The Long and Short of Leveraged ETFs: the Financial Crisis and Performance Attribution

by

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December 28, 2011

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Abstract

Leveraged ETFs have received much press coverage of late due to issues with their performance. Managers and the media have focused investors' attention on the impact of compounding, when the funds are held for more than one day. In this paper, I lay out a framework for assessing the performance of leveraged ETFs. In particular, I propose a simple way to disentangle the effect of compounding and that of i) the management of the fund and ii) the trading premiums/discounts, all of which affect investors' bottom line. The former (i) is influenced by the effectiveness and the costs of the manager's (synthetic) replication strategy and the use of leverage. The latter (ii) reflects liquidity and the efficiency of the market. I find that tracking errors were not caused by the effects of compounding alone. Depending on the fund, the impact of management factors can outweigh the impact of compounding, and substantial premiums/discounts caused by reduced liquidity during the financial crisis further distorted performance.

I. Introduction

In the last few years, the market for Exchange-Traded Funds (ETFs) has grown exponentially; there were more than 1200 ETFs listed in the U.S. and Canada in the spring of 2010. In this paper, my focus is on a relatively new type of ETFs: Leveraged ETFs. There are two main varieties of leveraged ETFs, those that magnify an index's return (ultra or bull ETFs), and those that track or magnify its inverse (bear ETFs). Approximately 13 percent of the ETFs traded in the U.S. are of the leveraged variety, and they account for 26 percent of the ETF trading volume. In Canada, the comparable numbers are 26 percent and a striking 61 percent, respectively.[1] These numbers continue to grow, and is testimony to the popularity of these funds, considering the first leveraged ETF was introduced in June 2006. However, exactly because they are relatively new investment vehicles, little academic research has focused on the performance of these funds.

The management of leveraged ETFs differ significantly from that of regular ETFs. For regular ETFs, which tracks an index or a portfolio,[2] an arbitrage mechanism exists through out the trading day to keep the price of an ETF in sync with the price of its underlying index. This mechanism is a process called in-kind redemption and creation. When an ETF is trading at a premium, authorized participants[3] can swap the underlying basket of securities for shares of the ETF (and hence new shares are created). When the ETF is trading at a discount, authorized participants can redeem their shares in return for the underlying basket of securities. Hence, unlike a closed-end mutual fund, the ETF's number of shares outstanding is always changing. That said, depending on the extent of the arbitrage activities and the liquidity of the market, ETFs can still trade at a premium or a discount.[4]

[1]Source: Presentation by Mark Yamada of Pur Investing at the 9th Annual Cup of Canada Investment Management conference, Toronto, 2010.

[2]Passive ETFs track an index, while the relatively new breed of active ETFs track an actively managed portfolio.

[3]Authorized Participants are usually trading desks of large financial institutions (i.e., market makers).

[4]Elton, Gruber, Comer and Li (2002), Ackert and Tian (2000, 2008) report that the mispricing in U.S. ETFs are small, which is not surprising since they are the most liquid. Jares and Lavin (2004) and Engle and Sarkar (2006) find that this is not the case for international ETFs. This is probably due to the fact that for international ETFs where there is little or no overlap in trading hours with their underlying markets,

The underlying index may be stale, however, if it is made up of securities that are traded overseas.

Leveraged ETFs operate very differently. These funds aim to track *daily returns*, instead of the price of an underlying index at a higher frequency (e.g., 15-minute intervals). Leverage and derivative securities such as total return swaps and future contracts are employed by the leveraged ETF manager (or a third-party structured product specialist) to magnify the underlying index's return or its inverse by two or three times. The portfolio is rebalanced once a day toward at the end of the trading day. The leveraged ETF's end-of-day net asset value (NAV) is made known to authorized participants, and so an arbitrage mechanism - albeit in cash rather than in kind - also exists to help keep the market price of the leveraged ETF close to its NAV, at least at the end of the trading day.

Investors are attracted to these ETFs, because these ETFs allow them to increase their market exposure or to hedge without a margin account, and without any expertise in leveraging or derivative securities. In the case of inverse leveraged ETFs, losses are limited to the value of the transaction, unlike regular short positions. In addition, they may serve as a substitute for short-selling when the underlying assets are difficult and expensive to borrow (Avellaneda (2010)).

Recently, the performance of leveraged ETFs has been called into question. Class action law suits are in the works,[5] and the SEC, FINRA and its Canadian counterpart, IIROC, have all issued investor alerts. Financial advisors have grown leery about recommending them because of the complexity of the products.[6] For example, in a recent CFA Magazine article, Sullivan (2009) advises that, "*Prudent investors .... should consider the use of leveraged funds with great caution, especially for periods longer than a day.*" Direxion Funds, which manages a number of leveraged ETFs, also says on its website that their products are for "*sophisticated*

deviations from net asset value are calculated with stale prices.

[5]According to Globe NewsWire on November 25, 2009, a law firm in the U.S. is investigating claims in several ProShares leveraged ETFs, that ProShares' registration statement, prospectuses, and statements of additional information were false and misleading, and did not provide adequate disclosure.

[6]In fact, in the U.S., certain brokerage firms such as Morgan Stanley and UBS have banned their advisors from recommending leveraged ETFs.

investors who understand ... (the) consequences of seeking daily leveraged investment results and intend to actively monitor and manage their investments ...". Similar disclaimers can be found on the website of virtually all leveraged ETF management companies.

Specifically, investors are being warned about the impact of compounding on returns, when a fund is held for more than one day. The reason given is that these funds have a daily return target; therefore, the compounded return of a leveraged ETF over a longer holding period "will likely differ in amount and possibly direction from the target return for the same period."[7] These statements are disconcerting for investors: Most of them have horizons that are longer than a day (except for day traders), and it is simply impractical and expensive for them to rebalance their portfolios on a daily basis.

In this paper, the performance of a leveraged ETF is defined in terms of its average deviations from its target return, as well as the volatility of the deviations, known as "tracking error" in the investment literature. To the leveraged ETF investor, there are three components to the fund's performance: The impact of compounding if the holding period is longer than one day, the effectiveness and the costs of the fund's management in achieving its investment objective, and the efficiency of the leveraged ETF market in maintaining a small trading premium/discount. The goal of this paper is to lay out a framework for assessing the performance of leveraged ETFs from an investor's perspective, using a select group of domestic and foreign equity leveraged ETFs. The underlying indices are: S&P/TSX60, S&P500, S&P/TSX Global Gold, DJ/Oil and Gas,[8] MSCI Europe, Australia, and Far East (EAFE), and MSCI Emerging Markets (EM).

The main contribution of this paper is the decomposition of the deviations into three buckets: 1) deviations due to compounding, 2) deviations due to the manager's ability to consistently achieve the target return, and 3) deviations due to the ETF being traded at a premium/discount to its net asset value (NAV). The impact of compounding has been

[7] http://www.proshares.com. I will elaborate on the impact of compounding further in the next section.

[8] The S&P/TSX Global Gold index is not based directly on the price of gold bullion, but rather, it is made up of 49 companies in the gold mining business. Similarly, the DJ/Oil and Gas index is made up of 94 companies in the oil and gas industry.

raised in several studies (Avellaneda and Zhang (2009), Cheng and Madhaven (2009), Lu, Wang, and Zhang (2009), and Hill and Foster (2009)). Leveraged ETF managers and the media have also focused investors' attention on the impact of compounding, especially when the funds are performing poorly. The missing piece of the puzzle is whether the other two factors contribute to that performance and by how much, as well as to what extent they are affected by the financial crisis of 2008. Hence, it is informative to disentangle the effects of compounding, fund management, and trading premiums/discounts. Fund management includes expenses and factors that may prevent the manager from achieving the target return consistently, including tighter credit conditions, counterparty risk, currency risk, and so on.

I begin the analysis by providing an overview of the performance of the sample of leveraged ETFs over different holding periods, focusing on their alphas and betas, for the period January 1, 2008 to December 31, 2009. Because they are return-tracking funds, estimated alphas that are statistically close to zero and estimated betas that are statistically close to 2 for bull ETFs (and -2 for bear ETFs) suggest good performance. The alphas and betas are estimated by regressing the returns of the leveraged ETF on the returns of its underlying index. The returns of the funds based on market prices are what investors receive. However, the returns are influenced by three different factors - compounding, management, and trading premium/discount, as discussed above. Hence, the next step in the analysis is to decompose the deviations of each leveraged ETF from its target return into the three different types of deviations, and highlight their relative importance. Since the financial crisis in the fall of 2008 occurred in the middle of my sample period, I am also able to assess its impact on the performance of the leveraged ETFs. Last but not least, I study the impact of the financial crisis on the market microstructure of the leveraged ETFs, focusing on the intraday share price volatility, trading volume, and bid-ask spread. The latter, of course, is a widely used measure of market liquidity, which may influence trading premiums/ discounts, particularly during the crisis period. I also examine whether the intraday trading patterns of leveraged ETFs differ from that of regular stocks.

To preview my results, I show that bear ETFs deviate from their target return much more quickly than their bull counterparts as the holding period lengthens. Contrary to popular belief though, market returns to leveraged ETFs can deviate from their target even if investors rebalance on a daily basis. For example, in the case of the EAFE and EM bear ETFs, their respective underlying indices explain only 36 to 40 percent of the variations in their daily market returns, possibly due to the problem of nonsynchronous trading between the ETF and its underlying index. In terms of the alphas, they are mostly negative, and they typically become statistically significant starting at the 1-week holding period. They can also be alarmingly large, particularly when the ETFs are held for a year. When I decompose the deviations of a leveraged ETF from its target return, I find - perhaps not surprisingly - that mean deviations due to compounding were the biggest in 2008. Tracking errors due to management factors and trading premium/discount also experienced a substantial increase during the financial crisis. For the EAFE, EM, and S&P500 bear ETFs, management factors had a much greater impact on their performance than compounding across all holding periods examined.[9] Interestingly, for the full sample period, the deviations due to compounding have overall a low or negative correlation with the deviations due to management factors. Hence, the two types of deviations appear to be driven by different forces, and do not reinforce each other in dragging down or pulling up the returns of the leveraged ETFs. This observation suggests that there may be some "diversification" benefits in holding periods that are longer than a day.[10] In terms of the deviations due to trading premiums/discounts, there was a noticeable jump during the financial crisis, suggesting a temporary loss of market efficiency and liquidity over that period. Last but not least, I find that the financial crisis had an asymmetric impact on the bull versus the bear ETFs' intraday trading patterns. It had a much bigger effect on the intraday share price volatility of the bear ETFs than the bull ETFs, even though the latter experienced a much greater surge in trading volume during

[9] Part of the reason, at least for the S&P500 bear ETF, is the one-time large capital gain distribution made by the fund at the end of 2008.

[10] The only exceptions were the S&P500 bull and bear ETFs, where the correlations increased to significant levels as the holding period lengthened, but this was observed only in specific years, namely 2006 and 2007.

the crisis. In terms of the intraday average bid–ask spreads, the results show that most of the leveraged ETFs suffered a significant reduction in liquidity during the financial crisis, explaining the jump in trading premiums/discounts during that period.

The rest of the paper is organized as follows. In section II, I provide a background discussion on the impact of compounding, and describe the data employed in the empirical exercises. In section III, I estimate the alphas and betas of a set of domestic and international equity leveraged ETFs over different holding periods. In section IV, I decompose their tracking errors into deviations due to compounding, deviations due to management factors, and deviations due to trading premiums/discounts. Additionally, I study how these deviations behave over time. In section V, I examine the market microstructure of the leveraged ETFs, followed by a discussion of how it was affected by the financial crisis. In particular, I look at whether the premiums/discounts documented in section IV coincided with a reduction in liquidity. A summary section concludes the paper.

II. Background and data

In this paper, I refer to all leveraged ETFs that are designed to produce twice the return of the underlying index as "2x bulls", and those designed to produce twice the inverse of the return as "2x bears". Recently, leveraged ETFs that seek to produce three times the return or the inverse of the return of an underlying index have been introduced, but due to their even shorter history, the funds that I examine in this paper are all of the 2x variety.

Because of growing investor concerns and complaints about the performance of leveraged ETFs, companies that manage these funds are now very careful to specify that leveraged ETFs seeks to replicate twice the return (or the inverse of the return) of an index for a single day only. Additionally, "*due to the compounding of daily returns, ProShares' returns over periods other than one day will likely differ in amount and possibly direction from the target return for the same period.*" (ProShares website)[11] The impact of compounding on

[11] http://www.proshares.com/funds/.

cumulative returns is a fact that cannot be changed. It is easy to demonstrate that over a 2-day holding period, the net return on the underlying index is:

$$(1 + r_t)(1 + r_{t+1}) - 1 = r_t + r_{t+1} + r_t r_{t+1} \tag{1}$$

And the net return on a 2x bull ETF is:

$$(1 + 2r_t)(1 + 2r_{t+1}) - 1 = 2(r_t + r_{t+1} + r_t r_{t+1}) + 2r_t r_{t+1} \tag{2}$$

Assuming that the $\times 2$ replication is perfect on a daily basis, the deviation due to compounding, (2) - $2\times(1)$, is $2r_t r_{t+1}$. Note that the effect of compounding is not symmetric: For a 2x bear leveraged ETF, the net return over a 2-day holding period is:

$$(1 - 2r_t)(1 - 2r_{t+1}) - 1 = -2(r_t + r_{t+1} + r_t r_{t+1}) + 6r_t r_{t+1} \tag{3}$$

Assuming perfect replication again, the deviation due to compounding is $6r_t r_{t+1}$ for the 2x bear ETF, which is three times bigger than the deviation of its 2x bull counterpart. If there is momentum (positive or negative) in daily returns (i.e., trending up or down), the deviations will be positive. In other words, if the underlying index is trending up, a 2x bull ETF will generate a higher return than otherwise, and a 2x bear ETF will generate a smaller loss than otherwise. I will call this the "trending" effect. If returns are negatively autocorrelated (i.e., a positive return on day t followed by a negative return on day $t + 1$, or vice versa), the deviations will be negative. Therefore, even if the underlying index breaks even, both the 2x bull and 2x bear ETFs will post a negative return, with the latter being three times larger. I will call this the "flat-return" effect.[12]

To study the impact of compounding, some authors[13] derive a relationship between

[12] Sometimes this is referred to as the volatility drag, but the term creates potential confusion, as whether there exists a drag depends on the type of volatility, or more precisely, serial correlation.

[13] See for example, Avellaneda and Zhang (2009), Cheng and Madhaven (2009).

the leveraged ETF return and the underlying stock index's volatility, assuming a normal distribution in returns. However, stock market returns are well-known to exhibit higher moment properties (skewness and kurtosis), particularly during a market crash. As a result, the second-order approximation may be less informative for the sample period in question, and lead to misleading tracking errors. The decomposition in (2) and (3) is exact, and can be extended to longer holding periods; it does not rely on the assumption of normality.

Any residual deviations in the actual leveraged ETF market returns are likely due to the management process and to the existence of trading premiums/discounts. First of all, the leveraged ETF manager may not be able to consistently replicate the target return perfectly, which can be caused by tighter credit conditions, counterparty risk, currency risk, and so on. Fees and expenses will also be a factor (thus creating a drag on returns), but they are low on a daily basis, and more importantly, they should not produce any significant time-series variations, as they are distributed evenly throughout the year (so that short-term investors pay their share as well). Second, a temporary loss in market efficiency (for example, during a period of financial turmoil and reduced liquidity) may cause the market price of a leveraged ETF to deviate from its NAV, to which the portfolio is rebalanced on a daily basis.

