THE SURPRISING COST OF VOLATILITY
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The late Peter Bernstein often reminded us that we don't know what will happen in the markets, and I stand in that camp today. I do know that the dispersion of probable outcomes is wider than we have seen in some time. We hear about the looming prospect for debilitating deflation alongside the espoused inevitability of substantial inflation; the strength of corporate balance sheets alongside the bloated and unprecedented size of sovereign ones; the record economic growth of China alongside the gigantic China bubble waiting to burst. The uncertainty caused by global imbalances and the precarious state of developed market economies increases risk in the capital markets. As the mood of the market shifts from hope to despair, it is reasonable to expect capital market volatility to sit at elevated levels for some time to come.

Twice in the last four years I felt compelled to express my thoughts in this format. Both of those times – discussing the illusion of liquidity in August 2006 and leverage in the credit default swap market in December 2007[1] – I believed I had come across systemic risks that carried significant and inevitable consequences, yet were overlooked by those at the forefront of investment thought. As it played out, the communal oversight of the dangers of illiquidity and leverage were indeed key proximate causes of our recent financial crisis.

The following exposition on volatility is the third such instance. Elevated volatility creates structural costs and magnifies fallible investor behavior, penalizing leveraged ETFs, short sellers, tail risk hedgers, and institutional investors. Whether by design or execution, the impact of high market volatility on investor portfolios may well factor into the next period of trouble and requires more of our attention to understand its potential impact. Fortunately, where great stress arises, great opportunities follow.

The Curious Case of Leveraged ETFs

Leveraged ETFs are a woefully misunderstood and misused investment vehicle. Over the past few years, a number of fund management companies introduced a cornucopia of exchange-traded funds, catering to every passive and semi-passive investor desire. While some unleveraged ETFs may serve a need, leveraged ETFs in volatile environments most certainly do not, as they fail to deliver what a naïve investor might expect over time.[2] As a representation, the following chart shows the performance of a group of ETFs referencing the Russell 2000 index over the two year period of 2008-2009.

The Russell 2000 ETF Experience (Jan 2008 – Dec 2009)			
	"Naïve" Return Expectation	Actual Return	Difference
Russell 2000 (Ticker: RTY)	-15.8 %	-15.8 %	0.0 %
Russell 2000 Ultra Long 2x (UWM)	-31.6 %	**-52.7 %**	**-21.1 %**
Russell 2000 Short (RWM)	15.8 %	**-16.5 %**	**-32.3 %**
Russell 2000 Ultra Short 2x (TWM)	31.6 %	**-51.3 %**	**-82.9 %**

Over the last two years, the short and leveraged ETFs decimated investors relative to a naïve expectation of the intended derivative of the index. During a period in which the Russell 2000 lost 16%, the Ultra 2x Short version, in which naïve holders expected to make a killing, managed to *lose* over 50%! *How is that possible?*

The answer to this riddle lies in the cost of volatility on short and leveraged ETF structures. With the assistance of money manager GMO, we can approximate ETF performance relative to an underlying index as follows:[3]

Geometric Mean (ETF) = Naïve Expected Return – Volatility Drag

where   Naïve Expected Return = m * Geometric Daily Mean (Index),
Volatility Drag = n * Daily Volatility (Index) ^2 * (1+ f), and

m = Multiple of leverage on ETF (ex. m= -2 for a 2x short ETF),
n = $(m^2 – m)/2$, and
f = Frictional costs

