West Texas Intermediate Crude Oil Futures

Summary
The long-term success of physically delivered futures for West Texas Intermediate (WTI) and other acceptable grades of light, sweet crude oil at Cushing, Oklahoma has proven so successful in building and maintaining crude oil inventories at Cushing as to affect the term structure of WTI futures as well as key spreads between WTI and Louisiana Light Sweet (LLS) at the U.S. Gulf Coast. These effects are particularly noticeable in the late winter as the U.S. refining system goes into its annual "turnaround," or maintenance cycle.

Markets treat these short-term effects as opportunities for long-term investment. Once this are made and new pipelines are completed, WTI at Cushing will resume its role as the unquestioned price benchmark for the North American crude oil market, and for good reasons.

Not only does WTI serve as a benchmark for mid-continent refineries and for Canadian crude oil moving south into the U.S., an increasingly important source of supply, it serves as a spreading benchmark for high-sulfur West Texas Sour (WTS) crude oil and thus for other sour crude oil streams coming into the U.S. Gulf Coast.

Waterborne cargoes priced off the North Sea Brent-Forties-Oseberg-Ekofisk (BFOE) benchmark can be and are directed elsewhere in the Atlantic Basin to the highest price. Unlike a pipeline-delivered crude oil whose destination is known from the moment it leaves the wellhead for a pipeline gathering system and whose supply is predictable both in quantity and in rate of delivery, Brent-basis cargoes have a higher and more unstable volatility of price and volume.

The depth and liquidity of physically delivered WTI remain unmatched, especially during periods of supply uncertainty. Moreover, its projected stability of supply exceeds that of the BFOE supply stream for Brent futures; this allows for it to serve as the basis for a wide array of long-term strips and swaps and for various financial instruments.

Pipeline Vs. Waterborne Markets
Any comparison of WTI and Brent as crude oil benchmarks requires an understanding of the differences between pipeline and waterborne markets. They are completely different. BFOE crude oils produced in the U.K. sector of the North Sea are delivered by undersea pipeline to the terminal at Sullom Voe for transshipment and depend on a conceptual marker called "Dated Brent" and an actual cash market, the 21-day BFOE index, for pricing.

Dated Brent refers to a cargo loading within the next 10-21 days, or 23 days if the trade date is a Friday. The 21-day BFOE index is based on the cheapest crude oil to deliver against the Brent futures contract and is used to price the Brent futures market on a daily basis and to settle the Brent futures contract on a cash basis.

A market for the contracts-for-differences (CFDs) between Dated Brent and BFOE crude oils in the 21-day BFOE market determine, in a very circular turn, the assessment for Dated Brent. The CFDs' prices are influenced by the forward curve of the Brent futures market. If the forward curve is in backwardation, the condition prevailing when futures trade at a discount to cash, the CFD is a positive value. If the forward curve is in contango, the condition prevailing when futures trade at a premium to cash, the CFD is a negative value.

Dated Brent thus is not an actual spot market; it is a short-term forward market whose level is affected by CFDs, the forward curve of Brent futures and short-dated cash market options. Many of the crude oils identified as being benchmarked to Brent are traded on a basis to Dated Brent.

WTI and other crude oils are delivered to Cushing via pipelines. These have defined capacity, can flow in only one direction at a time and seldom are reversed. While a waterborne cargo arrives all at once and frequently is priced for final delivery on a formula basis involving the days before, during and after the bill-of-lading date, pipelines deliver crude oil at a constant rate and can be priced either continuously or over a strip of dates.

This "ratable" delivery system for pipeline markets brought scheduling considerations to prominence. A crude oil producer needs to nominate space on a pipeline for next-month delivery; this is why crude oil deliveries are set in a window between the 25th day and the end of the current month and why, in turn, the WTI futures contract expires on the third business day prior to the 25th day of the month.

The combination of physically delivered futures and the structure of the pipeline market opened the North American crude oil market up to the range of strategies we see today. These futures allowed for fixed-price deliveries over the next month. Previously, prices were "posted" by refiners for each day during the delivery month. This posting or "posting-plus" market still exists and is vital in setting the floating leg for crude oil swaps whose fixed leg has been determined by WTI futures.

The physical delivery aspect of WTI also cements the basis, or spread between physical crude oil and the futures contract. Basis includes physical and financial costs of storage and transportation, differentials produced by location and grade and the time to the futures' expiration. Basis convergence toward zero at expiration is a feature of the WTI market that is not duplicable in the Brent market due to the circular nature of the contract's pricing.

The ability to use futures to price and deliver a fixed volume of crude oil delivered at a fixed price over a fixed period of time is the key feature of the North American crude oil market. While other crude oil futures markets can and do serve as price indicators, only the physically delivered WTI futures allow for seamless delivery of a fixed volume of crude oil to a specific place over a specific period of time and at a specific price. It also allowed for other grades of crude oil, including sour streams in the North American market to be quoted as a differential to WTI based upon differences in location and refining values. A waterborne cargo market simply cannot meet these criteria of delivery place and time. This does not even mention the potential for production and shipping disruptions during the Gulf of Mexico's hurricane season.

The discussion below is enabled by one feature of the WTI market too often taken for granted, the richness and timeliness of the data available. U.S. inventory data are available on a next-week basis as are statistics on refinery runs and imports. The Department of Energy's Energy Information Administration provides a wealth of data at a variety of frequencies, nearly all of which are of value to the industry and to traders. No comparable system of detailed and timely data is available for the world of non-U.S. petroleum.

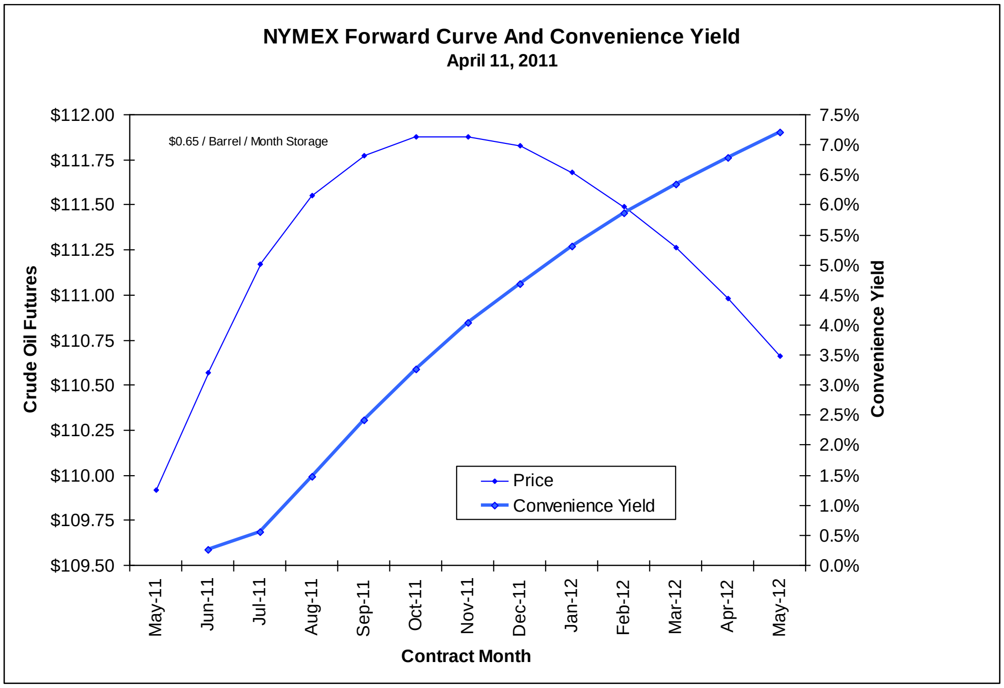
The Cushing Storage Market

The physical delivery mechanism has allowed for the growth of the Cushing storage market and indeed for the entirety of PADD II (Petroleum Administration Defense District). PADD II includes the Mid-Continent, Midwest and East North-Central regions. Ironically, this growing storage market is the very factor affecting the spread between crude oil priced at Cushing and, say, the U.S. Gulf Coast. The storage market is based on cash-and-carry arbitrage and works quite simply:

