

Contango in Cushing? Evidence on Financial-Physical Interactions in the U.S. Crude Oil Market

Background

The U.S. Energy Information Administration (EIA) launched its Energy and Financial Markets Initiative (EFMI) in September 2009. As part of this initiative, EIA and the University of Oklahoma (OU) surveyed the current academic literature pertaining to price formation, volatility, and the role of hedging and speculation in the global oil market. The survey results were summarized in "[Factors Influencing Oil Prices: A Survey of the Current State of Knowledge in the Context of the 2007-08 Oil Price Volatility](#)," which was released in August 2011 and posted on the EIA website. The report identified additional data that could be used to generate more definitive results, and also provided a set of questions for further empirical study. "Contango in Cushing?" is one of these proposed empirical studies and addresses the unresolved question as to whether there is a viable and active cash and carry market in crude oil.

Summary of "Contango in Cushing?"

While there has been considerable focus, especially in the aftermath of the 2007-08 oil price spike, on the role of financial speculators in influencing oil prices, a question that lies at the heart of this debate – how oil futures trading is related to spot oil prices – remains unresolved. A financial speculator who expects future oil prices to rise and wants to take a speculative position based on this expectation would typically go long in financial futures contracts. An index investor who wants to invest in oil would likely take a similar long position in futures contracts, which would be rolled over periodically. If such speculative or investment activity increases the futures price sufficiently relative to the prevailing spot price, a rational market response would be for arbitrageurs to step in to buy oil in the spot market and store it while simultaneously selling futures. This "cash and carry" (C&C) arbitrage provides the mechanism that links oil futures and spot markets, since the withdrawal of oil from the market by arbitrageurs will cause spot prices to also increase. Accordingly, a number of studies argue that if financial speculators or index investors drive up futures prices that, in turn, elevate spot oil prices above the level

dictated by supply-demand fundamentals, such an elevation in the oil price should be accompanied by a build-up in oil inventories.

However, the available evidence of such an inventory build-up during the sharp 2007-08 oil price increase is mixed at best. Studies by the International Energy Agency (IEA) (2008), International Monetary Fund (IMF) (2008), and Organization for Economic Co-operation and Development (OECD) Working Party on Agricultural Policies and Markets (2010) find no evidence of a speculative increase in crude oil inventories in 2007-2008. The Interagency Task Force on Commodity Markets (ITFCM) (2008) argues that oil inventories were near historical levels in 2006-2008, while Hamilton (2009) concludes “in late 2007 and the first half of 2008, when the [oil] price increases were most dramatic, inventories were significantly below normal.” Krugman (2008) makes the same point regarding the 2008 price run-up but does believe speculation contributed to higher prices in 2009 (Krugman, 2009). On the other hand, the U.S. Senate Permanent Subcommittee on Investigations (2006) argues that the behavior of inventories was consistent with speculation impacting cash prices and Einloth (2009) argues in support of a speculative build-up of inventory that accompanied the 2008 increase of oil prices from \$100 to \$140 a barrel but not during the preceding period.

This paper revisits these unresolved issues and studies the relationship between U.S. crude oil inventories and the spread between West Texas Intermediate (WTI) crude oil futures, while carefully accounting for the links between the U.S. and global oil markets, controlling for supply and demand shocks that affect both prices and inventories, and allowing for inventory response time lags. The study finds that over the 2004-2011 period, crude oil inventories at Cushing, Oklahoma were a significant positive function of the spread between the two- and one-month NYMEX WTI crude oil futures with a lag. Over the 1992-2004 period (before Cushing inventories were reported separately), total U.S. non-SPR inventories and inventories in the Petroleum Administration for Defense District (PADD) 2 (which includes Cushing) were positive functions of lagged spreads. However, over the 2004-2011 period, neither total U.S. non-SPR inventories nor PADD 2 inventories were significant functions of the spread once Cushing inventories were excluded. These findings are consistent with Cushing being the WTI pricing and physical settlement hub. None of the other four PADD inventories are significantly

related to the spread over either period, which may reflect significant limits to financial arbitrage at locations away from Cushing. Current crude oil inventories appear to be influenced by spreads over the last eight weeks, which suggests that current spreads likely lead to contracts for forward delivery that do not result in a change in actual inventory levels until delivery occurs sometime in the future. We further find evidence that total U.S and most individual PADD inventories (but not at Cushing) are a negative (positive) function of the change in current (next week) refinery inputs and a positive (negative) function of the current (next week) imports, indicating that storage operators are able to partially anticipate crude oil shortages and surpluses, and adjust their inventories accordingly.

These findings provide, to our knowledge, the first tangible evidence documented in the literature of a causal link between oil futures and spot markets via inventory changes resulting from cash and carry arbitrage, and provide an important foundation for future research on the impact of financial traders on the spot markets, especially the twin questions of (a) whether financial traders exacerbate or attenuate spot price volatility, and (b) whether they systematically affect the spot oil price level.