The market data used in this paper are from Bloomberg and Yahoo Finance; the NAVs of the leveraged ETFs are from BetaPro and ProShares. Before calculating the trading premiums/discounts, the NAVs are adjusted by any share splits or consolidations that might have taken place during the sample period, January 1, 2008 to December 31, 2009.[14] To calculate the daily change in the NAV, the latter is first adjusted by any capital gains and/or dividends the ETF might have distributed.

III. Overview: Alphas and Betas

It is instructive to start the analysis by providing an overview of the performance of the funds. I do so by estimating the alpha and beta of each fund over different holding periods.

[14] For funds that have longer history, I include the 2007 data in my calculation of the deviations from target returns.

Again, "performance" is defined in terms of the fund's ability to consistently achieve its target return. The set of leveraged ETFs I study are based on the following equity indices: Canadian blue chips (S&P/TSX60), gold (S&P/TSX Global Gold index)[15], oil and gas (DJ/ Oil and Gas index), international and emerging market equities (MSCI EAFE index and MSCI EM index), and U.S. blue chips (S&P500). All of the underlying indices are total-return indices. The first two are managed by BetaPro in Canada, and the rest by ProShares in the U.S.. Lu, Wang, and Zhang (2009), perform a similar analysis, but focus on four pairs of U.S. leveraged ETFs (based on the Dow Jones Industrial Average, S&P 500, Nasdaq 100, and Russell 2000). They conclude that holding periods can be as long as one year for the ProShares Ultras (designed to provide twice the return of the underlying index), and a quarter for the ProShares UltraShorts (designed to provide twice the *inverse* of the underlying index's return). A year and a quarter are long holding periods within the context of leveraged ETFs, but that may be due to the fact that the ETFs these authors pick are the most liquid, and the derivative market for their underlying indices are very well established.

In the regression analysis below, the ETF returns are calculated using market prices. In other words, the analysis are conducted from an investor's perspective: Although the ETF manager rebalances the portfolio with respect to the NAV of the fund, investors receive returns based on market prices, i.e., including any premium or discount at which the fund is trading. In Section IV where I assess the contribution of the management of the fund to the tracking error, returns of the ETFs will be calculated using NAVs, and the difference between the NAV and the market price is the trading premium/discount.

For each leveraged ETF, I provide summary statistics of the daily returns and that of their underlying index, for the sample period January 1, 2008 to December 31, 2009. As well, I regress the holding-period returns of each leveraged ETF on the holding period returns of its underlying index, to test i) whether the beta coefficients deviate from the "promised" magnitude (for example, for a 2x bull, investors would expect a coefficient of 2, and for a

[15] The Index consists of securities of global gold sector issuers listed on the TSX, NYSE, NASDAQ, and AMEX.

2x bear, -2), and ii) whether the intercept, or the "alpha" of the fund is statistically and economically different from zero; and iii) whether variations in the underlying index explains a significant portion of the variations in the returns of the leveraged ETFs (as indicated by a high R^2). I consider the following investment horizons: One day, two days, one week (5 trading days), three months (63 trading days), and one year (252 trading days). Due to potential bias created by overlapping samples (e.g., today's and tomorrow's one-week holding period returns overlap), I report t statistics calculated using Newey-West (1987) standard errors. For each holding period, the regression model is:

$$r_t^{ETF_i} = \alpha_i + \beta_i r_t^{Index_i} + \varepsilon_{i,t} \tag{4}$$

I report the summary statistics in Table 1, and the regression results Table 2.

[Tables 1 and 2]

I begin with the overall performance of the S&P/TSX 60 2x bull (ticker: HXU) and 2x bear (ticker: HXD) ETFs. Over the sample period, HXD has a larger mean than HXU, due to all the large negative returns in the S&P/TSX60 during the market crash in the fall of 2008. The standard deviations of both ETFs are similar in magnitude, about twice that of the underlying index. HXU exhibits negative skewness, as did the underlying index, while the inverse ETF, HXD, shows the opposite. In terms of kurtosis, the S&P TSX60 index is actually the most leptokurtic of the three, because it has more tail observations (e.g., those that are more than one standard deviation away from the mean), and likely to have a narrower, single peak in the distribution.

The adjusted R^2s are all reasonably high. The null hypothesis for the alpha estimates[16] is $H_0 = 0$, and the null hypothesis for the beta estimates is $H_0 = 2$ for the 2x bull ETFs, and $H_2 = -2$ for the 2x bear ETFs. It is interesting that for HXU, the 1-month and 3-month

[16] In their regressions, Lu, Wang and Zhang (2009) force the intercept term to be zero. However, the intercept, commonly known as "alpha" in the investments literature, may represent a measure of the manager's ability to replicate the promised returns, which may in turn be influenced by factors such as the liquidity of the stock and derivate markets, and credit conditions.

holding period betas are closest to 2 (they are 1.9835 and 1.9590, respectively), and the null cannot be rejected for these two estimates. For HXD, it is the 1-week and 1-month holding period beta estimates where the null cannot be rejected. The deviation is the largest over a 1-year holding period, where the estimated coefficient for beta is -1.3323. So it is interesting - at least for the sample period in question, that the best replication results - from an investor's perspective - are not found in the 1-day holding period returns, as argued by leveraged ETF management companies.

Comparing only the beta estimates, however, does not tell the whole story. Some of the alphas are quite significant both statistically and economically. These alphas are estimates of the leveraged ETFs' returns when their underlying index has a return of zero during the holding period, i.e., they are part of the return that is unrelated to the underlying index. For HXD, for example, even if the S&P/TSX60 had a zero percent return, investors would still have lost 24.03 percent for the year.

In the rest of this section, I will discuss the results for the other leveraged ETFs, based on the S&P/TSX Global Gold, DJ/US Oil and Gas, MSCI Emerging Markets, MSCI EAFE, and S&P500.

For the 2x bull Gold ETF (ticker: HGU), beta increases initially with the holding period, peaking at 1-month. Except for the 1-month and the 1-year holding periods, the null hypothesis of $H_0 = 2$ can be rejected. For the 2x bear Gold ETF (ticker: HGD), the null hypothesis of $H_0 = -2$ is rejected for all of the holding periods. Of note is the performance of HGD at the 1-year horizon: During the sample period in question, it has a very small beta estimate of -0.0959, and an alpha estimate of -0.8347. That is, if the global gold index had a zero percent return, investors would still suffer a loss of 83.47 percent for the year! Given these estimates, the gold index would have to drop by 870% within the year just for investors to break-even.[17] Contrast this to the 1-week holding period for HGD, where the global gold index only has to lose 0.28 percent over five days (15.79 percent annualized) for

[17] This result may seem alarming, but it is likely to be the worst-case scenario, unless we experience another major financial crisis.

investors to break even.

For the 2x Oil and Gas ETF, DIG, the null hypothesis of $H_0 = 2$ cannot be rejected for the 1-week, 1-month, and 3-month holding periods. For the 2x bear Oil and Gas ETF, DUG, the null of $H_0 = -2$ cannot be rejected for the 2-day and 1-week holding periods. The largest deviation in beta can be found in DUG when it is held for a year: The beta estimate is -0.7911, which is significantly bigger than -2. The alphas can again be sizeable. Holding DUG for 1-year can result in a loss of 49.97 percent even if the DJ/Oil and Gas index has a zero percent return. Put another way, even if investors bet in the right direction, it takes a 63.17 percent drop in the index for them to break even.

Next, I discuss the regression results for the 2x Bear ETF for the MSCI EAFE index and the MSCI Emerging Markets (EM) index (Tickers: EFU and EEV, respectively). Interestingly, the 2x bear ETFs for these indices were introduced in the fall of 2007, but the companion 2x bull ETFs were introduced much later, in June 2009. Due to the lack of observations, I do not include the 2x bull MSCI ETFs. For both 2x Bears, EFU and EEV, the results are again poor for certain holding periods. To summarize, there is a substantial drop in R^2 across the board in these regressions compared to the other leveraged ETFs. The alphas (especially for EEV) are large and statistically significant once the holding period is 1-week or longer, and the beta for the 1-day EFU deviates significantly from 2, and the R^2 for the regression is only 0.3628, indicating that only 36.28 percent of the variations in the daily EFU returns can be explained by the variations in the MSCI EAFE returns, the lowest across all holding periods. A likely reason is the nonsynchronicity in the trading of the ETF and its underling index: While the ETF is being traded in New York, the Asian markets are already closed, and the European markets close half way through. Hence, additional information might have been impounded into the price of the ETF.[18] Note that there is an inverted U-shape relationship between the adjusted R^2 and the holding period: The explanatory power of the underlying index peaks at 1-month for EFU and 1-week for EEV,

[18] Note that this issue applies to all ETFs with a foreign underlying index, leveraged or not. For a recent analysis of the impact of nonsynchronous trading in international ETFs, see Shum (2010).

and then declines. Finally, for investors to break even over a one-year horizon, the EAFE index needs to fall by 20.54 percent, and the EM index, 205.74 percent during the sample period in question.

The daily returns of the 2x S&P500 bull and bear ETFs, SSO and SDS, are about twice as volatile as their underling index, and equally leptokurtic. For SSO, the beta estimates are closest to their target of 2 for the 1-month and 3-month holding periods, while for SDS, they are closest to their target of -2 for the 1-week and 1-month horizon. Of all the 2x bear ETFs in the sample, SDS's beta estimate is the closest to -2 at the 1-year horizon: it is -1.6275, compared with, for stance, EEV's -0.3238. SDS's alpha estimate is also the smallest at the 1-year horizon, although it is still statistically and economically significant, at -22.46 percent.

There are three noteworthy observations from the results in this section. First, there is a lot more noise in the 2x bear ETFs. For the 2x bulls, the adjusted R^2 are consistently above 94 percent for all holding periods, while for the 2x bears, the adjusted R^2 can be as low as 36 percent. Second, while shorting a bear ETF (i.e., shorting a short) is an inefficient strategy if the underlying index is expected to go up, but it could be very profitable if the index is expected to drop by less than the break-even amount. Third, better results are often observed at the 1-week or 1-month holding period rather than the 1-day, suggesting that other forces are at work. I will elaborate on this issue in the next section.

IV. Decomposing the deviations from target return

IV.A. Decomposition

From the regression results above, we saw that even for a 1-day holding period (i.e., rebalancing daily and has no compounding effect), the betas calculated using market prices can differ significantly from 2 (or -2). Daily deviations from target return would have to come from factors related to the management of the leveraged ETFs and/or trading premiums/discounts. These factors include liquidity, the efficiency of the derivative and the ETF markets, cost of leverage, and are unlikely to be caused by fees alone. Unless these daily deviations are random and cancel each other out over time, they would also affect returns over holding periods longer than one day. In this section, I decompose the deviations of the leveraged ETFs from their target return to examine the relative importance of the effect of compounding and the effect of management factors for different holding periods. A related question is whether these two types of deviations are correlated. For example, if they are driven by different forces and have zero correlation, then holding the ETF for a longer period will not be as damaging to the performance as if they were positively correlated. Additionally, I show the daily trading premiums/discounts of each fund, and how they vary over time.

To illustrate how the decomposition is done, consider again a holding period of 2 days. Using equation (2), for a 2x bull ETF, the deviation on day t due to compounding, D_{CP_t}, can be written as:

$$D_{CP_t} = [(1+2r_t)(1+2r_{t-1}) - 1] - 2[(1+r_t)(1+r_{t-1}) - 1] \quad (5)$$

where r_t is the underlying index return.

The deviations due to management factors, D_{M_t}, is therefore the residual difference:

$$D_{M_t} = [(1+R^{Bull}_{NAV,t})(1+R^{Bull}_{NAV,t-1}) - 1] - [(1+2r_t)(1+2r_{t-1}) - 1] \quad (6)$$

where $R^{Bull}_{NAV,t}$ is the return of the 2x bull ETF's NAV. I use the NAV here instead of the market price, because the ETF manager rebalances his portfolio to the fund's NAV, not to the market price. Note that the standard deviation of D_{CP_t}, $\sigma(D_{CP_t})$, is the tracking error due to compounding; similarly, the standard deviation of D_{M_t}, $\sigma(D_{M_t})$, is the tracking error due to management.

Given equations (5) and (6), the net return of holding the 2x bull ETF for 2 days, absent any trading premium/discount, is:

$$(1+R^{Bull}_{NAV,t})(1+R^{Bull}_{NAV,t-1})-1=2[(1+r_t)(1+r_{t-1})-1]+D_{CP_t}+D_{M_t} \tag{7}$$

For 2x bear ETFs, "2" (i.e., twice the return) in (5) to (7) would be replaced by "-2". The same methodology is extended and applied to the longer holding periods in the analysis that follows.

The premium, P_t, that the ETF (bull or bear) may be trading at the end of day t is:

$$P_t = ETF_t - NAV_t \tag{8}$$

where ETF_t is the end-of-day market price and NAV_t is the end-of-day NAV of the leveraged ETF on day t. While some commodities may have an earlier close during the trading day, all of the eight leveraged ETFs in this study are equity-based, so non-synchronous close (between the ETF and the NAV) is not an issue here in the calculation of P_t. If the difference in (8) is negative, then the leveraged ETF is trading at a discount on day t.

IV.B. Tracking Errors

I summarize the compounding and management tracking errors, which are the standard deviations, $\sigma(D_{CP_t})$, and $\sigma(D_{M_t})$, in Table 3. The beginning of each sample period is the date the leveraged ETF was introduced. Since the inception dates vary, comparisons are not necessarily appropriate across different leveraged ETFs. Deviations due to trading premiums/discounts are discussed later on section IV. As expected, tracking errors due to compounding, $\sigma(D_{CP_t})$, increase with the holding period, but so do tracking errors due to management factors, $\sigma(D_{M_t})$. Tracking errors due to compounding are in general larger, except for EFU, EEV, and SDS (2-day, 1-week, and 1-month). So it seems that for these three 2x bear ETFs, compounding is not the main culprit in producing tracking errors. Upon further investigation, I find that part of their tracking errors due to management can be attributed a single capital gains distribution made by each fund during the sample period: EFU distributed $24.11 per share on December 23, 2008, EEV distributed $16.99 on September 24, 2008, and SDS distributed $11.46 on December 23, 2008. These capital gains distributions were so large that they created significant tracking errors in the model. Next, I will turn to the magnitude of the daily deviations, and their cumulative effect over longer horizons.

[Table 3]

IV.C. Mean Deviations

Tracking errors measure the variability of the deviations. It is also useful to look at whether each type of deviations are positive or negative on average, across different holding periods. In Panels A and B of Tables 4 to 8, I present the mean returns and the mean decomposed deviations, $\overline{D_{CP_t}}$ and $\overline{D_{M_t}}$, of the 10 leveraged ETFs, for different holding periods. Because we are dealing with daily observations, the mean returns and the deviations are small. Hence, to put the deviations into context, I report the mean deviation as a percentage of the mean return of the ETFs for the same holding period. Specifically, I calculate the mean deviation as a percentage of the absolute value of the mean return, so that a negative deviation remains a drag even though the mean return of the ETF might be negative. Note that D_{CP_t} is zero if the ETF is held for 1 day, as there is no compounding. In Panel C of each table, I present the correlation coefficients between D_{CP_t} and D_{M_t}, again, for different holding periods.