1. Go long a futures contract for next-month delivery; say January 2011;
2. Go short a futures contract in the succeeding month of February 2011;
3. Take delivery of the crude oil during January 2011;
4. Pay the physical costs of storage, pump-over, insurance and other charges;
5. Account for the cost of capital;
6. Hold the crude oil in storage, hedged by the short February futures contract; and
7. As the February contract approaches expiration, either deliver the crude oil in storage against the contract or repurchase the short February contract and sell March or some other month whose price will allow you to cover the costs of storage.

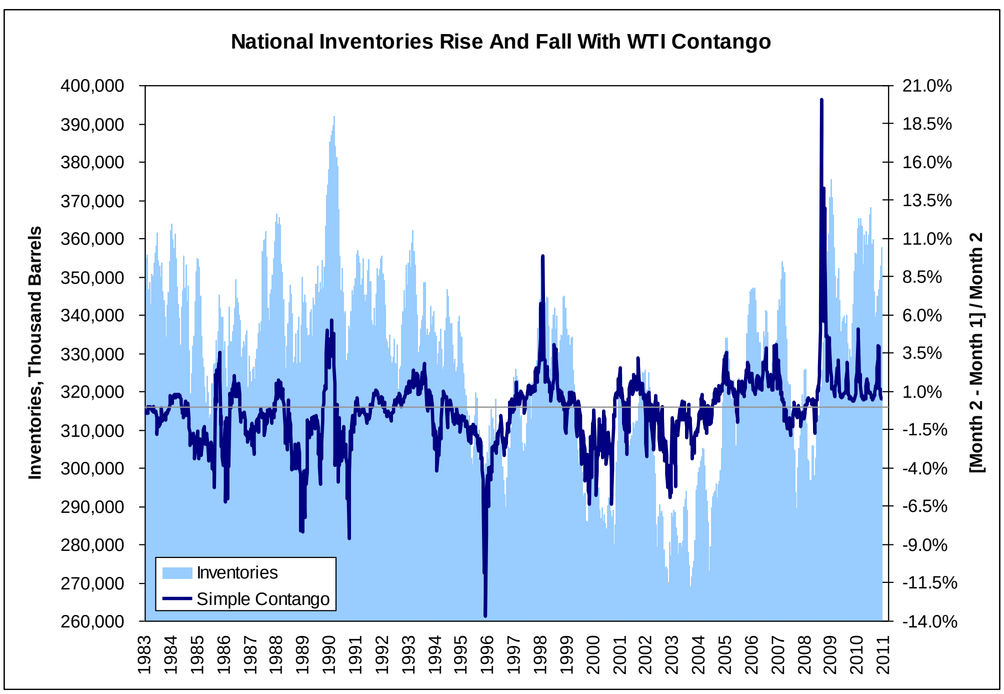
The threshold discount or level of contango required for inventories to be build changes continuously. As interest rates rise, a greater discount is needed to cover the financing cost, and vice-versa for falling interest rates. As storage levels rise, each incremental unit and class of storage requires a greater discount. A simple tank at Cushing can be filled and hedged at a smaller cost than can a pipeline, a barge, remote tankage or a waterborne vessel moored off the U.S. Gulf Coast. As storage levels increase and as incrementally more expensive storage facilities are brought on-line, contango levels move in a stairstep fashion in response.

The snapshot below uses actual NYMEX settlement data for Monday, April 11, 2011 and calculates the annualized convenience yield of the forward curve at a $0.65/barrel/month storage charge and current LIBOR cost of capital. As these convenience yields are positive at these numbers, refiners would find it unprofitable to add to storage; a negative convenience yield is required.



Source: Bloomberg

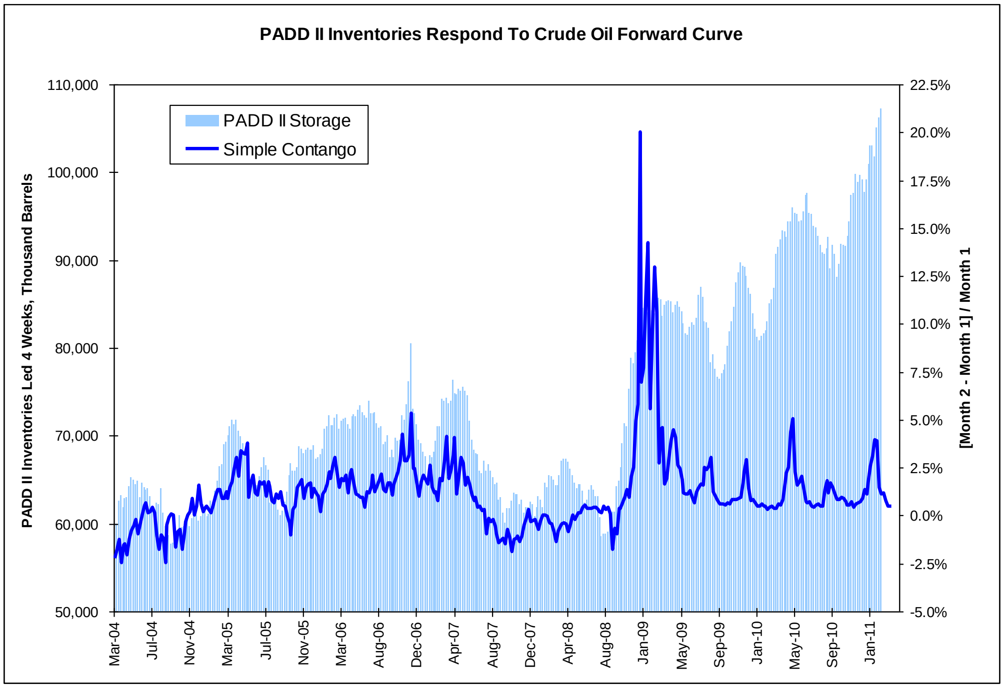
National inventories have risen and fallen in response to the simple contango displayed below, simply the spread between second- and first-month WTI futures divided by the second-month future itself. National inventory levels trended lower from the early 1990s into 2003 as just-in-time inventory management became popular. National inventory levels trended higher from 2003 onwards as the term structure of WTI futures moved into more frequent contango.



