Alternative Investment Analyst Review™

What a CAIA Member Should Know

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Dear Reader,

We are pleased to introduce the inaugural issue of the Alternative Investment Analyst Review. This new publication advances our mission to provide the CAIA community and its members with the most comprehensive and up-to-date knowledge of alternative investments; and to foster an ongoing dialog among industry professionals. The Alternative Investment Analyst Review will publish new, original research and review extant research, providing a new vehicle for CAIA members and leading academics to publish articles of interest to the alternative investment community. The purpose of the Alternative Investment Analyst Review is to disseminate practitioner-oriented knowledge in a practical and accessible format.

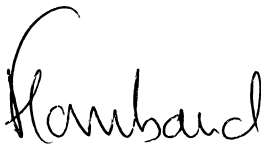
In this issue, the authors walk us through some of the lessons drawn from the aftermath of the 2008 banking crisis— from a fresh look at benchmarking to a revival of the risk parity approach to asset allocation—as well as analyses of the impact of VIX levels on alternative investment strategies and the performance of the equity index buy-write strategy during the crisis.

As I write these words at the start of 2012, rating agencies around the world are downgrading the sovereign debt of several countries, as well as major banks and financial institutions. The talk is of a possible end to the euro and the unfathomable consequences of a long and protracted worldwide recession. I wonder what lessons will be drawn in the future from the current lack of political leadership and resulting economic debacles in Europe and the U.S.

As investors continue to seek more stable returns, away from bonds and equities and into alternative investment strategies, it is of the utmost importance that CAIA take the lead and publish a cross section of diverse materials that readers will find interesting and useful to fulfill our mission of alternative investment education. To accomplish this goal, we will solicit suggestions and feedback from our readership. In addition, we encourage you, CAIA members, and academics to submit articles for review for inclusion in future issues.

It is through collaboration and the exchange of our combined knowledge and expertise that the alternative investment industry will continue to increase in value and importance—weathering the current storms and playing an even larger role in a brighter economic future. Your thoughts and feedback on current topics in alternative investing are most welcome.

Sincerely,



Florence Lombard
CEO, CAIA Association

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approach to asset allocation, it does not represent a trading strategy that can be employed by active managers. This is largely due to the fact that it does not require any estimate of expected return on an asset class (potentially a source of skill for active managers) and it always leads to positive weights for asset classes (long/short strategies cannot be implemented). It is a suitable model for institutional and high net worth investors who do not face significant constraints on their asset allocation policies and are able to use leverage.

ABSTRACT: This article investigates the statistical properties and relationships of VIX with alternative investment strategies. The author finds that different VIX quintiles result in very different risk adjusted performance for all strategies and confirms that significant deviations from normality are observed in the quintiles and the full sample, which are not fully captured by traditional risk metrics. The author demonstrates that correlations among strategies are unstable and non-linear, leading to highly concentrated diversification benefits at times of market stress, which a broad set of exposures is likely to negate. The analysis also demonstrates that at certain quintiles, correlations are high between traditional and alternative investment strategies, and their performance characteristics are quite similar. The article establishes that the superior, long term performance of such strategies relative to traditional asset classes is not due to higher returns in good times, but rather better preservation of capital in bad times.

ABSTRACT: This article provides a summary of Kapadia and Szado [2011] which examines the performance of buy-write strategies on the Russell 2000 over the 15-year period of February 1996 to March 2011. Overall, the results suggest that the buy-write strategy can outperform the Russell 2000 index under standard performance measures. This risk adjusted outperformance even holds during the unfavorable (relative to a long index position) market conditions of March 2003 to October 2007, where the Russell 2000 was steadily trending upwards. Although the main driver of the return is the underlying index, both transaction costs and the option volatility risk premium (defined as the implied

volatility less the realized volatility) are critical to the performance of the strategy. It is clearly evident that the method of execution of the strategy, as well as the choice of the options, has a large impact on the performance of the strategy. In this light, Szado and Kapadia provided a somewhat conservative analysis of the buy-write strategy's performance, in the sense that the implementation does not allow for an active selection of the moneyness or time to expiration of the calls.

AIAR SUBMISSION

Articles should be approximately 15 pages in length (single spaced) and on a topic of general interest to the CAIA community.

Please **download the submission form** *and include it with your article in an email to* **AIAR@CAIA.org**.

