

# Oxford Energy Comment

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## An Anatomy of the Oil Pricing System

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### Introduction

The sharp swings in oil prices and the marked increase in volatility during the latest price cycle have focused attention on the possibility that crude oil has acquired the characteristics of financial assets such as stocks or bonds. The view that the oil market has become ‘financialised’ and that crude oil price behaviour in recent months has mimicked the behaviour of other financial assets has gained credence among many analysts. However, the nature of ‘financialisation’ and its implications are not yet clear. Discussions and analyses of ‘financialisation’ of oil markets have partly been subsumed within analyses of the relation between finance and commodity markets indexes which include crude oil. The elements that have attracted most attention have been *outcomes*: correlations between levels, returns, and volatility of commodity and financial indexes.

However, a full understanding of the degree of interaction between oil and finance requires, in addition, an analysis of *processes*: the investment and trading strategies of distinct types of financial participants; the financing mechanisms and the degree of leverage supporting those strategies; the structure of oil derivatives markets and financial instruments; and most importantly the mechanisms that link the financial and physical layers of the oil market.

One important aspect of the “financialisation” of crude oil often highlighted is the increasing role that expectations play in the pricing of financial instruments. For instance, in the case of equities, pricing is based on expectations of a firm’s future earnings. In the oil market, expectations of future market fundamentals have increasingly been playing an important role in oil pricing. If there is large uncertainty as to what the long-term oil market fundamentals are, or if perceptions of these fundamentals are highly exaggerated and inflated, then the oil price can diverge away from its true underlying fundamental value causing an oil price bubble.

However, unlike a pure financial asset, the crude oil market also has a ‘physical’ dimension that should, in principle, anchor these expectations in oil market fundamentals: crude oil is consumed, stored and widely traded with millions of barrels being bought and sold every day at prices agreed by transacting

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parties. Thus, in principle, prices in the futures market through the process of arbitrage should eventually converge to the so-called ‘spot’ prices in the physical markets. These ‘spot’ prices form the underlying basis of physical supply agreements and should reflect existing supply-demand conditions.

In the oil market, however, the story is more complex. To begin with, the ‘current’ market fundamentals are never known with certainty. The flow of data about oil market fundamentals is not instantaneous and is often subject to major revisions which make the most recent available data highly unreliable. More importantly for this article, though many oil prices are observed on screens and reported in the media, it is important to understand what these different prices really mean. Thus, although the futures price often converges to a ‘spot’ price, it is important to understand the process of convergence and what the ‘spot’ price, in the context of the oil market, really means.

Unfortunately, little attention has been devoted to such issues and the processes of price discovery and price formation in oil markets remain under-researched. It is important to stress that while this topic is strongly inter-linked to the role of speculation versus fundamentals in determining oil prices, it goes beyond the existing debates which have dominated policy agenda. It offers a fresh and deeper perspective on the current debate by identifying the various layers relevant for the price formation process and by examining the links between the financial and physical layers in the oil market, which lie at the heart of the current international oil pricing system.

## **Background to the Oil Pricing System**

The collapse of the OPEC administered pricing system in 1986 ushered in a new era in oil pricing in which the power to set oil prices shifted from OPEC to the ‘market’. First adopted by the Mexican national oil company PEMEX in 1986, the market-related pricing system received wide acceptance among many oil-exporting countries and by 1988 it became and still is the main method for pricing crude oil in international trade. The oil market was ready for such a transition. The end of the concession system and the waves of nationalizations which disrupted oil supplies to multinational oil companies established the basis of arm’s-length deals and exchange outside the vertically and horizontally integrated multinational companies. The emergence of many suppliers outside OPEC and many buyers further increased the prevalence of such arm’s-length deals. This led to the development of a complex structure of interlinked oil markets which consist of spot and also physical forwards, futures, options and other derivative markets referred to as paper markets. The most complex structures emerged in the North Sea around Brent and in North America around the West Texas Intermediate (WTI).

Physical delivery of crude oil is often organised through long term contracts. These contracts are negotiated bilaterally between buyers and sellers for the delivery of a series of oil shipments. They specify among other things, the volumes of crude oil to be delivered, the delivery schedule, the actions to be taken in case of default, and above all the method that should be used in calculating the price of an oil shipment. Price agreements are usually concluded on the method of formula pricing which has become the basis of the pricing system.

Formula pricing has two main advantages. Crude oil is not a homogenous commodity. There are various types of internationally traded crude oil with different qualities and characteristics which have a bearing on refining yields. Thus, different crudes fetch different prices. Given the large variety of crude oils, the price of a particular crude oil is usually set at a discount or at a premium to a marker or reference price according to its quality and the relative demand-supply conditions. These reference prices are often referred to as benchmarks or ‘open market spot prices’. The formula used in pricing oil in these contracts is straightforward. Specifically, for crude oil of variety  $x$ , the formula pricing can be written as  $P_x = P_R \pm D$  where  $P_x$  is the price of crude  $x$ ,  $P_R$  is the benchmark crude price and  $D$  is the value of the price

differential. The differentials are adjusted periodically to reflect differences in the quality of crudes as well as the relative demand and supply of the various types of crudes.