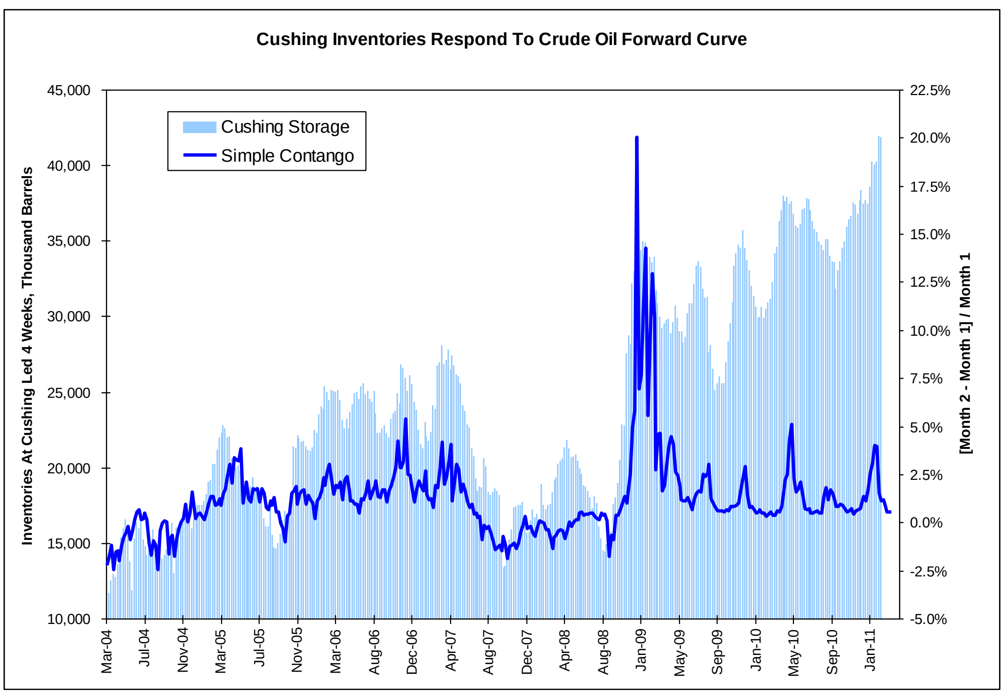
Source: Bloomberg

If we isolate storage at PADD II and at Cushing itself, a more dramatic pattern becomes apparent. Inventory levels shifted higher during the financial crisis of late 2008 and have remained at this higher level ever since. Moreover, these inventory levels respond to changes in the simple contango of WTI futures; as contango rises or falls, inventories follow by four weeks on average. This is a highly efficient market in operation.

The profits available from inventory storage at Cushing predictably have attracted new storage capacity into the market. An additional 14 million barrels of capacity are planned for 2011. This would bring capacity up toward 65 million barrels. The larger storage capacity means contango levels do not have to move toward the exaggerated discounts seen in early 2011 to bid successfully for storage capacity. This will narrow the differential between Cushing and the U.S. Gulf Coast and Atlantic Basis Brent Blend markets.



Source: Bloomberg

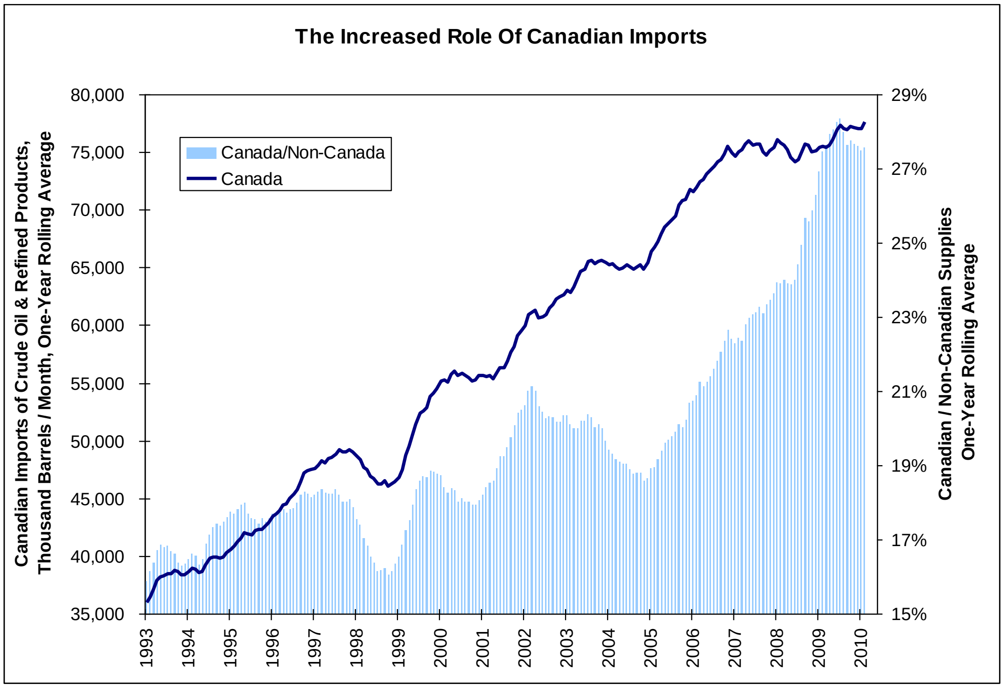


Source: Bloomberg

New North American Supply Factors

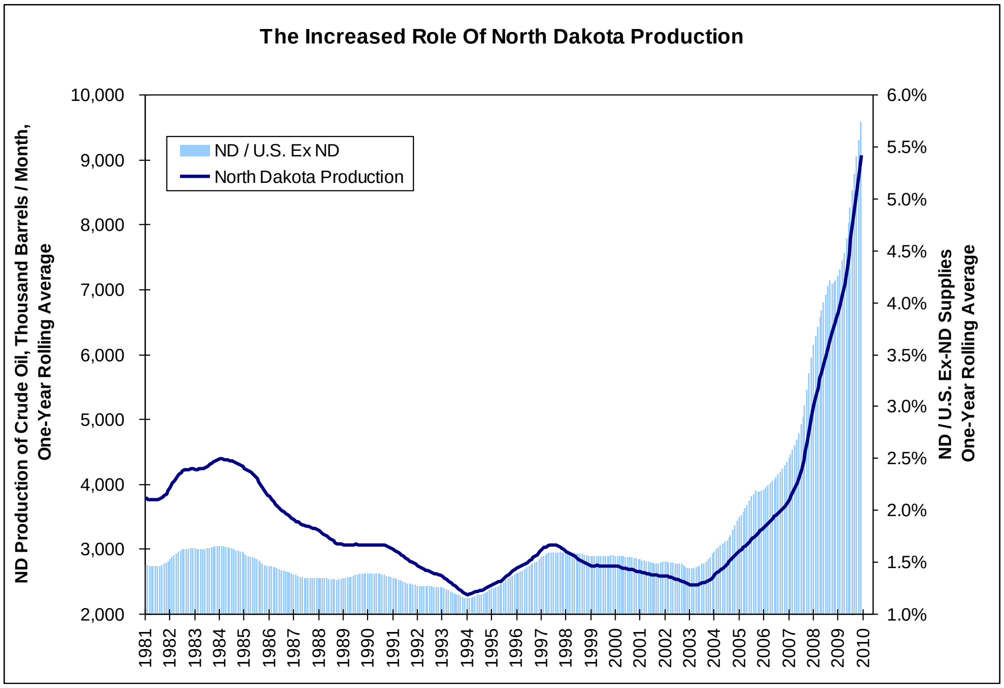
The history of the energy exploration business, natural gas as well as crude oil, is one of imminent shortage and higher prices followed by the opening up of new supply sources as new resources become economic. Two major supply developments have affected the Cushing market over the past decade. The first is an increased role of Canadian exports to the U.S., particularly crude oil from the high-cost Alberta oil sands projects. The second is expanded production from North Dakota's Bakken Shale, a resource previously uneconomic at lower prices and before improved technology.