In terms of the ETF-specific results, I begin the discussion with HXU and HXD, in Table 4. Several observations can be made. First, for both of these S&P/TSX60 leveraged ETFs, the mean deviations due to compounding are negative, across holding periods and calendar years.[19] The mean deviations due to management factors, however, can be positive or negative. Second, for the full sample period, 2007-2009, management factors overall had a

[19] The only exception was HXU in 2008, for the 63-day (three-month) holding period.

bigger impact on HXU, while the reverse was true for HXD (when we compare the absolute value of the percentages). The year 2007 was an exception, when the deviations from target return came mostly from management factors for both funds. One may argue that since the TSX60 posted a positive return on average in 2007, the relatively large positive $\overline{D_{M_t}}$'s that year for HXD were beneficial to investors of the 2x bear ETF, because they resulted in smaller losses. This would be true if an investor held HXD for speculation purposes, and had a long position. However, a deviation, whether positive or negative, still represents a departure from the fund's investment objective. Note that the large percentages for the full sample period 2007 to 2009 (last row in Panels A and B) are due to the fact that the 2007-2009 mean returns, i.e., the denominators, were very small. The mean returns over the three years were very small because of the sharp reversal in the stock market from one year to the next;[20] this is related to the "flat-return" effect that was explained in Section II. In terms of the relationship between D_{CP_t} and D_{M_t} over time, the correlation coefficients in Panel C are all fairly low. Hence, D_{CP_t} and D_{M_t} tend not to reinforce each other, which should be welcoming news to investors.

[Table 4]

The results for the gold leveraged ETFs, HGU and HGD, are reported in Table 5. In 2007 and 2008, we see that $\overline{D_{M_t}}$ for HGD is positive for all holding periods. Hence, during the bull gold market, investors suffered a smaller loss than otherwise from this 2x bear ETF. However, this has nothing to do with the "trending" effect discussed in Section II, since the positive deviations came from management factors, not compounding. The other mean deviations were all negative, creating a drag on the ETFs' returns. The drag due to compounding for HGD, in particular, was large in 2008. Again, the correlation coefficients between D_{CP_t} and D_{M_t} are fairly small.

[Table 5]

[20] For example, over a 5-day holding period, the mean return of HXU was 0.413 percent in 2007, -1.633 percent in 2008, and 1.340 percent in 2009, resulting in a three year average of 0.040 percent.

In Table 6, I show the results for the oil and gas leveraged ETFs, DIG and DUG. There are two noteworthy observations. First, compounding had a large, negative impact in 2008 for DUG, the 2x bear ETF. However, for the 2x bull ETF, DIG, the negative impact in 2008 was much smaller. Second, interestingly, for DUG, the mean deviations due to management factors, $\overline{D_{M_t}}$, were positive in 2008, but the opposite was true for DIG. These are examples of the asymmetric effect of volatility on bull versus bear ETF returns.

[Table 6]

Next, I turn to the two MSCI 2x bear ETFs in Table 7. Since these two ETFs were introduced in the fall of 2007, I perform the analysis for 2008 and 2009 only. Several results should be highlighted: First, unlike the leveraged ETFs above, the full sample (2008-2009) $\overline{D_{CP_t}}$ is positive across all holding periods,[21] with the exception of EFU at the 1-week and 1-month horizon. Second, there is a striking contrast between the impact of compounding and the impact of management factors on the performance of the ETFs: For both EFU and EEV, $\overline{D_{M_t}}$ dominates $\overline{D_{CP_t}}$ in absolute value in most cases. (Note that the larger $\overline{D_{M_t}}$'s were not a result of nonsynchronous trading between the ETFs and their underlying index, because NAVs, *not* market prices, were used in the calculations.) As mentioned in section IV.B, both funds made a sizeable capital gains distribution in 2008, which contributed to the large deviations due to management factors. Third, the correlations between D_{CP_t} and D_{M_t} in Panel C are again fairly low, with the largest being 59 percent.

[Table 7]

Last but not last, I report the results for the S&P500 leveraged ETFs, SSO and SDS in Table 8. Like EFU and EEV above, $\overline{D_{M_t}}$ dominates $\overline{D_{CP_t}}$ in absolute magnitude for the overall period 2006 to 2009, providing additional examples where compounding is not the

[21] Consider the simple 2-day holding period scenario discussed earlier in equations (2) and (3). If there is trending or momentum in the returns of the underlying index, i.e., positive (negative) returns tend to be followed by postive (negative) returns, and the magnitude of the returns on those days is larger than average, then the overall impact would be positive.

main cause of deviations from target returns. Note in particular that even the 1-day mean deviation due to management factors can be large, at 380.52 percent of the average 1-day return in NAV in 2007 in the case of SDS. In terms of the time series relationship between D_{CP_t} and D_{M_t}, shown in Panel C, it is fairly weak for both SSO and SDS overall for the full sample period.

[Table 8]

IV.D. Time-series variations in deviations not due to compounding

As noted in the introduction, prior research has focused mainly on the properties of compounding; for example, the effect of volatility on a leveraged ETF's returns over different holding periods. In this subsection, I examine the properties of the residual deviations that are *not* due to compounding, using returns based on market prices, i.e., the returns that are relevant to investors. Rearranging (6) and replacing the returns based on NAV, $R^{Bull}_{NAV,t}$, by the returns based on market prices, $R^{Bull}_{Mkt,t}$, we have the following expression of the deviation *not* due to compounding, D_{NCP_t}, for a bull ETF over a 2-day holding period:

$$D_{NCP_t} = (1 + R^{Bull}_{Mkt,t})(1 + R^{Bull}_{Mkt,t-1}) - 1 - 2[(1 + r_t)(1 + r_{t-1}) - 1] - D_{CP_t} \qquad (9)$$

Again, for a bear ETF, the "2" in the above equation would be replaced by "-2".

Specifically, I want to see if they are random, or whether they exhibit any time-series patterns. To provide some visual evidence, I plot these deviations for the 10 leveraged ETFs for the 1-day, 1-week, and 1-month holding periods in Figures 1 to 4.[22] A striking observation in all of the figures is the sharp increase in the magnitude and the volatility of the deviations in the fall of 2008, i.e., during the height of the financial crisis. Volatility clustering of the deviations is evident. Phillips-Perron tests also reject that the daily deviations have a unit

[22] I do not show the plots for all of the holding periods to conserve space, and also because they do not change my conclusions qualitatively.

root in any of the leveraged ETFs (not reported). The deviations during the financial crisis were likely a reflection of tighter credit conditions (affecting the cost of leverage) and reduced market liquidity.

[Figures 1 to 4]

The financial crisis had an indisputable impact on liquidity. To further investigate the sources of the deviations in Figures 1 to 4, I plot the daily trading premium, P_t, of the eight leveraged ETFs in Figure 5. It is very clear from Figure 5 that there was increased volatility in P_t in the fall of 2008. Given the financial turmoil and uncertainty at the time, trading premiums/discounts might have been influenced by market sentiment, similar to the case of closed-end mutual fund discounts (Lee, Shleifer, and Thaler (1991)), and by the drying up of liquidity which caused larger bid-ask spreads.

[Figure 5]

V. Intraday trading dynamics

To substantiate the claim that reduced liquidity caused the increase in premium/discount volatility during the financial crisis, I examine the market microstructure of the leveraged ETFs during the crisis period. To be specific, I study the impact of the crisis on the leveraged ETFs' intraday trading patterns. The three intraday variables that I focus on are: Share price volatility (as measured by the standard deviation of transaction prices), trading volume, and the bid-ask spread. To investigate how share price volatility changes throughout the trading day, I need to estimate it within a fixed time interval. Some market microstructure studies such as Fleming and Romolona (1999) employ a 10-minute interval, whereas others, such as Kleindon and Werner (1996), use a 15-minute interval. I follow the latter in this paper, and construct my variables of interest for each 15-minute interval. Each trading day consists of 26 15-minute intervals starting at 9:30-9:44, and ending at 15:45-15:59. In other words, I include only trades recorded during the NYSE Arca's "Core Trading Session".

Due to the large volume of intraday data, studies in this literature typically employ a sample period of one year.[23] In order to explore the impact of the financial crisis on the market microstructure of the leveraged ETFs, I focus on the year 2008. In particular, I divide the intraday data into two subsamples: January 1 to September 14, and September 15 to December 31. The significance of September 15, 2008 is of course the fall of Lehman Brothers, which is widely regarded as the pivotal point of the financial crisis, and the start of the precipitous slide of the global stock market. In Panel A of Figure 6, I show the average share price volatility, in Panel B, the average trading volume (in thousands), and in Panel C, the average percentage spread, before and after September 15, 2008. Due to the lack of access to Canadian intraday data, the two TSX-traded leveraged ETFs are excluded from this analysis. Overall, for all three intraday variables, they display an approximately U-shape pattern that is found in NYSE-traded stocks (see for example, McInish and Wood (1992), and Chan, Chung, and Johnson (1995)) and international ETFs (Shum (2010)).

[Figure 6]

A fairly clear picture emerges from Panel A. The financial crisis has a much bigger impact on the mean intraday share price volatility of the 2x bear ETFs than the 2x bull ETFs. For the 2x bear ETFs (SDS, DUG, EFU, and EEV), the jump in mean volatility is substantial and statistically significant. For the 2x bull ETFs (SSO and DIG), however, the slight increases in the middle of the trading day are *not* statistically significant. That said, both types of ETFs have in common that during the financial crisis, mean volatility showed a more decisive U-shape pattern, meaning that volatility was the highest at market open and at close.

Panel B shows the mean intraday trading volume pattern and the impact of the financial crisis during the regular trading hours. Trading volume was higher across the board, and the differences were significant at the five percent level, except for five 15-minute periods (indicated by the grey bars in the diagram) for DUG. Interestingly, even though the financial

[23] Quotes data, for example, cae be in the hundreds of million for just one year.

crisis increased the mean intraday share price volatility of the two 2x bull ETFs in a relatively moderate fashion, the impact it had on their mean intraday trading volume is by comparison much more prominent. In other words, a surge in trading volume does not necessarily increase share price volatility.

Panel C shows that the mean intraday bid-ask spread pattern before and after the start of the financial crisis. The spread variable is a percentage, and is defined as (*Ask-Bid)/Bid* * 100%, where *Ask* and *Bid* are the average bid and average ask prices over each 15-minute interval on a given trading day.[24] The bid-ask spread is a widely recognized measure of market liquidity, and the larger the spread, the higher the indirect cost of trading for investors. Panel C indicates that prior to the financial crisis, the mean spread was the highest within the first 15 minutes of the regular trading hours (9:30-9:44), except for SDS. (For SDS, the highest was between 10:00 and 10:14.) This is the typical pattern observed elsewhere in the stock market. Brock and Kleidon (1992) provides a market power model that explains the simultaneous observation of high trading volume and large bid-ask spreads at market open. They argue that because trading is halted after 4pm, there is an inelastic transaction demand when the market re-opens. Market makers take advantage of this knowledge, and widen the spread. After September 15, 2008, the spreads increased significantly for the rest of the year, except for DIG. This reduction in liquidity helps explain the jump in trading premiums/discounts shown in Figure 5.

VI. Conclusion

Leveraged ETFs have quickly become popular with investors who want to hedge their positions, or simply to magnify their bets. While the proliferation of new leveraged ETFs since their introduction in mid-2006 has been phenomenal, the market for leveraged ETFs has reached a boiling point recently: Investors are complaining that the returns were different from their expectations, some brokers in the U.S. have banned their advisors from

[24] I use the average over each 15-minute interval to help reduce the significant amount of noise and outliers in quotes data.

recommending these products, and regulators are calling for better investor education.

The goal of this paper was to lay out a framework for assessing the performance of leveraged ETFs, and in particular, to disentangle the different components of a fund's returns, from an investor's perspective. A secondary objective was to examine the impact of the recent financial crisis on the performance and the market microstructure of these funds.

To recap, a leveraged ETF is designed to replicate twice (or thrice) the daily return of its underlying index. If the fund is held for more than one day, then its compounded return will deviate from that of the underlying index, creating tracking errors. However, deviations from target return can also be caused by management factors, including the manager's ability to deliver the promised returns, expenses, margin costs, counterparty risk (e.g., in the case of swap contracts), currency risk (in the case of foreign indices), and so on. In addition, deviations can also result from trading premiums/discounts. There is a tendency for leveraged ETF managers and the media to blame poor performance on the effects of compounding, and the other two types of deviations have received little attention. In this paper, I attempted to shed light on this issue. I decompose the returns of a leveraged ETF to investors into these three "buckets", and study the relative importance of each, focusing on the periods before, during, and after the financial crisis. Further, I explored whether the financial crisis affected the intraday trading patterns of the leveraged ETFs.

To summarize the results, I found empirical support that bear ETFs deviate from their target return much more quickly than their bull counterparts as the holding period lengthens. Contrary to popular belief though, returns to leveraged ETFs can deviate from their target even if investors rebalance on a daily basis. For example, in the case of the EAFE and EM 2x bear ETFs, their respective underlying indices explained only 36 to 40 percent of the variations in their daily returns during the sample period. A likely explanation is the nonsynchronicity in the trading between the ETFs and their respective underlying indices. That said, the impact of nonsynchronicity seems to average out over a week (five trading days), as the explanatory power improves to 70 percent. In terms of the alphas, which represent the return accrued to investors if the underlying index had a zero percent return, they are all negative, and they typically become statistically significantly different from zero starting at the 1-week holding period. Some alphas can be alarmingly large, particularly when the funds are held for a year.

When I decompose the deviations of the leveraged ETFs from their target return, I found that the tracking error due to management factors can be greater than that due to compounding for certain ETFs. In addition, the mean deviations due to compounding and to management factors in a given year can be positive or negative. In terms of the time-series relationship between the two types of deviations, the correlation coefficients tend to be small or negative overall, suggesting that the two are likely driven by different forces, and do not reinforce each other in dragging down or pulling up the returns of the leveraged ETFs. For most of the funds in the study, the mean deviations due to compounding were the biggest in 2008, the year of the financial crisis. There was a noticeable jump in trading premiums/discounts during the financial crisis, both in terms of magnitude and volatility, likely due to a temporary loss of liquidity and market efficiency over that period. Last but not least, I find that the financial crisis had an asymmetric impact on the bull versus the bear ETFs' intraday trading patterns. It had a much bigger effect on the intraday share price volatility of the bear ETFs than the bull ETFs, even though the latter experienced a much greater surge in trading volume during the crisis. In terms of the intraday average bid–ask spreads, the results show that most of the leveraged ETFs suffered a significant reduction in liquidity during the financial crisis, explaining the jump in trading premiums/discounts in that period.

In conclusion, because of the unprecedented volatility and the drying up of liquidity in the fall of 2008, the performance of some of the leveraged ETFs studied in this paper was severely impacted. Going forward and barring another major financial crisis, the deviations from target return shown in this paper may represent an upperbound, as are the volatile trading premiums/discounts.

References

Ackert, Lucy and Yisong S. Tian. 2000. "Arbitrage and Valuation in the Market for Standard and Poor's Depository Receipts." Financial Management (Autumn), 5-20.

Ackert, Lucy and Yisong S. Tian. 2008. "Arbitrage, Liquidity, and the Valuation of Exchange-Traded Funds". *Financial Markets, Institutions, and Instruments*, vol.17-5:331-62.

Avellaneda, Marco. 2010. "Leveraged ETFs: All You Wanted to Know but were Afraid to Ask." Risk Professional, February, pp.54-60.

Avellaneda, Marco and Stanley Zhang. 2009. "Path-Dependence of Leveraged ETF Returns." Working Paper, Courant Institute of Mathematical Sciences, New York University.

Brock, William A. and Allan W Kleidon. 1992. "Periodic Market Closure and Trading Volume: A Model of Intraday Bids and Asks." Journal of Economic Dynamics and Control, vol.16, pp.451-489.