Setting the Benchmark: Spotlight on Private Equity

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What is Benchmarking?

Benchmarking is the process of comparing a firm's business processes and performance metrics to those of the firm's industry or another industry. The benchmarking process may focus on specific segments of the industry such as the top performing firms or the "average" firm. Dimensions typically measured are quality, time, cost, risk, and return.

The term benchmarking was first used by cobblers to measure people's feet for shoes. They would place someone's foot on a "bench" and mark it out to make the pattern for the shoes. In the investment industry, benchmarking is the process of finding a quantifiable standard against which to measure a portfolio's performance. The focus of this essay is on benchmarking for investment products and in particular for private equity investments. First, we discuss the desirable properties that a proper benchmark should possess. Second, we present a framework for classification of asset classes depending on the liquidity of the product itself, liquidity of its underlying assets, and the degree to which the product is actively managed. Third, we discuss two broad approaches to benchmark construction and then discuss the role of benchmarks in the evolution of asset classes. Finally, we examine various private equity benchmarks and discuss their properties.

Desirable Properties of Benchmarks

The purpose of creating a benchmark is to establish a measure, which can be used to evaluate the performance of an actively managed portfolio. A proper benchmark should have the following characteristics:

1. *Transparent and Unambiguous* – The underlying investments of the benchmark should be clearly defined.
2. *Frame-able and Customize-able* – Investors and managers should be able to use available information to develop a quantifiable measure of performance and to create sub-benchmarks that reflect different investment objectives of comparison.
3. *Appropriateness and Coverage* – The benchmark should represent the investment style of the manager and its components must adequately span the representative universe.
4. *Invest-able* – The benchmark should represent a viable investment opportunity as an alternative to the actively managed portfolio that is being evaluated.

Below, we discuss each of these characteristics in greater detail.

Transparent and Unambiguous

There are three aspects of being **transparent and unambiguous** that center around the **components**, **prices**, and **methodology** used to construct the benchmark. The **components transparency** aspect implies that there is full disclosure on the actual choice of components used in the benchmark, and that there is no ambiguity in the

choices of components of the benchmark. For example, S&P 500 is generally composed of the 500 largest firms listed in the U.S., and more importantly, the list of these firms and their relative weights are fully disclosed to the public. The **prices transparency** aspect refers to a need for full and unambiguous disclosure on the actual prices of the components of the benchmarks. Thus, in the aforementioned S&P 500 Index, we know that the price of say "GE" is X and that this price was used to generate the value of Y for the benchmark. Finally, the third aspect, the **methodology**, refers to the ability to understand the benchmark calculation methodology. For instance, the process for calculating the weight of each component of the S&P 500 Index is clearly established and is such that market participants can verify these values independently.

Frame-ability and Customize-ability

The second desirable property of benchmark construction centers on its **frame-ability** and **customize-ability**. **Frame-ability** or **measurement** is the ability to clearly understand what the interpretation of the comparison means; e.g., the S&P 500 Index allows one to measure the performance of a portfolio against a cap-weighted portfolio of largest firms whose stocks are listed in the U.S. Further, the S&P 500 index allows one to use a quantifiable method to measure the relative performance of the portfolio (e.g., one can calculate Sharpe ratios to compare risk-adjusted performance). The **Customize-ability** requirement goes one step further and refers to the ability to create sub-benchmarks that reflect different investor objectives. For instance, the S&P 500 Communications Index, reflects those companies in the S&P 500 that invest in the communications area. Private Equity, in particular, raises requirements not just around customize-ability by strategy (industry, product, geography) but customize-ability around investor objectives on performance because unlike marketable equities, private equity commitments are NOT co-incident with capital calls or disbursements and hence there is no 1-1 correspondence between the different metrics such as IRR and Multiple of Capital. A long term focused family office that does not optimize its cash balance has very different benchmark methodology requirements as opposed to a financial advisor who optimizes cash on hand.

Appropriateness and Coverage

The third desirable property is **appropriateness** and **coverage**, which has two dimensions. First, **appropriateness** requires that the benchmark should represent the investment style according to which portfolio is being managed. For example, MSCI Emerging Markets Index is an appropriate benchmark for a diversified portfolio of large cap emerging markets stocks. The second dimension of this property is **coverage**. This means the benchmark should cover the entire investment universe that the manager is allowed to access. Going back to MSCI Emerging Markets Index, we may conclude that the benchmark is not complete because it does not cover all large cap stocks that trade in emerging markets. The benchmark must be able to answer questions like what percentage of the entire universe does the benchmark cover? The **coverage** shows how relevant the benchmark is and a very poor coverage number begs the question of whether the benchmark is relevant. The **coverage** also answers important questions around selection bias – Is there an adverse selection in the choice of components?