Not only have Canadian imports increased absolutely, the ratio of Canadian to non-Canadian imports of crude oil and refined products has increased sharply. Higher prices induce new supplies in an efficient market and this is no exception.



Source: Energy Information Administration

The increase in North Dakota production since 2004 has been even more dramatic. North Dakota's Williston Basin had been a oil production province for decades, but was considered in long-term decline. To say the addition of the Bakken Shale production changed the state's outlook dramatically since 2003 would be an understatement.



Source: Energy Information Administration

Once again, markets can and do find solutions to opportunities created by surpluses in one region and deficits in another. The simplest solution to bring new North American production to wherever it is needed is to build a pipeline running south from Cushing to refining centers at the U.S. Gulf Coast. TransCanada Corporation, which has a clear interest in finding a market for Canadian crude oil has announced plans for a 150,000 barrel per day pipeline it hopes to have operational in 2013. When this link is operational, the role of Cushing as the North American benchmark will be stronger than ever.

Long-Term Supply

The expansion of North American supply sources is of vital importance in the long-term relative viability of WTI and Brent as benchmark crude oils. The North Sea has been a productive petroleum province since the 1970s; indeed, its discovery and production history is parallel to that of the Prudhoe Bay field of Alaska's North Slope. But all petroleum provinces face reserve depletion and production decline issues eventually, and the outlook for the North Sea is poorer in comparison to the remaining potential serving the North American pipeline market.

The BP Statistical Review pegged the proven reserves, defined as those recoverable at present prices and technology, for the U.K. and Norway at 3.10 and 7.10 billion barrels, respectively, at the end of 2009. Production from those reserves was 1.448 and 2.342 million barrels per day in 2009.

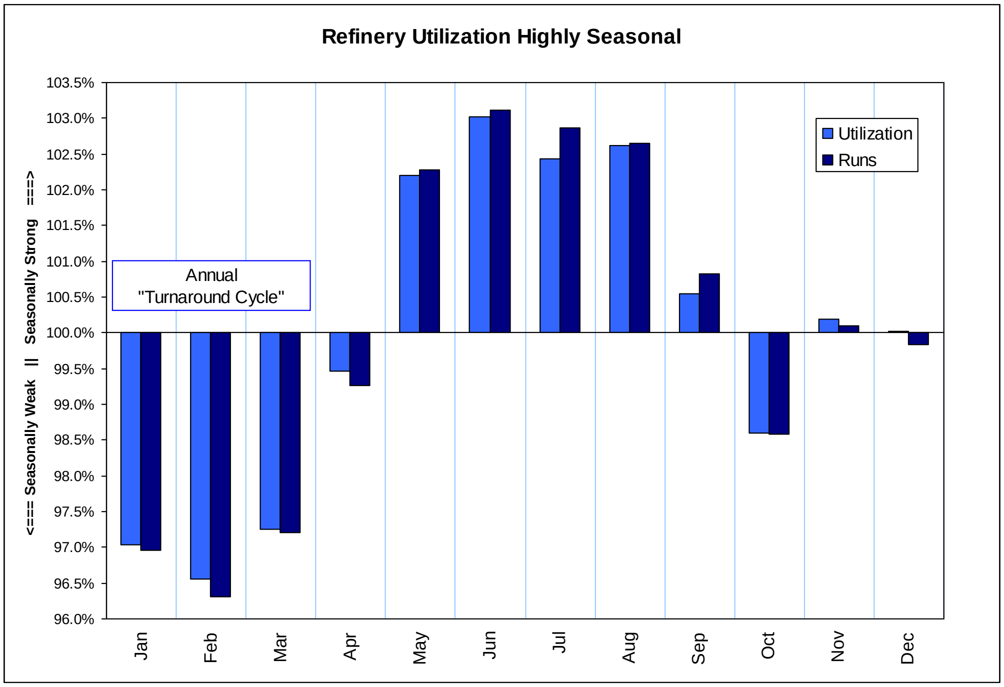
The comparable figures for North American reserves were 73.3 billion barrels of conventional crude oil and 143.26 billion barrels in the Canadian oil sands. Production from the U.S. and Canada in 2009 was 7.196 and 3.212 million barrels per day.

Many of the reserves of West Africa, including those of Nigeria and Angola, are priced on a Brent basis as are many of the crude oils coming into both the Mediterranean and Baltic basins from North Africa, the Middle East and Russia. These crude oils will face separate pricing comparability issues as North Sea production declines. The real issue is whether such a relatively small resource base located in a different region can and should serve as a North American benchmark.

Refinery Seasonality

Supplies are not the only factor determining swings in inventories. While refineries are designed to operate continuously when in operation, they also have an annual maintenance or "turnaround" cycle. Not only does this involve switching the plant from winter to summer configurations, it involves retooling, adding new processing units, changing catalyst configurations, replacing worn and damaged equipment and all of the other factors designed to keep these exquisitely complex industrial plants operating.

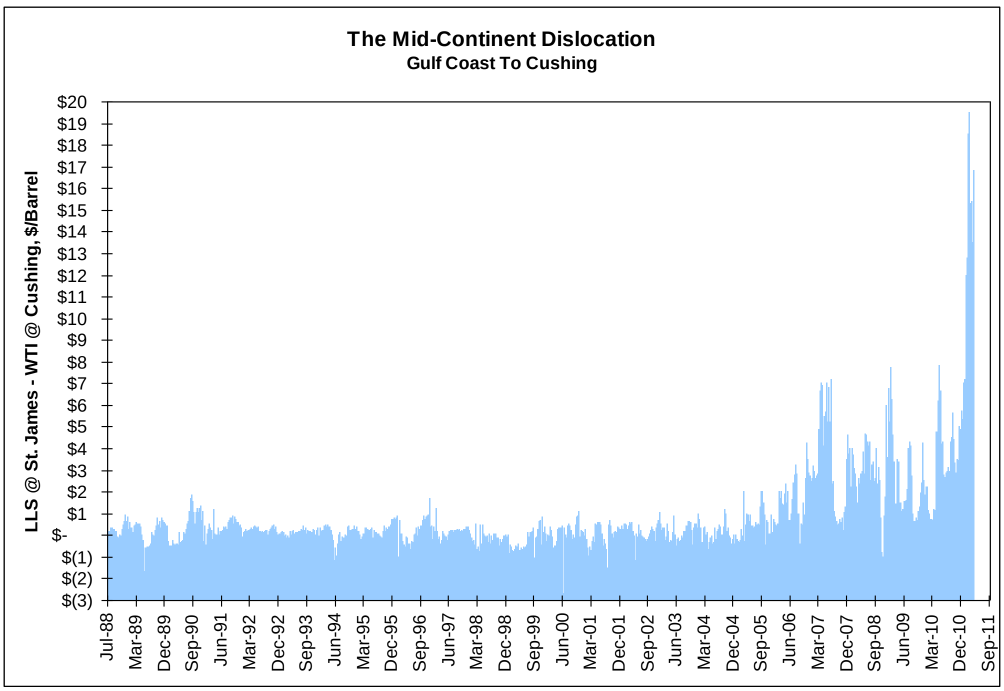
The turnaround cycle is concentrated in the first quarter of each year. The average seasonal adjustment factors for the American Petroleum Institute's data on refinery capacity utilization and "runs" or refinery throughput show this very distinctly. Both utilization rates and runs are low during the first quarter and high during the summer months.



