LEVERAGED, INVERSE, AND FUTURES-BASED ETFS

Tim Dulaney, PhD, Tim Husson, PhD, and Craig McCann, PhD[1]

Exchange-traded funds (ETFs) offer retail investors a superficially simple way to obtain exposure to a wide variety of underlying assets and investment strategies. These products have become increasingly complex over time, and now many ETFs offer leveraged (multiple of daily returns) or inverse (negative multiple of daily returns) exposure to their underlying indices. Also, many ETFs that have commodities as their underlying assets obtain exposure to those markets not through purchasing the physical assets but through futures contracts, which involve complex "rolling" strategies. These leveraged, inverse, and futures-based ETFs show substantial deviations from the returns investors might expect or intend when they purchase them. This potential for misunderstanding could lead to substantial losses, especially since most of these ETFs grossly underperform the spot prices of their underlying assets. In this paper we describe the reasons for this tracking error in these two types of ETFs, highlighting their complexity and potential unsuitability for retail investors.

I. Introduction

Exchange-traded funds (ETFs) are investment funds that are listed on a major stock exchange and typically track some underlying security, index, commodity, or other asset. ETFs are in many ways similar to mutual funds, but are characterized by generally lower fees and higher liquidity. ETFs enable retail investors to purchase exposure to a wide variety of asset portfolios and investment strategies with relatively small investments, and many have been tailored to offer highly specific return characteristics for

 This paper benefitted greatly from the collaborative effort of many SLCG employees, and is the product of ongoing research and casework. Dr. Dulaney can be reached at 703-539-6777 or timdulaney@slcg.com. Dr. Husson can be reached at 703-890-0743 or timhusson@slcg.com and Dr. McCann can be reached at 703-246-9381 or craigmccann@slcg.com.

different investment objectives. Put simply, ETFs make sophisticated complex investment strategies accessible to retail investors.

Unfortunately, ETFs also enable retail investors to establish highly risky positions they may not fully understand. For example, there are now well over 200 ETFs that offer leveraged exposure to some underlying investment. Retail investors may assume that this leverage means that if they hold, for instance, a 2x leveraged ETF, its returns will be double the gain or loss from holding the investment itself. Likewise, there are over a hundred ETFs that track commodities, but do not purchase those commodities directly. Retail investors may assume that those ETFs track the widely quoted spot price of a commodity, such that when the price of oil (or silver, or wheat) rises or falls, the ETF's value will rise or fall a proportional amount.

While such investor expectations seem reasonable and intuitive, they are almost always wrong. As we demonstrate below, the tracking error between a leveraged or commodities-based ETF and its underlying asset or index can become substantial over time. In this paper we describe the sources of tracking error in leveraged, inverse, and futures-based ETFs, highlighting the particular sources of risk to retail investors. We also discuss the suitability of these complex ETFs for retail investors.

II. Leveraged and inverse ETFs

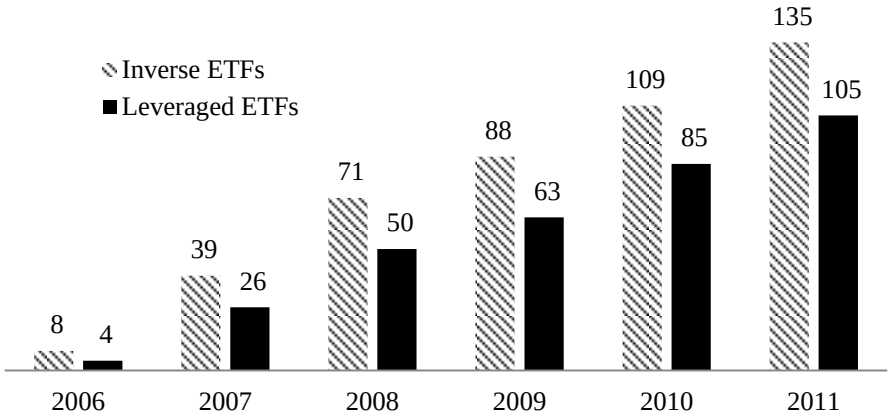
ETFs, like mutual funds, are often designed to track assets that are otherwise difficult to purchase individually or in small amounts, such as a well-diversified stock portfolio index or a commodity. The ETF structure can be combined with internal borrowing to create leveraged investments—products that return a multiple of the returns on the asset itself—which would be either inconvenient or impossible for many retail investors to achieve themselves. Similarly, ETFs can systematically short a particular asset.

It is much easier for retail investors to purchase ETF shares than to attempt the complicated and cumbersome process of achieving similar exposure through direct investments. Thus retail investors can use ETFs to achieve exposure that would be unsuitable if purchased directly. For example, a 3x leveraged ETF borrows 200% of the equity in its portfolio (put differently, equity represents only 33% of the portfolio value). Retail investors may be able to achieve this leverage in a retail margin account, and so ETFs could be used to sidestep market regulations and enable retail investors to take otherwise prohibited positions.

The first leveraged and inverse ETFs were released by ProFunds in June 2006, but were quickly followed by issuances from several major ETF

issuers.[2] The growth in the leveraged and inverse ETF market is shown in Figure 1. Leveraged and inverse ETFs are some of the most popular exchange-traded investments and receive regular news and analyst coverage from major media outlets.

