HIM Proposal - Finance

Honors Thesis Proposal

For

The Effects of Leveraging on Tracking Error in Leveraged and Inverse Exchange Traded Funds

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Tracking Error of Leveraged and Inverse Index ETFs

Chapter One: Introduction

The financial crisis has directed a lot of attention to leveraged products. Jason Zweig in the Wall Street Journal states in 2009, “Leveraged exchange traded funds are the hottest thing on Wall Street. In March alone, $3.4 billion of new money poured into ETFs that use leverage to magnify the returns on U.S. stocks.” Leveraging has become more common among investors due to the potential return. Leveraged exchange traded funds (ETFs) have grown significantly over the past five years. As of September 30, 2011, there was $36.6 billion invested in geared ETFs: $11.4 billion in leveraged products, and $25.3 billion in inverse funds. With easy access to these higher risk products, investors should be well informed before they invest. On May 2, 2011, Ari Weinberg from the Wall Street Journal states, “Although they are mostly targeted to institutions and sophisticated investors, these ETFs trade on exchanges, meaning anyone with an online brokerage account can buy them—as easily as they would a stock.” I will look into the risks in this paper; but first, I’ll explain the basics.

In financial markets, indices track the performance of a group, such as the prices of equities, exchange rates, or interest rates. The most well-known ones track specific stocks, which, together, are used as benchmarks for the equity market performance. These include the Standard and Poor’s 500 (S&P 500), the Dow Jones Industrial Average (DJIA or Dow), and the NASDAQ Composite Index. Each of these tracks a specific part of the overall equity market. The S&P 500, for example, tracks 500 large U.S. companies by market capitalization.
One tool that allows investors to invest in these indices is mutual funds. A mutual fund is an investment vehicle that gathers funds from many investors and invests those funds in securities such as stocks, bonds, money market instruments, or other financial assets. Mutual funds are operated by money managers who invest the fund's capital and attempt to produce capital gains and income for the fund's investors. A mutual fund's portfolio is structured and maintained to match the investment objectives developed by the fund’s manager. Although they originated in Europe, the first open-end mutual fund was established in the United States in 1924. Managers would sell shares of the mutual fund to investors, rather than shares of all the individual companies. This created economies of scale in investing, as mutual fund managers could manage the money collectively at a lower cost. Shares of the funds can be created or redeemed by the fund at their net asset value (NAV) at the end of each trading day. The net asset value is the value of the mutual funds holdings. The per-share value of the fund is calculated by dividing the total value of all the securities in its portfolio, minus any liabilities, by the number of fund shares outstanding.

Like a index mutual fund, an index exchange traded fund (ETF) is a security that tracks an index, a commodity, or a basket of assets, but trades like a stock on an exchange. ETFs came about in the late 1980's, but really took off with the State Street Global Advisors S&P 500 tracking ETF, the spider (ticker symbol: SPY). SPY was first traded in 1993, and it is now the largest ETF in the world with more than 300 hundred million shares traded each day and over 81 billion dollars in assets as of October 1, 2011.
ETFs track a wide variety of assets. The most common ETFs track well known indices such as the S&P 500, the Dow Jones Industrial Average, the NASDAQ, and the Russell 2000. They also track other equity market sectors, commodities, bonds, stock price volatility, and much more. ETFs give investors easy access to an asset or baskets of assets.

It is important to distinguish between primary and secondary markets when studying ETFs. A primary market is one in which new securities are issued, such as when companies, governments, and other entities obtain financing through issuing debt or equity securities. Primary markets are facilitated by underwriters, typically investment banks, which help set the issue price for a security and assist in selling it to investors. A secondary market is one in which investors purchase existing securities or assets from other investors. The national exchanges, such as the New York Stock Exchange and the NASDAQ, are secondary markets. In any secondary market transaction, the cash proceeds go to an investor rather than the issuer of the security. Trading of ETFs occurs in the secondary market.