Source: American Petroleum Institute

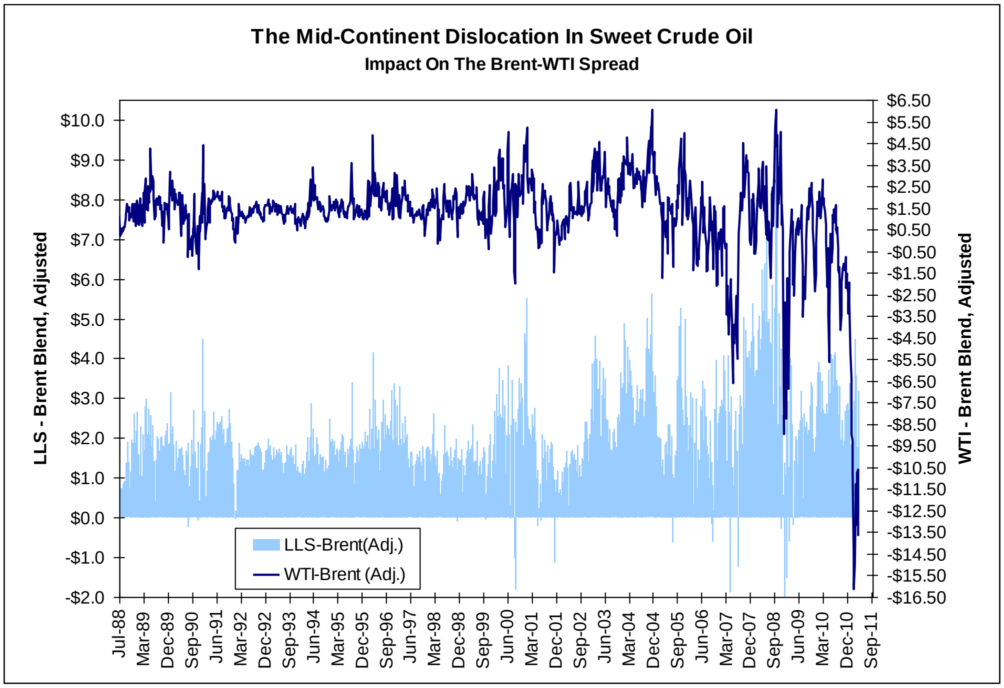
Crude Oil Spread Distortion

Quite predictably, this seasonal decline in refining has intersected with the increased production flow from Canada and North Dakota to produce seasonal dislocations in the spread between WTI and LLS. The spikes in the spread between LLS and WTI since 2007 have tended to occur during and immediately after the first quarter turnaround cycle.



Source: Bloomberg

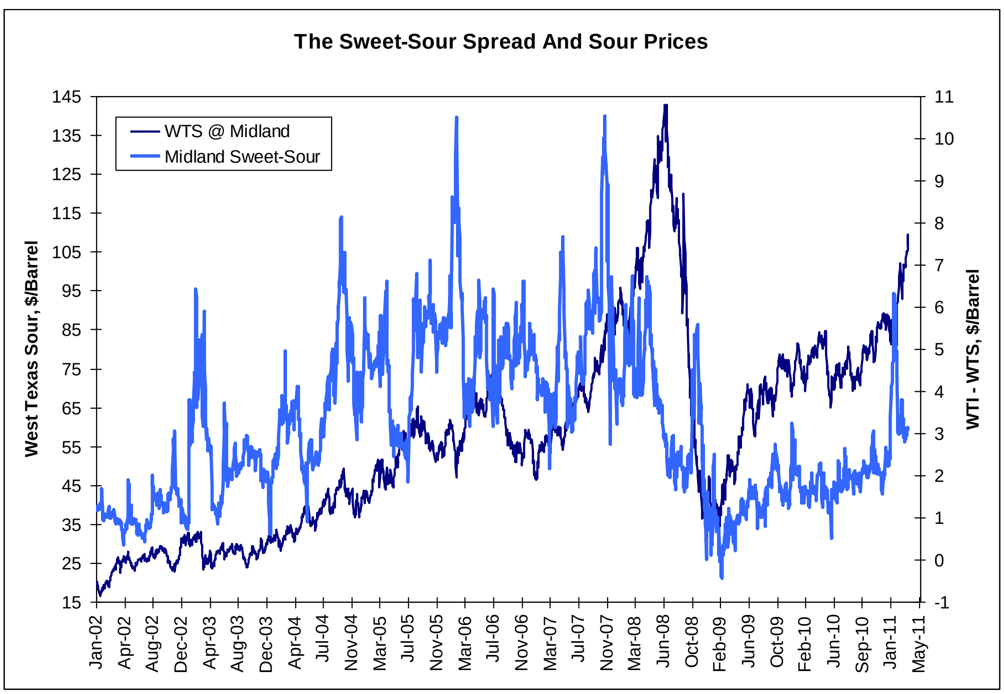
It is this spread, the consequence of crude oil pipelines flowing north from the U.S. Gulf Coast into Cushing and not south from Cushing to the U.S. Gulf Coast that has been affected by rising inventories at Cushing. While the spread between WTI and Brent, with Brent's price being adjusted by half of the intermonth spread to account for voyage time, moved to record levels in early 2011, the spread between LLS and Brent remained well within its normal range.