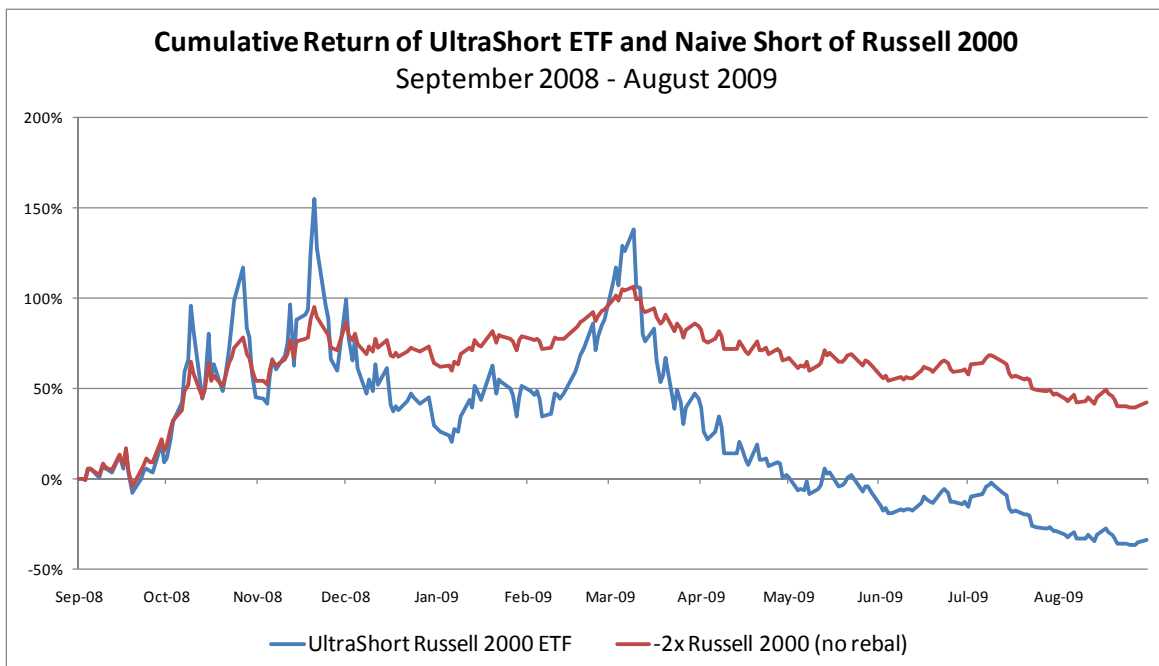When applied to the example of the Russell 2000, we derive the following results:

	Russell 2000	Ultra Long (2x)	Short	Ultra Short (2x)
Actual Total Return	-15.8 %	-52.7 %	-16.5 %	-51.3 %
Geometric Daily Mean (ETF)	-3.4 bp	-14.8 bp	-3.6 bp	-14.2 bp
Naïve Daily Expected Return	-3.4 bp	-6.8 bp	+3.4 bp	+6.8 bp
Daily Volatility Drag (f = 0)	0.0 bp	-6.9 bp	-6.9 bp	-20.6 bp
Estimated Daily Return	-3.4 bp	-13.7 bp	-3.5 bp	-13.8 bp
Estimated Total Return	-15.8 %	-49.9 %	-16.1 %	-50.3 %
Difference (due to frictional cost)	0.0%	2.8%	0.3%	0.9%

While the math behind this equation is tricky to digest, the variables raise a number of important costs of volatility in a leveraged ETF structure. First, the higher the volatility of the reference index, the larger the cost incurred by an investor holding the security. Second, volatility reduces the Naïve Expected Return *independent of market direction and regardless of whether the ETF is long or short.* Third, ETFs with more leverage (|m|>1) and short ETFs (m<0) suffer a greater drag on return. Lastly, frictional costs such as management fees, transaction costs, and tracking error further detract from ETF returns relative to expectations.

This hidden cost of volatility in leveraged ETFs arises from its daily constant-proportion rebalancing strategy.[4] A twice short ETF starts each day exposed to its reference index by a factor of two. As underlying market movements shift exposure away from the 2x target, the manager of the ETF must reset the exposure for the next business day. To accomplish this objective, the ETF manager buys if the market has risen and sells if it has fallen. In markets that are more volatile than directional, the repeated process of rebalancing the ETF follows a pattern of buying high and selling low that takes a toll on asset value over time.[5]

By rebalancing in this fashion, leveraged ETFs deliver short exposure with protection from the worst index outcomes and upside from the best. Without rebalancing, a twice leveraged ETF would lose more than 100% anytime the reference index moves 50% in the opposite direction (see Appendix). The constant-proportion rebalancing strategy offers portfolio insurance from a total loss of capital. Additionally, in a strong bull market, simple leverage would underperform a twice leveraged long ETF, which adds exposure into the rally.

The cost of upside optionality and downside protection is underperformance in any outcome other than the extremes. For those seeking leveraged exposure in almost every environment, ETFs effectively pay an unnecessary premium for portfolio insurance and a deep out-of-the-money call option.[6] As shown graphically below, through the crisis and rebound of 2008 and 2009, the 2x short ETF shows brief periods of outperformance after forceful market declines (Oct 2008 and Feb 2009), but lags a naïve strategy most of the time. Over the year, the leveraged short ETF underperforms despite substantial market losses.

