend, and the Dubai Blend.
- There are multiple groups of players with various degrees of cartelization each with substantial market power in the upstream or downstream segments of the oil industry. The main upstream producers can be broadly classified into OPEC and non-OPEC. Further downstream are the oil multinationals like Exxon-Mobil and Shell (although some multis also have production facilities). The world-wide consumer market can be categorized as OECD (the Western nations) and non-OECD.

Some of the theories that have been advanced to explain the recent increased volatility of oil prices are as follows:

1. *Organic demand growth.* According to this theory, the strong GDP growth rates registered by Asian developing economies (mainly China and India) has led to surging demand for oil products, and this trend is likely to continue, and until supply capacity can be expanded to cope with this demand growth, the oil market is likely to be tight and high prices levels and price volatility are to be expected.
2. *Oil industry practices.* Recent advances in computerized inventory management has led several industries including the oil majors to the concept of “just-in-time inventory”. Publicly traded companies have an incentive to minimize inventories in order to increase profitability and shareholder value. However less inventory automatically means more price volatility. (This could be interpreted to mean that the much-hyped computerized inventory management systems do not work, but that is outside the scope of this report!)
3. *Speculation in futures markets.* Proponents of this theory [3] believe that trading in financial instruments e.g. oil futures contracts, while increasing liquidity and potentially improving efficiency, also leads to higher volatility. It is claimed that trading activity in oil derivatives account for a substantial part of recently observed volatility.

4. *Good old-fashioned greed.* Several commentators, particularly in the popular press, attribute high oil prices directly to price fixing by the participants. This is theoretically possible because of the existence of cartels formal (OPEC), and informal (the oil multinationals).
5. *Peak Oil.* This school of thought is based on the belief that the world oil supply is poised for severe shocks with the most productive reserves reaching peak production capacity and going into decline.

It appears that all of these theories have some amount of credibility in the marketplace (note that the market cares only about the participants perceptions, not about the “truth”). In the remainder of this report, we present findings from some recent research that sheds some light on these hypotheses. In Section 2, we provide some background into the history of the world crude oil market, and the forces driving supply and demand. In Section 3, we survey recent research on this subject, and conclude the report in Section 4.

2 Background Information on Oil Prices

2.1 A Brief History of Oil

The oil industry was effectively inaugurated with the drilling of the world’s first oil well in 1859 in Titusville, Pennsylvania. Ever since then, the supply of petroleum has always been uncertain and demand rabust and inelastic. Therefore price volatility has always been a fact of life in the oil industry [2]. The history of oil is understood best, by considering several different epochs:

1. *The early years.* Initially the petroleum market was small, and uncertain. Discovery of new oil wells and drying up of old ones kept introducing supply shocks to the system. The industry was ripe for consolidation, and from this climate emerged the monopoly of Standard Oil.
2. *post-Standard Oil Trust.* After Standard Oil was broken up by anti-trust regulators, the market once again became fragmented and volatile. This was worsened by supply shocks due to discovery of oil in East Texas, and demand shocks from World War 1 and subsequently the Great Depression. In 1928, the major oil companies reached agreement at Achnacarry to control over-capacity and stabilize the market. Subsequently import quotas were established in the US, allowing for relatively high prices, and decreased volatility.
3. *The 1970s shocks.* The relatively stable oil oligopoly lasted until the early 1970s, when several important developments changed the oil industry forever. First the oil-rich Middle Eastern nations nationalized their oil-fields. This ended the control of the oil majors over the world supply. In 1973, OPEC was formed to stabilize the oil market at terms acceptable to the producing nations. Until this point, the producing nations were not deriving direct economic rent over the mining of petroleum. OPEC put an

end to that situation. Curiously the resulting increase in world oil prices were highly beneficial to the oil majors, who were now free to develop higher cost reserves elsewhere in the world. There was also an oil shock in the late 70s because of the Iranian revolution. Overall the 1970s were the most volatile period in the history of petroleum.