Chan, Kalok, Y. Peter Chung, and Herb Johnson. 1995. "The Intraday Behaviour of Bid-Ask Spreads for NYSE Stocks and CBOE Options." *Journal of Quantitative and Financial Analysis*, September, 329-46.

Cheng, Minder and Ananth Madhaven. 2009. "The Dynamics of Leveraged and Inverse Exchange Traded Funds." *Journal of Investment Management,* vol.7-4.

Elton, Edward J., Martin J. Gruber, George Comer, and Kai Li. 2002. "Spiders: Where are the Bugs?" *Journal of Derivatives* (Summer), 27-45.

Engle, Robert and Debojyoti Sarkar. 2006. "Premiums-Discounts and Exchange Traded Funds" *Journal of Derivatives* (Fall), vol.13-4: pp. 27-45.

Kleidon, Allan W. and Ingrid M. Werner. 1996. "U.K. and U.S. Trading of British Cross-Listed Stocks: An Intraday Analysis of Market Integration." *Review of Financial Studies*, vol.9-2: 619-64.

Fleming, Michael J. and Eli M. Romolona. 1999. "Price Formation and Liquidity in the U.S. Treasury Market: The Response to Public Information." *Journal of Finance*, vol.54-5, pp.1901-15.

Hill, Joanne and George Foster. 2009. "Understanding Returns of Leveraged and Inverse Funds: Examining performance over periods longer than one day." ProFund Advisors LLC White Paper, July 14.

Lee, Charles, Andrei Shleifer, and Richard Thaler. "Investor Sentiment and the Closed-End Fund Puzzle." Journal of Finance, vol.46-1, pp.75-109.

Lu, Lei, Jun Jonathan Wang, and Ge Zhang. 2009. "Long Term Performance of Leveraged ETFs." Available at SSRN: http://ssrn.com/abstract=1344133.

McInish T. H., and R.A. Wood. 1992. "An Analysis of Intraday Pattern in Bid/Ask Spreads for NYSE Stocks." *Journal of Finance*, vol.47, pp.345-74.

Newey, Whitney K. and Kenneth D. West. 1987. "A Simple, Positive Semi-definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix." *Econometrica*, vol. 55(3), pp.703–708.

Shum, Pauline. 2010. ""How Passive are International ETFs? A Study of Their Intraday Behaviour" Journal of Index Investing, Vol.1-4, pp.74-84.

Sullivan, Rodney. 2009. "The Pitfalls of Leveraged and Inverse ETFs." *CFA Magazine*, May/June 2009: 12.

Table 1

Summary Statistics of Daily Returns Based on Market Prices
January 1, 2008 - December 31, 2009

HXU is the 2x (bull) leveraged ETF of the S&P/TSX60 index, and HXD is the 2x inverse (bear) leveraged ETF of the same underlying index. HGU is the 2x (bull) leveraged ETF of the S&P/TSX Globe Gold index, and HGD is the 2x inverse (bear) leveraged ETF of the same underlying index. DIG is the 2x (bull) leveraged ETF of the DJ/US Oil and Gas index, and DUG is the 2x inverse (bear) leveraged ETF of the same underlying index. EFU is the 2x inverse (bear) leveraged ETF of the MSCI EAFE, and EEV is the 2x inverse (bear) leveraged ETF of the MSCI Emerging Markets. SSO is the 2x (bull) leveraged ETF of the S&P 500 index, and SDS is the 2x inverse (bear) leveraged ETF of the same underlying index.

Ticker	Mean	Std Dev	Skewness	Kurtosis	Max	Min
TSX60	-0.0001	0.0222	-0.2778	3.4393	0.1033	-0.0979
Ticker:HXU	-0.0002	0.0413	-0.4099	2.2705	0.1476	-0.1860
Ticker:HXD	0.0000	0.0419	0.3028	2.5164	0.1967	-0.1702
TSXGold	0.0008	0.0403	0.7928	6.4977	0.2776	-0.1624
Ticker:HGU	0.0010	0.0736	0.9108	6.0041	0.5010	-0.2461
Ticker:HGD	-0.0019	0.0750	-0.9585	7.4245	0.2846	-0.5414
Oil&Gas	-0.0002	0.0303	0.1040	6.3934	0.1880	-0.1575
Ticker:DIG	-0.0005	0.0589	0.0694	6.4529	0.3629	-0.3155
Ticker:DUG	0.0002	0.0585	-0.1762	6.5394	0.3176	-0.3656
EAFE	-0.0004	0.0198	-0.0520	3.5481	0.0858	-0.0843
Ticker:EFU	0.0004	0.0502	-0.4358	6.6561	0.2214	-0.3247
EM	-0.0001	0.0221	-0.1471	4.1646	0.1060	-0.0948
Ticker:EEV	-0.0011	0.0698	-0.7678	7.2352	0.3104	-0.4482
S&P500	-0.0002	0.0219	0.0958	4.5461	0.1158	-0.0903
Ticker:SSO	-0.0006	0.0416	0.2019	4.8548	0.2241	-0.1728
Ticker:SDS	0.0004	0.0420	-0.1599	4.5582	0.1808	-0.2244

Table 2

Regression Analysis Using Returns Based on Market Prices
January 1, 2008 - December 31, 2009

The null hypothesis for the intercept is H_0=0; the null hypothesis for the slope coefficient is H_0=2 for the 2x bull and H_0= -2 for the 2x bear leveraged ETF. Newey-West t-statistics are reported in parentheses. An asterisk denotes a coefficient that is significantly different from its hypothesized value (H_0) at 5 percent. HXU is the 2x (bull) leveraged ETF of the S&P/TSX60 index, and HXD is the 2x inverse (bear) leveraged ETF of the same underlying index. HGU is the 2x (bull) leveraged ETF of the S&P/TSX Globe Gold index, and HGD is the 2x inverse (bear) leveraged ETF of the same underlying index. DIG is the 2x (bull) leveraged ETF of the DJ/US Oil and Gas index, and DUG is the 2x inverse (bear) leveraged ETF of the same underlying index. EFU is the 2x inverse (bear) leveraged ETF of the MSCI EAFE, and EEV is the 2x inverse (bear) leveraged ETF of the MSCI Emerging Markets. SSO is the 2x (bull) leveraged ETF of the S&P 500 index, and SDS is the 2x inverse (bear) leveraged ETF of the same underlying index.

Holding Period		1-day	1-week	1-month	1-year
HXU	Intercept	-0.0003 (-1.36)	-0.0014*(-2.93)	-0.0062*(-5.09)	-0.0899*(-8.03)
	TSX60	1.8341*(-4.2104)	1.9466*(-2.9808)	1.9835 (-0.6796)	1.8413*(-3.7245)
	Adjusted R^2	0.9675	0.9882	0.9907	0.9797
HXD	Intercept	0.0000 (0.12)	-0.0013 (-1.69)	-0.0110*(-3.56)	-0.2403* (-12.68)
	TSX60	-1.8614*(4.3719)	-1.9715 (0.6870)	-1.8881 (1.9002)	-1.3323* (8.4626)
	Adjusted R^2	0.9683	0.9737	0.9505	0.8223
HGU	Intercept	-0.0005 (-1.36)	-0.0028*(-2.81)	-0.0173*(-5.43)	-0.4286* (-29.41)
	TSX GOLD	1.7997*(-7.2050)	1.9328*(-2.8217)	1.9519 (-1.0058)	1.9152 (-1.0923)
	Adjusted R^2	0.9702	0.9862	0.9807	0.9454
HGD	Intercept	-0.0004 (-1.35)	-0.0054* (-2.84)	-0.0476* (-4.88)	-0.8347* (-117.42)
	TSX GOLD	-1.8392*(7.6586)	-1.9124* (2.1215)	-1.6483* (3.6217)	-0.0959* (140.01)
	Adjusted R^2	0.9771	0.9582	0.8376	0.2101
DIG	Intercept	-0.0001 (-0.58)	-0.0016* (-2.26)	-0.0081*(-3.81)	-0.1338*(-10.25)
	DJ Oil & Gas	1.9347*(-4.1573)	1.9804 (-1.2881)	1.9654 (-1.5224)	1.6312*(-10.2148)
	Adjusted R^2	0.9889	0.9894	0.9841	0.9748
DUG	Intercept	-0.0002 (-1.13)	-0.0055* (-2.76)	-0.0343* (-5.10)	-0.4997* (-30.83)
	DJ Oil & Gas	-1.9218* (5.1092)	-1.9707 (0.6134)	-1.7509* (2.6557)	-0.7911* (24.6222)
	Adjusted R^2	0.9898	0.9384	0.8300	0.7526
EFU	Intercept	-0.0001 (-0.14)	-0.0035 (-1.54)	-0.0169* (-3.19)	-0.2919* (-8.88)
	MSCI EAFE	-1.5282* (4.3848)	-1.8956 (1.2811)	-1.7763* (2.9981)	-1.4210* (5.9943)
	Adjusted R^2	0.3628	0.7527	0.8403	0.7418
EEV	Intercept	-0.0013 (-1.10)	-0.0102* (-2.46)	-0.0557* (-4.84)	-0.6662* (-36.87)
	MSCI EM	-2.0088 (-0.0684)	-2.0016 (-0.0158)	-1.4326* (4.6777)	-0.3238* (52.382)
	Adjusted R^2	0.4032	0.6965	0.6162	0.5559
SSO	Intercept	-0.0002 (-1.53)	-0.0001* (-3.46)	-0.0054* (-4.92)	-0.0748* (-6.44)
	S&P500	1.8780* (-5.1950)	1.9692* (-2.2464)	1.9746 (-1.1802)	1.7435* (-6.8578)
	Adjusted R^2	0.9816	0.9910	0.9923	0.9788
SDS	Intercept	0.0001 (0.38)	-0.0018* (-2.20)	-0.0113* (-3.52)	-0.2249* (-8.74)
	S&P500	-1.8973* (6.2218)	-2.0137 (-0.2506)	-1.9296 (1.1277)	-1.6275* (3.8521)
	Adjusted R^2	0.9844	0.9700	0.9427	0.8059

Table 3

Decomposing the Tracking Errors Based on NAVs
All 10 Leveraged ETFs

The tracking error of each leveraged ETF for a given holding period is the standard deviation of the fund's deviations from the target return. The figures in the table are in percentages. HXU is the 2x (bull) leveraged ETF of the S&P/TSX60 index, and HXD is the 2x inverse (bear) leveraged ETF of the same underlying index. The sample period for HXU and HXD is January 9, 2007 to December 31, 2009. DIG is the 2x (bull) leveraged ETF of the DJ/US Oil and Gas index, and DUG is the 2x inverse (bear) leveraged ETF of the same underlying index. The sample period for DIG and DUG is February 1, 2007 to December 31, 2009. HGU is the 2x (bull) leveraged ETF of the S&P/TSX Globe Gold index, and HGD is the 2x inverse (bear) leveraged ETF of the same underlying index. The sample period for HGU and HGD is July 1, 2007 to December 31, 2009. EFU is the 2x inverse (bear) leveraged ETF of the MSCI EAFE, and EEV is the 2x inverse (bear) leveraged ETF of the MSCI Emerging Markets. The sample period for EFU and EEV is January 1, 2008 to December 31, 2009. SSO is the 2x (bull) leveraged ETF of the S&P 500 index, and SDS is the 2x inverse (bear) leveraged ETF of the same underlying index. The sample period for SSO and SDS is July 14, 2006 to December 31, 2009.

Tracking Errors (%)

	Due to Compounding				Due to Management Factors				
	3-Month	1-Month	1-Week	2-Day	3-Month	1-Month	1-Week	2-Day	1-Day
HXU	2.729	0.981	0.331	0.140	0.452	0.141	0.036	0.019	0.013
HXD	7.908	3.073	1.014	0.421	1.303	0.446	0.111	0.055	0.034
DIG	3.975	2.000	0.718	0.256	1.872	1.052	0.500	0.340	0.256
DUG	17.873	6.692	2.284	0.769	6.527	3.473	1.824	1.275	0.952
HGU	9.437	3.145	0.908	0.364	0.832	0.488	0.143	0.098	0.076
HGD	24.845	10.289	2.828	1.093	1.120	0.482	0.320	0.218	0.182
EFU	11.653	3.970	1.140	0.334	14.474	7.539	5.645	5.210	4.847
EEV	24.358	7.601	1.690	0.398	39.896	14.562	7.587	6.732	6.053
SSO	2.092	0.922	0.327	0.101	0.619	0.311	0.171	0.120	0.090
SDS	7.301	2.973	1.032	0.302	5.313	3.046	1.471	0.983	0.756

Table 4

Mean Deviations from Target Return Based on NAVs
S&P/TSX60, HXU (2x Bull), and HXD (2x Bear)
January 9, 2007 - December 31, 2009

Panel A: Mean NAV return of HXU, mean deviation due to compounding as a percentage of (the absolute value of) mean return, and mean deviation due to the management process (including fees, the manager's ability to meet the investment objective) as a percentage of (the absolute value of) mean return.

	Mean HXU NAV Returns					Due to Compounding				Due to Management				
	3-month	1-month	1-week	2-day	1-day	3-month	1-month	1-week	2-day	3-month	1-month	1-week	2-day	1-day
2007	0.0470	0.0136	0.0042	0.0019	0.0010	-7.19%	-4.42%	-1.09%	-1.17%	-34.66%	-38.44%	-28.99%	-25.43%	-25.39%
2008	-0.1477	-0.0693	-0.0160	-0.0056	-0.0025	6.07%	-6.19%	-6.55%	-3.76%	-7.71%	-5.67%	-6.06%	-7.00%	-7.80%
2009	0.1140	0.0532	0.0134	0.0049	0.0024	-12.31%	-4.20%	-0.75%	-0.59%	-6.30%	-4.16%	-3.63%	-3.94%	-3.97%
2007-09	0.0007	-0.0017	0.0005	0.0004	0.0003	-405.27%	-208.81%	-75.69%	-20.90%	-1621.03%	-321.02%	-168.28%	-85.58%	-60.80%

Panel B: Mean NAV return of HXD, mean deviation due to compounding as a percentage of (the absolute value of) mean return, and mean deviation due to the management process (including fees, the manager's ability to meet the investment objective) as a percentage of (the absolute value of) mean return.

	Mean HXD NAV Returns					Due to Compounding				Due to Management				
	3-month	1-month	1-week	2-day	1-day	3-month	1-month	1-week	2-day	3-month	1-month	1-week	2-day	1-day
2007	-0.0485	-0.0118	-0.0034	-0.0016	-0.0008	-18.30%	-15.28%	-4.12%	-4.23%	56.02%	79.87%	67.12%	56.92%	60.42%
2008	0.1475	0.0463	0.0121	0.0049	0.0026	-14.27%	-46.71%	-27.48%	-12.76%	15.75%	14.60%	12.05%	11.67%	11.03%
2009	-0.1765	-0.0636	-0.0144	-0.0053	-0.0025	-23.14%	-8.41%	-1.97%	-1.66%	-0.28%	-0.93%	-1.05%	-1.22%	-1.28%
2007-09	-0.0241	-0.0098	-0.0019	-0.0007	-0.0002	-103.87%	-100.36%	-66.27%	-40.08%	64.63%	51.48%	62.06%	72.08%	99.52%

Panel C: Correlation between deviations due to compounding and deviations due to management factors.