Investability

Investability is the final desirable property of an investment benchmark. The term **investability** refers to the degree to which an investor (in this case the user of the benchmark) can physically invest in the benchmark and acquire the returns represented by the benchmark. Investors should be able to access a highly investable benchmark at almost no cost (e.g., fees, due diligence cost, infrastructure, etc.). For example, if a benchmark includes hedge funds or

mutual funds that are closed to new investments, the benchmark is not investable. Clearly, the investable property can be achieved only in certain types of assets, which will be discussed in detail later.

A Framework for Classification of Asset Classes

The development and application of benchmarks are greatly dependent on the characteristics of the investment under consideration. While there are many methods for delineating investment characteristics, one clear and concise method is to consider investments in three dimensions – *active vs. passive, liquid investment product vs. illiquid investment product, and liquid underlying assets vs. illiquid underlying assets* as shown in Exhibit 1. The last dimension distinguishes between the liquidity of underlying assets of an investment product (e.g., publicly traded securities used to create a mutual fund's portfolio) and the liquidity of the investment product itself (e.g., the mutual fund).

It is worth noting that the degree of liquidity of an investment product is normally related to the liquidity of the underlying assets of the investment product as well as the liquidity inherent in the investment structure itself. For example, an equity long/short hedge fund may trade highly liquid large cap exchange traded equities, but if it imposes significant redemption fees or lockup periods, the hedge fund could be illiquid from the perspective of the investor.

Exhibit 1: Investment Characteristic Matrix of Financial Intermediaries

	Liquid Product Liquid Underlying	***Liquid Product Illiquid Underlying***	***Illiquid Product Liquid Underlying***	***Illiquid Product Illiquid Underlying***
Passive	(A) Index Tracking ETFs and Mutual Funds	(B) Bank Deposits; Asset Backed Securities; Some Real Estate Investment Products; Some Closed End Funds;	(C) Some Annuity Programs; Universal Life Insurance	(D) Some Load Mutual Funds; Some PE Funds; Some Real Assets Funds (e.g., timber, land, infrastructure)
Active	(E) Active Mutual Funds; Some Liquid Hedge Funds and CTAs	(F) Actively Managed Real Estate Funds; Some Closed End Funds; Some Hedge Funds	(G) Most Hedge Funds and CTAs	(H) Most PE Funds and Some Hedge Funds

In general, the simplest investments to benchmark fall in the upper left box (A). In fact, these investments are often used as benchmarks for other, more difficult to benchmark, investments. These investments are both liquid and passive in nature. Since both the product and the underlying assets are liquid, obtaining accurate current prices is generally a simple matter. In addition, since they are passive in nature, benchmarking is usually as simple as finding an appropriate existing index or constructing an index with similar exposures such as a broad equity index (e.g., Russell 2000) or a sector index (e.g., S&P 500 Consumer Discretionary Index).

The investments in the lower right box (H) are the most difficult products to benchmark as no reliable market prices are available for their underlying assets and the products themselves are not liquid and therefore reported returns are

DIFFERENCES

Transparent & Unambiguous vs. Appropriate & Coverage: Complex benchmarks that attempt to capture active management of the product by using sophisticated quantitative techniques are bound to become ambiguous and less transparent (e.g., hedge fund replication products).

Appropriateness & Coverage vs. Investability: Using peer groups to create appropriate benchmarks generally make the benchmark less investible.

subject to potential errors. Further, due to the illiquidity of their underlying assets, these investment products are typically quite heterogeneous and therefore custom-made benchmarks must be used to evaluate their performance.

Exhibit 2 presents a rough guide as to whether the four desirable properties discussed previously are typically satisfied by benchmarks that could be constructed for various types of assets.

