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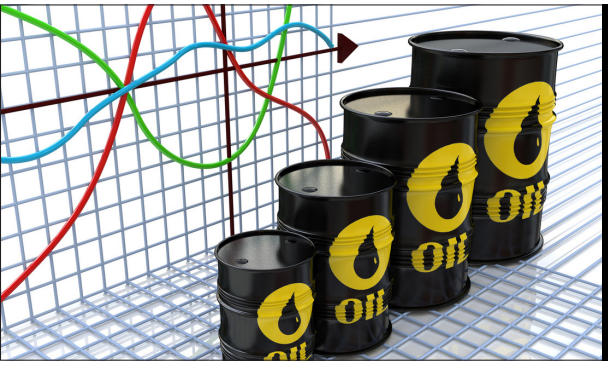


Economic Letter

Costs of Oil Price Exchange-Traded Funds Diminish Usefulness

by Sung Je Byun

ABSTRACT: Crude oil exchange-traded funds (ETFs) are investments designed to track oil price changes. They bear unique costs of which many investors are unaware. Since the first crude oil ETF went to market in April 2006, these costs have been sizable, reducing ETF returns by 1.33 percent per month on top of the average monthly loss of 0.23 percent attributable to weak oil prices.

Historically, only a few investors could participate in the crude oil market because of high fixed costs associated with the acquisition of storage facilities needed to hold the commodity.

Crude oil futures contracts—financial claims for crude oil to be delivered at a future date—were introduced in early 1983. They lowered this barrier by eliminating the need for investors to take delivery.[1] A buyer (seller) of a crude oil futures contract can avoid physical delivery by selling (purchasing) the same futures contract before the contract expires. However, the large standard contract size (currently 1,000 barrels per contract) still limited individual-investor direct participation.[2]

Crude oil exchange-traded funds (ETF), which debuted in April 2006, further reduced barriers to investor access to the crude oil market. The crude oil ETF is a security that tracks oil price movements, providing individual investors with a low-cost way of participating in the market. Because ETFs trade in real time, investors gain more opportunities to respond to oil price movements.

But the strategy comes at a price. While crude oil ETFs may provide attractive investment opportunities, they also include unique costs. Some of these arise from the need to roll over expiring futures contracts.[3] The ETFs also offer only intermittent benefits as a means of portfolio diversification.

Gaining Popularity

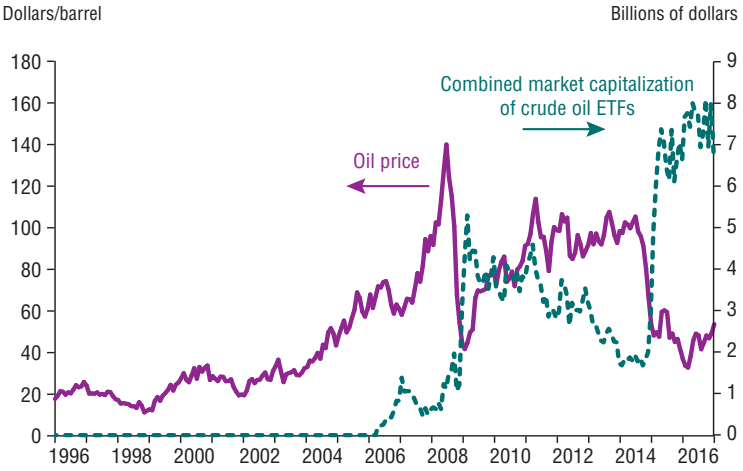
Crude oil ETF investments gained particular popularity following large oil price declines (*Chart 1*). When oil prices suddenly collapsed in July 2008—falling 68 percent through February 2009—the total market capitalization of crude oil ETFs increased 374 percent.[4] During the subsequent oil price recovery, the total market cap gradually declined over the relatively short investment horizon of one year or less.

Again, when oil prices declined starting in late 2014, investors increased ETF exposure in anticipation that oil prices would recover just as they had in early 2009.[5]

To track oil prices, crude oil ETFs generally have large exposures on the nearest-to-maturity crude oil futures contracts, of which the last trading day is around the 20th calendar day of each month. Thus, ETF managers must roll over expiring futures contracts to the next-nearest-to-maturity contracts.