Cumulative Return of UltraShort ETF and Naive Short of Russell 2000
September 2008 - August 2009

UltraShort Russell 2000 ETF   -2x Russell 2000 (no rebal)

Unfortunately, most investors in leveraged ETFs do not appreciate the dynamics at work. In volatile market conditions, leveraged ETFs face insurmountable challenges for unsuspecting buyers that have parallels elsewhere in the investment world.

Hedge Fund Hedging

In long-short hedge funds, the "short" half of the equation constitutes the "hedge" in "hedge fund." Indeed, the short book that is concurrently revered by those in the space and vilified by public officials faces a battle with volatility that echoes the problems in managing ETFs and is exacerbated by behavioral biases that introduce implicit frictional costs.

The cost of volatility on hedge funds can best be described by considering the vicissitudes of managing a short only fund. The architect of a short only portfolio must choose between rebalancing and unlimited loss potential. In the absence of rebalancing, a short only book has the same negative asymmetric return profile as that of an individual stock short: limited upside and unlimited downside. By rebalancing selectively, short sellers limit liability and attempt to "sell high and buy low," but they cannot avoid the whims of volatility.

The recent financial crisis provides a textbook example of the plight of short sellers. Through the fall of 2008, short sellers had it pretty good. The S&P 500 fell 9% in September, 17% in October, and 7% in November, and short only funds sat on tidy gains. However, short selling is a strategy that gets less short as the market drops – negative convexity in quant speak. From September through November, not only did a fully invested short book (100% short) drop to approximately 50% short from market moves[7], but also short sellers further reduced their short exposure by covering positions that reached target prices. If we assume that half of the names in a typical short portfolio reached target prices by November, a short seller would have left the month with only 25% net short exposure.

The challenge that short sellers faced was deciding when to rebalance the portfolio to 100% short. As the winter of 2008-2009 remained ice cold in the financial markets, most short sellers waited for prices to rise before pressing their bets. In doing so, short sellers were under invested and missed the vast majority of the 20% selloff in January and February of 2009. Classic, relative performance-chasing behavior may have led short sellers to rebalance once the market started to move up in March and April, just in time to get smoked by the market rally the rest of the year. The behavioral bias that influenced the rebalancing decision is another frictional cost in the equation described above.

Short sellers exemplify the difficulties of managing a long-short hedge fund in volatile times. As if the inherent uphill slog in shorting stocks (rising markets, unlimited downside, expensive borrows, short squeezes, and regulatory pressure) were not enough, the structural cost of volatility wreaks havoc on long-short hedge fund managers. The presence of a long book to balance out the shorts eases some of the burden, but market movements alter the leverage and position sizing of a hedge fund portfolio unless the manager takes action.

Like running on a treadmill, hedge fund managers must scurry just to stay still in volatile environments. When markets rise both long positions and short positions increase in value,

growing a hedge fund manager's balance sheet and market exposure unless he consciously counters the gravitational pull. A market fall has the opposite effect, geometrically reducing risk independent of a manager's action. In volatile times, transaction costs are a necessary evil for a hedge fund manager who seeks to maintain a constant risk exposure.

Unlike traditional long only portfolio management, the hardest aspect of managing a hedge fund is staying still, and volatility is the force behind change. As discussed below in "Elusive Alpha," only the skill of a hedge fund practitioner can make up for the costs of playing the game.

Tail Risk Hedging

The concept of tail risk hedging has gone from a novel idea popularized by a single author to a hackneyed phrase at the forefront of the lips of sell side research analysts.[8] Tail risk hedging is a form of insurance in which investors seek protection against unlikely, but severely damaging, market events. While the universe of possible tail risk hedges is as wide as the scenarios conjured up by imaginative investors, protection against equity market crashes, sovereign debt declines, hyperinflation, and deflation are the ones most frequently bantered about in today's markets.

Tail risk hedging is hard to execute and tricky to monetize in volatile market conditions. When volatility is high, options are expensive and credit spreads are often wide, increasing the premium on many forms of insurance. Investors may still choose to purchase necessary insurance for their portfolio; however, at some point prices get too high to justify the expected loss. We wouldn't buy flood insurance that costs 50% of our home value each year, so somewhere in between free and excessive lies an appropriate price for each investor. Tail risk hedges are most attractive when the market forgets about the possibility of outlier events. Volatile markets remind investors of what might happen.