Another advantage of formula pricing is that the price of physical deliveries can be linked to the time of delivery. When there is a lag between the date at which a cargo is bought and the date of arrival at its destination, there is a price risk. Transacting parties usually share this risk through the pricing formula. Agreements are sometimes made for the date of pricing to occur around the delivery date. For instance, in the case of Saudi Arabia's exports to the United States, the date of pricing can vary between 40 to 50 days after the loading date. The price used in contracts is the benchmark quotes averaged over 10 days around the delivery date which renders the point of sale closer to the destination than the origin.

At the heart of formulae pricing is the identification of the price of key 'physical' benchmarks, such as West Texas Intermediate (WTI), Dated Brent and Dubai. These benchmark crudes are widely used in contracts and are often inaccurately referred to as 'spot' market prices. Since these constitute the basis of the large majority of physical transactions, some observers claim that derivatives instruments such as futures, forwards, options and swaps derive their value from the price of these physical benchmarks i.e. the prices of these physical benchmark drive the prices in paper markets. However, as argued below, this is a gross over-simplification and does not accurately reflect the process of crude oil price formation.

### **Main Features of Benchmarks**

It is important to stress three features of crude oil benchmarks that are useful for our analysis later on. First, the prices of these benchmarks are not directly derived from physical markets. Instead, the prices are assessed or identified by oil pricing reporting agencies such as Platts and Argus Media. Assessments are needed in opaque markets such as oil where transactions concluded between parties cannot be directly observed. Assessments are also needed in illiquid markets where not enough transactions occur. One of the most interesting features of the current oil pricing system is that the least liquid markets (WTI, Brent, and Dubai) set the price for most liquid markets. Oil reporting agencies assess their prices based on information about bids and offers, concluded deals, as well as other private and public information gathered by journalists. Since oil prices are 'assessed' prices and given that the type of information used in these assessments and pricing methodologies differ, these agencies do not always produce the same price for the same benchmark.

Second, the nature of these benchmarks tends to evolve over time. Although the general principle of benchmarking have remained more or less the same over the last twenty five years, the details of these benchmarks in terms of their liquidity and the type of crudes that are included in the assessment process have changed dramatically over the years. The assessment of the traditional Brent benchmark now includes the North Sea streams Forties, Oseberg and Ekofisk (BFOE) and that of the Dubai price includes Oman and Upper Zakum. These streams are not of identical quality and often fetch different prices. Thus, the assessed price of a benchmark does not always refer to a particular 'physical' crude stream. It rather refers to a constructed 'index' which is derived on the basis of a simple mathematical formula which aggregates the assessed prices of the different crudes.

Third and most importantly, in the last two decades or so, many financial layers (paper markets) have emerged around these benchmarks. These include the forward market (in Brent), swaps, futures, and options. Some of the instruments such as futures and options are traded on regulated exchanges such as ICE and CME Group, while other instruments, such as swaps and forward contracts, are traded bilaterally over-the-counter (OTC). Nevertheless, these financial layers are highly interlinked through the process of arbitrage. Over the years, these markets have grown in terms of size, liquidity, sophistication and have attracted a diverse set of players both physical and financial. These markets have become central for

market participants wishing to hedge their risk and to bet (or speculate) on oil price movements. Equally important, these financial layers have become central to the oil price identification process.

### **The Links between Physical and Financial Layers**

At the early stages of the current pricing system linking prices to ‘physical’ benchmarks in formulae pricing provided producers and consumers with a sense of comfort that the price is grounded in the physical dimension of the market. There are still big suspicions as to whether the oil price derived from paper markets such as the futures markets reflects the physical realities of the market - which, in part, explain the current reluctance of many players to adopt futures prices in the pricing formulae. In recent years, the futures markets have attracted a wide range of financial players including swap dealers, pension funds, hedge funds, index investors, technical traders, and retail investors. There are concerns that these financial players and their trading strategies could move the oil price away from the ‘true’ underlying fundamentals.

However, these suspicions implicitly assume that the process of identifying the price of benchmarks can be isolated from the ‘contamination’ of financial layers. This is far from reality. Oil markets are highly interconnected and form a complex web of links, all of which are needed for the price discovery process. In fact, one could argue that without these financial layers it would not be possible to ‘discover’ or ‘identify’ oil prices in the current oil pricing system.

The NYMEX contract is a physical one and the price of the futures contract converges to the spot price at the expiration of the contract. Hence, in the case of WTI, the main benchmark used to price oil shipments to the US, the use of the futures price instead of assessed prices in the pricing formulae would make little difference. In fact, the depth and the high liquidity of the futures market surrounding WTI and the diversity of its market participants should incentivise traders to use the futures price in their formula pricing. In practice though, there is some evidence that the front-month WTI futures price can exhibit high volatility around the expiry date in some instances, which can explain the preference of traders to stick to assessed WTI prices.