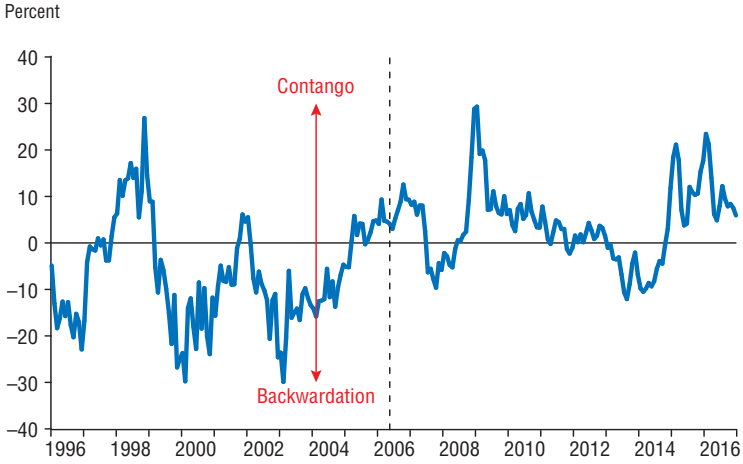
Such rollover transactions are executed every month following a predetermined schedule. Transactions may be spread

Chart 1 ETF Investments Responsive to Oil Price Volatility



SOURCES: Bloomberg; author's calculations.

Chart 2 Contango Prevails Since Inception of Crude Oil ETFs



NOTES: The term spread is calculated as a log price difference between 12- and one-month-to-maturity crude oil futures contracts. To reflect continuously compounded returns on financial investments, the log price difference—also known as the log return—is calculated for the analysis. Similarly, the geometric average of returns is used here. The vertical dashed line indicates the introduction of the first crude oil ETF in April 2006.

SOURCES: Bloomberg; author's calculations.

over an entire trading day, at the end of trading hours on one day or over a number of business days before the last trading day.

For an example of the impact of rollover transactions on investor returns, consider a transaction executed on Jan. 8, 2016. If managers executed rollover transactions at the end of day, the ETFs would have sold the nearest-to-maturity contract at $33.16 per barrel while purchasing the contract that is next-to-nearest to maturity at $34.32 per barrel, resulting in a loss of $1.16 per barrel, or about 3 percent of the ETF's value.

Even if the rollover transactions were executed over the five consecutive business days, Jan. 8–14, 2016, the ETFs would still incur similar-sized rollover losses.

Futures Market Conditions

Gains and losses on rollover transactions are influenced by the shape of the futures curve, also known as the term structure of futures contracts. Contango is a market condition in which a futures contract trades above its expected spot price at maturity, generating a positive slope of the futures curve.

Hence, when the crude oil futures market is in contango, the rollover transactions result in losses for the ETFs by selling expiring futures contracts at lower prices than the purchase price for the same number of available futures contracts. Backwardation is the opposite market condition, where the rollover transactions would be beneficial to ETF returns.[6]

The term spread, the difference in returns between futures contracts with two different maturities, measures a slope of the futures curve between the two periods. The term spread between 12- and one-month-to-maturity crude oil futures contracts historically has oscillated between contango and backwardation.[7]

Repeated Rollover Losses

Since the inception of the crude oil ETF in April 2006, the crude oil market has been largely in contango (*Chart 2*). There have been 92 months with positive term spreads but only 37 months with negative spreads, and the average term spread was 4.17 percent through December 2016. The average positive term spread (7.97 percent) is approximately 1.5 times larger than that experienced during the negative periods (–5.26 percent).