Once an investor identifies an attractive tail risk hedge, behavioral psychology takes hold in managing the position. Insurance purchased in the financial markets is very different from insurance on a house, car, or life. When we buy insurance from a broker, we pay a small premium and collect a large payout should a catastrophic event occur. The outcome is binomial – either our home burns down or it doesn't; our car is totaled, or it is not; we die or we live. In contrast, financial insurance is re-priced in the markets every day, and the more volatile the underlying instrument, the more tempted we may be to sell our contract prematurely.

For example, a savvy investor who purchased one-year, 20% out-of-the-money put options on the market in the spring of 2008 would have watched those options turn in-the-money by the end of September. The buyer of those options might have taken his chips off the table, fearing that any bounce in the market would render the now valuable options worthless. Had he done so, he would have lost the important protection offered by the "insurance" in October…and November…and January… and February. On the contrary, another investor who purchased a similar option a few months later and held on tight would have made substantial paper gains through March and then watched the value of the securities evaporate through the spring and summer of 2009.

The endogenous cost of volatility on tail risk hedges when market events play out over time leaves purchasers of the instruments in a predicament. At times, an investor feels compelled to declare an artificial expiration date on their contract, because otherwise, he can only extend the contract term by rolling it over at prices tied to an unknowable future level of implied volatility. In higher volatility regimes, tail risk insurance is more expensive and harder to manage.

Perpetual Institutions

Shifting from investors with relatively short time horizons to those with the longest, the behavior of endowments and foundations ("E&Fs") through the financial crisis revealed that extreme levels of volatility can negatively affect even those with a perpetual time horizon and stable asset base. Heightened market volatility in 2008 catalyzed actions that belied the pristine framework with which many E&Fs carefully charted their long-term investment strategy.

The highly publicized liquidity issues that befell E&Fs should be surprising. From January 2008 to December 2009, the S&P 500 lost 20.1%, an outcome falling 1.3 standard deviations below the mean two-year return since 1928.[9] Investors with long duration liabilities would ordinarily be prepared for an outcome expected to occur 10% of the time. However, the inordinately volatile interim path created an earthquake that shook the foundation of the asset-liability structure of these institutions.

One component of the highly successful "Yale Model" is the essential practice of active rebalancing to long-term asset class policy targets, a constant-mix rebalancing strategy. The systematic selling of relative outperformers and purchase of underperformers instills discipline on investor behavior and adds value over time when asset classes are more volatile than directional relative to one another. In a little known, "ongoing friendly dispute" between two investment luminaries, Peter Bernstein "insist(ed) that Yale's strict rebalancing policy is a form of market timing, although mechanical rather than a matter of judgment." David Swensen took the position that "faithful adherence to the policy, no matter what, prevents panicky or greedy reactions from getting in the way of buying low and selling high."[10]

While in theory I agree with Swensen, in practice extreme market volatility all too often turns "faithful adherence" into "panicky and greedy reactions," creating investment behavior that resembles the traits of unsuccessful market timers. Towards the end of 2008, many E&Fs used "rebalancing" as a euphemism for their desperate thirst for cash at the worst possible moment. By redeeming investments across asset classes, many E&Fs raised cash wherever they could to assuage fears of spending shortfalls and future capital calls.

Whenever an investor is forced to unload, he adds another frictional cost to our equation. In this case, the frictional cost of volatility on E&F portfolios was twofold. First, the fear and liquidity driven "rebalancing" was a one-way trade. The perceived need for cash caused E&Fs to avoid buying equities and credit at their nadir in early 2009. As a result, they abandoned a long held strategy at precisely the moment when their portfolios would have benefitted the most from buying cheap assets. Second, by selling private equity portfolios, certain E&Fs lightened up on the very irreplaceable investments that drove impressive returns over two decades. The

press reported that prestigious institutions sought to relieve some exposure to less liquid assets in the midst of the crisis.[11] These same private equity investments, run by some of the best venture capitalists and leveraged buyout managers in the world, had been a substantial contributor to the returns of leading endowments over the prior twenty years. For those with perpetual time horizons, losing this precious exposure surely is a suboptimal long-term strategy driven by a short-term desire for liquidity.