In the case of Brent, the issue is more complex. The Brent futures contract is not a physical one and at expiration the futures price converges to the ICE Futures Brent Index. This in turn is based on the 21 day BFOE market (the informal forward Brent market). This peculiar feature of the Brent market has led to the creation of a series of market layers for the purposes of risk management such as Exchange for Physicals (EFPs) and contract for differences (CFDs) markets. Trades in the levels of the oil price rarely take place in these layers. Instead, these markets trade price differentials which fluctuate based on hedging pressures and expectations of traders. The participants in these markets are mainly ‘physical’ and include refineries, producers, downstream consumers, and market makers. Financial players such as pension funds, index and retail investor have limited presence in these markets.

This feature poses a legitimate question: how can markets that trade price differentials set the price level for the oil market? The answer is that the information derived from financial layers plays an important role in identifying the price of the benchmark. In the Brent market, the oil price in the forward market is sometimes priced as a differential to the price of the futures contract on ICE using the Exchange for Physicals (EFP) market. The price of Dated Brent or North Sea Dated (the closest one can get to the spot market in Brent and the most widely used reference price in contracts) in turn is priced as a differential to the forward market through the market of Contract for Differences (CFDs) which is a swaps market. This is also evident in other benchmarks such as Dubai. Given the limited number of physical transactions and hence the limited amount of deals that can be observed by oil reporting agencies, the price of Dubai, the main benchmark used for pricing crude oil exports to East Asia, is priced as a differential to the very liquid OTC Dubai/Brent swaps market. The OTC Dubai/Brent swap market is in turn linked to Dated Brent which in turn is linked to the Brent futures market through CFDs and EFPs.

Thus, one could argue that the level of the oil price is set in the futures markets; the financial layers such as swaps and forwards set the price differentials. These differentials are then used by oil reporting agencies to identify the price level of a physical benchmark. If the price in the futures market becomes detached from the underlying benchmark, the differentials should in principle adjust to correct for this divergence through a web of highly interlinked and efficient markets.

The above discussion has some important implications. First, the idea that one can isolate the physical layers from the financial layers in the current oil pricing regime is a myth. The oil price is jointly or co-determined in both layers. The issue of whether the paper market drives the physical or the other way around is difficult to construct theoretically and test empirically.

Second, the idea that the current oil pricing system can generate a spot price that reflects the true current fundamentals of the oil market is also flawed. In reality, changes in the benchmark price reflect the hedging and speculative pressures and the arbitrage between very efficient markets. These price changes are in turn influenced by expectations of these players most of which are physical and how the flow of information affects their expectations. The pricing system is a reflection of how the oil market functions: if market participants attach more weight to future rather than current fundamentals and/or if market participants expect key players to react in certain ways if prices go above or below a certain level, these expectations will be reflected in the different layers and will ultimately be reflected in the assessed price.

Third, the current regulatory reforms in the US and elsewhere aimed at derivatives instruments will affect the pricing of 'spot' crude oil by affecting the structure of different layers in the oil market and the players' incentives to hedge and speculate. However, their impact remains unclear at this stage.

Finally, the above analysis shows that the level of oil price, which consumers, producers and their governments are most concerned with, is not the most relevant feature in the current pricing system. Instead, the identification of price differentials and the adjustments in these differentials in the various layers underlie the basis of the current oil pricing system. Unfortunately, this fact has received little attention and the issue of whether price differentials between different markets showed strong signs of adjustment in the 2008-2009 price cycle remains an open question and has not yet received its due attention in the empirical literature.

## **Conclusions**

The current oil pricing system has now survived for almost a quarter of a century, longer than the OPEC administered system did. While some of the details have changed, such as Saudi Arabia's decision to replace Dated Brent with Brent futures price in pricing its exports to Europe and the more recent move to replace WTI with Argus Sour Crude Index (ASCI) in pricing its exports to the US, these changes are rather cosmetic. The fundamentals of the current system have remained the same since the mid 1980s (i.e. the price of oil is set by the 'market' and not by an administrator). In the light of the 2008-2009 price swings, the current oil pricing system has received wide criticisms with some observers calling for its radical overhaul such as bringing back the administered pricing system or calling for producers to assume a greater responsibility in the method of price formation by removing destination restrictions on their exports, or allowing their crudes to be auctioned. These calls have so far received limited attention. However, they are constant reminder of the unease that some observers feel about the current system. Although alternative pricing systems can be devised (at least theoretical ones), the reality remains that none of the key players has an interest in rocking the boat, especially that the pricing system has generated a current price range that 'everyone is happy with'. The contradiction is that even in times of high volatility and sharp price swings, key market players get very concerned about oil price behaviour and its global and local impacts, but show little or no interest in the pricing system and the market structure that generated such price behaviour in the first place.