

Bachelor Thesis in Banking and Finance

An examination of futures and future spot prices of WTI and Brent Crude Oil and price determinants of these crude oil benchmarks compared to each other.

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Abstract

This thesis examines the WTI and Brent crude oil market. Between 2005 and 2011, WTI and Brent crude oil prices were most of the time in contango. The spread between them was a reaction of the market to a higher supply of WTI and high transportation costs. Due to a pipeline that links markets in the Houston area with oil storage facilities near Cushing, the spread began to narrow. WTI and Brent crude oil prices can be expected to be similar in the future with a discount on WTI because of the high transportation costs in the U.S.

Executive Summary

This thesis provides an examination of WTI and Brent Crude Oil prices for the period of January 2005 to December 2011. Especially the spread between them that has opened up in 2010 is of interest.

In a first step, I was searching for a theoretical relation in the case of commodities and in the case of crude oil in particular. In a second step, I collected all the data that I needed from Bloomberg, including front month prices, future prices and risk free rates. With all this information available it was possible to calculate theoretical values for the estimated convenience yield of WTI and Brent crude oil. In a second step, I tried to find possible determinants of crude oil prices and to provide descriptive statistics on these possible determinants. In a third step, I examined the market structure of the two crude qualities. And in a last step, I tried to regress the spread of WTI and Brent front month future prices on the spread of futures with longer time horizons.

The market of WTI and Brent crude oil frequently exhibited contango during the time period of 2005 to 2011. The WTI nine month futures price was in strong backwardation only 18.5 percent of time and in weak backwardation 26.5 percent of time. The Brent crude oil nine month futures contract was 27.5 percent of time in strong backwardation and 39.5 percent of time in weak backwardation. The price trend was to go up with exception of the large price spike and fall between 2008 and 2009. The strong demand from China and elsewhere in the world, a negative shift to oil supply from higher production costs and probably depreciation of the USD may explain this trend. Global recession played an important role in the collapse of oil prices in the second half of 2008. In addition, speculation led to overshooting in the first half of 2008 and undershooting in the second half of 2008. The spread between Brent and WTI crude oil prices began to differ in the end of 2010 when increasing volumes of crude oil production from Canada and the Bakken shale formation moved into the U.S. Midwest market. There was no cheap transportation possibility and the price stayed low. Estimated convenience yields of WTI were sometimes negative and lower than estimated convenience yields of Brent crude oil. When ConocoPhillips announced it was selling its 50% share of the Seaway crude oil pipeline to Enbridge, Inc. between October and November 2011, WTI crude oil prices rose. This pipeline links markets in the Houston area with oil storage facilities near Cushing, Oklahoma. The spread between WTI and Brent crude oil prices and estimated convenience yields of WTI and Brent crude oil narrowed. So the spread was a reaction of the market to a shift in WTI crude oil supply and not an abnormality and the market was not able to remove it. It may be expected that the spread between the prices of Brent and WTI crude oil narrow. But there will be a discount required to account for the costs of moving inland US crudes to the Gulf Coast.

I found seven possible determinants of crude oil prices: crude oil demand, crude oil supply, speculation, the convenience yield y , inventories and reserves, the risk free rate and inflation. Income and price elasticity of crude oil demand are both below unity. The strong demand growth from China and the Middle East resulted in a big price increase. Total crude oil supply is among other things affected by the Organization of Petroleum Exporting Countries (OPEC). They include 12 of the important oil producing countries and make production agreements. Together with the less price elastic demand they are powerful. Enormous lead times and the challenge of depletion also affect crude oil supply. Speculation plays an important role. Commodity index funds are the reason why data volume of oil futures has grown spectacularly. They are possibly the reason for a change in term structures from backwardation to contango. The convenience yield y has a direct impact on futures prices and term structures. When the benefit of holding the commodity becomes lower or

storage costs higher, future prices will go up. The opposite will result in falling futures prices. When prices of WTI and Brent crude oil began to differ, the estimated convenience yield of Brent stayed positive and constant, while the estimated convenience yield of WTI was negative sometimes.

The volatility of a commodity tends to be inversely related to the level of global inventory. In times of low inventory, prices of WTI and Brent crude oil seemed to be very volatile, for example between 2007 and 2009. The risk free rate influences the relationship between spot and futures prices. The higher the risk free rate, the higher the futures price. The New York and London USD Overnight Swap both increased sharply between 2005 and the middle of 2007, then stayed constant and fell rapidly in the second half of 2007 until the end of 2009. This was the result of the Fed activities after the beginning of the subprime crisis in 2007. The last possible determinant of crude oil prices is inflation. Several studies found impacts of exchange rates on oil prices. Akram (2009) found that a weaker dollar leads to higher commodity prices. When the USD devaluates against other currencies, it is cheaper to buy crude oil for these countries. Demand would go up and prices would go up as well to restore equilibrium. The devaluation of the Dollar against the Swiss Franc was very severe. This could also have led to higher crude oil prices.

It is possible that there were arbitrage opportunities when the spread between WTI and Brent oil occurred. Unfortunately, there is no index for a spot rate or a forward freight agreement from the U.S. Gulf to Rotterdam or the UK/Continent available on Bloomberg because the U.S. is a crude oil importer. It has the policy not to ship crude out of the U.S.

In the last part, I tried to make a regression the spread of WTI and Brent front month future prices on the spread of futures with longer time horizons. This was not possible for me, neither for the period of 2005 to 2011, nor for the period of 2005 to 2009. Residual plots did not look like “chaos” and R^2 was very small in both cases.