While both mutual funds and ETFs allow investors to invest in a portfolio of assets, there are differences between them. Shares in ETFs can be sold short. This is important for investors who, not only pull out their funds in down markets, but also want to profit from the downturn. Short selling requires borrowing shares from a broker, selling them in the open market, and buying them back in the future and returning them to the broker, hopefully at a lower price. The investor’s profit is the difference in price, minus any transaction costs and dividends. Investors cannot short mutual funds because their shares are not sold in a secondary market. An investor who wants to “sell” shares in a mutual fund redeems them with the fund provider.
Another advantage of ETFs that has been debated is their tax efficiency. ETFs are more tax efficient because they do not create realized capital gains when shares are issued or redeemed. When investors redeem mutual fund shares, the fund’s manager might have to sell securities in order to generate cash for the redemption. Such selling might create realized capital gains or losses, which are distributed to the fund’s remaining investors. If an investor owns a mutual fund when it sells securities it is holding, he or she is responsible for paying taxes on any capital gains, even if he or she did not earn those gains. When invested in an ETF, you only pay taxes on the gain or loss in share price and dividend distribution that is realized when the shares are sold.

Another advantage of ETFs is the ability to trade intraday. With most open end mutual funds, an investor can only acquire or redeem shares at the end of the day, at that day’s closing NAV. Others can only be acquired or redeemed at set times throughout the day, but still not at any instance. If an investor anticipates a move in the market and wants to trade on it, they will have to wait until the set time or the market close. ETFs trade just like a stock, so an investor can buy and sell at any point during the day while the market is open.

Although it seems that exchange traded funds are better investment vehicles mutual funds, they have a few disadvantages. One of these involves transparency. ETFs must provide complete transparency to the public regarding assets held and traded. When an index releases information stating it will be rebalancing its portfolio, investors can anticipate which shares will be bought or sold, creating a front running opportunity. Front running is buying (selling) a
security before the large fund does, to capture the increase (decrease) in price that is very likely to occur when the fund buys (sells) a large volume of the security.

An issue that affects both mutual funds and ETFs is the way they reinvest their dividends. Most funds don't reinvest their dividends as they come in. This would not be efficient due to trading costs. Instead, they pool the cash flows, and reinvest at set time intervals, or not at all. Some funds pay out cash inflows to investors as dividends. The result, in a rising market, is underperformance to the underlying index. Of course, this can help the fund outperform the index in a declining market.

Another issue that can affect both index mutual funds and index exchange traded funds is tracking error. Index mutual funds and index ETFs are designed to mimic (track) a specific underlying index. An index mutual fund is always invested in or redeemed at NAV so its performance will only deviate from the index if its holdings fail to match the index. In contrast, an index ETF trades like a stock, so its price may deviate from its NAV. Investors can create new shares of the ETF if the price is higher than the NAV, or redeem shares if the price is lower than the NAV, in order to bring the fund back to its NAV. This is not always feasible due to the transaction costs involved. In either case, these deviations can result in what is known as tracking error. Tracking error is an important focus of this thesis.

Investors can amplify returns by leveraging. Leveraging is using borrowed capital to purchase additional assets. Derivatives are securities that derive their value from an underlying asset, and allow the investor leverage to enhance returns. Leverage and Inverse ETFs use derivatives to achieve this leverage and enhanced returns. Inverse ETFs are used to place a bet
on a downturn in the market. Leveraged ETFs started appearing in 2006, and have growth substantially ever since. As of September 2011, there were $36.6 billion dollars of assets under management in leveraged and inverse ETFs. They use various financial instruments, such as derivatives, or borrowed capital, such as margin, to increase the potential return of an investment. Some leveraged ETFs promise investors two or three times the return of an underlying index, while other inverse ETFs promised one, two, or three times the opposite of an index return.