	HXU			
	3-month	1-month	1-week	2-day
2007	-0.4706	-0.1463	0.0210	0.0442
2008	0.6994	-0.0553	-0.0448	-0.0395
2009	-0.5126	0.0304	-0.2129	-0.0503
2007-09	0.0515	-0.0647	-0.0122	-0.0164

	HXD			
	3-month	1-month	1-week	2-day
2007	-0.9086	-0.1070	-0.0355	-0.0877
2008	0.2194	0.5218	0.1546	0.0296
2009	-0.7214	-0.1823	0.0375	-0.1670
2007-09	0.0821	0.0842	0.0336	0.0011

Table 5

Mean Deviations from Target Return Based on NAVs
S&P/TSX Global Gold, HGU (2x Bull), and HGD (2x Bear)
July 1, 2007 - December 31, 2009

Panel A: Mean NAV return of HGU, mean deviation due to compounding as a percentage of (the absolute value of) mean return, and mean deviation due to the management process (including fees, the manager's ability to meet the investment objective) as a percentage of (the absolute value of) mean return.

	Mean HGU NAV Returns					Due to Compounding				Due to Management				
	3-month	1-month	1-week	2-day	1-day	3-month	1-month	1-week	2-day	3-month	1-month	1-week	2-day	1-day
2007	0.1674	0.0241	0.0078	0.0042	0.0023	-9.50%	-12.48%	-5.27%	-4.12%	-11.94%	-24.02%	-17.34%	-12.59%	-11.68%
2008	-0.1740	-0.0126	0.006	0.0035	0.0023	-29.38%	-145.22%	-30.71%	-12.00%	-6.25%	-18.77%	-12.40%	-9.04%	-6.94%
2009	0.1935	0.0412	0.0066	0.0026	0.0016	-34.49%	-26.26%	-17.67%	-5.79%	-2.13%	-5.73%	-7.67%	-7.76%	-7.45%
2007-09	0.0267	0.0159	0.0067	0.0033	0.0019	-202.71%	-79.10%	-19.93%	-8.04%	-33.21%	-18.52%	-11.63%	-9.53%	-8.20%

Panel B: Mean NAV return of HGD, mean deviations due to compounding as a percentage of (the absolute value of) mean return, and mean deviation due to the management process (including fees, the manager's ability to meet the investment objective) as a percentage of (the absolute value of) mean return.

	Mean HGD NAV Returns					Due to Compounding				Due to Management				
	3-month	1-month	1-week	2-day	1-day	3-month	1-month	1-week	2-day	3-month	1-month	1-week	2-day	1-day
2007	-0.2045	-0.0325	-0.0083	-0.0045	-0.0021	-12.47%	-28.93%	-14.92%	-11.64%	11.87%	30.23%	28.89%	21.55%	23.77%
2008	-0.0812	-0.0597	-0.0138	-0.0047	-0.0020	-259.50%	-98.19%	-48.25%	-26.97%	22.92%	11.72%	14.73%	17.67%	21.56%
2009	-0.3215	-0.08358	-0.0120	-0.0035	-0.0015	-17.73%	-34.10%	-29.77%	-13.02%	-0.03%	-0.72%	-1.31%	-1.82%	-2.13%
2007-09	-0.2018	-0.0649	-0.0120	-0.0042	-0.0018	-60.95%	-58.15%	-36.36%	-19.06%	5.45%	6.68%	10.17%	11.99%	14.30%

Panel C: Correlation between deviations due to compounding and deviations due to management factors.

HGU	3-month	1-month	1-week	2-day
2007	-0.8006	-0.4969	-0.2415	0.0594
2008	-0.4136	-0.0876	-0.1780	-0.1554
2009	-0.1954	0.1723	0.2242	0.0621
2007-09	-0.3477	-0.1124	-0.1693	-0.1399

HGD	3-month	1-month	1-week	2-day
2007	-0.9276	-0.1322	0.1718	0.0052
2008	0.5055	0.1208	-0.1750	-0.2189
2009	0.1718	-0.2972	-0.0498	-0.0414
2007-09	-0.0345	-0.0034	-0.1606	-0.2049

Table 6

Mean Deviations from Target Return Based on NAVs
DJ/US Oil and Gas, DIG (2x Bull), and DUG (2x Bear)
February 1, 2007 - December 31, 2009

Panel A: Mean NAV return of DIG, mean deviation due to compounding as a percentage of (the absolute value of) mean return, and mean deviation due to the management process (including fees, the manager's ability to meet the investment objective) as a percentage of (the absolute value of) mean return.

	Mean DIG NAV Returns					Due to Compounding				Due to Management				
	3-month	1-month	1-week	2-day	1-day	3-month	1-month	1-week	2-day	3-month	1-month	1-week	2-day	1-day
2007	0.1986	0.0634	0.0151	0.0060	0.0030	-1.46%	-1.11%	-1.70%	-1.06%	10.72%	10.71%	10.05%	10.32%	10.74%
2008	-0.1703	-0.0755	-0.0190	-0.0057	-0.0023	-0.58%	-16.06%	-15.53%	-8.47%	-2.27%	-0.87%	-1.18%	-1.18%	-0.85%
2009	0.0604	0.0299	0.0094	0.0032	0.0016	-55.78%	-14.37%	-2.60%	-3.63%	7.54%	4.50%	3.82%	4.50%	4.46%
2007-09	0.0082	0.0024	0.0013	0.0010	0.0007	-167.85%	-247.27%	-89.27%	-22.62%	68.15%	91.96%	38.83%	21.89%	16.46%

Panel B: Mean NAV return of DUG, mean deviation due to compounding as a percentage of (the absolute value of) mean return, and mean deviation due to the management process (including fees, the manager's ability to meet the investment objective) as a percentage of (the absolute value of) mean return.

	Mean DUG NAV Returns					Due to Compounding				Due to Management				
	3-month	1-month	1-week	2-day	1-day	3-month	1-month	1-week	2-day	3-month	1-month	1-week	2-day	1-day
2007	-0.1895	-0.0595	-0.0149	-0.0057	-0.0027	-1.69%	-3.58%	-5.33%	-3.40%	-3.21%	-0.13%	-1.37%	-0.09%	1.93%
2008	0.0792	0.0193	0.0107	0.0058	0.0035	-155.95%	-283.15%	-87.60%	-24.42%	47.14%	58.31%	39.81%	37.58%	36.14%
2009	-0.1936	-0.0469	-0.0120	-0.0039	-0.0018	-47.61%	-23.69%	-6.74%	-8.96%	-6.14%	-6.31%	-8.68%	-9.51%	-10.65%
2007-09	-0.0900	-0.0272	-0.0047	-0.0011	-0.0002	-90.84%	-87.90%	-80.42%	-64.89%	8.97%	10.74%	23.28%	61.22%	175.33%

Panel C: Correlation between deviations due to compounding and deviations due to management factors.

	DIG			
	3-month	1-month	1-week	2-day
2007	0.6791	0.3525	0.0914	0.9825
2008	-0.2861	-0.0910	-0.0765	0.1400
2009	0.0482	-0.0722	-0.1535	0.4393
2007-09	0.0489	0.0126	-0.0161	0.2393

	DUG			
	3-month	1-month	1-week	2-day
2007	-0.5478	-0.3228	-0.0304	-0.7757
2008	0.2048	0.2849	0.2004	0.2414
2009	-0.2540	-0.0353	-0.0634	0.6369
2007-09	0.0832	0.2190	0.1704	0.1498

Table 7

Mean Deviations from Target Return Based on NAVs
MSCI Europe, Australia, and Far East (EAFE), EFU (2x Bear)
MSCI Emerging Markets (EM), and EEV (2x Bear)
January 1, 2008 - December 31, 2009

Panel A: Mean NAV return of EFU, mean deviation due to compounding as a percentage of (the absolute value of) mean return, and mean deviation due to the management process (including fees, the manager's ability to meet the investment objective) as a percentage of (the absolute value of) mean return.

	EFU NAV Returns					Due to Compounding				Due to Management				
	3-month	1-month	1-week	2-day	1-day	3-month	1-month	1-week	2-day	3-month	1-month	1-week	2-day	1-day
2008	0.3104	0.0752	0.0209	0.0096	0.0052	13.95%	-7.63%	-3.03%	2.34%	-1.27%	-5.12%	7.83%	17.27%	23.88%
2009	-0.2206	-0.0646	-0.0147	-0.005	-0.0025	3.35%	9.22%	4.34%	2.41%	-25.02%	-16.92%	-15.70%	-11.22%	-0.41%
2008-09	0.0076	0.0024	0.0030	0.0021	0.0013	299.53%	14.42%	0.22%	8.45%	-435.15%	-310.70%	-11.63%	25.08%	45.84%

Panel B: Mean NAV return of EEV, mean deviations due to compounding as a percentage of (the absolute value of) mean return, and mean deviation due to the management process (including fees, the manager's ability to meet the investment objective) as a percentage of (the absolute value of) mean return.

	Mean EEV NAV Returns					Due to Compounding				Due to Management				
	3-month	1-month	1-week	2-day	1-day	3-month	1-month	1-week	2-day	3-month	1-month	1-week	2-day	1-day
2008	0.1129	0.0065	0.0084	0.0057	0.0036	134.76%	134.26%	31.97%	14.66%	-354.56%	-1754.94%	-243.63%	-93.60%	-45.34%
2009	-0.3741	-0.1154	-0.0267	-0.0103	-0.0050	12.60%	7.89%	4.87%	2.23%	-24.35%	-13.73%	-10.52%	-7.21%	-1.19%
2008-09	-0.1647	-0.0570	-0.0093	-0.0023	-0.0007	56.01%	15.60%	21.33%	23.20%	-135.96%	-109.68%	-124.07%	-132.31%	-128.43%

Panel C: Correlation between deviations due to compounding and deviations due to management factors.

	EFU			
	3-month	1-month	1-week	2-day
2008	0.1468	0.2740	0.2837	0.1246
2009	0.5731	-0.0342	0.0478	-0.0101
2008-09	0.2795	0.2197	0.2539	0.1084

	EEV			
	3-month	1-month	1-week	2-day
2008	-0.5997	-0.268	0.2163	-0.0184
2009	0.5924	-0.0084	-0.0032	-0.0391
2008-09	-0.4295	-0.2335	0.1895	-0.0230

Table 8

Mean Deviations from Target Return Based on NAVs
S&P 500, SSO (2x Bull), and SDS (2x Bear)
July 14, 2006 - December 31, 2009

Panel A: Mean NAV return of SSO, mean deviation due to compounding as a percentage of (the absolute value of) mean return, and mean deviation due to the management process (including fees, the manager's ability to meet the investment objective) as a percentage of (the absolute value of) mean return.

	Mean SSO NAV Returns					Due to Compounding				Due to Management				
	3-month	1-month	1-week	2-day	1-day	3-month	1-month	1-week	2-day	3-month	1-month	1-week	2-day	1-day
2006	0.1795	0.0543	0.0128	0.0052	0.0025	3.13%	0.45%	-0.16%	0.05%	1.89%	1.46%	1.90%	1.99%	1.61%
2007	0.0305	0.0059	0.0016	0.0005	0.0003	-11.29%	-14.62%	-8.37%	-6.59%	-47.04%	-84.99%	-75.56%	-88.55%	-78.05%
2008	-0.2174	-0.0832	-0.0199	-0.0069	-0.0032	1.39%	-5.72%	-6.53%	-2.93%	-4.74%	-4.54%	-4.55%	-5.02%	-5.27%
2009	0.1071	0.0456	0.0116	0.0043	0.0021	-9.39%	-2.79%	-1.11%	-1.49%	-4.30%	-2.70%	-2.24%	-2.53%	-2.59%
2006-09	-0.0126	-0.0032	-0.0003	0.0001	0.0001	-22.52%	-62.25%	-165.08%	-104.15%	-69.67%	-88.36%	-234.86%	-304.79%	-111.14%

Panel B: Mean NAV return of SDS, mean deviation due to compounding as a percentage of (the absolute value of) mean return, and mean deviation due to the management process (including fees, the manager's ability to meet the investment objective) as a percentage of (the absolute value of) mean return.

	Mean SDS NAV Returns					Due to Compounding				Due to Management				
	3-month	1-month	1-week	2-day	1-day	3-month	1-month	1-week	2-day	3-month	1-month	1-week	2-day	1-day
2006	-0.1681	-0.0566	-0.0135	-0.0054	-0.0025	9.49%	1.40%	-0.44%	0.15%	-8.06%	-7.26%	-6.29%	-5.58%	-4.45%
2007	-0.0322	-0.0022	-0.0002	0.0002	0.0002	-30.34%	-121.33%	-255.72%	-53.23%	80.07%	554.77%	2031.79%	678.59%	380.52%
2008	0.2475	0.0766	0.0196	0.0083	0.0043	-17.71%	-29.45%	-20.36%	-7.29%	32.83%	31.99%	30.46%	30.92%	31.21%
2009	-0.1605	-0.0517	-0.0125	-0.0047	-0.0022	-22.66%	-6.29%	-3.18%	-4.06%	-1.47%	-0.62%	-1.03%	-1.15%	-1.27%
2006-09	0.0058	0.0003	0.0003	0.0004	0.0003	-467.61%	-2807.8%	-529.18%	-66.20%	550.39%	3458.24%	941.62%	274.02%	170.35%

Panel C: Correlation between deviations due to compounding and deviations due to management factors.

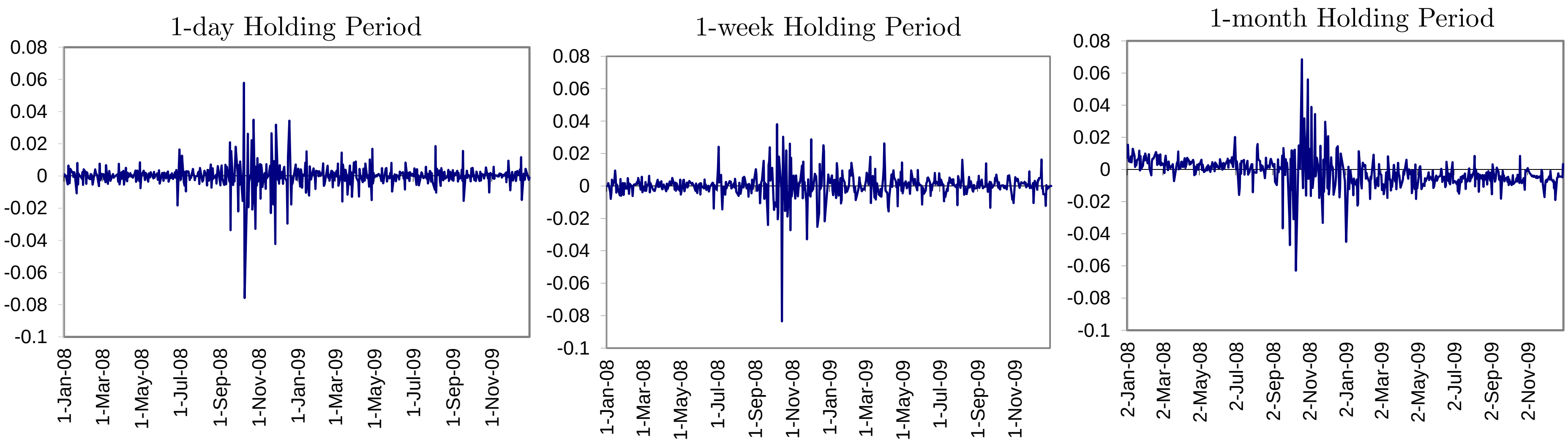
SSO	3-month	1-month	1-week	2-day
2006	0.9718	0.8875	0.4824	0.1998
2007	0.7729	0.3276	-0.0251	0.1842
2008	0.2850	-0.0710	-0.0436	-0.0775
2009	0.8103	0.172	0.1481	-0.0665
2006-09	0.2239	0.0783	0.0206	-0.0124