Exhibit 2: Investment Characteristic Matrix of Benchmarks

	Liquid Product Liquid Underlying				*Liquid Product Illiquid Underlying*				*Illiquid Product Liquid Underlying*				*Illiquid Product Illiquid Underlying*			
	T and U	F and C	A and C	Inv	T and U	F and C	A and C	Inv	T and U	F and C	A and C	Inv	T and U	F and C	A and C	Inv
Passive	+	+	+	+	+	+	0	+	0	+	0	0	0	+	0	–
Active	0	+	0	+	0	0	0	+	–	0	–	–	0	+	0	–

("+" = property is strongly satisfied, "0" = property is barely satisfied, "–" = property is not satisfied)

It is important to note that the above taxonomy of asset classes and properties of their corresponding benchmarks does not apply to every available benchmark. In fact, benchmark providers have a great deal of latitude in creating their products by considering various tradeoffs. As stated in the side box, a benchmark provider may wish to emphasize one dimension (e.g., invest-ability) at the expense of another dimension (e.g., transparency).

Approaches to Benchmark Construction

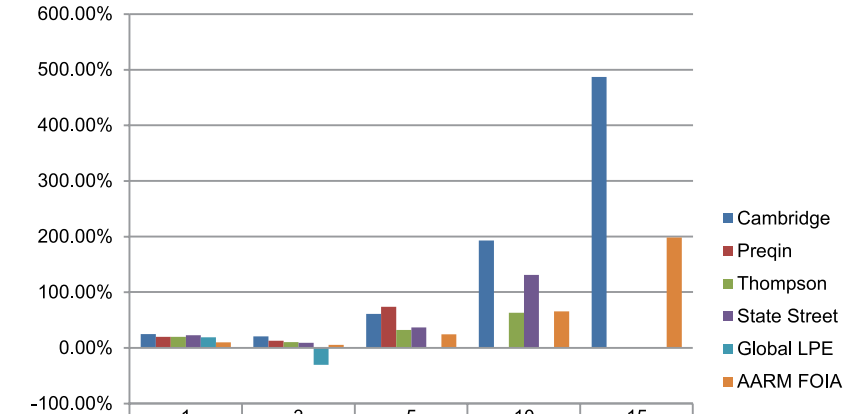
There are two broad approaches to the construction of benchmarks: *(1) asset-based benchmarks and (2) peer groups*. In asset-based benchmarks, the underlying assets that a manager can potentially invest in are used to construct an index. For example, S&P 500 Index is an example of an asset-based benchmark. In the case of S&P 500 Index, the underlying assets and their corresponding weights are specified in advance. Alternatively, one can construct an asset-based benchmark using Sharpe style approach, which uses the return of the portfolio to construct a benchmark with the same style profile. Asset-

based benchmarks would normally satisfy the desirable properties discussed above when the underlying assets of the investment product are liquid. In some cases, asset-based benchmarks are constructed using publicly traded securities that are supposed to have the same risk exposures as the assets used to construct the portfolio that is being evaluated.

However, the assets used to construct the benchmark may not be the same assets used in the portfolio. For example, there is an Exchange Traded Fund (PowerShares Listed Private Equity (PSP)) based on an index of publicly listed private equity firms Global LPE. This could be viewed as an asset-based benchmark for private equity investment products. However, a comparison of the returns on all 5 PE benchmarks that we examined shows that there could be significant differences between them (see Exhibit 3).

The second approach to the construction of benchmarks is to use peer groups. With the exception of Global LPE, the four remaining private equity indices that we detail later are all examples of peer group benchmarking. Peer groups are typically employed when the portfolio is actively managed and/or the returns on the underlying assets of the portfolio are not available (e.g., the underlying assets of the portfolio are illiquid). The illiquidity of the underlying assets prevents one from using style analysis or similar approaches to create a portfolio that tracks the risk-return properties of these investment products. More importantly, an important source of return to these products is the illiquidity premium that the underlying assets carry. Clearly, this important source of return cannot be captured using a portfolio of liquid securities.

Exhibit 3: Asset Based and Peer Based Private Equity Benchmarks



	1	3	5	10	15
Cambridge	24.80%	20.66%	61.12%	192.76%	486.74%
Preqin	19.70%	12.81%	73.89%		
Thompson	19.90%	10.23%	31.94%	62.89%	
State Street	22.60%	8.86%	36.82%	130.94%	
Global LPE	19.08%	-30.61%			
AARM FOIA	9.80%	5.51%	24.29%	65.60%	198.27%

Source: Listed in Reference Section of Paper, AARM Analysis 2011

5yr, 10yr as of Dec 31, 2010

INSIGHTS

Insights on benchmark differences: Other than differences in the underlying sets, the differences in the benchmarks are also attributable to several subtle distinctions. The Cambridge Index does not include Venture in its Private Equity benchmark and reports two separate benchmarks for the U.S.