None of those in the driver's seat during the depth of the crisis wanted to sell, but they felt they had to. Had they known what 2009 would bring, they may have come to a different conclusion. But that is the cost of volatility – we don't know what will happen. When market volatility caused institutions with perpetual time horizons and modest spending needs to release some of their most treasured assets, how can anyone be sure they will remain solvent long enough for a volatile market to return to rationality.

Hope on the Horizon

While market volatility introduces a host of structural and frictional costs in the financial markets which require our attention, we need not sit idly by and await impending doom. Understanding and appreciating the cost of volatility helps direct investors towards better solutions.

Caveat Emptor

In the eye-opening example of leveraged ETFs, most investors do not understand what they are buying. The Prospectus of leveraged ETFs describes the "single day investment objective" of the vehicles.[12] For anyone with a time horizon longer than a day, leveraged ETFs usually do little more than create expensive leverage with substantial frictional costs and a hefty tax bill. (And anyone able to predict market movements repeatedly within a single day should be retired and counting their billions).

Despite comprehensive Prospectus disclosures about the shortcomings of leveraged ETFs, sensible regulators should consider banning the vehicle. Just as Wall Street prop desks and the CDS market grew beyond rationality to influence the recent crisis, so too do leveraged ETFs exist primarily to enrich the coffers of their peddlers to the detriment of an unsuspecting public. Regulatory reform is usually complex – this one is not.

Elusive Alpha

Despite the structural challenges of shorting stocks, the small universe of short only funds has generated a lot of alpha over time, outperforming the inverse of the S&P 500 by 5.0% per annum.[13] All of that outperformance arose from superior stock selection or well-timed rebalancing decisions, notwithstanding the winter of 2009. Although Darwinian selection has placed this small subset of managers on the endangered species list, truly talented short sellers both add value and deliver returns that are negatively correlated with other hedge fund and long only strategies, a highly desirable characteristic in a diversified portfolio of investments.

Another perspective on volatility may also prove beneficial to investment managers. For those professionals attuned to fundamental intrinsic value and a disciplined approach to position sizing, volatile markets provide more opportunities for Mr. Market to get things wrong. Leading hedge funds who consciously and actively seek to capture the discrepancy between price and value may be just the investment vehicle for these erratic times. Though their search for alpha must overcome the cost of volatility on the short side, the best among them likely will thrive.

Cash Ain't Trash (Revisited)

Seekers of portfolio protection and asset managers of all types can take refuge in cash. For decades, long-term thinking and a low turnover, buy-and-hold investment philosophy rewarded U.S. equity market participants. When seen in the rear-view mirror, cash was trash, as it offered the lowest return among asset choices. The same cannot be said, however, for investors in the Japanese equity market over the last two decades, where the degree of volatility dwarfed the total returns available to patient investors. Should volatility reign supreme over return going forward in the U.S., investors must consider different ways of achieving goals than blithely buying and holding on a wild roller coaster ride.

Individuals and institutions who share a belief that attractive investments may be more cyclical than secular in nature going forward will be well served to embrace an opportunistic investment approach. When discussing prescriptions to handle a sudden disappearance of liquidity four years ago, I suggested that "Cash Ain't Trash."

> Those investors with adequate, highly liquid reserves will be the most nimble in seizing the most attractive prospects of tomorrow…By embracing the uncomfortable position of overtly accepting short-term underperformance of long-term return objectives, these investors stand the best chance of reaching their goals over a full cycle. Behavioral, career, and client pressures prevent just about everyone from taking this stance, so it is likely to remain an opportunity for the few who can stand alone.[14]

The value of cash lies in the financial and psychological flexibility it provides should future opportunities be more attractive than current ones. As described elegantly by money manager Jim Leitner, "holding cash when markets are cheap is expensive, and holding cash when markets are expensive is cheap."[15] For example, the extraordinary value in credit markets following the collapse of Lehman Brothers could only be captured by those whose portfolios were not fully invested in the thick of the crisis. Those holding cash had available resources to deploy and a frame of mind clear of the psychological baggage caused by severe losses on existing positions. Having the flexibility to invest opportunistically by holding cash in the absence of unusually attractive investment alternatives is one way to navigate a volatile market environment.