Source: Bloomberg

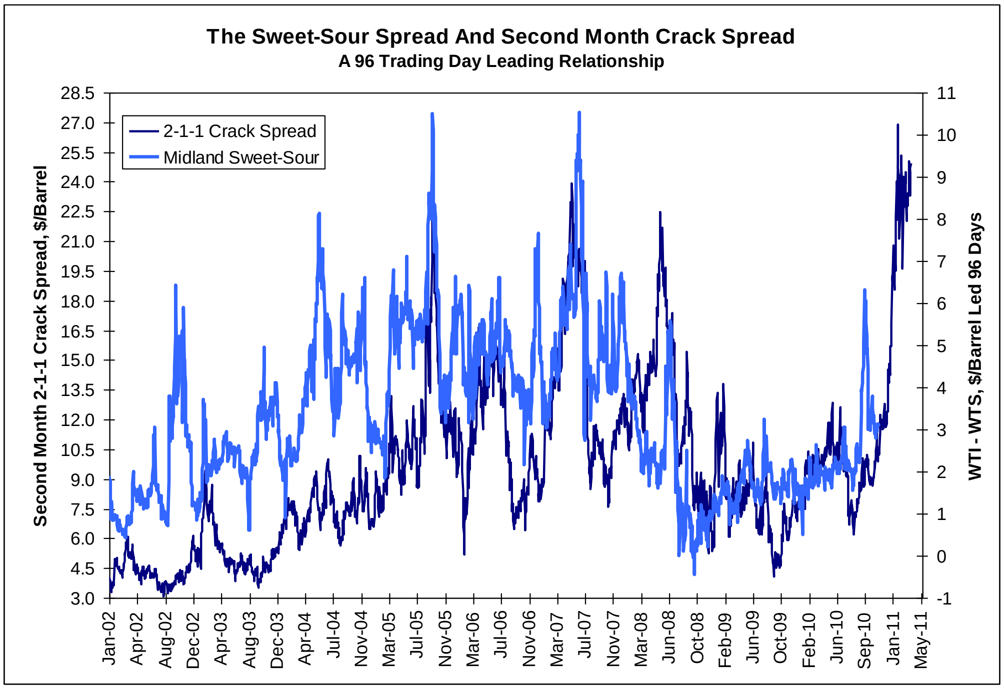
Another indication WTI futures have continued to function normally within the context of the U.S. pipeline markets is the spread between it and West Texas Sour (WTS) at Midland, Texas. This spread tends to widen during periods of refining system stress or high demand as refiners who have made the investment in desulfurization units prefer the cheaper high-sulfur WTS and only buy the more expensive WTI when they have to do so.

When the spreads between WTI and both Brent and LLS were moving to record-wide levels in early 2011, the "sweet-sour" spread between WTI and WTS was rising as well. Both grades of crude oil were in high demand and were acting normally in relation to one another; the only difference is both were in high supply relative to sweet crude oil at the U.S. Gulf Coast.



Source: Bloomberg

Not only was this spread perfectly normal within the context of the U.S. pipeline market, but it remained in synch with the second-month crack spread with a normal 96-day lag. If WTI futures had lost their utility as a benchmark for the U.S. refining system, they were not showing it by any of these key industry metrics.

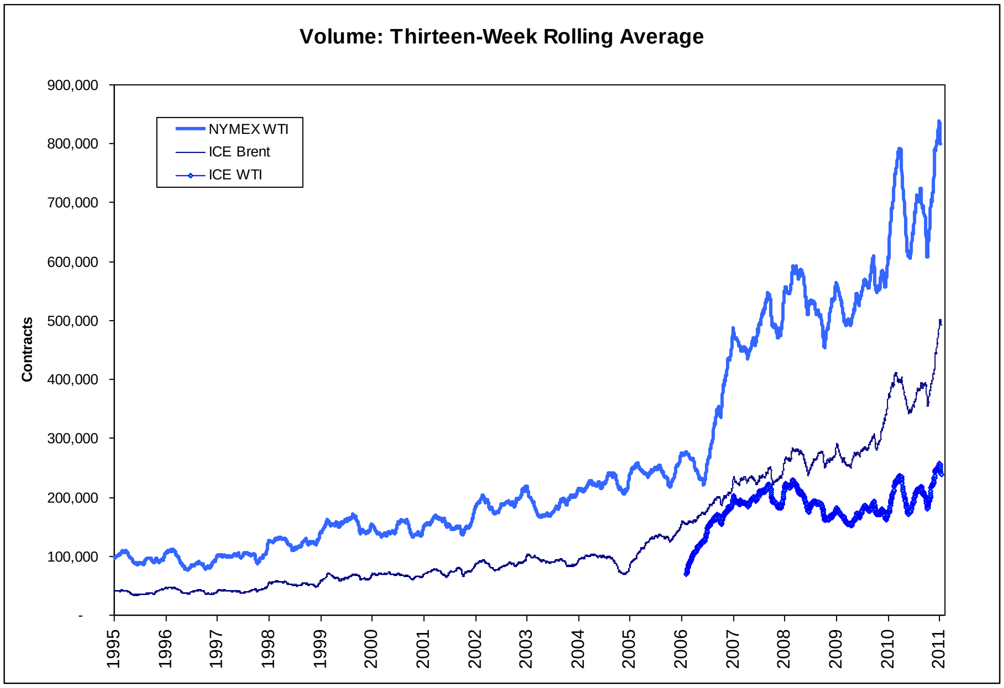


Source: Bloomberg

The reference to refining margins and crack spreads underscores a critical aspect of WTI as the North American benchmark, and that is the well-established system of performance bond offsets available on the NYMEX. These include straight offsets against heating oil and RBOB gasoline futures as well as credits for more complex crack spreads and spreads against other crude oil futures and swaps, including Brent. More than a quarter-century of industry practice has led to a system of U.S. refined product spreads and basis differentials linked financially to WTI futures as well as physically via the contract's delivery mechanism.

Depth And Liquidity

As investor interest in commodities in general and crude oil in particular has increased since the mid-2000's, the NYMEX WTI contract has increased its lead over two other crude oil futures contracts, the Intercontinental Exchange Europe's (ICE) Brent futures and a cash-settled version of WTI futures. This can be seen in the weekly average volume and open interest data for all contracts traded on each exchange.