Figure 1: Number of Leveraged and Inverse ETFs (US Domiciled) from 2006 to 2011



Leveraged and inverse ETFs are highly complex and easily misunderstood. Investors may not understand that in order to achieve constant leverage, ETFs must regularly rebalance their portfolio, which can generate returns that deviate from a constant multiple of returns over an investor's holding period. Investors may be surprised to learn that leveraged ETFs can produce negative returns over long holding periods despite significant positive returns on the asset itself over that time period. Likewise for inverse ETFs: the inverse ETF's return can be negative even if the return on the underlying asset is negative.

The possibly counterintuitive returns to leveraged and inverse ETFs raised concerns at both FINRA and the SEC. FINRA's Notice to Members on non-traditional ETFs warns that "while such products may be useful in some sophisticated trading strategies, they are highly complex financial instruments that are typically designed to achieve their stated objectives on a daily basis." Likewise, the SEC released an Investor Alert "because [they] believe individual investors may be confused about the performance objectives of leveraged and inverse exchange-traded funds." It is clear that

2. (ProFunds Readies ETFs That Leverage Indexes 2006)

investors must understand the specifics of complex ETFs, and that their particular risks must be clearly disclosed. [3]

A. Rebalancing, Compounding, and Holding Period Returns Example of Tracking Error

Typically, leveraged and inverse ETFs rebalance their positions in the underlying asset daily.

Table 1 illustrates the effect of daily rebalancing over the course of several days for a -1x (inverse) and 3x leveraged ETF.

Table 1: Effects of Daily Rebalancing

	Index Returns		Traditional ETFs and Cash or Margin Debt			Leveraged and Inverse ETFs	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Day	Daily Return	Cumulative Return	Unlevered ETF	$200 cash, short $100 ETF	$200 margin, $300 ETF	1X I-ETF	3X L-ETF
0			$100.00	$100.00	$100.00	$100.00	$100.00
1	23%	23.00%	$123.00	$77.00	$169.00	$77.00	$169.00
2	-20%	-1.60%	$98.40	$101.60	$95.20	$92.40	$67.60
3	20%	18.08%	$118.08	$81.92	$154.24	$73.92	$108.16
4	-23%	-9.08%	$90.92	$109.08	$72.76	$90.92	$33.53
5	10%	0.01%	$100.01	$99.99	$100.03	$81.83	$43.59

Column (c) represents the returns of an ETF that simply tracks the index (ignoring fees), with a starting value of $100. Column (d) shows the returns from using $100 to collateralize a short sale of $100 worth of the same ETF. Column (e) shows the return on a 3x leveraged position, obtained by borrowing an additional $200 and investing $300 in the ETF. These three positions are all non-rebalancing, meaning that the amount of leverage is relative to the initial amount ($100), not to the portfolio value on any other day. In the investments which are not rebalanced, a cumulative gain of 0.01% over these five days results in predictable returns: the unlevered ETF gained the same 0.01%, the inverse position lost it, and the leveraged position gained three times that amount.

In contrast, columns (f) and (g) reflect the returns of an inverse ETF and a leveraged ETF that is rebalanced daily. Both of these funds deviate from their intuitive non-rebalanced versions (columns (d) and (e)), and significantly underperform the underlying index. This tracking error is

3. (FINRA 2009) (SEC 2008)

known as the 'constant leverage trap': over five days, the index return was 0.01%, but the inverse ETF lost 18.2% and the 3x leveraged ETF lost 56.4%. While the daily volatility in this example is high, the cumulative rebalancing systematically erodes the value of an ETF over long holding periods.

Source of Tracking Error

The tracking error illustrated in Table 1 is well known to both industry practitioners and academic theorists: daily rebalancing leads to large deviations from 'margin account' leverage for holding periods longer than the rebalancing frequency, typically only one day for ETFs.[4] This tracking error grows with volatility and the degree of leverage, and is highly dependent on the direction and magnitude of past moves (it is 'path dependent'). Leveraged ETF investors can earn negative returns even when the underlying asset increases in value, and inverse ETF investors can earn negative returns even when the underlying decreases in value.

Tracking Error Risk Not Fully Disclosed

It is crucial for investors to be aware of the differences between a leveraged ETF and a 'margin account' leveraged position, as well as the difference between an inverse ETF and a 'short' position. Unfortunately many early ETF prospectuses described their leverage (or inverse leverage) in ambiguous ways. For example, the description of Rydex's leveraged funds read, "*The Fund's current benchmark is 200% of the performance of the [Underlying Index]. If the Fund meets its objectives, the value of the Fund's shares will tend to increase on a daily basis by 200% of the value of any increase in the Underlying Index."*[5] A clearer warning might describe the potential misunderstanding, as retail investors might have no reason to suspect that the term "daily basis" indicated returns wildly contrary to their expectations given the previous sentence.

Likewise, Direxion's September 29, 2008 levered and inverse ETF prospectus stated, "*The Funds described in this Prospectus seek to provide daily investment results, before fees and expenses that correspond to the*

4. These issues are discussed in detail in (Cheng and Madhaven 2009) and (Wang 2009).

5. (Rydex ETF Trust 2006)

performance of a particular index or benchmark. The Funds with the word "Bull" in their name (collectively, the "Bull Funds") attempt to provide investment results that correlate positively to the return of an index or benchmark, meaning the Bull Funds attempt to move in the same direction as the target index or benchmark. The Funds with the word "Bear" in their name (collectively, the "Bear Funds") attempt to provide investment results that correlate negatively to the return of an index or benchmark, meaning that the Bear Funds attempt to move in the opposite or inverse direction of the target index or benchmark. The correlations sought by the Bull Funds and the Bear Funds are generally a multiple of the returns of the target index or benchmark."[6]