Innovation Among Institutional Asset Allocators

In a world where volatile traditional assets fail to deliver returns that meet spending needs, institutional allocators must find a new approach.[16] Over the last decade, institutions broadly adopted the feature of the Yale Model that outlined asset allocation based on qualitative and quantitative risk, return, and cross-correlation characteristics. But as Peter Bernstein first introduced in 2003, an opportunistic approach may serve institutions better than adherence to rigid policy portfolios in less robust times.[17]

More recently, some E&Fs have looked through different lenses, employing investment themes, risk budgets, or macroeconomic drivers to categorize their investment portfolios.[18] As far as I know, only Harvard Business School professor André Perold and his team at HighVista Strategies has adopted a risk management construct into an endowment-style investment pool that assesses the impact of volatility on asset classes. By lowering the amount of risk taken during periods of high volatility in the markets, their novel approach successfully navigated the crisis of 2008 better than most. Strategies that customize asset allocation to particular market environments are worthwhile new frameworks to achieve objectives in volatile conditions.
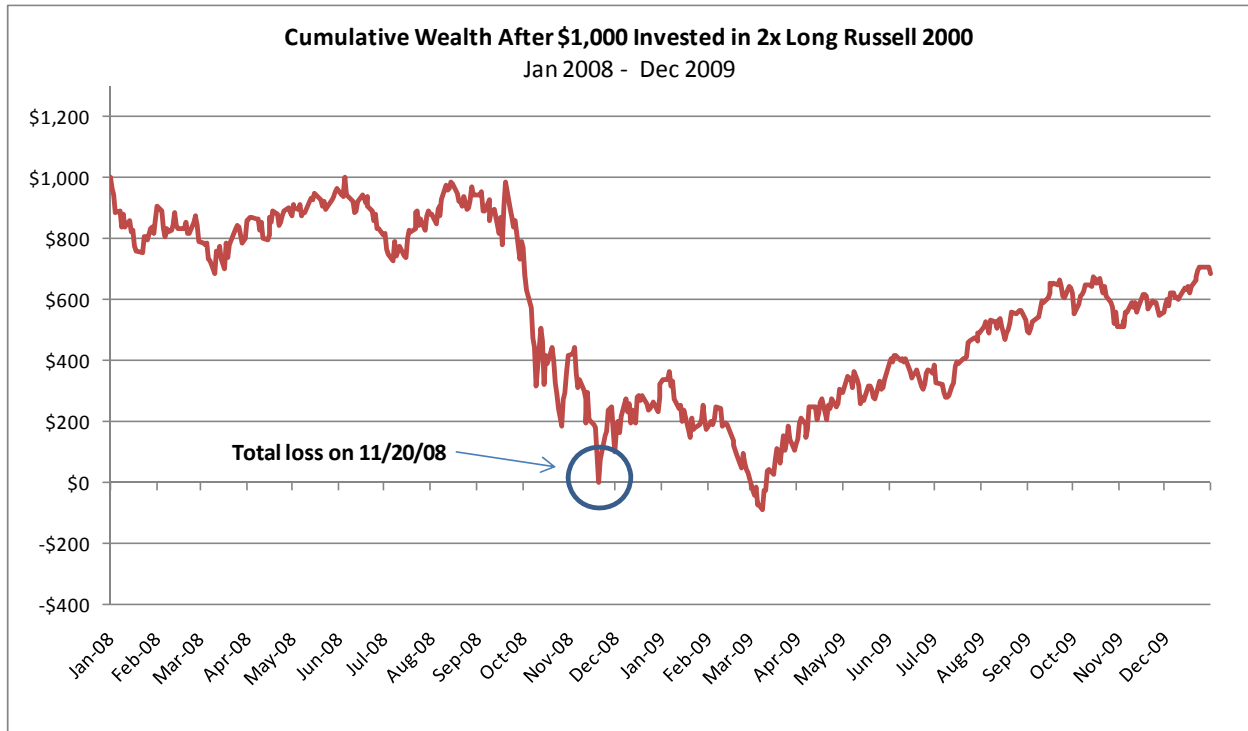