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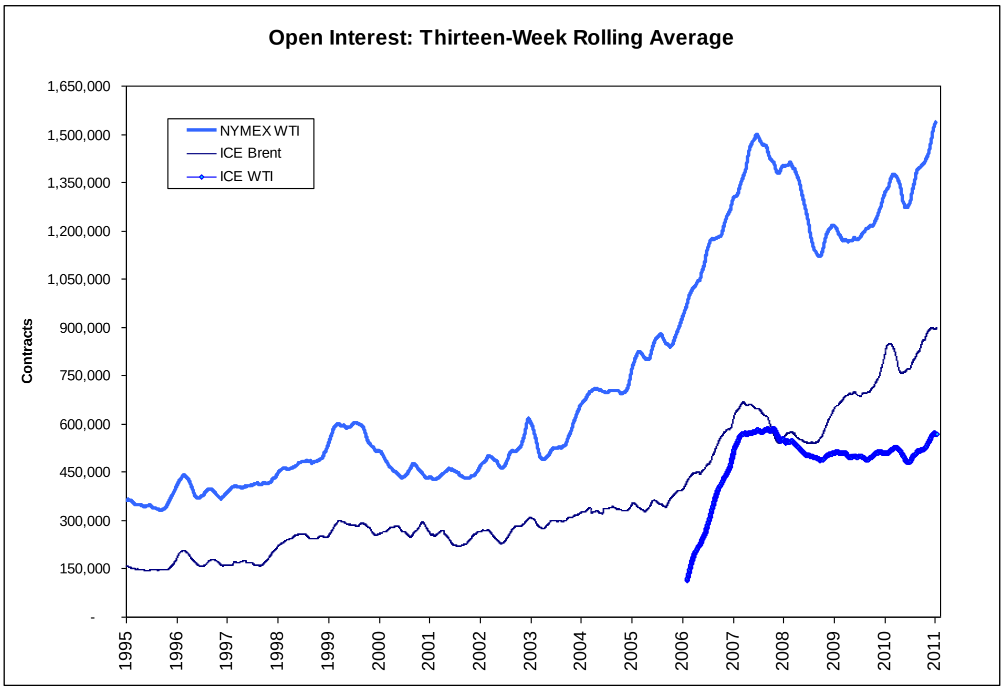
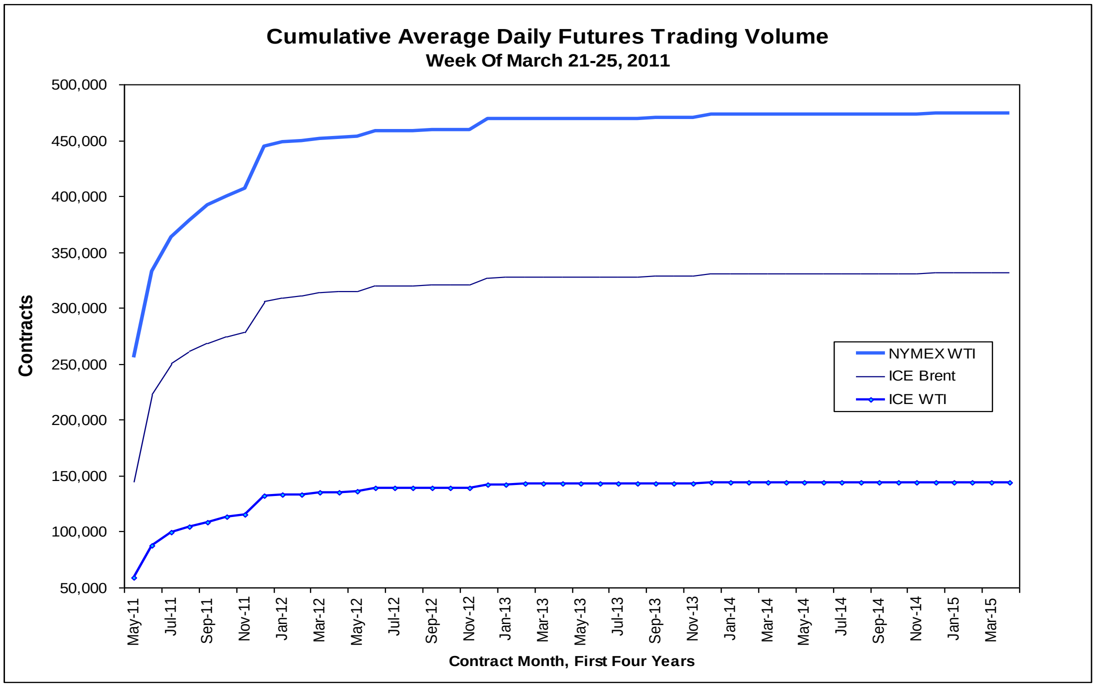


Source: Bloomberg

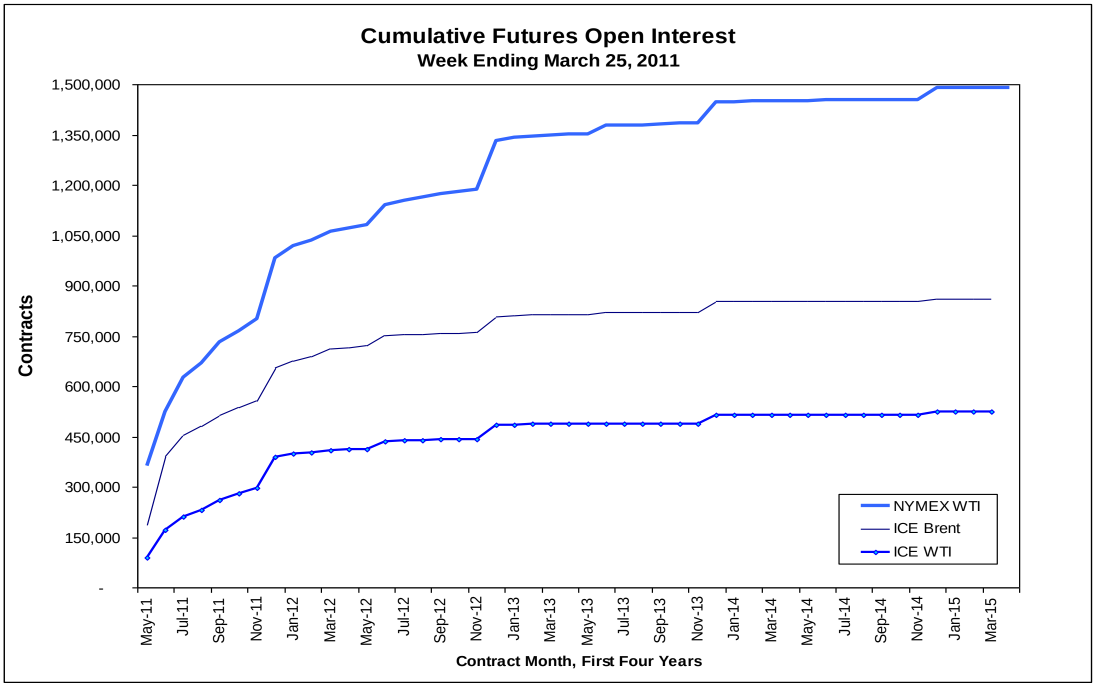
Not only is NYMEX WTI futures volume and open interest far greater on an aggregate basis, its cumulative distribution over time shows greater depth and liquidity as well. The chart below depicts the cumulative average daily volume of NYMEX WTI, and ICE Brent and WTI contracts across the first four years of monthly contracts.



Source: Bloomberg

A similar cumulative chart of open interest for the three contracts over the first four years indicates a much longer maturity schedule for NYMEX WTI open interest. This is a clear signal to commercial traders in the very active swap and strip market their trading demands can be accommodated more efficiently in NYMEX WTI.

The market has been presented with a choice between a physically delivered WTI contract regulated by the U.S. Commodity Futures Trading Commission and a cash-settled WTI contract offered by a non-U.S. exchange and has expressed a clear preference for physical delivery even though the financial risk profiles of the two contracts are quite similar. The market has been presented with another choice, that between a contract based on WTI and one based on Brent Blend and has expressed a clear preference for WTI for all applications of futures markets combined, including price discovery, risk management, physical delivery and diversification of investment activities into the commodities markets.