Such general statements are not sufficient to convey the complexity of the leverage or inverse leverage embedded in the Direxion ETFs. It should be highlighted that the leverage advertised by the ETFs only applies to holding periods of one day or less, and that holding the ETFs for any longer could create substantial deviations with the results of traditional forms of leverage. Fortunately, disclosures have improved, though they remain potentially ambiguous. Rydex's December 16, 2009 prospectus emphasized the *daily leveraged* investment goals and stated the leveraged ETFs were not suitable for "*investors who do not intend to actively monitor and manage their portfolios*."[7] ProShares' June 23, 2009 prospectus addressed investor suitability in a separate paragraph on two new products and then on all of the leveraged and inverse leveraged ETFs in their July 31, 2009 prospectus.[8]

Typical Example

Figure 2 plots the value of an investment of $100 in Direxion Financial Bull 3X ETF (FAS), Direxion Financial Bear 3X ETF (FAZ) and the Russell 1000 Financial Services Index (RGUSFL).[9] FAS and FAZ were first issued on November 6, 2008. Both the 3x and -3x leveraged ETFs not only fail to track the underlying index, but both plummet in value over time.

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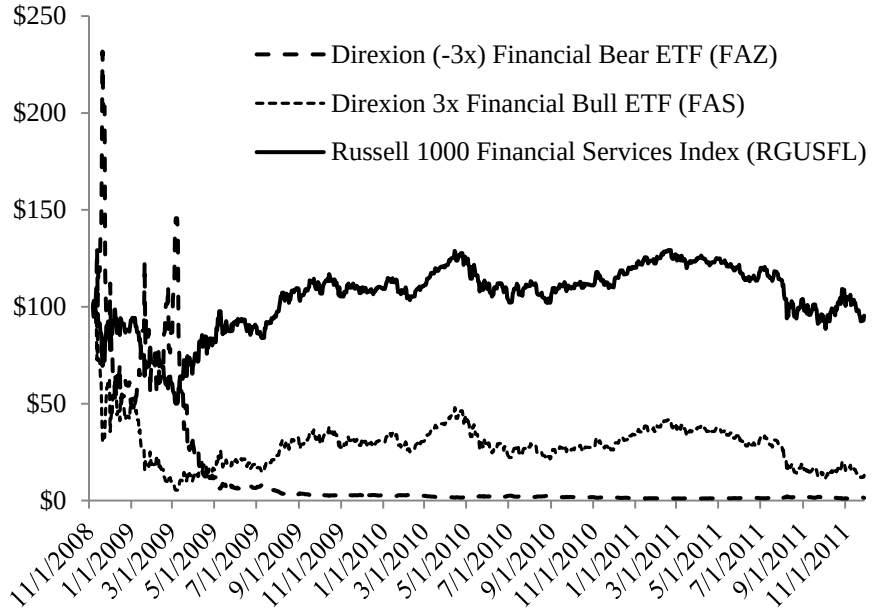
6. (Direxion Shares ETF Trust 2008)

7. (Rydex ETF Trust 2009)

8. (ProShares Trust 2009) and (ProShares Trust 2009).

9. As of May 28, 2010, RGUSFL 10 largest constituents were JPMorgan Chase, Bank of America, Wells Fargo, Citigroup, Goldman Sachs, US Bancorp, American Express, Morgan Stanley and Visa. (Russell Investments n.d.)

Figure 2: Leveraged and Inverse Leveraged Historical Prices versus Underlying Index



B. Long-Term Risks Holding Period Shortfall

We have quantified the investment shortfall of an ETF relative to its underlying index or to 'margin account' leverage for five example leveraged or inverse ETFs from a variety of issuers, listed in Table 2.

Table 2: Example Leveraged and Inverse ETFs

Ticker	Name	Issuer	Leverage	Index
DPK	Developed Markets Bear 3X	Direxion	-3	MSCI EAFE
TYO	10-Year Treasury Bear 3X	Direxion	-3	NYSE 10 Year Treasury
RHO	Inverse 2X S&P Select Sector Health Care	Rydex	-2	AMEX Health Care Select
SBB	Short Small Cap 600 Fund	ProShares	-1	CBOE S&P Small cap 600
UVG	Ultra Russell 1000 Value Fund	ProShares	2	Russell 1000 Value

The deviation between the leveraged ETF and a 'margin account' position grows with the number of days the positions are held, as shown in Figure 3. For all holding periods, DPK on average had lower returns than a 'margin account' leveraged investment in the benchmark. On average, an investor who held DFK for 15 trading days lost 3% of her investment compared to the benchmark. In other words, had the investor created the leverage themselves in a margin account they would have earned 3% more over a 3 week time period, the equivalent of more than 50% on an annualized basis. This deviation is illustrated in dollar terms in Table 2 which shows the dollar value lost for each of the five example funds from inception to June 1, 2009.