A Volatile Future

The inherent problem with high volatility environments is the absence of easy ways to solve complex problems. In discussing this increasingly influential and poorly understood risk in investment portfolios, I hope more of us will begin asking the right questions and shed more light on possible answers.
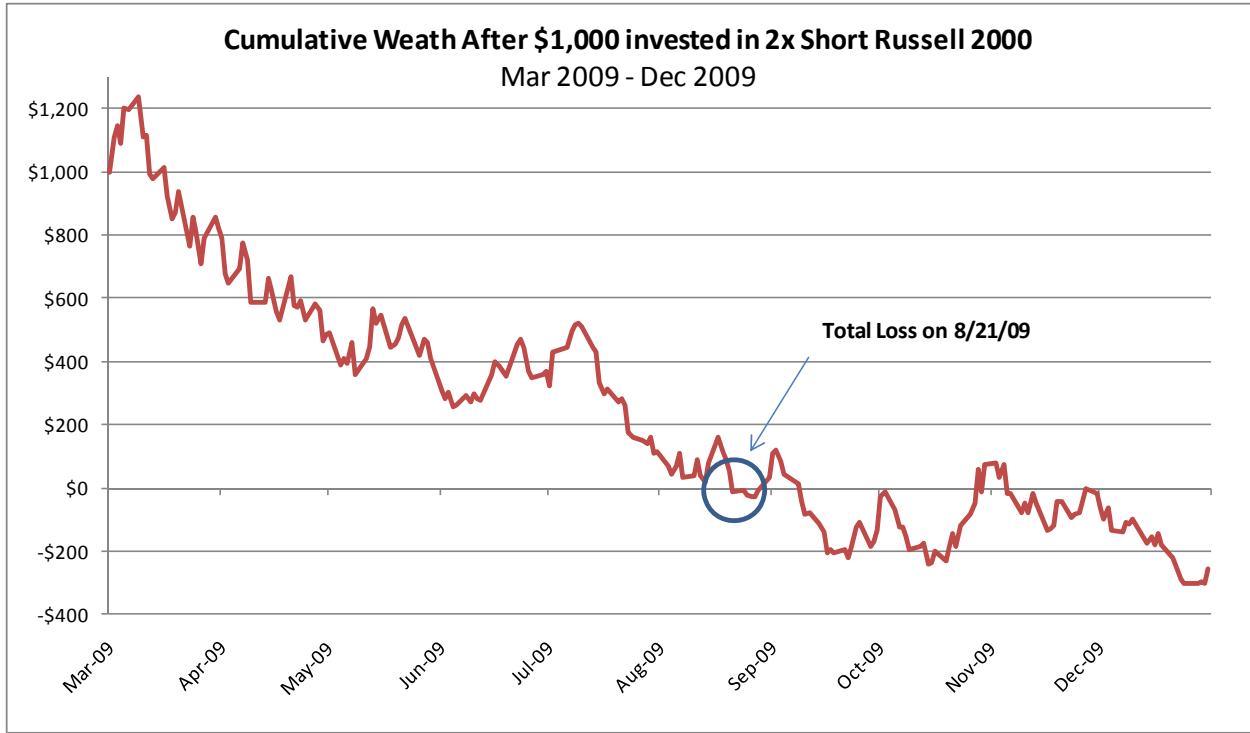
APPENDIX

The Unlimited Loss Potential of Maintaining Leveraged Exposure

   The following charts show the fortunes of an outright twice-levered long position in the Russell 2000 (January 2008- December 2009) and an outright twice-levered short position (March 2009 – December 2009). In both cases, the investor would have ended the period with precisely twice the total return of the Russell 2000, but would have suffered a loss of more than 100% of their initial capital outlay before the period culminated.

	Russell 2000	2x Levered Russell 2000
Total Return	-15.8 %	-31.6 %

Cumulative Weath After $1,000 invested in 2x Short Russell 2000
Mar 2009 - Dec 2009

Total Loss on 8/21/09

	Russell 2000	Short 2x Levered Russell 2000
Total Return	62.9 %	-125.8%

[1] Ted Seides, "Liquidity: Let's Don't Wait Til the Water Runs Dry," *Economics & Portfolio Strategy*, Peter L. Bernstein, Inc., August 15, 2006 and Ted Seides, "The Next Dominos: Junk Bond and Counterparty Risk," *Economics & Portfolio Strategy*, Peter L. Bernstein, Inc., December 1, 2007.