SDS	3-month	1-month	1-week	2-day
2006	-0.9601	-0.9215	-0.4709	-0.1887
2007	-0.6403	-0.2645	0.0909	-0.1405
2008	0.1708	0.3796	0.3693	0.1289
2009	0.1621	-0.0981	-0.1646	-0.1388
2006-09	-0.0324	0.1284	0.2256	0.0696

Figure 1

Deviations from Target Return Not Due to Compounding
January 1, 2008 - December 31, 2009

Panel A: HXU (2x bull leveraged ETF of the S&P/TSX60)



Panel B: HXD (2x bear leveraged ETF of the S&P/TSX60)

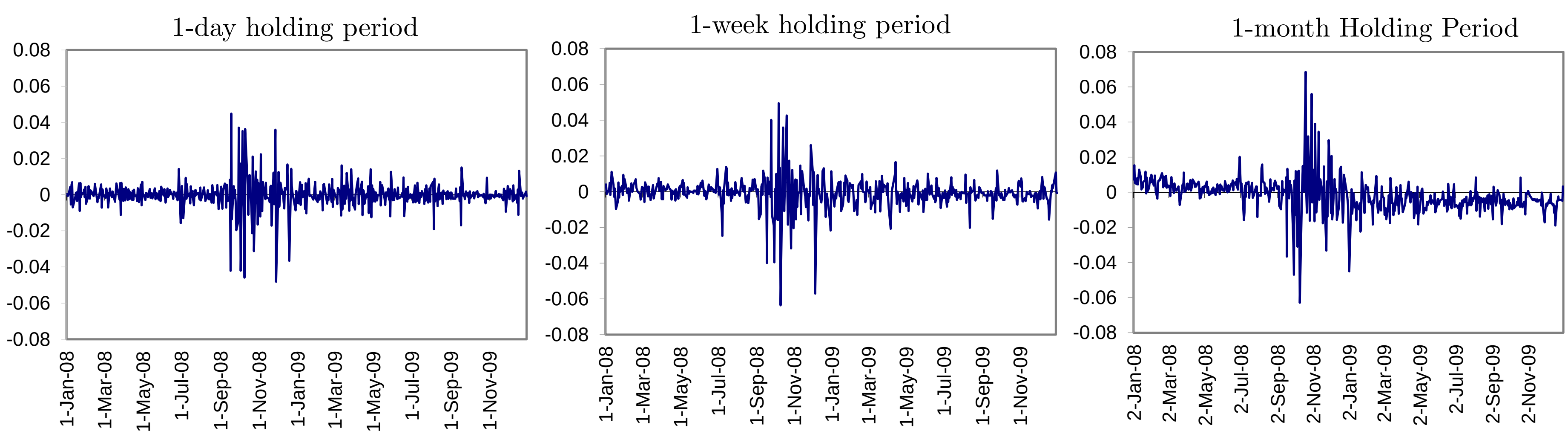
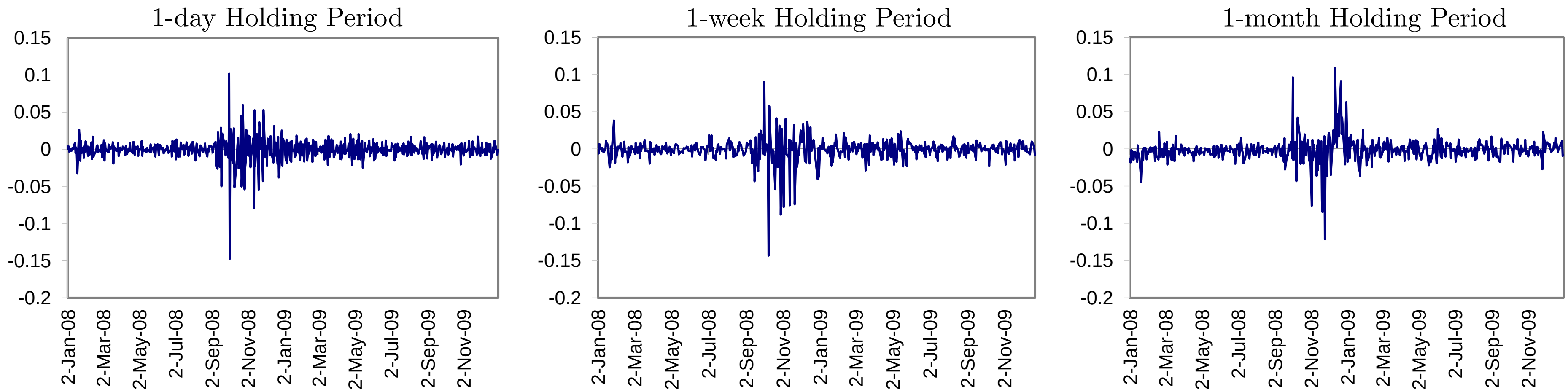


Figure 2

Deviations from Target Return Not Due to Compounding
January 1, 2008 - December 31, 2009

Panel A: HGU (2x bull leveraged ETF of the S&P/Global Gold index)



Panel B: HGD (2x bear leveraged ETF of the S&P/Global Gold index)

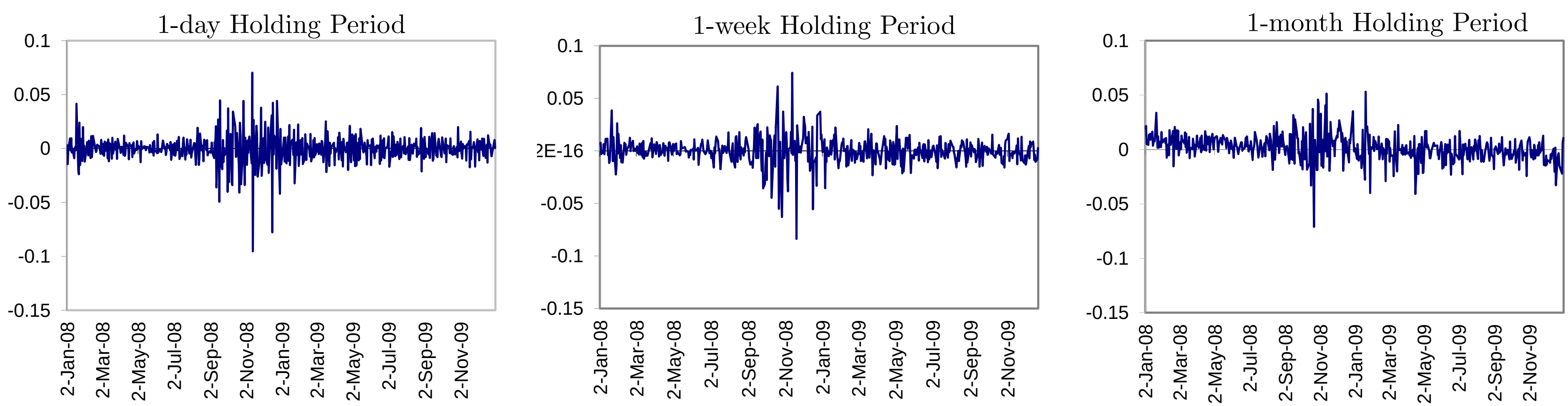
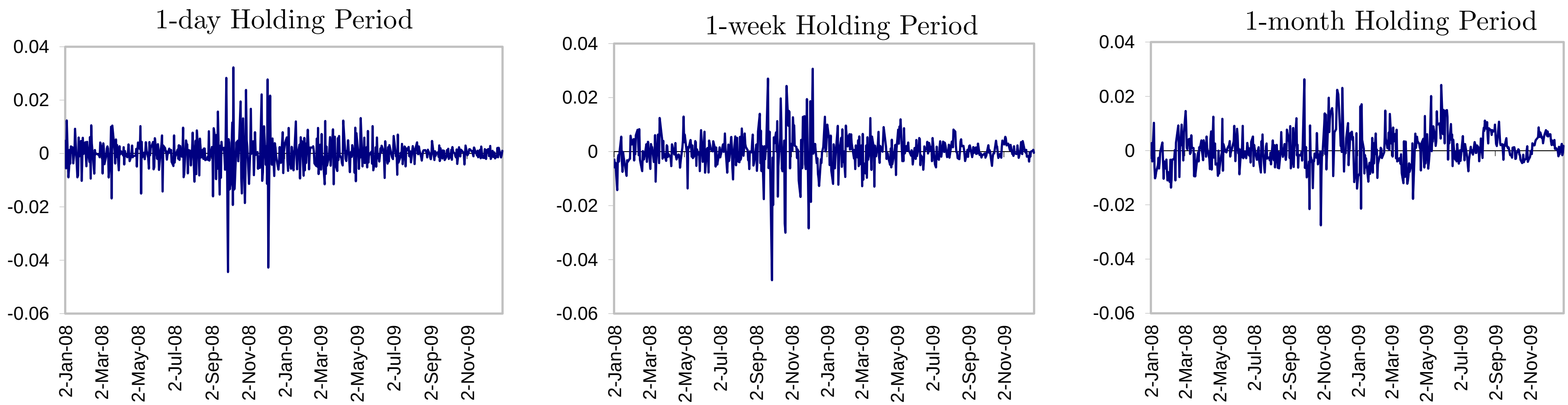


Figure 3

Deviations From Target Return Not Due to Compounding
January 1, 2008 - December 31, 2009

Panel A: DIG (2x bull leveraged ETF of the DJ Oil and Gas index)



Panel B: DUG (2x bear leveraged ETF of the DJ Oil and Gas index)

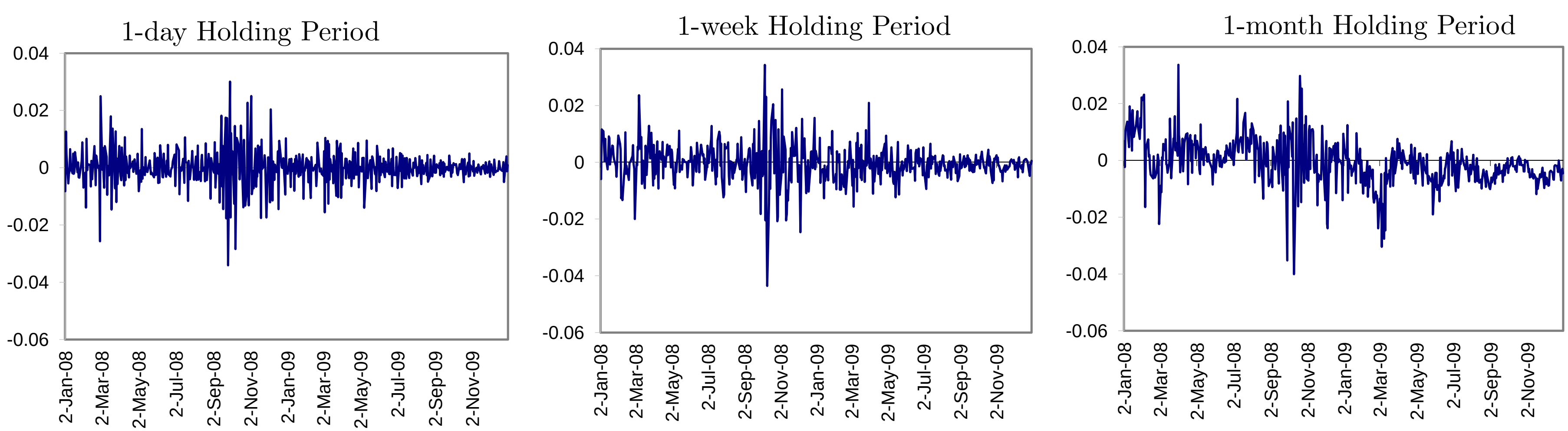
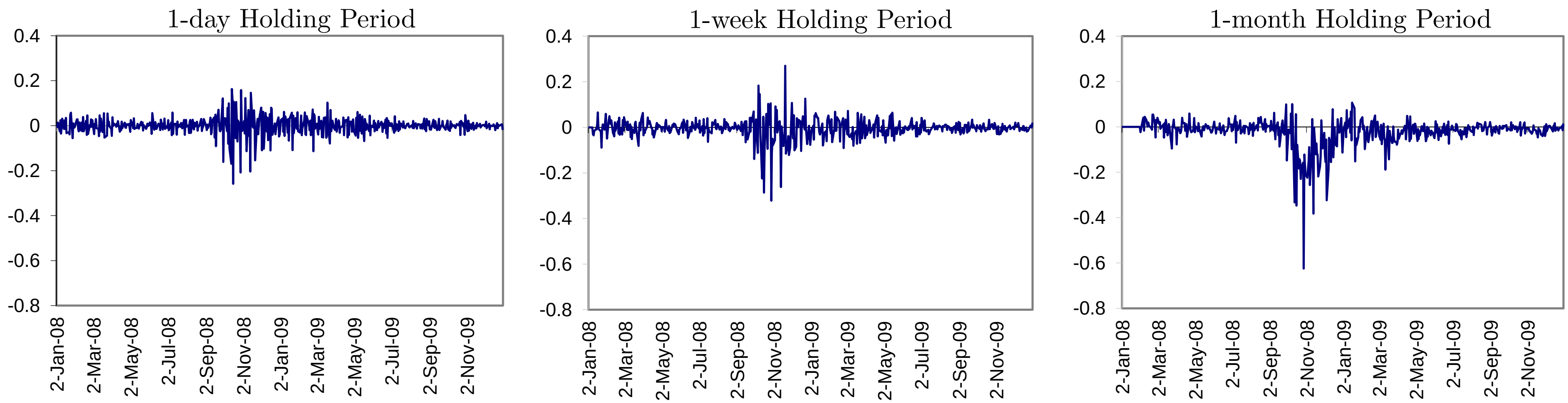


Figure 4

Deviations From Target Return Not Due to Compounding
January 1, 2008 - December 31, 2009

Panel A: EFU (2x bear leveraged ETF of the MSCI EAFE index)



Panel A: EEV (2x bear leveraged ETF of the MSCI EM index)