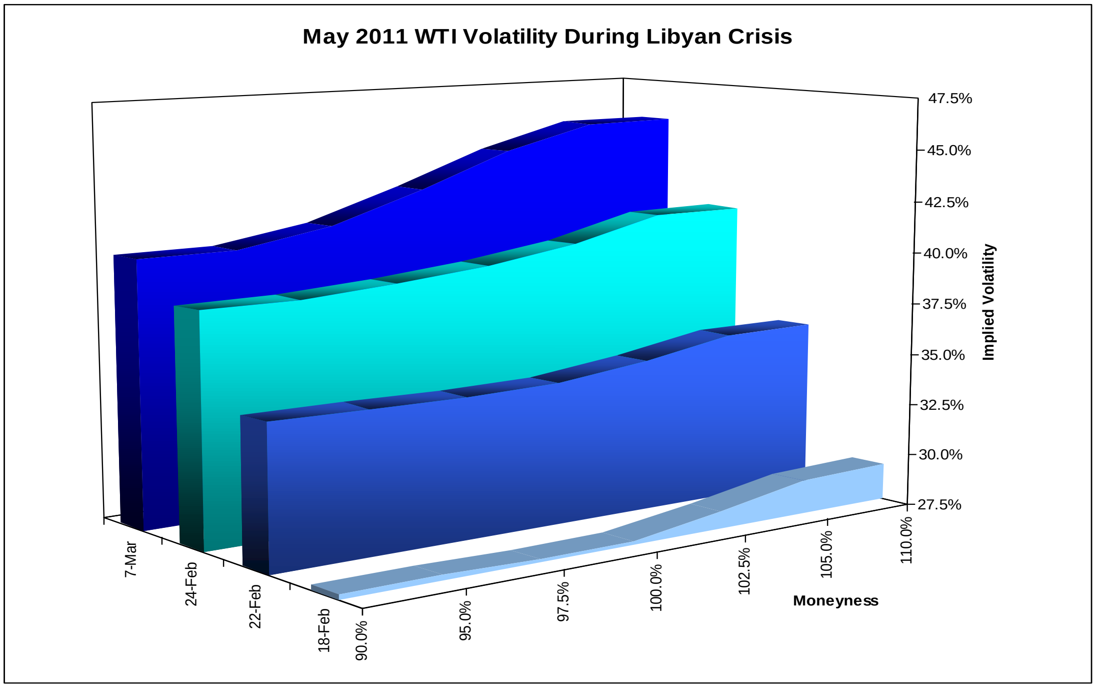
Source: Bloomberg

Stability And Relative Volatility

Average depth and liquidity are fine, but what is really important to a market is its surge capacity or its ability to handle increased activity during times of crisis. The outbreak of violence in Libya in late February 2011 provides an excellent case study for comparing the surge capacity of the WTI and Brent futures markets. Between Friday, February 18, 2011 and Monday, March 7, 2011, the price of April 2011 WTI, then the front-month contract, jumped from $97.88 to $105.44 on a closing basis. The comparable numbers for April 2011 Brent were $102.52 and $116.35. These represent price increases of 7.72% and 13.49%, respectively, over the same timeframe. While the larger price increase for Brent can be explained in large part by the disruptions to exports of Brent-Basis Es Sider crude oil from Libya to European refineries, the susceptibility of the Brent futures contract to events in the Mediterranean Basin raises concerns about the viability of a waterborne cargo priced off North Sea crude oil for the North American crude oil market.

More curious, though, are the relative movements of implied volatility in the two markets. The implied volatilities of the respective May contracts are plotted over dates in the range above as a function of their "moneyness," with values over 100% corresponding to prices higher than the current-at-the-money level. We should expect implied volatilities to rise during a price jump of this nature accompanied by a rise in uncertainty. In addition, the higher-priced strikes' volatility should rise more to account for the very real risk prices could go much higher given the situation at hand. Finally, Brent volatilities should exhibit this behavior more than WTI volatilities.

What we see, however, is a pattern where WTI volatility rose much more responsively on Tuesday, February 22, 2011 than did Brent volatility. The Brent skew finally converged to its expected pattern by Thursday, February 24, 2011.



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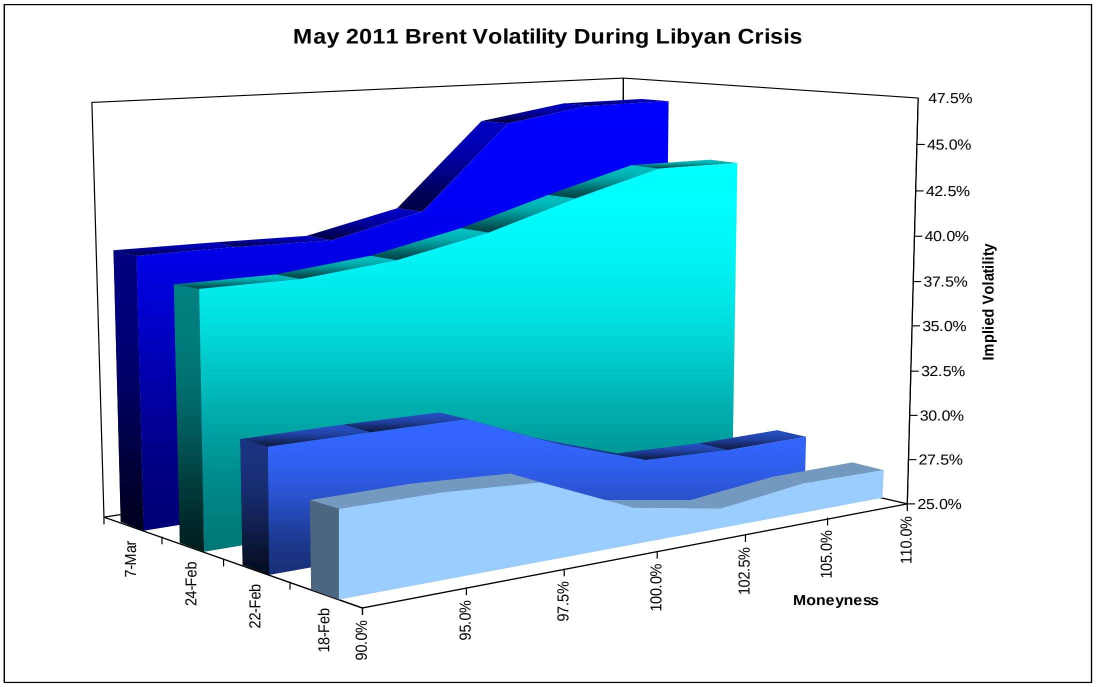

Source: Bloomberg

WTI As A Financial Instrument

The depth and liquidity of the WTI futures market and the demand by investors for exposure to this market has led to a wide array of financial instruments based on the contract. These include exchange-traded funds (ETFs) such as the U.S. Oil Fund and the U.S. 12 Month Oil Fund, exchange-traded notes (ETNs) such as the iPath S&P GSCI Crude Oil Total Return Index, and broader commodity instruments such as the iPath DJ-UBS Commodity Index Total Return ETN, the PowerShares DB Commodity Index Tracking Fund and the iShares S&P GSCI Commodity-Indexed Trust. WTI is and has been a dominant component of the most widely benchmarked investable commodity indices, the S&P/GSCI index and the Dow Jones-UBS index.

Conclusion

The WTI market has played a vital and central role in the evolution of North American petroleum markets since the introduction of futures in 1983. It has evolved and in a way has created its own financial ecosystem; it has served as the benchmark for other crude oils, for refined product spreads and prices, for the creation of a vibrant market for inventory management at Cushing, for new investment products and for new energy infrastructure.

It has adapted to previous shifts in global energy markets and it is already in the process of adapting to the periods of mid-continent dislocations in late winter. Once new investments are complete, the pipeline market for WTI and the physically delivered futures that make it so efficient and transparent will return to unquestioned prominence as the benchmark for the North American crude oil market. Moreover, the simple imperatives of where global reserves and production potential lie will make the WTI benchmark stronger relative to its competition.