Figure 3: Deviation between Margin Account and Leveraged ETF Returns for Different Holding Periods

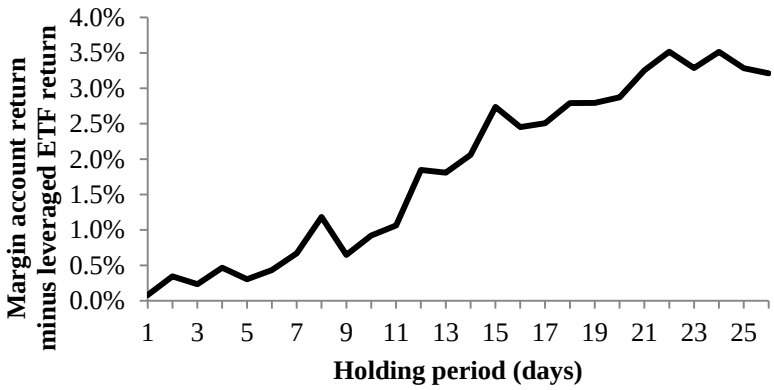


Table 3: Cumulative Shortfall for Example Funds

ETF	Leverage Ratio	Inception	Market Capitalization at Inception	Estimated Aggregate Shortfall
DPK	-3	12/17/2008	$ 6,046,000	$ 1,412,489
TYO	-3	4/15/2009	$ 6,100,000	$ 745,502
RHO	-2	6/12/2008	$ 7,802,000	$ 207,726
SBB	-1	1/25/2007	$ 15,630,750	$ 1,573,060
UVG	2	2/22/2007	$ 10,407,000	$ 464,699

Do Investors Hold Leveraged and Inverse ETFs Too Long?

Table 4 lists the average daily turnover ratio for our five example funds. Even the highest turnover (18.1% for DPK) implies an average holding period of several days—enough, by our calculations in Figure 3 above, to cause substantial deviations—despite its prospectus's statement: "*the Funds are designed as short-term trading vehicles for investors who intend to actively monitor and manage their portfolios.*[10] The other ETFs listed in Table 4 have average holding periods approaching a month. Indeed, some investors clearly view leveraged or inverse ETFs as very long term

10. (Direxion Shares ETF Trust 2010), page 30.

investments. This analysis suggests that investors do not understand the risks of long-term exposure to leveraged and inverse ETFs, despite improvements to disclosures in the prospectus.

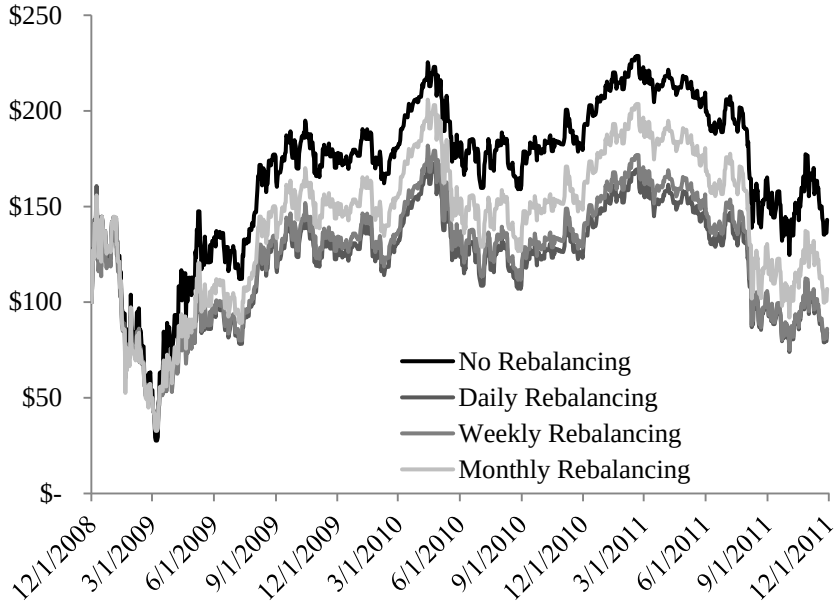
Table 4: Holding Periods

ETF	Average Daily Turnover Ratio	Leverage Ratio	Average Holding Period (days)	Purchases Held for More Than 1 Week	Purchases Held for More Than 1 Month	Purchases Held for More Than 1 Quarter
DPK	18.1%	-3	5.3	16.42%	6.30%	1.22%
TYO	5.5%	-3	12.8	48.02%	16.39%	3.89%
SBB	4.6%	-1	21.4	55.49%	21.62%	8.50%
RHO	2.9%	-2	18.4	61.28%	27.62%	6.58%
UVG	3.7%	2	22.7	54.31%	23.91%	8.90%

C. Attempts to Mitigate Rebalancing Effects

ETF issuers have recognized the potentially adverse effects of daily rebalancing and have developed new leveraged strategies which attempt to mitigate their effects. Most of these have focused on changing the frequency by which the rebalancing occurs. Figure 4 plots the value of the Dow Jones US Financials Index from December 1, 2008 to December 1, 2011 with 'margin account', daily rebalanced, weekly rebalanced, and monthly rebalance leverage. In general, longer times between rebalancing decreases the ETF's tracking error to the underlying index.

Figure 4: Effect of Rebalancing Frequency on Tracking Error



The downside to longer rebalancing frequencies is that the leverage percentage is only accurate relative to an investment directly after the last rebalancing. An investor who purchases the fund in between rebalancing will not achieve returns leveraged by the targeted amount. In the extreme example, if a leveraged or inverse fund *never* rebalanced, the leverage would only be accurate relative to an investment on the inception date. There is clearly a tradeoff between potential tracking error and accuracy of the stated leverage, and no clear solution yet exists for mitigating the potentially confusing aspects of leveraged and inverse ETFs.