These observations are opposite to what had characterized the crude oil market before April 2006, when term spreads averaged -6.79 percent and positive spreads appeared 34 out of 123 times from January 1996 to March 2006.[8]

The prevailing contango has resulted in repeated rollover losses for crude oil ETFs. Since April 2006, the geometric average of monthly rollover yields is –1.33 percent (or 14.88 percent on an

annualized basis), a loss much larger than the average monthly loss of 0.23 percent (2.69 percent annualized) incurred due to weak oil prices (*Chart 3*).[9]

Portfolio Performance

The repeated rollover losses that diminish the returns from crude oil ETFs can be viewed in the context of their contribution to larger portfolio management issues. Put another way, how do crude oil ETFs' low co-movement with other assets enhance overall portfolio performance by improving risk-adjusted return when invested with other assets.[10]

Crude oil futures contracts provided higher and more volatile average returns than the Standard & Poor's 500 from January 1996 to March 2006 (*Table 1*). Given the historically low correlation between the two assets, investors could construct a portfolio providing a higher expected return per unit of risk (measured by a standard deviation of the portfolio return).

For example, an investor investing half his portfolio in the S&P 500 and the other half in crude oil futures would earn an expected monthly return of 1.08 percent—higher than that of the S&P 500 (with a standard deviation of 5.26 percent) and lower than that of crude oil.[11] Note that the historically low correlation results in the small standard deviation for the portfolio while not affecting its expected return.

However, after April 2006, this expected benefit has largely disappeared. Crude oil has delivered a monthly return of 0.28 percent, below the average S&P 500 returns of 0.52 percent, and is more highly correlated with the S&P 500 returns with a correlation coefficient of 0.43 versus –0.02 percent in the earlier period. (The larger positive number indicates more synchronous movement between the two variables.)

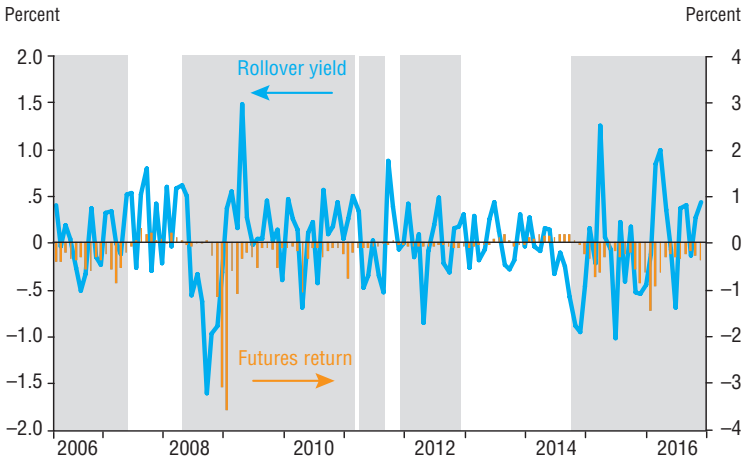
The shift in performance suggests crude oil ETFs no longer provide a better investment opportunity than the S&P 500. The performance of the equal-weighted portfolio—formerly suggesting a higher expected return per unit of risk—is worse than that of the S&P 500 alone. The portfolio provides a lower monthly return and greater volatility, as seen in Table 1.[12] In fact, one can show that any portfolio holding oil in positive amounts would be worse, in this sense, than holding the S&P 500 alone.

Crude Oil ETF Impact

Crude oil ETFs provide individual investors with a low-cost way of participating in the crude oil market. Since the April 2006 introduction of ETFs, investors have been increasing their holdings of them to try to profit from oil price volatility.

However, they have experienced diminished performance due to rollover losses. Additionally, oil prices' changing impact on overall portfolio performance may moderate the usefulness of a crude

Chart 3 Rollover Losses Reduce Futures Returns During Contango



NOTES: The monthly rollover yield is a geometric average return of rollover transactions between the fifth and ninth business days, and futures return is a monthly return of the nearest-to-maturity futures contract. Shaded regions are contango periods; white regions are backwardation periods.

SOURCES: Bloomberg; author's calculations.

Table 1 Crude Oil Returns Lower, Positively Correlated Since April 2006

	Average return	Standard deviation	Correlation
A. Jan. 1996–March 2006			
Crude oil	1.45%	9.58%	
S&P 500	0.71%	4.60%	–0.02
50/50 portfolio	1.08%	5.26%	
B. April 2006–Dec. 2016			
Crude oil	0.28%	9.34%	
S&P 500	0.52%	4.26%	0.43
50/50 portfolio	0.40%	5.90%	

NOTES: Monthly crude oil returns are calculated from prices of the nearest-to-maturity crude oil futures contracts. The 50/50 portfolio represents monthly returns of the equal-weighted portfolio constructed by the crude oil and S&P 500 returns.