[2] For the purposes of this discussion, I assume that a "naïve investor" would expect to receive the inverse of the Russell 2000 when purchasing a short ETF over any period of time, and similarly would expect to receive twice the return of the Russell 2000 when buying a 2x long ETF and twice the inverse of the Russell 2000 when buying a 2x short ETF independent of the time period in question.

[3] I am indebted to money manager GMO for introducing a model that approximates the geometric returns of leveraged ETFs from their arithmetic returns. This derivation relies heavily on their insights and preparation.

[4] The leveraged ETF rebalancing strategy is a derivative of dynamic asset allocation rebalancing described in André F. Perold and William F. Sharpe, "Dynamic Strategies for Asset Allocation," *Financial Analysts Journal*, Jan/Feb 1988.

[5] Consider a 2x short ETF priced at $100. At the beginning of the day, the manager has $200 of short exposure. If the market rises 5% that day, the $200 of short exposure would rise to $210 in market value, while the asset value of the ETF would fall from $100 to $90. As a result, the ETF ends the day leveraged 2.33x ($210/$90). In order to rebalance to the 2x target, the ETF manager must buy back $30 of stock to leave $180 of short exposure ($180/$90). If the market then falls 4.8% the next day, the ETF gains $8.64 taking NAV to $98.64. Short exposure rises to $188.64, for resulting leverage of 1.91 ($188.64/$98.64). The ETF manager then shorts more stock to bring short exposure to $197.28 (2 x $98.64). After these two days, the market return is 0% but the ETF has fallen from $100 to $98.64. This occurs because the ETF manager bought stock after a market rise and then sold stock after a fall. The mechanics of running a leveraged ETF are the epitome of "buy high, sell low."

[6] The strike price of the call option rises over time at approximately the rate of the Volatility Drag. As opposed to listed options that are priced on implied volatility, the cost of these implicit options is based on realized volatility.

[7] In a 30% market loss, a dollar of short positions would fall to 70 cents. At the same time, a short portfolio NAV would rise to 130 cents, leaving the fund 53.8% short (70/130).

[8] Nassim Nicholas Taleb popularized the concept of outlier events in *Fooled By Randomness: The Hidden Role of Chance in Life and in the Markets*, (Texere Publishing, 2001.) More recently, strategies to hedge tail risks are abundant. (See "The Best Hedges for Tail Risks," Bank of America Merrill Lynch Global Strategy, November 16, 2009 or "Time for Tail Risk Hedges," Morgan Stanley Global Research, January 8, 2010.)

[9] Standard & Poor's, S&P 500 Index (Total Return), 1928-2009.

[10] Peter L. Bernstein, "Capital Ideas Evolving," (John Wiley & Sons, 2007), pages 156-157.

[11] "Harvard-Led Sale of Private-Equity Stakes Hits Values," December 1, 2008, www.bloomberg.com.

[12] www.proshares.com/funds/prospectus.html?ticker=twm, page 4.

[13] Credit Suisse/Tremont Dedicated Short Bias Index returned -2.5% per annum from January 1994 – December 2009, as compared to the 7.6% annual return of the S&P 500. (www.hedgeindex.com).

[14] Ted Seides, "Liquidity: Let's Don't Wait Til the Water Runs Dry," *Economics & Portfolio Strategy*, Peter L. Bernstein, Inc., August 15, 2006, page 7.

[15] Steven Drobny, "The Invisible Hands: Hedge Funds Off the Record – Rethinking Real Money," (John Wiley & Sons, 2010), page 57.

[16] Another untold story about endowments in the crisis relates to spending, not investing, as the true cause of the alleged failure of the Yale model. Fueled in part by implicit government threats over taxation of endowment pools, many universities raised spending levels dramatically in fiscal 2009. As dictated by Murphy's Law, the timing of the policy change couldn't have been worse.

[17] Peter L Bernstein, "Are Policy Portfolios Obsolete?" *Economics & Portfolio Strategy*, Peter L. Bernstein, Inc., March 1, 2003.

[18] Lawrence E. Kochard and Cathleen Rittereiser, "Foundation & Endowment Investing," (John Wiley & Sons, 2008), Chapter 12, Driven by Intellectual Curiosity: Donald Lindsey; Chapter 13, page 196; The CIO as CEO: Jonathan Hook, page 215; and Chapter 14, Navigating New Investment Waters: Daniel Kingston, page 234.