D. Suitability

Retail investors may not understand that the leverage in leveraged and inverse ETFs is different than purchasing the underlying in a margin account or simply shorting the ETF; in fact, they may not recognize that any other type of leverage exists. It may not be clear to them that when the prospectus claims that a particular fund is a 'short term investment,' that 'short term' means 'single day,' and that after that point the advertised leverage does not

apply to their holding period return. It also might not be clear that 'active monitoring and managing' of their portfolio means only using leveraged and inverse ETFs for day trading.

Leverage is a complex and highly risky investment strategy that until recently was only available through margin accounts and short positions. ETFs have made purchasing such a leveraged or short position easier, but only by providing a meaningfully different type of leveraged investment. FINRA now requires that leveraged and inverse ETFs must caution investors that they are short-term investments that require monitoring, but these general statements do not reveal the specific risks and features that investors must be aware of to make informed decisions regarding these investments. The empirical data on leveraged and inverse ETFs show that a large fraction of investors hold them for much longer than a day, despite daily rebalancing and substantial losses, which suggests that they do not fully understand the products or their risks.

While leveraged and inverse ETFs are highly complex investments, another set of ETFs also exhibits a form of tracking error that many investors may not understand or appreciate. Futures-based ETFs, typically tied to commodities but also available on a wide variety of asset classes, are not leveraged but only obtain exposure to their underlying asset through futures contracts instead of purchasing the underlying asset itself. This is yet another example of the ability of ETFs to bundle complex positions typically considered beyond the realm of unsophisticated investors, into retail products.

III. Futures-Based ETFs

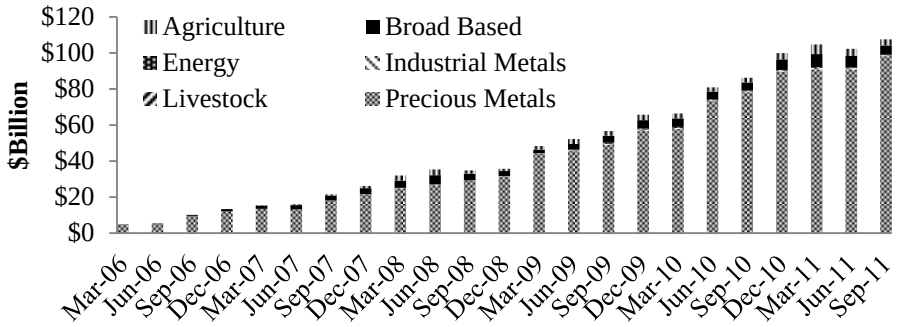
Although commodities investments purchased by institutional investors have increased dramatically over the past decade, until recently there was no simple way for retail investors to invest in commodities without using futures contracts.[11] To purchase a certain futures contact, an investor must first open a margin account. A contract purchased with the margin account has a specific expiration date and, as the contract nears expiration, the investor must "roll-over" the expiring contract into a new contract with later expiration date to avoid physical delivery of the underlying commodity. In addition to the complicated logistics of investing in commodities futures, futures contracts can be highly leveraged since the required initial margin is usually a small fraction of the futures price. Furthermore, the contracts are

11. (Commodity Futures Trading Commission 2008) and (Masters 2008).

usually only traded in large blocks (requiring a large investment), and are marked-to-market daily (exposing investors to risks associated with the volatility of futures prices). These characteristics of futures contracts made diversification through investing in commodities impractical for unsophisticated investors.

The first commodity ETF in the U.S. was State Street's SPDR Gold Trust ETF (GLD) issued on November 12, 2004. Since then, the amount invested in commodities ETFs has grown from approximately $5 billion in March of 2006 to almost $110 billion in September 2011. *See* Figure 5.

Figure 5: Growth in Commodities ETFs by Asset Value



The Dynamics of Futures Market

Since the storage of most commodities is impractical, an investor that wants exposure to commodities in his or her portfolio will likely buy futures contracts, either directly or indirectly. Since all futures contracts have expiration dates, an investor will have to replace an expiring contract that he or she owns with a new contract that expires later, a process known as "rolling-over." Usually the investor realizes a gain or loss by selling the expiring contract since the purchase price of the contract expiring later is either lower or higher than the selling price of the contract the investor owns. This is referred to as a "roll yield." Since the gain or loss is determined by the expected future spot price of the underlying commodity at two different

times (the expiration date of the two contracts), the expected roll-over gain or loss is correlated with the term structure of the futures market.[12]

The price of a futures contract depends upon the maturity of the contract. The curve describing the relationship between the prices of futures contracts and their time to maturity is called the term structure. A longer term futures contract that trades at a higher (lower) price than nearer-term futures contracts will lead to an upward (downward) sloping term structure. Much academic literature and commodity trading practitioners frequently uses the term "backwardation" when referring to a "downward sloping term structure," where the near-term future price is higher than long-term future price. We use the terms *upward (downward) sloping term structure* if the longer-term futures price is higher (lower) than the near-term futures price.

The commodities futures term structure may contain information that can be used to predict the expected futures spot price.[13] Since the expected futures spot price determines the roll-over return, understanding the futures market term structure is critical for evaluating the effects of roll yield on a futures-based ETF. The roll-over return is determined by the changes of the yield curve over time and does not correspond to the term structure of the yield curve. Since the dynamics of the yield curve determine the roll-over return of a futures contract, the dynamics will also impact the ETFs that use futures contracts to track an underlying commodity. An investment in commodities ETFs will depend on the dynamics of the spot price of the underlying commodity and on the characteristics of the term-structure.