The funds allow investors to make oversized bets on the market, long or short, by using swaps, futures, and other derivatives,” says Murray Coleman of Barrons. A typical two times leveraged ETF seeks to track two times the return of the underlying index. The concept is simple; an investor buys the 2x leveraged ETF, Ultra S&P 500 (Ticker: SSO), and earns twice the return of the S&P 500. Inverse ETFs use short selling and leverage to create the negative of the return of their underlying index. An investor should therefore be able to buy the 2x inverse (-2x) ETF, Ultra Short MidCap 400 (Ticker: MZZ), and earn twice the negative of the return on the S&P 400. This should hold true in theory, but these leveraged products typically have much higher levels of tracking error than traditional (1x) index ETFs.

Tracking error is the divergence between the price of a portfolio and the price of its benchmark, or underlying index. There are many ways to compute tracking error. One way to calculate tracking error is the root mean squared error (RMSE). This is done by squaring each deviation (the difference between the portfolio return and the benchmark return), calculating the arithmetic average of the squared deviations, and then calculating the square root of that average.
Another way of calculating it is as the standard deviation of the percent difference between the fund return and the index return. This is the way I will calculate tracking error in my analysis.

It is also important to note that tracking error can be measured as ex-ante or ex-post. Ex-ante tracking error is a forecast of what tracking error is expected to be. Ex-post is a calculation of tracking error based on historic returns. In this thesis, the focus is on ex-post tracking error.

Investors have different opinions about tracking error. It is most often viewed negatively because it indicates the fund manager is not doing what was promised; that is, not tracking the index (underlying asset prices), although a small amount of tracking error may be unavoidable and is therefore accepted. Even if the tracking error is associated with an average excess return above the underlying index (positive alpha), giving the investor better returns, it can still be seen as bad. Problems may arise between a manager and investors if the manager is not tracking an index the way promised in the ETF prospectus. Investors do not want excess risk being taken with their money.

On the other hand, some investors take a more optimistic approach when looking at tracking error. They believe that if there is positive alpha, there is no reason to complain about the associated tracking error. Of course, this only holds true when the manager is creating positive alpha, not negative.

Most exchange traded funds don’t track their underlying portfolio perfectly. Tracking error can come from a variety of sources including commissions, rebalancing, and transaction costs. Fund management fees can also cause an investor’s return to be less than the benchmark. Managers rebalance their portfolios periodically to align them better with the underlying index or
portfolio of securities. This can happen because the index changes the weights or securities held in it. Rebalancing the portfolio re-aligns the weights of the assets in the portfolio with those in the underlying index. This does not happen continuously; therefore, the fund may not, at every instant, hold an exact replica of the underlying index. This can cause returns to deviate from the index. The final major contributor to tracking error is commissions. When managers trade, possibly for rebalancing, they incur transaction costs. These costs, although maybe small, are not found in the index returns. For these reasons, some small amount of tracking error would be expected even for the best run funds.

Because of the techniques used to create leveraged and inverse ETFs, tracking error can be even more severe for them. “The zigs and zags of daily price action can cause leveraged ETFs to chart unexpected courses,” says Marc Gerstein in Forbes (2010). Leveraged ETF managers will not just try to attain a representative sample of the underlying portfolio, as this will only give them the same return (roughly). Instead, they may use derivatives, margin, or other means to create the multiplied return of the index. A typical leveraged ETF will hold a small portion swaps, options, and futures, and other derivative contracts, and a larger portion of cash. The cash is held to manage losses on the derivative contracts. This technique can cause the tracking error to be larger than in traditional funds.

There has been a lot of research done regarding ETFs, some of which has been focused on leveraged and inverse products. Researchers have looked at the price behavior and tracking ability of these funds. In this paper, I will be looking at the tracking ability of the world’s largest
manager of leveraged and inverse ETFs, ProShares, in multiple ways to understand what causes greater amounts of tracking error.