The Thomson VentureXpert only covers the underlying assets and therefore does not account for the aggregation and selection inherent in a fund as well as the extra-normal participation in the returns that a typical PE professional ensures through term sheets.

Finally, the lack of transparency in methodology for Cambridge and Preqin Indices makes it impossible to understand what they are best compared against; which metric of performance or which type of portfolio and for what type of investor objective.

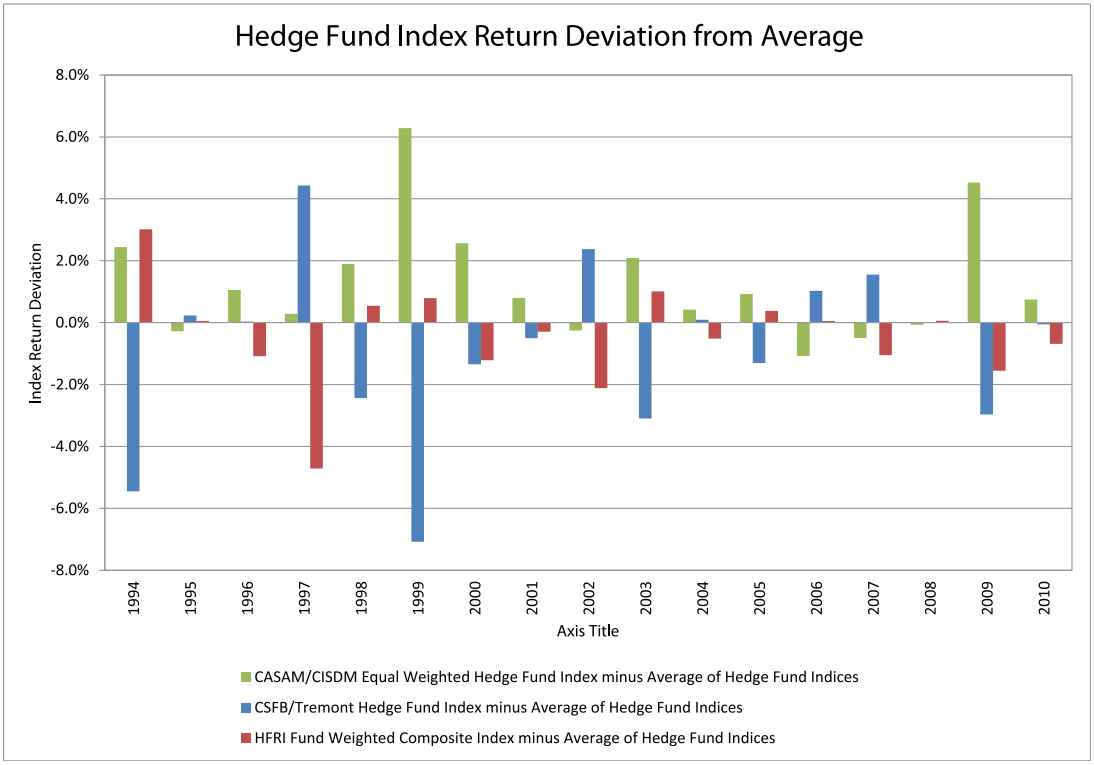
INFORMATION

Asset Based Benchmarks: Note that market prices are not always used to construct asset-based benchmarks. For instance, some real estate indices use appraisal values to create benchmarks. These appraisal values may or may not reflect the current market prices of the underlying asset class.

In some cases, it might be possible to create benchmarks for passive illiquid investment products with illiquid underlying assets. For example, various real estate, timber, and infrastructure indices have been developed to benchmark the performance of these products. But when the portfolio is actively managed, peer group benchmarking appears to be the only option. As was mentioned previously, one desirable property of a benchmark is to be investable. This property is generally not available with illiquid investment products and it becomes especially difficult to achieve when the underlying asset is illiquid as well.

Exhibit 4 compares the performance of three different hedge fund indices which are based on a peer group approach.