A. Case Study of Crude Oil ETFs

The maturities for crude oil futures contracts range from one month to nine years. The West Texas Intermediate (WTI) light, sweet crude oil spot price is a common, widely cited crude oil benchmark.[14] In this paper, we study two ETFs that use different strategies to gain exposure to the price dynamics of crude oil. Figure 6 shows the value of $100 invested in each of

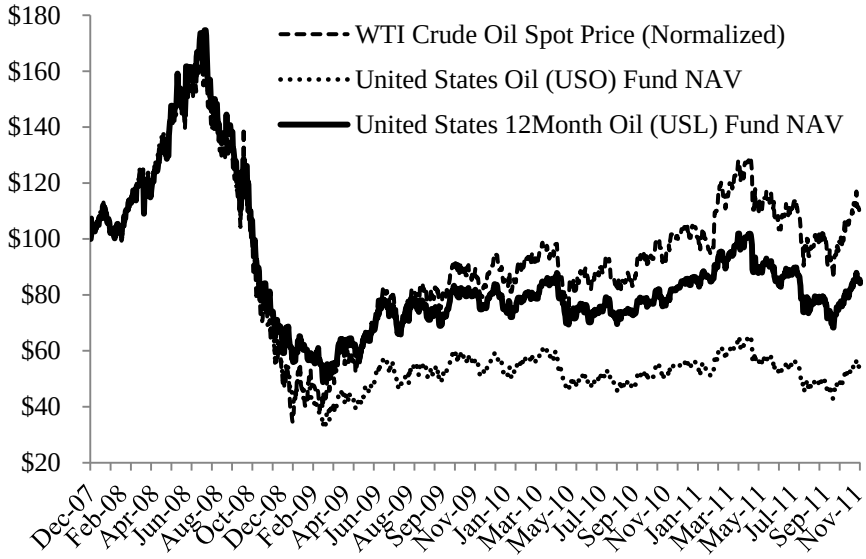
12. See the following section for a detailed explanation.

13. (Gorton and Rouwenhorst, Facts and Fantasies about Commodity Futures 2005)

14. "Sweet" crude oil is low sulfur petroleum. Gasoline is usually processed from low sulfur crude oil and hence is in high demand. Usually, when the media refers to the price of a barrel of oil it usually refers to a barrel of WTI Crude, to be delivered to Cushing, Oklahoma. See http://www.eia.doe.gov/dnav/pet/TblDefs/pet_pri_spt_tbldef2.asp for the U.S. Energy Information Administration definition of WTI.

these two ETFs from December 10, 2007 to November 23, 2011. For comparison, a theoretical investment in the spot price of oil is also included in Figure 6.

Figure 6: Value of $100 Investment in Futures-Based ETFs versus Historical Spot Price of Underlying



Neither USO nor USL tracks changes in crude oil spot prices well. For example, the holding period returns for the USL and USO from January 4, 2010 to November 23, 2010 were 2.5% and -7.7% respectively while WTI crude oil spot price increased 18.0% over the same period.

As one would expect, the day-to-day dynamics of the two ETFs' net asset values (NAV) are highly correlated with the daily changes in crude oil prices. Table 5 summarizes the correlation of the changes in the ETFs' NAVs and changes in oil spot prices. Table 5 Panel A shows the deviation from the return one would have expected from the trend in crude oil spot prices. Although the correlations are high, the holding period returns for each ETF does not track the theoretical return from investing in crude oil spot prices. For example, the spot price of oil increased by 77.9%, while USO's NAV increased only by 14.1%, a difference of 63.8% in holding period return over the period December 31, 2008 to December 31, 2009.

Table 5: Daily Correlation of Returns for ETFs and Underlying Spot Price

	USO		**USL**	
	4/10/2006		12/5/2007	
Issue Date	Daily Correlation with	Return Deviation from	Daily Correlation with	Return Deviation from
Panel A: Spot Price:				
Issue Date - 12/31/2008	91.0%	-14.4%	89.6%	11.5%
12/31/2008 - 12/31/2009	93.4%	-63.8%	85.2%	-48.7%
1/1/2009 - 12/31/2010	93.8%	-91.3%	86.2%	-67.5%
Panel B: Six Month Futures Contract:				
Issue Date - 12/31/2008	97.8%	-25.2%	99.7%	-0.4%
12/31/2008 - 12/31/2009	94.6%	-37.0%	99.5%	-21.9%
1/1/2009 - 12/31/2010	94.7%	-59.6%	99.5%	-35.8%

Table 5 Panel B reports the correlations of daily changes of the USO and USL's net asset value and the six month futures contract. Since these ETFs use futures contracts to track the spot price of crude oil, the correlations in panel B are much higher than those in panel A. Although correlations are higher than 99% in some cases, the holding period returns deviated substantially from the returns one would have expected from the dynamics of futures prices. From January 1, 2009 to December 31, 2010, the holding period return for USO was nearly 60% less than the change in the price of the six months futures contract. Even though USL's daily return correlation with the six month futures contract was above 99% for each period, the holding period return was as much as 35.8% below the change in price of the six month futures contract.

United States Oil Fund (USO)

The United States Oil Fund (USO) invests in oil futures contracts traded on the New York Mercantile Exchange (NYMEX). Since the price of the nearest term futures contract converges to the spot price upon expiration, investing in the near-month futures contract should intuitively follow the spot price of the underlying commodity closely. USO invests in near-month futures contracts and rolls-over their futures contract to the next month futures contract once every month when the near-month futures contracts are two-weeks to expiration.[15] The contract with the shortest maturity is the near-month futures contract, typically expiring in less than 22 days.