SOURCES: Bloomberg; author's calculations.

oil ETF investment as a means of managing risk.

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Notes

[1] In theory, the price of a crude oil futures contract should coincide with the cost necessary for carrying the crude oil to maturity. Here, the cost refers to all expenditures including storage, transportation, insurance and interest charges, net of expected benefits such as the convenience yield.

[2] Crude oil futures contract specification is provided by the CME Group, www.cmegroup.com/trading/energy/crude-oil/light-sweet-crude_contract_specifications.html.

[3] Rollover yields are not unique to crude oil ETFs. Depending on futures market conditions, they would occur with any ETF whose underlying asset is the futures contract, which requires periodic rollover transactions.

[4] As of Dec. 31, 2016, there were 18 crude oil ETFs—13 long ETFs benchmark the prices of crude oil futures contracts or indexes tracking oil price performance, whereas five short ETFs track an inverse of such oil price performance. The combined market capital of the 13 long ETFs is $6.41 billion, accounting for about 94 percent of market capital among 18 crude oil ETFs. Accordingly, the potential gains and losses to financial investors purchasing the long-crude-oil ETFs are discussed here.

[5] Various motivations/necessities of oil market participants facilitate transactions in the oil futures market. For example, crude oil ETF investors take the other side of transactions with commercial traders seeking to hedge their oil price risk. See more details about crude oil financial markets from "What Drives Crude Oil Prices: Financial Markets," a monthly updated analysis by the U.S. Energy Information Administration, www.eia.gov/finance/markets/crudeoil/financial_markets.php.

[6] *A Treatise on Money*, vol. II, by John Maynard Keynes, New York: Harcourt, Brace and Co., 1930, pp. 142–44.

[7] Prices of futures contracts with shorter maturities do not respond in the same way as those with longer maturities. For example, weaker economic performance tends to lower short-term oil price forecasts more severely than long-term price forecasts.

[8] Given rapidly increasing financial investments and the structural change in the crude oil market, many researchers investigate the effects of financial investors' activities on the crude oil market and reach a conclusion that the contribution of these activities is weak. See "Speculation in Commodity Futures Markets, Inventories and the Price of Crude Oil," by Sung Je Byun, *Energy Journal*, vol. 38, no. 5, 2017, pp. 77–97.

[9] The geometric average is used to show continuously compounded returns on financial investments.

[10] This benefit of diversification is discussed within a strategic allocation of investment portfolios. See "The Strategic and Tactical Value of Commodity Futures," by Claude B. Erb and Campbell R. Harvey, *Financial Analysts Journal*, vol. 62, no. 2, 2006, pp. 69–97.

[11] The Sharpe ratio—an excess portfolio return above the risk-free rate per unit of standard deviation of portfolio returns—is a popular risk-adjusted performance measure. Assuming a monthly risk-free rate of 0.3 percent, the equal-weighted portfolio provides a Sharpe ratio of 0.149, higher than those of crude oil futures contracts (0.120) and the S&P 500 (0.090).

[12] Assuming a monthly risk-free rate of 0.08 percent, the Sharpe ratio of the equal-weighted portfolio becomes 0.054, lower than that of the S&P 500 (0.103) but higher than that of crude oil futures contracts (0.021).

When investing in crude oil ETFs along with other assets, individuals may find that oil prices' changing impact on overall portfolio performance may make the strategy a less-useful way of managing risk.

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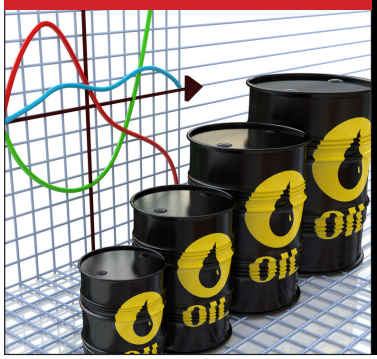

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