4. *Saudi Arabia as swing producer.* As the dominant member of OPEC, Saudi Arabia took on the role of “swing producer”. This meant that Saudi oil production would be increased up and down in response to variations in demand and supply from other nations, in order to achieve OPEC’s price target. However this sometimes required Saudi Arabia to reduce production to extremely low levels, and eventually Saudi Arabia abandoned the role of swing producer, resulting in a disastrous price war in 1986.
5. *OPEC quotas.* The price war of 1986 was particularly disastrous because of the extreme short-term inelasticity of oil demand. Oil demand was already rather depressed in response to the supply shocks of the 1970s (in the medium term, the oil demand curve is very much elastic, due to conservation and substitution with other fuels). Therefore the over-supply barely caused the demand to increase at all, causing a steep drop in price and loss of revenue for all producers. In the post 1986 era, OPEC switched to a system where they set production quotas for member nations. The production quotas were set to keep prices within a certain target range. This regime persists to this day, and until recently has worked reasonably well.

2.2 Who sets the Price?

Typically it takes a series of transactions before oil gets from the ultimate upstream producer (e.g. a Saudi oil-field) to the eventual downstream consumer (e.g. a cab-driver filling up at the gas station). At each step of the way, there are costs associated with drilling, transportation, refining, storage, taxes and profit margins. We now present a simplified description of how this process works in practice. First, however, we observe that classical economic theory does not describe this process very well.

Classical market theory asserts that in a competitive free market, the price of a commodity is determined by the supply and demand curves. In particular, price is equal to the marginal cost of production at equilibrium, where supply and demand are perfectly balanced.

In the real world, there is always a market participant who sets a price, and others who react, e.g. in retail the seller sets a price to which buyers react, whereas in auctions buyers set the price. Indeed according to Adam Smith, the market is analogous to a contest where players try to predict what “the average opinion of the average opinion is”. Under ideal conditions, intelligent market participants eventually discover the equilibrium price.

However the oil market is far from ideal, in several important ways. The most important non-ideality is that the market does not possess accurate and timely

information about supply and demand. Sometimes the uncertainty could be as large as 1 mb/d [2]. This combined with inelastic short-term demand curves essentially make the price indeterminate over a wide range [4]. This does not mean that market participants are unable to determine the equilibrium price, but that the concept of a unique equilibrium price is meaningless. In this situation, momentum and sentiment, rather than the supply-demand fundamentals determine the price the markets eventually settles on. Finally this price itself serves as a signal about supply-demand imbalances (because direct data is not readily available) completing a feedback loop.

The whole process works as follows:

1. The ministers of the OPEC nations set production quotas for their respective nations. These quotas are based on the most recent information on supply, demand and inventory levels, and is set with a price-target range in mind. The quotas are not monitored or enforced, i.e. OPEC operates on the honor system. However because of the extreme destructiveness of an oil price war, the quota limits are observed voluntarily most of the time. Saudi Arabia acts as informal swing producer to smooth out imbalances, not previously noticed. The OPEC meets whenever it needs to, and not on any set schedule. While the OPEC has a vested interest in keeping prices high, the organization makes an attempt to keep it from getting too large, perhaps to avoid “killing the golden goose”.
2. Downstream companies (mostly the oil majors) negotiate prices for crude oil from the producers. This picture is complicated by the fact that the oil majors are also producers in some cases. There are three major forums for such transactions: term contracts, the crude-oil spot market and the futures exchanges. Term contracts are bilateral contracts for crude oil between a buyer and seller. Futures exchanges usually trade financial instruments that represent future obligations to deliver crude oil. Spot markets deal with immediate delivery of crude oil.
3. The spot-market has no particular location, but rather refers to an informal network of dealers, that wish to transact on immediate deliveries of crude oil. In spot-markets, actual oil changes hands, therefore they are sometimes called “wet-barrel” markets in contrast with the futures exchanges, in which paper contracts for future delivery is bought and sold rather than actual barrels of oil. The large amounts of money involved have made these markets highly liquid, and therefore we may reasonably assume “no arbitrage” conditions across markets. Typically a refiner who has capacity in excess of contract obligations would seek to transact on spot markets.
4. The actual retail price of gasoline and other petroleum products is determined by the parent oil multinational for “branded” gasoline stations. Non-brand operators typically set their prices at a level dependent on their local branded competitor [5].

