

# Contractual Options on Marker Oil Spreads, a Monte Carlo Approach

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## Extended Abstract

Up to the second oil shock (1979-80) commercial transactions with oil futures, whose prices were set by the selling side, were responsible for more than 95% of total transactions in the international market (ENERGY INTELLIGENCE, 2006). This sort of commercial transaction involved a low level of transparency and few agents, mostly among the big oil companies from the OPEC cartel, together with multinational firms remaining from the “seven sisters”: ExxonMobil, Shell, Chevron & BP. This system, mostly because of the lack of transparency from the OPEC group, such as price increases and non-negotiated production cuts, is considered responsible for the search of different supply alternatives. In effect the counter shock price that occurred in the second half of the 1980’s emerged from the demand side of a reaction of oil consuming companies to this hermetic pricing system. And from the offer side, the resilience of high prices stimulated marginal production from non-OPEC producers, using not as rigid contractual bases in spot markets. On its own side, in 1985 Saudi Arabia ended the era of untransparency of price system in contracts, as a response to the appearance of alternate producers, using a system based on netback value of its oil. Nevertheless this system, which was intended to regain Saudi Arabia its lost market share, ultimately brought the price of oil to a historically lower level, beyond the stigmatization of the new pricing methodology, which lasted for only one year (YERGIN, 1999; Energy Intelligence, 2006).

In fact the netback methodology of pricing, based on the market value of oil derivative “implicitly contained” in the commercialized oil, was undone by a transactional industry *modus operandi*, imposed to the producers, specially the OPEC members, that the price of their oil should be linked to the spot market, reflecting the value of true production and market. After a frustrated attempt at reestablishing the previous fixed price system in the end of the 1980’s, and with the continued pressure from outside OPEC producers, a new flexible model, based on spot prices of different oils from distinct markets, was gradually adopted in oil trading (YERGIN, 1999; Energy Intelligence, 2006).

Therefore industry and trading agents selected some “marking oils”, as reference for values in commercial contracts. The adoption of markers brought an increase in price transparency, increasing also the market liquidity in general, but mostly for denser and more viscous oils whose contracts have a long term and do follow price formulas based on markers. Therefore the pricing of raw oils became more and more transparent from the end of the 1980’s on, through the use of marker oils, such as West Texas Intermediate (WTI) in the US, Brent in Europe, and Dubai & Oman for Asian markets.

The main marker oils of this new contractual pricing system, which came to be broadly used, are the Brent and the WTI, which are not traded in the same geographical region. From the start there are significant differences as to the production dynamics of both oils. Additionally the This WTI condition in Cushing brought significant price spreads (discounts) in face of the international oil market, including the Brent, as those occurred in the end of 2011 when such discounts reached 25 to 30 US\$/barrel. Therefore there is constant questioning on the maintenance of the WTI oil as a marker of commercial contracts, driving other light oils to assume this role in the north American market, even the Brent which is an European oil, and recently has been having some influence in the pricing of refining oils in the US East coast. Due to the uncertainty related to WTI price, which is also present in other marker oils, producers can bargain a contractual flexibility in the relative level of prices of the marker oil (or spread between markers) that will be used in its sales contract. This flexibility could be exerted on a monthly basis at the delivery of its cargo at the designated port, by the buyer of the market in question. Symmetrically, for the buyer, this contractual flexibility could be valuable since at exercise this player has the possibility of buying a cheaper cargo for its refinery if the equilibrium between markets is changed.

The purpose of this paper is to value contractual options which allow the producer/exporter to sell its cargo at a marker oil price (WTI, Brent or LLS – a second north American marker oil) but to choose the mode convenient differential (or spread) up to the moment of delivery. This appraisal, by the buyer, followed by a possible change in marker checking of market conditions, could be pondered on a monthly basis by the seller validated by agreed conditions by both parties at the contract setup. On the other hand, it can provide the buyer an option of buying at a lower cost, equally up to the end of liquidation period. The most synthetic flexibility form in buying and selling of options where the underlying asset is the spread of two markers, in conformity with the expectation of prices that the agent has over several price markers in the international oil market. While negotiating an annual oil sale contract with an option in which the underlying asset is the price spread, the producer captures value of this flexibility, while the buyer can charge for the additional contractual clause, and vice-versa. As exposed then, in light of oil market uncertainties, the possibility of choice of spread levels between marker oils in contracts for a buyer or seller helps mitigating risk of these spreads. The problem involved in WTI price is an emblematic case of uncertainty in this market, which could be extrapolated to other marker oils in the futures, such as Brent whose production is declining. Therefore it is important to create a methodology for pricing spread options between marker oils which could be applicable to other groups of oil.

This article starts by characterizing petroleum, whose price determinants in the international market and the uncertainty inherent to its behavior are conceptual elements essential for the paper course. Oil price markers will be defined as contractual references in commercial transactions, as well as the problematic involved in the maintenance of WTI as the main marker oil in the world market, especially in the US. Next is presented the mitigation instrument for uncertainties related to prices of oil and object of the paper: contractual option of spreads of marker oils. The main stochastic models in the literature are then described for clarification of possible oil price trajectory in the modeling of contractual options. Two statistical tests are also described in order to determine which stochastic modeling is more suitable to the contractual options presented in the paper, where the uncertainty to be modeled is directly the spread between two marker oils, chosen among WTI, Brent and LLS.

In the third chapter the stochastic processes selected for the option to be modeled are described in their formula and concept and calibrated to the series of prices used in the model. The modeling and calculation of the option value is done using Monte Carlo simulation as these are bundles of European options, and simulation equations and characteristics are described, for the options comparison among the three oil prices spreads used as markers in this paper: Brent-WTI, LLS-WTI e Brent-LLS. The last topic of the paper is the application itself and results obtained: these are grouped in sets of european options for different contract duration. Lastly a sensitivity analysis is made for different strike values for each option, and final considerations before we conclude.