Because of their investment strategy, USO's monthly roll-over requires USO to sell all their futures contracts each month and replace them with new futures contracts.[16] We describe USO's roll-over strategy in Table 6. For example, on January 6, 2009, USO sold contracts expiring on January 20, 2009 and bought contracts expiring on February 20, 2009 for $53.13. The following month, on February 6, 2009, USO sold the contract expiring on February 20, 2009, for $40.17 and bought the new contract expiring on March 20, 2009 for $46.15. From January 6, 2009 to February 6, 2009, USO's buying and selling of the contract expiring on February 20, 2009 generated a loss of 24.4% (40.17/53.13-1), excluding fees, interest or other expenses. Over the same time period, the WTI crude oil spot price declined from $48.58 to $40.17, a decline of only 17.3%.

15. If USO waits to sell the contracts until just before expiration, there may not be enough liquidity in the market to allow USO to sell their large position in these contracts.

16. Prior to the March 2009 contract, USO had historically used one-day window to roll-over contracts; however, since then USO changed over to a four-day roll-over window. Expiration date is when the front-month futures contract stops trading, defined as the third business day prior to the 25th calendar day (or the first business day before the 25th calendar day if the 25th is not a business day) of the month prior to the delivery month. We use the delivery month to refer to a particular futures contract, e.g., a March 2009 contract means the delivery month is March 2009 (expiration date of February 20, 2009).

Table 6: Futures Contracts Transactions by USO:
(b) denotes bought; (s) denotes sold

Contract Name	Expiration Date	Trading Date 1/6/09	2/6/09	3/6/09
February 2009	1/20/09	$48.58 (s)		
March 2009	2/20/09	$53.13 (b) →	$40.17 (s)	
April 2009	3/20/09		$46.15 (b) →	$45.52 (s)
May 2009	4/21/09			$47.72 (b)

United States 12 Month Oil Fund (USL)

United States 12 Month Oil Fund (USL) holds 12 equally-weighted oil futures contracts, starting from the near-month futures contract[17] to the next 11 delivery month futures contracts. Each month, in contrast to USO, USL sells the near-month futures contract and purchases a contract that has roughly 12 months to expiration. As a result, USL only turns over one twelfth of the portfolio every month whereas USO turns over their entire portfolio. USL's monthly return depends on the changes in the values of all the twelve contacts it holds.

B. Term Structure Dynamics and Roll Yield Typical Crude Oil Term Structure

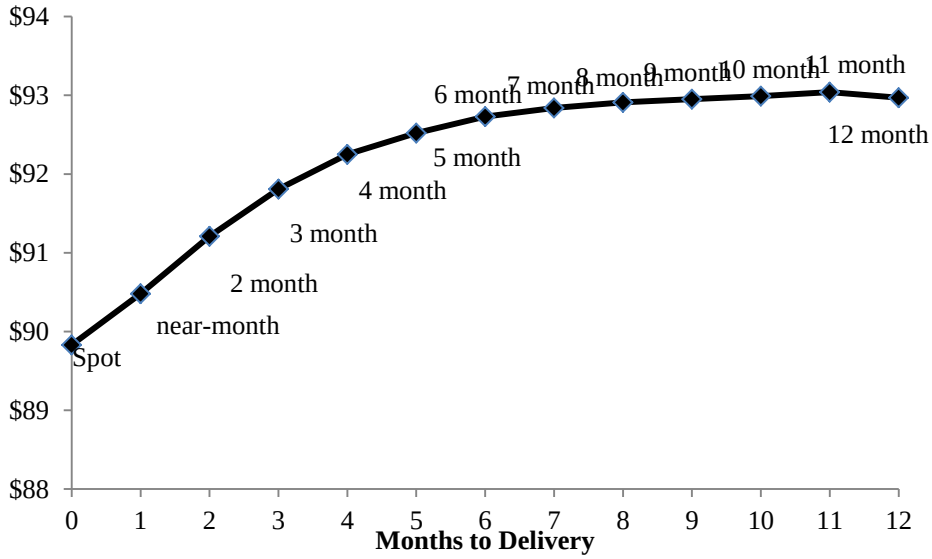
USO uses only the near-month futures contract and rolls over the entire contract every month. USL uses all contracts from the near-month to the 12th delivery-month contracts to gain exposure to crude oil price changes. For a concrete example of the term structure of oil prices, we plot in Figure 7 the

17. Unless the near-month futures contract expires within two weeks, it will be replaced (rolled-over) by the 13th delivery month contract, i.e. 12th expiring-month contract. For example, if the near-month futures contract is March 2012 contract, which expires on February 24, 2012, on and around February 10, 2012, USL will replace this contract with the March 2013 contract, which expires on February 20, 2013. (United States 12 Month Oil Fund, LP 2007)

term structure as of December 22, 2010. As of this date, the term structure was upward sloping. Longer term futures contract prices were higher than shorter term futures contract prices. Furthermore, the term structure was increasing at a decreasing rate (the slope was steeper between the second-month and near-month contracts than it was for any other two adjacent contracts). Since the futures contracts are traded daily, the curve changes over time. As the near-month futures contract converges to the spot price, the value futures contract decreases. Since USO only invests in the near-term futures contracts, USO is very sensitive to the short-term term structure of crude oil prices. On the other hand, USL holds a diversified set of contracts. As a result, USL investors are exposed to the average of differing slopes instead of being exposed to only one slope.