5. If we assume the “no arbitrage” condition across all petroleum markets, spot market prices represent the best signal to supply-demand imbalances. Indeed if spot market prices are outside the OPEC price target (in either direction), the OPEC often schedules meetings to adjust quotas accordingly. This completes the feedback loop that determines the oil price.

3 Recent Research into Oil Price Trends

With the background into oil prices in Section 2, we now take a look at the hypotheses discussed in Section 1 to explain recent price trends.

3.1 The Demand Growth Hypothesis

The surge in demand for oil from China in recent years is an undeniable fact [1]. If robust demand growth continues, the recent upward trends in oil prices can be expected to stay, and this indeed seems to be the prognosis of most industry watchers. However a minority opinion by Andy Xie of Moragn Stanley, suggests an alternative scenario where Chinese demand growth is slowing [6]. This slowdown is consistent with the anticipated cooling down of the over-heated Chinese economy, and indeed this may be a self-fulfilling prophesy as high oil prices increase costs for Chinese industry, and also help bring about a current account adjustment with the US.

It is impossible to predict which of the two scenarios presented above will come to pass. One possible hint is in the futures market prices that have been tracking the recent highs in spot market prices [7]. Is this a good indicator of high oil prices persisting in the future?

Unfortunately the observation that the futures price tracks the trends in spot market price is merely a tautology, both prices incorporate the same information about supply-demand expectations. In fact, an arbitrage condition can be derived for the two prices as suggested in [8]. Indeed the empirical evidence in [8] shows that the spot market price is actually a better predictor of future prices than the futures market prices. This is not that surprising, because there is no reason to think that the futures market can actually see into the future. Unfortunately some people have developed an unfounded faith in the ability of the market’s “Invisible Hand” to find the right prices. To complicate things, the futures prices do provide good forecasts sometimes [9], the only way to explain this (without assuming futures trading time-travellers) is if price is determined to some extent, by market momentum.

3.2 A Speculative Oil Price Bubble?

This brings us to the hypothesis that oil price is driven by momentum trading in oil derivatives in the futures market. This is a commonly offered reason for price volatility in recent years. To understand this phenomenon more clearly we

observe that futures market transactions can be used for two purposes: hedging and speculating. At the risk of some over-simplifications, we categorize futures traders as “commercials” and “non-commercials” [10]. “Commercials” are entities that have inherent economic exposure to oil price, typically oil majors. “Non-commercials” have no inherent oil-price exposure because they are not in the oil business. Indeed most non-commercials never deal with physical crude oil, buying and selling “paper barrels” exclusively. This distinction, however, has become a little imprecise recently because some former oil industry outsiders have subsequently acquired considerable physical assets in order to trade in this market more profitably, e.g. see [11]. The reason for the increased non-commercial interest is easy to understand. With the stock market stuck in neutral since the collapse of the Internet bubble, several financial firms like hedge funds, and investment banks have looked for other investment opportunities in a “quest for yield”.

The remaining question is whether such “paper trading” makes the market more or less efficient. This question is examined in [10], in which the authors pose two hypotheses. In the so-called wolf theory, non-commercials represent “smart money”, who use superior market intelligence to adapt quickly (like a wolf) to market fundamentals. However the price itself is determined by fundamentals, and therefore the effect of traders is only to make the market adaptation quicker and therefore their influence is benign.

The alternative hypothesis is that non-commercials being outsiders, have no means of acquiring market intelligence ahead of others, therefore they are price followers, rather than leaders (like sheep)¹. This does not rule out the possibility of making trading profits; indeed so-called noise-traders [12], by acting like herds in following trends, can influence price by sheer momentum thereby increasing market volatility and decreasing efficiency. This leads to a popular scenario, where rampant speculation by hedge-funds has resulted in unsustainably high oil prices with no regard for fundamentals, in other words an oil price bubble [6].

This “sheep” theory is intuitively appealing, however it is necessary to test this hypothesis empirically before it can be accepted as fact.

4 Conclusion

In this report, we have presented and analyzed several interesting explanations for the recent volatility in crude oil prices. We have summarized pertinent research results. Considering the importance of the crude oil market for global economic prosperity, further research is required in order to gain more insight into the mechanics of this process.

¹The wolf-sheep terminology is confusing because for the market as a whole wolves are a good influence, and sheep bad!

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