

Executive Summary

Speculation in Commodity Futures Markets, Inventories and the Price of Crude Oil

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The recent volatility of crude oil prices has renewed interest in the behavior of crude oil markets and the possible contribution of financial investors in the commodity futures markets. Contrary to the popular notion that prices and inventories are inversely related, we recently observe puzzling comovements in crude oil markets – inventories have been increasing along with increasing prices. These observations are enough to invoke the public's concern on the potential effect of financial investors in the commodity market.

While puzzling observations may lead the public to suspect new participants as a potential cause for increasing crude oil prices and changing historical relationships in the crude oil market, it is also an intellectually challenging job to distinguish investors' contributions from those of traditional players. A popular approach has aimed to explain risk-premiums in the crude oil price based on the positions of different types of commodity traders (e.g., Supplemental Commitment of Traders provided by the U.S. Commodity Futures Trading Commission). Though the empirical evidence is mostly negative (i.e. weak financial investors' contributions), the statistical significance of investors' contributions varies among researchers depending on the dataset, the sample period and the empirical approach.

This paper provides an alternative approach to address the question of investors' contributions to oil prices by using the well-known notion of the convenience yield, which is the flow of services that accrues to an owner of the physical commodity but not to an owner of a contract for future delivery of the commodity. While the refinery has efficient storage facilities, I propose an equilibrium storage model of the risk-averse refinery whose gasoline production could be enhanced from sufficient crude oil stocks allowing the refinery to respond to unanticipated gasoline demand increases, providing an incentive to hold inventories despite anticipated falling crude oil prices. In equilibrium, the refinery makes its optimal storage decision by equating its expected benefits with the relevant costs of holding inventories. The refinery's expected benefits, such as expected profit gains from high utilization of the future gasoline production, are the marginal convenience yields. In contrast, financial investors do not see these benefits as they generally do not hold crude oil inventories. Here the refinery's optimal

storage decision holds regardless of the financial investors' actions in futures markets because the refinery can always respond to arbitrage opportunities arising from storing oil and selling a futures contract. However, financial investors' activities – tending toward forward rollovers of maturing futures contracts rather than taking physical deliveries of crude oil – could be reflected through risk premiums that the risk-averse refinery pays for its hedging activities in the crude oil market.

Using data on crude oil inventories and prices for futures contracts, I find empirical evidence that the proposed model is consistent with earlier researchers' conjectures: the marginal convenience yield decreases at a reduced rate when the crude oil inventories increase. Furthermore, I find that the marginal convenience yields exhibit seasonal and procyclical behaviors along business cycles. In regard to the former observation, the refinery has higher benefits for spring and summer than for other seasons. The historical marginal convenience yield averages about 18% of the oil price from March 1989 to November 2014; this flow of value constitutes a sizable contribution to the refinery's gasoline production. During the period with increasing financial investor participation in the commodity market since 2004, I find empirical evidence for a structural change in crude oil market fundamentals in a rising permanent component of crude oil prices and also in changing model parameter estimates for time periods before and after June 2004. Despite a potential structural change in crude oil market fundamentals themselves, I find that the price-inventory relationship is stable over time, as evidenced by the stable predictive power of inventories in forecasting crude oil spot prices. The empirical evidence indicates that crude oil prices remain tied to oil-market fundamentals such as inventories, suggesting a weak contribution of financial investor participation in the commodity futures market.

This paper discusses fluctuations of crude oil prices using inventory behavior prior to November 2014, where the most recent periods include the oil price surge that re-emerged since the Great Recession. The sharp decreases in oil prices were expedited after the Organization of Petroleum Exporting Countries' failed to agree upon near-term oil production cutbacks in November 2014. To this end, the stable price-inventory relationship evidenced in this paper is important when investigating reasons for dramatic oil price movements such as those occurred during the most recent periods. Put differently, the proposed storage model could help to explain oil market behaviors by providing answers for questions such as whether the sharply falling crude oil prices are consistent with the oil market fundamentals of observed inventories and the state of the economy (or changes in market participants' beliefs on fundamentals). If left unaddressed, lags on aboveground inventory data could challenge applications of the proposed model on a real-time basis. However, one can overcome such a limitation for the proposed model with estimates for inventories, which could be constructed based on the accounting identity (aka law of motion) for inventories by using publicly available estimates/forecasts for petroleum production and consumption.