**Literature Review**

Investors are concerned with tracking error because it impacts their returns. Poterba and Shoven (2002) look at a comparison of Index Fund and ETF returns on a pre-tax and after-tax basis. They find that there are many contributors to deviations of returns of each to the underlying. These include expense ratios, purchase price (or purchase value), and tracking error on a pre-tax basis. Deviations are further realized on an after-tax basis when the investor accounts for the difference in realized capital gains between the funds. They also finds that the Vanguard 500 Index fund outperformed the market in the sample period 1994-2000, net of expenses. They believe this is attributable to the Vanguard fund rebalancing when the index announces it will. The index announces rebalancing before it actually does. This allows the fund to gain from the buying of the rebalanced portfolio.

Robertson (2003) also looks at what causes tracking error in equity index funds, stating that the goal of index funds is to minimize both expense ratios and tracking error, and that funds should be evaluated on these two metrics. He finds that tracking error is attributable to the use of derivatives, daily volatility, sampling error, and liquidity issues. First, funds will use derivatives to hedge prices until they can buy or sell a portion of their portfolio. The use of derivatives has costs, therefore creating tracking error. Next, funds may buy or sell securities throughout the
day, and not at their closing price. This can cause the fund's daily price to deviate from the index. Further, some indices contain a large number of securities. Having to fully replicate these funds would be costly. Instead, fund managers may hold a representative group of the securities, known as a sampling approach to index replication. The sampling error associated with not holding exactly the same securities as the index leads to more tracking error. His final variable was liquidity issues. Not all securities are traded every day. Smaller stocks may not have the volume to trade, or trading them may cause substantial price changes. This is called market impact cost. He believes these three issues cause substantial tracking error in index funds.

Gastineau (2001) provides good background on ETFs and how they originated. He discusses products that came before ETFs, such as program trading or portfolio trading. This is the original way investors traded portfolios of stocks, like the S&P 500, in a single trade. He also reviews the redemption and creation in ETF shares. These features allow for arbitrage to keep the fund trading close to its NAV.

Elton (2002) studies how dividend reimbursement to investors affects the returns of ETFs compared to their underlying index. He finds that if the fund decides to hold the dividends to release them in set intervals, say quarterly, the fund will underperform the index or index fund in a rising market if the funds reinvest the dividends immediately. This is due to the fund missing out on the gains that could be earned on reinvested dividends in a rising market.

Aber, Li, and Can (2009) look at the tracking ability for iShares ETFs. They find that most ETFs trade at a premium to their NAV, even on high volume days (where arbitrage should be easy), suggesting the market overvalues ETFs. They also find that ETFs and mutual funds
vary when compared by tracking error. Some mutual funds and ETFs had almost identical returns. Others differed by more than ten percent, with the ETF performing better than the mutual fund. This shows that tracking is still an issue in most fund types, and still has reason to be examined.

Rompotis (2011) also looks at tracking error by comparing 50 iShares fund performances with the performance of the NAVs of the indices. He states, “When we use the NAV return tracking errors, we remove the expense ratio from the model because NAVs are free from management expenses and therefore there must be no sensible relationship between tracking error and expense ratio.” He finds that the age and risk of the fund directly and significantly affect its tracking error. He also finds that funds can be constructed in a variety of ways, using a mixture of growth and value, large cap and small, emerging markets and established, etc., to have positive alphas. They have higher risk-adjusted returns when expressed by their Sharpe ratios.

As leveraging comes into the ETF family in 2006, we see leveraged and inverse ETFs being released into the market. Trainor and Baryla (2008) ask whether leveraged ETFs provide the returns they promise, by studying the long run holding period returns of leveraged ETFs. They find that returns vary in different market conditions. They demonstrate that returns on leveraged ETFs are lognormally distributed. As they state, “Although it is a statistical fact that compounding random returns causes long term returns to be lognormally rather than normally distributed, the effect of this is not always understood.” This is important because it causes the distribution of returns to be positively skewed. With a lognormal distribution, the median is
below the mean. This tells us that investors are statistically more likely to get a return less than the average return; however, the returns that are larger than the average can be a lot larger.