Exhibit 4: Hedge Fund Index Return Deviations from Average of the Indices



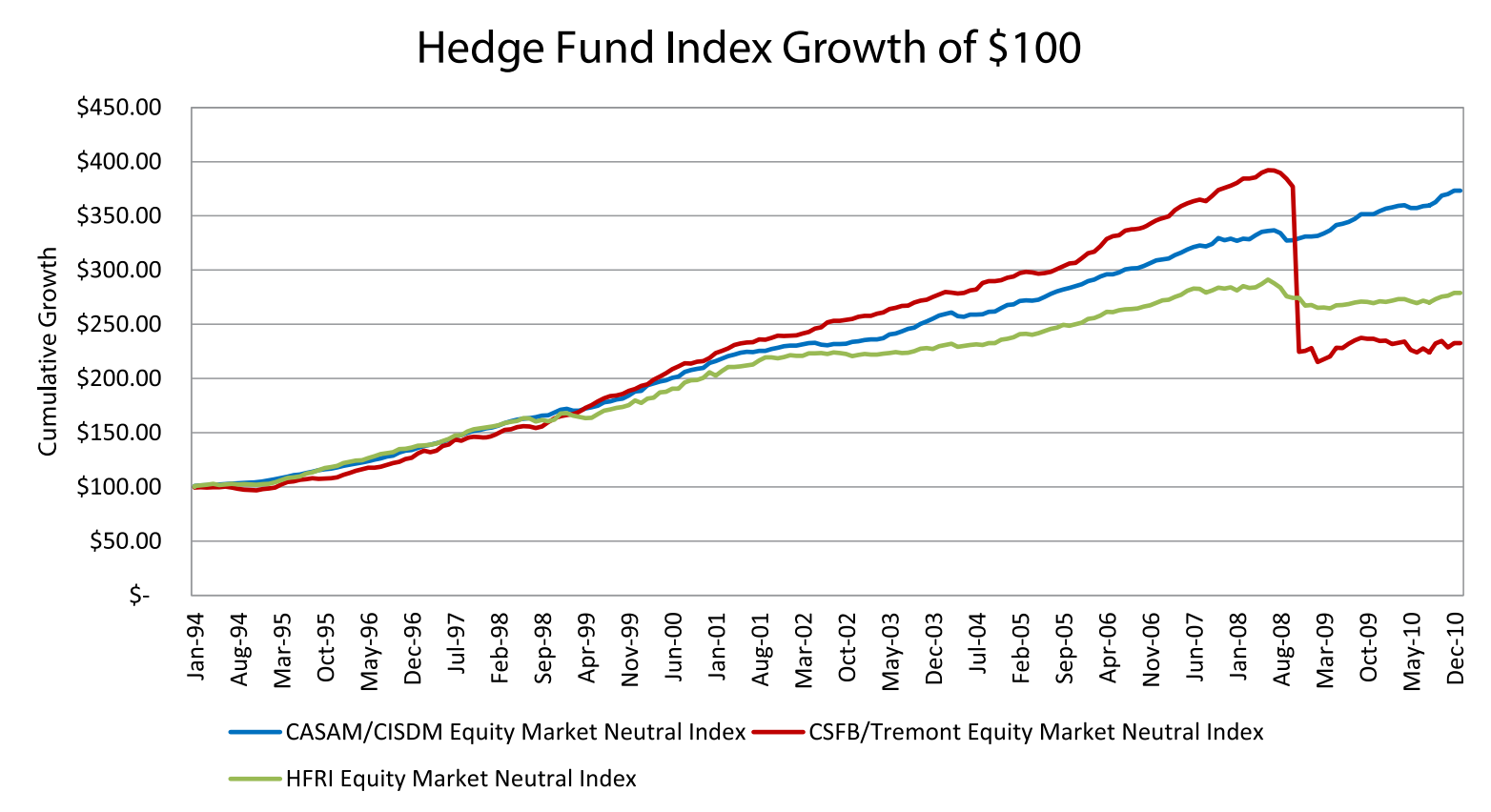
Source: Listed in Reference Section of Paper, AARM Analysis 2011

Generally, the peer group approach compares the performance of a portfolio manager to other similar managers. This has a number of implications. First, the peer group is not likely to be completely investible (e.g., some of the managers may not be open or may have a large minimum investment that would prevent the investor from investing in the entire peer group). Second, it may not be possible to find managers that match our manager's characteristics (e.g., they may differ in terms of size, age, currency, location, fees, and, mostly importantly, the investment strategy). Finally, and most importantly, the peer group is typically constructed using publicly available databases, which are subject to a number of biases. Because of the above issues, different peer groups may report significantly different returns.