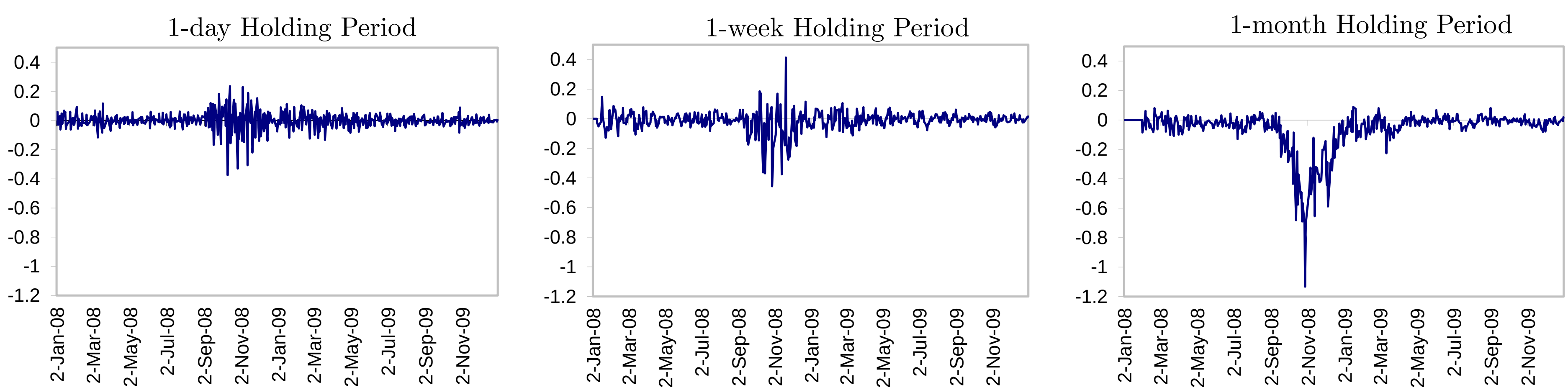
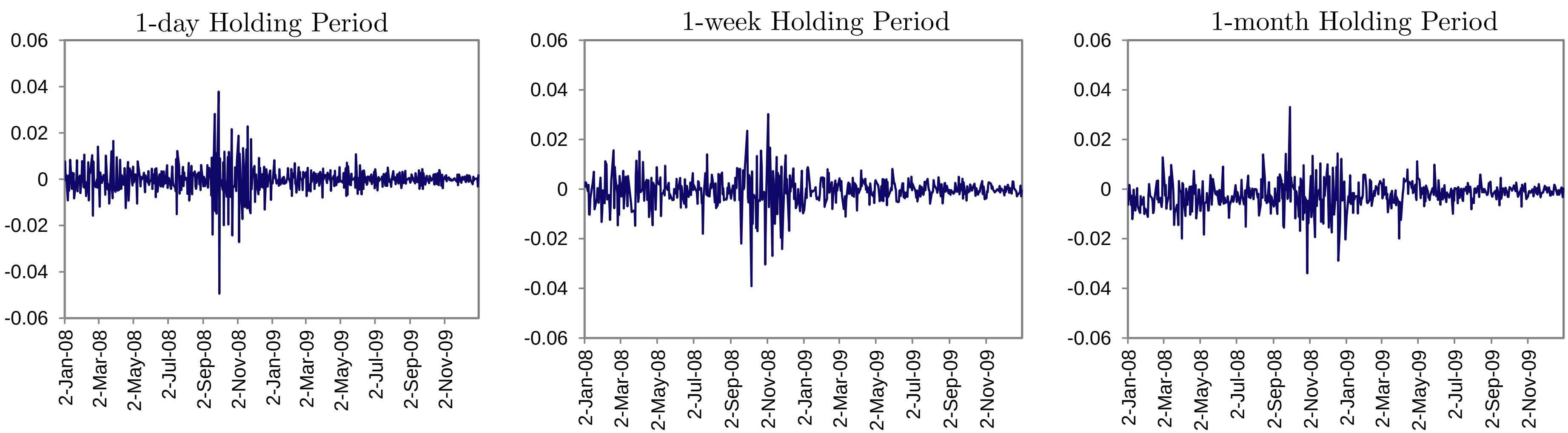


Figure 5

Deviations from Target Return Not Due to Compounding
January 1, 2008 - December 31, 2009

Panel A: SSO (2x bull leveraged ETF of the S&P 500)



Panel B: SDS (2x bear leveraged ETF of the S&P 500)

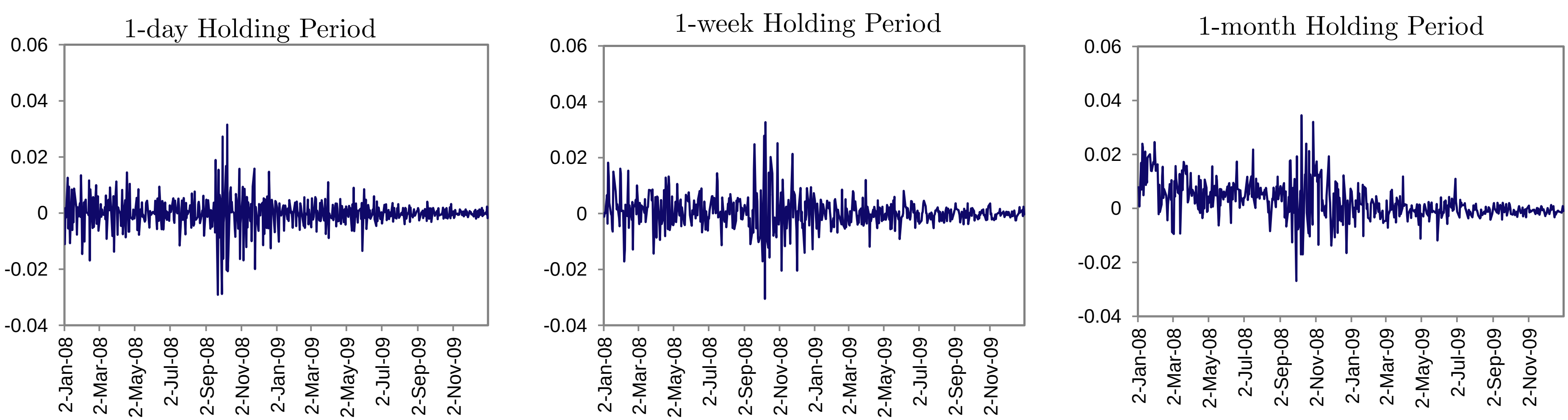


Figure 6
Daily Premium/Discount as a Fraction of NAV
January 1, 2008 - December 31, 2009

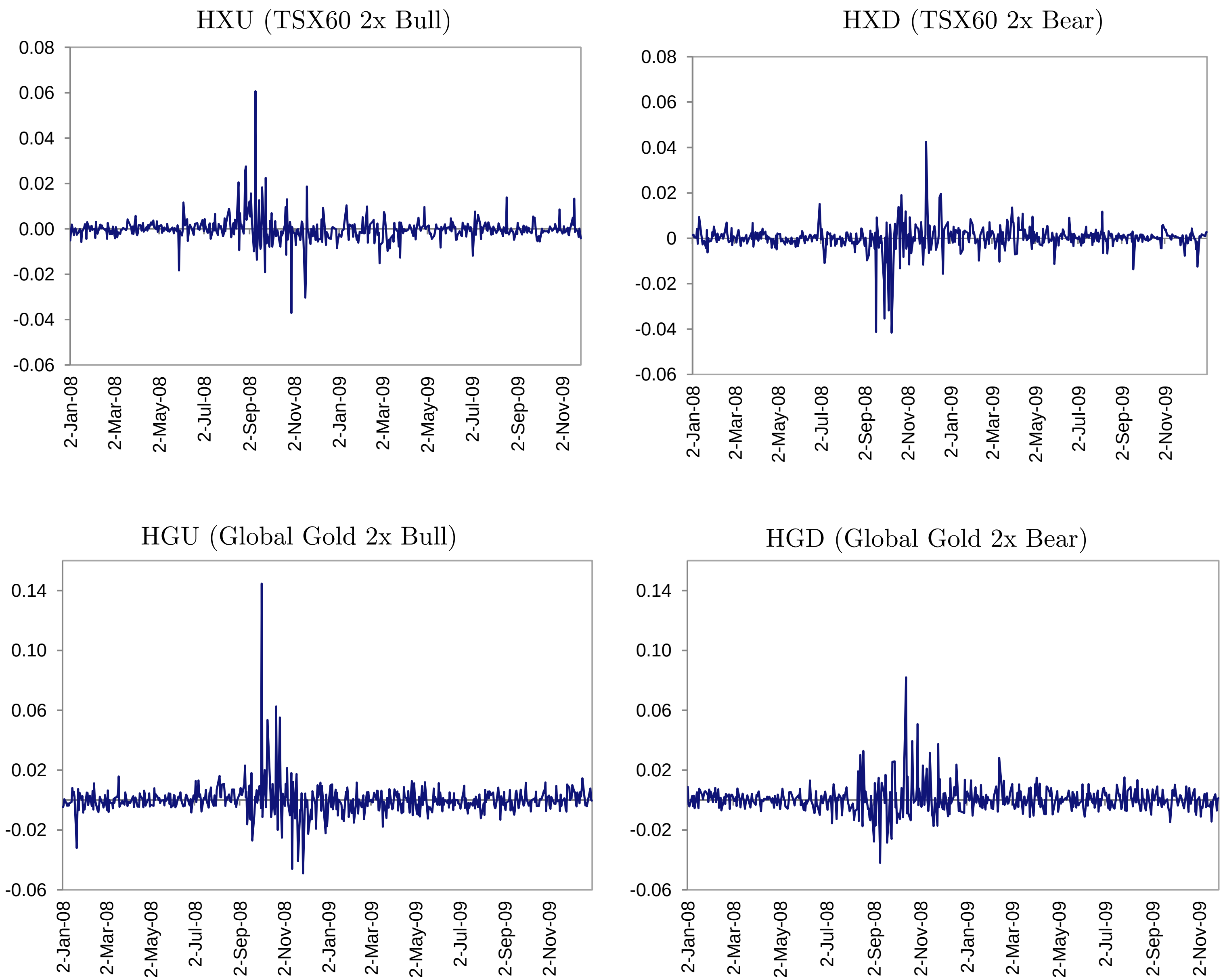
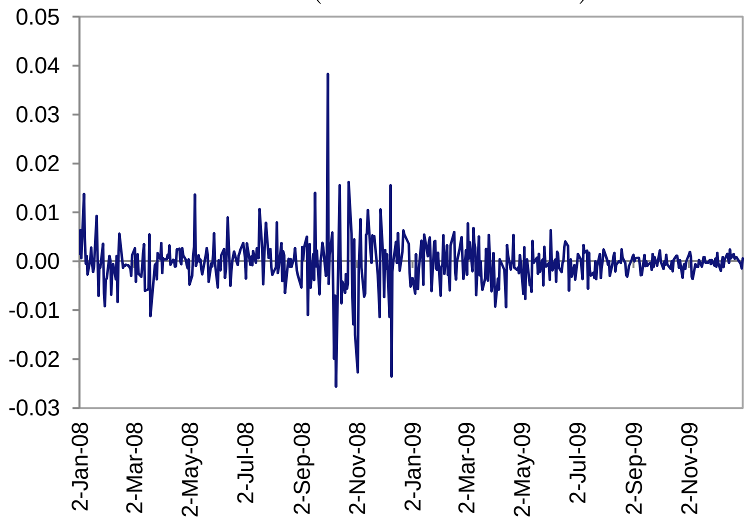
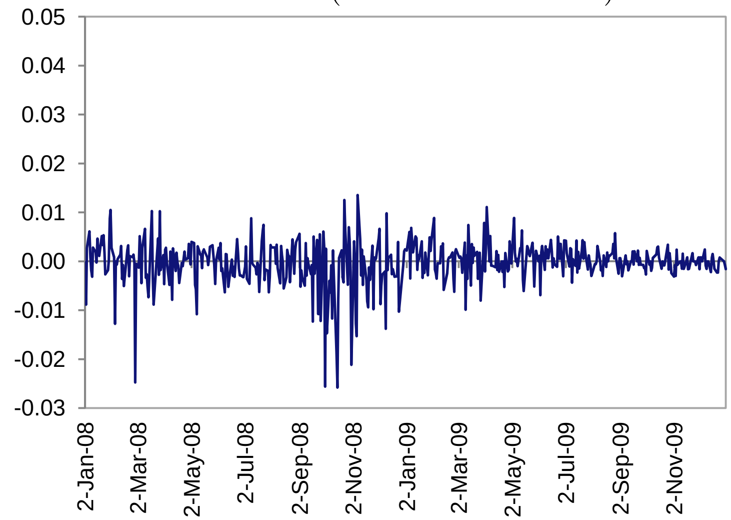


Figure 6 (cont'd)
Daily Premium/Discount as a Fraction of NAV
January 1, 2008 - December 31, 2009

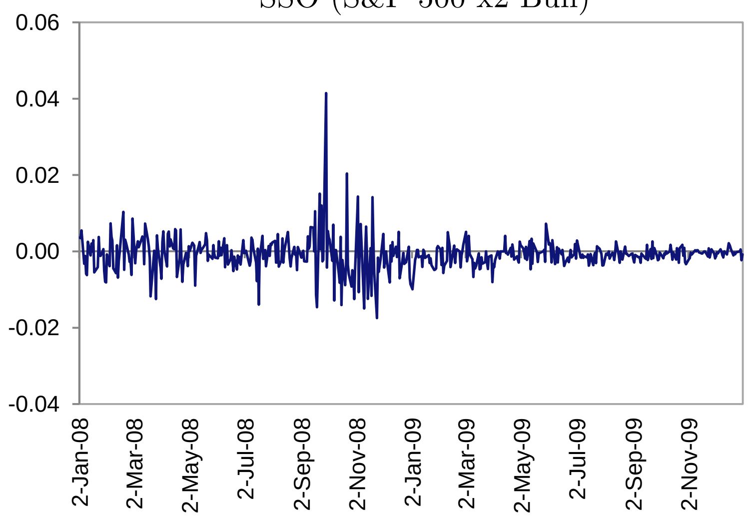
DIG (Oil & Gas 2x Bull)



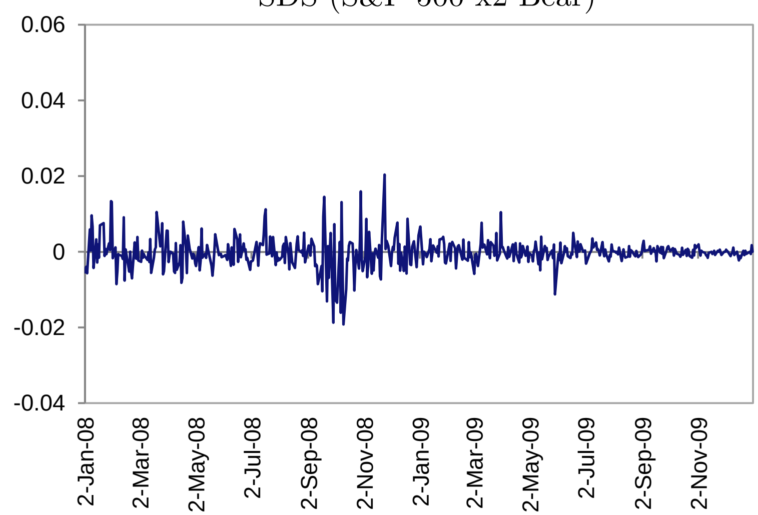
DUG (Oil & Gas 2x Bear)

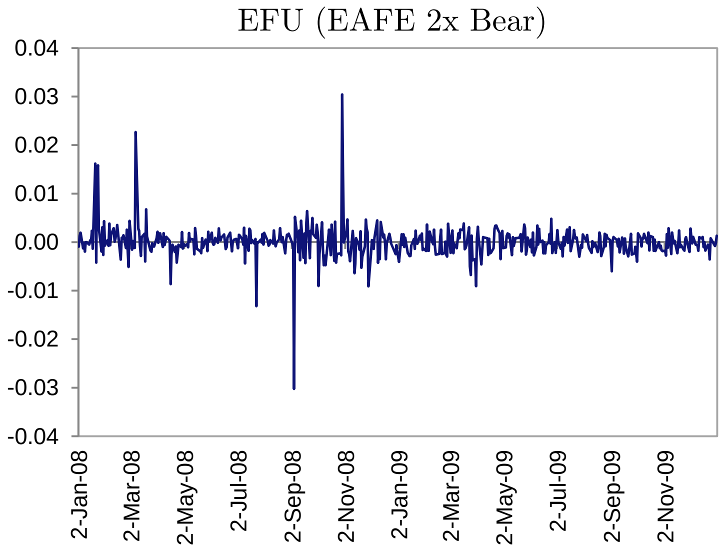


SSO (S&P 500 x2 Bull)



SDS (S&P 500 x2 Bear)




EFU (EAFE 2x Bear)
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
2-Jan-08
2-Mar-08
2-May-08
2-Jul-08
2-Sep-08
2-Nov-08
2-Jan-09
2-Mar-09
2-May-09
2-Jul-09
2-Sep-09
2-Nov-09