Another important concept they discuss is the constant leverage trap. This is not a new concept, and has been talked about by fund companies and in the popular press. They state:

Constant leverage requires an investor to maintain an exact percentage of leverage over the entire time horizon. If one is using a margin account, this requires an investor to buy in a rising market and sell in a declining market. The ‘trap’ occurs because this type of strategy magnifies the compounding problem. The compounding problem is based on the mathematic principle that the geometric mean of a series of numbers is lower, the greater the variance of the numbers. Using leverage magnifies the variance of the returns.

(Trainor and Baryla, 2008).

Modeling both concepts, they run Monte Carlo simulations on leveraged ETF returns. They find, for holding periods out to ten years, a typical 2x leveraged ETF only returns 1.4x the index on an annual basis; however, an investor still assumes twice the risk of the traditional ETF measured by the standard deviation of returns. They also compare this with buying a traditional ETF on margin as a way of replicating a leveraged ETF. Their results show leveraged ETFs are better due to lower costs associated with trading and interest on the margin account.

Militaru and Dzekounoff (2010) compliment this research, finding that the amount of volatility determines the distribution of possible returns for a leveraged fund, using the fund SKF for their analysis. They state, "The lower the volatility, the more symmetric the alternative
outcomes will be.” They find that high volatility pushes the majority of possible returns downward.

Charupat and Miu (2011) find that, while price deviations are generally small, the leveraged and inverse ETFs are more inclined to large price premiums or discounts. These deviations are generally larger than traditional ETFs. They also find that while bull leveraged ETFs (leveraged ETFs structured to return positive multiple returns of the index) trade at a discount or slight premium, on average, bear leveraged ETFs (leveraged ETFs structured to return negative multiple returns of the index) tend to trade at relatively larger premiums. They state, “This is consistent with the fact that premiums occur more frequently than discounts for all bear ETFs. In contrast, we observe discounts more frequently than premiums for all bull ETFs.”

They also observe that leveraged ETFs successfully deliver the promised return for holding periods of up to one week. However, for holding periods out to one month, there is significant tracking error, especially in inverse ETFs. Holding periods longer than this can see returns considerably different than what is promised.

Research Plan

In this paper, I will examine the tracking error of leveraged and inverse ETFs compared to the appropriate multiples of their underlying indices. I will use the ProShares leveraged exchange traded fund series in my research. I will be looking at three underlying indices: S&P400, S&P 500, and S&P 600. The S&P 500 represents the large-cap sector of the equity
market, the S&P 400 represents the mid-cap sector, and the S&P 600 represents the small-cap sector. I will use the ETFs outlined in exhibit 1.

Table 1

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<th>Ticker</th>
<th>Leverage</th>
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<td>Large Cap</td>
<td>SSO</td>
<td>2x</td>
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<td>Ultra SmallCap 600*</td>
<td>S&amp;P 600</td>
<td>Small Cap</td>
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* Jan. 23 2007 inception date
** Jan. 23, 2009 inception date

I will use historical closing price data from Yahoo Finance for the time period January 1, 2007 to December 31, 2011. I will be using the adjusted close for both the underlying indices and the leveraged ETFs. This price factors in the dividend by adjusting the price down for the equity.
paid out of the company. This allows me to examine an equal amount of data for all of the funds, except for those with inception dates after January 1, 2007 (which are indicated by asterisks in the exhibit.) I will use the following measure of tracking error. Alpha will be the deviation of return from the underlying index. This will be calculated as: \( \text{Alpha} = \text{appropriate multiplied return of the underlying index - return of leveraged or inverse ETF} \). Tracking error will be measured as the standard deviation of alpha. Using this measure of tracking error, and the funds described above, I will examine the effects on tracking error. I will examine daily tracking error for the time period stated, paying attention to market conditions within the time period. I will also compare this tracking error across the different funds to examine the effects from the amounts of leverage. By comparing the funds described, I will also be able to see if there are differences in tracking error related to market cap. Finally, I will examine tracking error based on the length of holding period by comparing the daily, weekly, monthly, annual, and cumulative tracking error.
Works Cited