The effect of using the average rather than just the first- and second-month futures contracts can be significant. As illustrated in Figure 7, the difference in price between the second and first month futures contracts is typically larger than the difference in price between any other adjacent months' contracts. Therefore the roll yield of selling the first month to buy second month contracts incurs a larger loss than selling any other futures contract and purchasing its nearest later-dated neighbor. Using a broad set of futures contracts of a variety of maturities has the effect of averaging these differences, making the resulting roll yield smaller. However, longer-dated maturities tend to have a lower correlation with the underlying spot price, meaning that an ETF that holds longer-dated futures contracts will not track the underlying spot price as precisely as one that uses shorter-dated contracts. There is therefore a tradeoff between using short-dated maturities which better reflect movements in the spot price versus longer-dated maturities which incur less roll yield.

Figure 7: Term Structure in WTI Crude Oil Futures Market on December 22, 2010



How the Term Structure Determines Returns

The two ETFs we study use similar approaches to expose their investors to changes in crude oil prices. Both of these funds, therefore, have the same fundamental problem – if the term structure is upward sloping, then an investment in a futures contract will exhibit a lower return than the change of the spot price of the underlying commodity. This is because for both funds, whenever they roll forward on the term structure, they sell their current holdings at a lower price than they purchase new contracts. On the other hand, if the term structure is downward sloping, an investment in a futures contract will exhibit a higher return than the change of the underlying commodity's spot price.

There are a number of theories that attempt to explain the price differences for futures contracts of various maturities. For example, Storage Theory argues that inventory cost and interest rate play an important role in determining both the spot price and the future price of the commodity.[18]

18. (Pindyck 2001), (Litzenberger and Rabinowitz 1995), and (Brennan and Schwartz 1985).

During times of low oil inventory due to low production or increased demand, the relatively high demand causes the spot price to be higher than the futures price.

The Risk Premium Theory, on the other hand, suggests that futures contracts can be viewed as insurance for hedging needs of commodity producers. These producers pay a risk premium (the excess of the expected future spot price over its futures price) to futures contract investors to transfer the uncertain price risk. If such a risk premium were zero, why would a counterparty sustain volatility without compensation? Despite over a century of research and inquiry, there remains no consensus about the theoretical reason for a particular term structure shape.

We therefore turn to historical data and analyze the price difference between the second-month futures price and the near-month futures price as a measure of the slope of the term structure. A positive (negative) price difference indicates an upward (downward) sloping term structure. In Table 7 we summarize the frequencies of positive and negative differences over different periods.

Table 7: Frequency of Positive or Negative Differences between the Price of the Second-Month and the Price of the Near-Month Crude Oil Futures Contracts

Time Period	Positive Difference	Negative Difference
3/30/1983-12/31/1991	26%	74%
1/1/1992-3/31/2006	50%	50%
4/1/2006-12/31/2010	82%	18%

Between 1983 and 1991, 74% of the days exhibited a negative price difference while only 18% of the days exhibited a negative price difference between 2006 and 2010. Sustained time periods with a positive price difference can lead to holding period returns for holders of futures contracts that fall well short of those expected by the change in spot prices of the underlying commodity.

Table 7 also makes clear that there are time periods with no clear preference for positive or negative price differences as was experienced in the oil futures market between 1992 and 2006.

The frequencies in Table 7 indicate that there exists the potential for long time periods with substantially higher frequencies of either positive or negative differences. Persistence would indicate that knowledge of the

current market condition would allow investors to estimate the likelihood that a given fund's methodology will generate a positive or a negative deviation in the following month. Knowing in advance whether those market conditions would be persistent could allow investors to increase their risk-adjusted returns.

As a result, the under-performance of a futures-based ETF's monthly return from the change in the spot price of the underlying commodity over the same time period may persist over time and can be predicted given current and past market conditions. Our results indicate that an investment in future-based commodity ETFs needs to be monitored carefully by investors to prevent pervasive underperformance compared to changes in the spot price of the underlying commodity.

IV. Conclusions

In this paper, we discussed the shortcomings of two types of exchange-traded funds (ETFs): leveraged/inverse ETFs and futures-based ETFs. Both of these types of funds generically suffer from a sort of tracking error that is due to the strategy the fund employs to give the investor exposure to the underlying index or commodity. Both tracking errors lead to holding period returns that differ significantly from return expected from the realized price movements of the underlying index or commodity.

For leveraged and inverse ETFs that purport to track a given index, we showed that the source of the tracking error was the high frequency of rebalancing. We showed, in agreement with intuition, that when the frequency of rebalancing decreases, the realized return of an ETF more closely matches that of the underlying index. Although these funds exhibit features that render them similar to passive investments in stock indexes, the high frequency of rebalancing makes these investments unsuitable for the passive investor.

For futures-based ETFs that target the price movements of an underlying commodity, we showed that the source of the tracking error was the term structure of futures contracts. Through a case-study of two crude oil ETFs, we showed that the deviation of realized returns from the price movement of the underlying commodity was due to the relative cost of futures contracts with different expiration dates. We advise that futures-based ETFs are not suitable investments for unsophisticated investors since the expected return is dependent upon the term structure of the underlying commodity's futures contracts, which would only be understood by sophisticated traders.

Although ETFs offer another avenue for investors who seek diversification within their portfolios, we argue that at least two types of exchange-traded funds are not suitable for the average retail investor. ETFs make sophisticated investment strategies look simple, but this simplicity often leads to lower than expected returns due to the underlying mechanics of each particular exchange-traded fund.

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