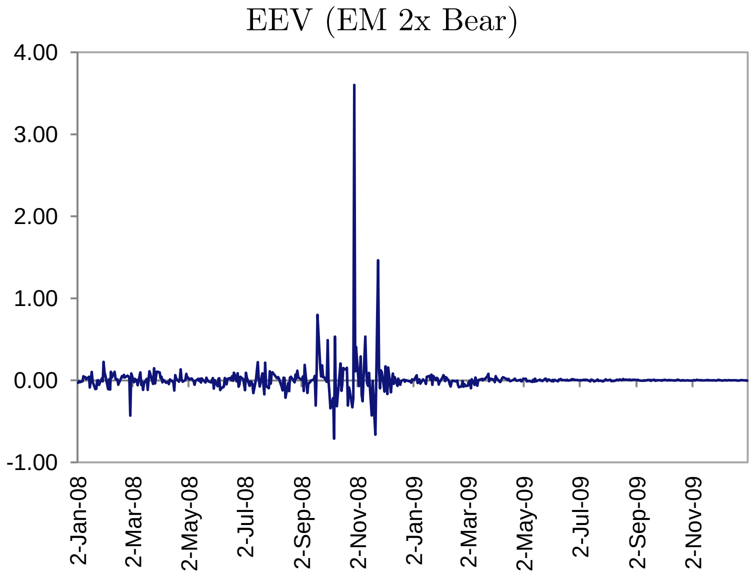
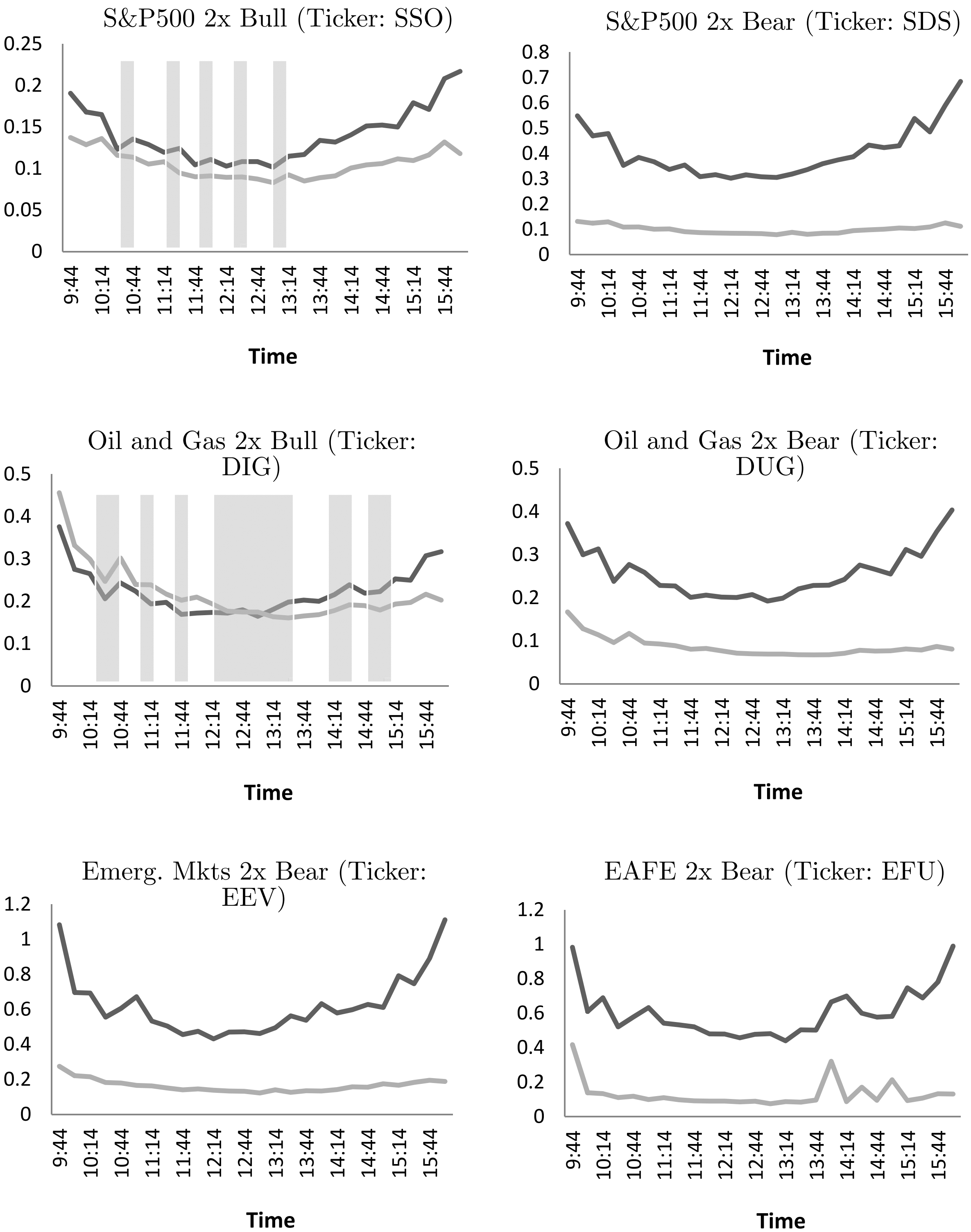

EEV (EM 2x Bear)
4.00
3.00
2.00
1.00
0.00
-1.00
2-Jan-08
2-Mar-08
2-May-08
2-Jul-08
2-Sep-08
2-Nov-08
2-Jan-09
2-Mar-09
2-May-09
2-Jul-09
2-Sep-09
2-Nov-09

Figure 7

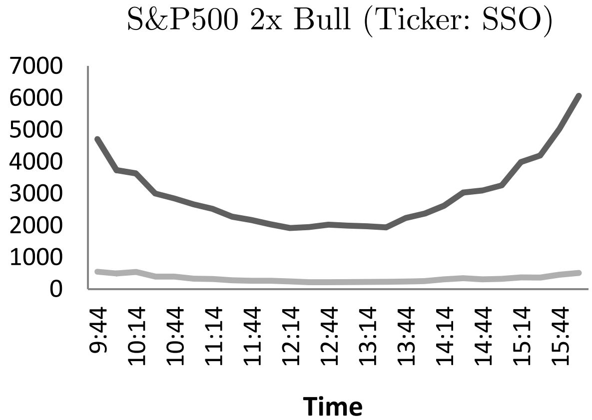
Intraday Trading Patterns
Before and After September 15, 2008

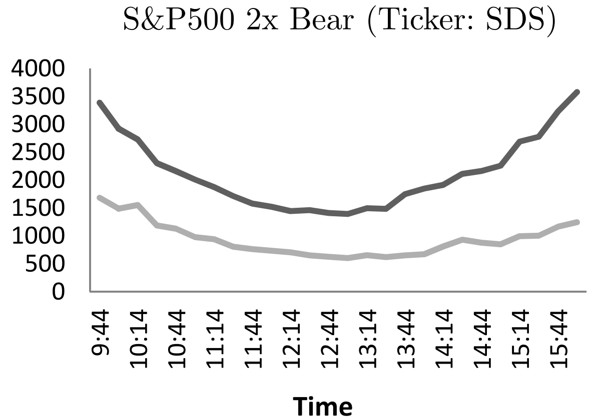
Panel A: Mean Share Price Standard Deviation
Black line: September 15 to December 31, 2008; Grey line: January 1 to September 14, 2008. Grey bars indicate time intervals when the difference in mean is statistically insignificant at five percent.

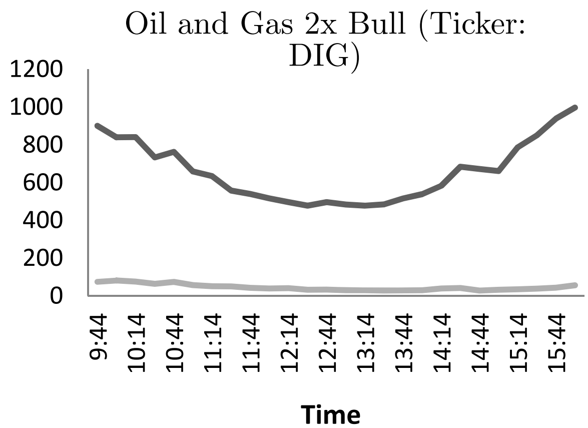


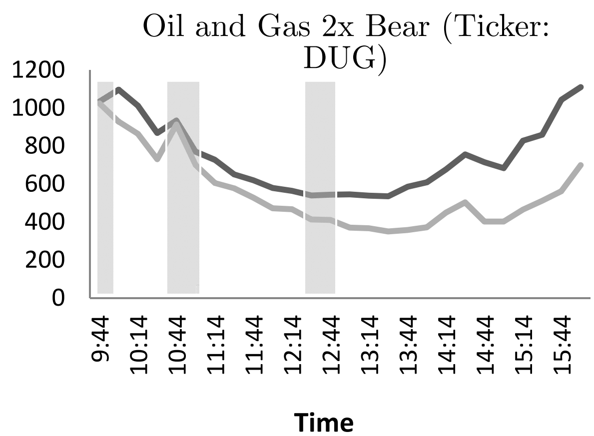
Panel B: Mean Trading Volume in thousands

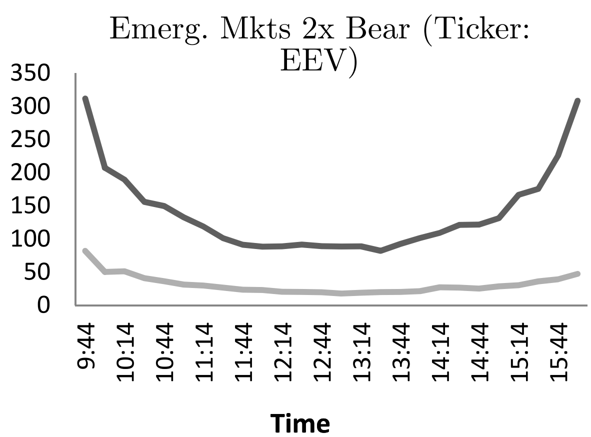
Black line: September 15 to December 31, 2008; Grey line: January 1 to September 14, 2008. Grey bars indicate time intervals when the difference in mean is statistically insignificant at five percent.

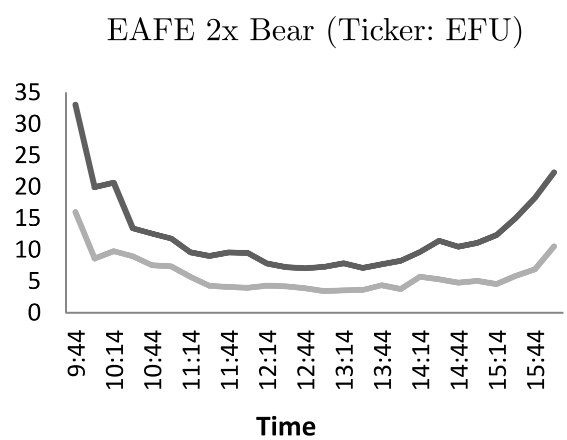






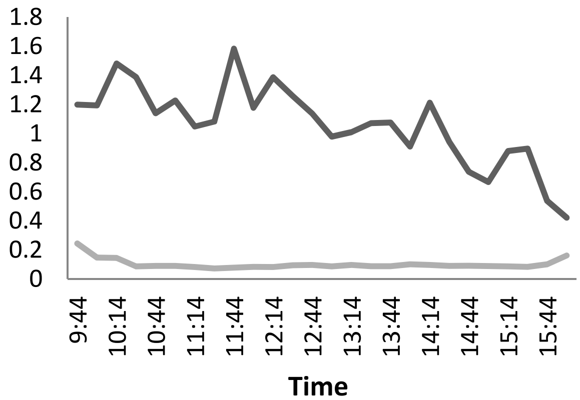




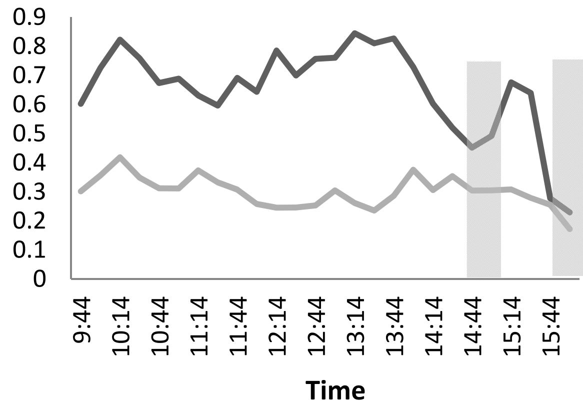


Panel C: Mean Percentage Bid-Ask Spread (%)
Black line: September 15 to December 31, 2008; Grey line: January 1 to September 14, 2008. Grey bars indicate time intervals when the difference in mean is statistically insignificant at five percent.

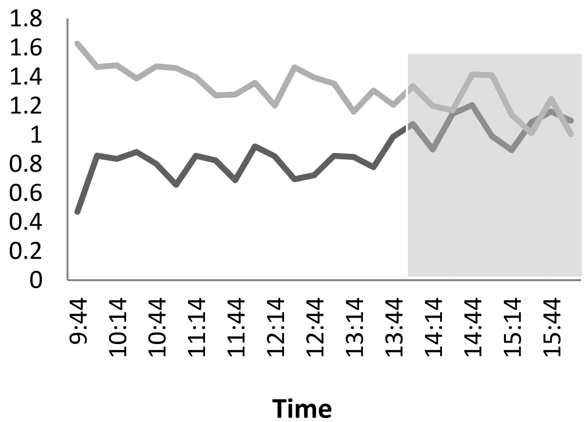
S&P 2x Bull (Ticker: SSO)



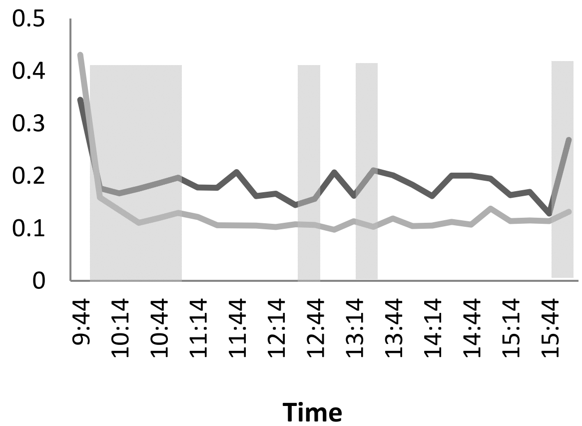
S&P 2x Bear (Ticker: SDS)



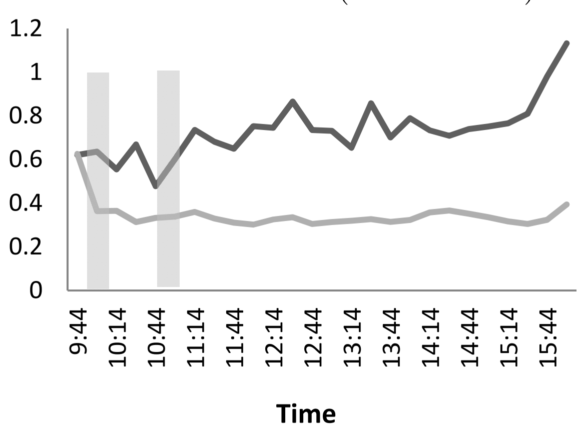
Oil & Gas 2x Bull (Ticker: DIG)



Oil & Gas 2x Bear (Ticker: DUG)



EAFE 2x Bear (Ticker: EFU)



EM 2x Bear (Ticker: EEV)