Impact of Benchmarking on the Evolution of Asset Classes

The existence of reliable benchmarks can have a profound impact on the growth of aggregate investment in an asset class. Benchmarks provide a basis for recording and understanding the performance of an asset class and investments in the asset class, as well as providing a basis for analyzing the relative performance of individual investments. Consultants and investment advisors rely on benchmarks for decision making and reporting, and therefore the growth of aggregate investment in a particular investment class is significantly affected by the availability of effective, reliable, and transparent benchmarks.

Exhibit 5: Equity Market Neutral Hedge Fund Indices Jan 1, 1994 to Jan 31, 2011



Source: Listed in Reference Section of Paper, AARM Analysis 2011

Benchmarking for Private Equity Investments

We will discuss 5 different purported benchmarks in the private equity industry and show whether they are adequate in terms of meeting the criteria of proper construction of a benchmark. These are the Cambridge Index, the Preqin Index, the State Street Index, the AARM FOIA Index, and the Global LPE Index. Most of these indices do not meet the standards of a proper benchmark outlined above. This is expected in a nascent industry such as private equity (PE), and in order to achieve the status of benchmark, most of the indices require modification. As part of this discussion, we ignore the Thomson VentureXpert Index, which covers only underlying portfolio assets and is completely irrelevant to the benchmarking of PE funds. Just as we don't benchmark a company's performance based on its buildings and other underlying assets that its general managers combine to get enterprise value, it also makes no sense to benchmark a PE fund's performance on underlying portfolio investments that its GP general

POTENTIAL BIASES

Selection Bias: Peer group is constructed using a sample of actively managed portfolios that is different from a universe of managed portfolios. For example, those managers that are closed to new investors may not report their performance to any public database.

Survivorship Bias: Peer group is constructed using actively managed portfolios that currently report to a database. Because these managers have survived for an extended period, they are likely to have a superior performance in comparison to the entire universe of active and defunct portfolio managers.

Instant History Bias: Peer group benchmark may contain performance figures that relate to the incubation period. These returns are generally inflated because it is at the discretion of the manager to report these figures to the public.

manager is responsible for actively managing.

Private equity has unique characteristics that put additional requirements on proper benchmarks. In particular, PE raises requirements not just around customize-ability by strategy (industry, product, geography), but customize-ability around investor performance objectives. PE commitments are NOT co-incident with capital calls or disbursements, and funds have a finite lifetime. Hence there is no 1-1 correspondence between the different metrics such as IRR vs. Multiple of Capital and the fund-set is continually changing as old funds reach end of life.

Thus, the right benchmark and method in private equity is determined by investor goals and investor context. A long term focused family office, which does not optimize its cash-balance, is quite content with the use of Multiple of Capital as a performance metric. On the other hand a financial institution that optimizes cash-on-hand will require real IRR for performance benchmarking. A newly created fund investor prefers to benchmark against funds of the same age but a mature portfolio is best compared against a well-diversified age set spanning the entire J-curve. An investor may choose a benchmark against similar vintages during diligence but prefer all vintages for reporting.

Cambridge Index

The Cambridge Index is constructed by Cambridge Associates by leveraging their confidential and proprietary non-marketable alternative assets database. The benchmark claims that it compiles the performance results for more than three-fourths of institutional-quality venture capital assets and nearly two-thirds of leveraged buyouts, subordinated debt, and special situations partnerships to publish Cambridge Associates U.S. Venture Capital Index and the Cambridge Associates Private Equity Index. These indices report preliminary returns in Barron's Market Laboratory section and quarterly returns approximately 12-15 weeks following the close of each quarter.

While Cambridge's benchmark was one of the first attempts at PE benchmarking in the industry, it does not satisfy most of the criteria for correct benchmark construction. Neither the **components** nor the **price** in the Cambridge benchmarks are disclosed by Cambridge Associates. Thus, it fails construction for **component** and price **transparency** and **un-ambiguity**. However, Cambridge does disclose some of the construction methodology, but does not clarify all ambiguity on implicit set used for IRR, Multiple, Age calculations, etc. Cambridge fails **frame-ability** and **customize-ability** because of its lack of transparency and its services business model that does not allow any type of dynamic customization.

The biggest factor in favor of Cambridge is that arguably Cambridge lays claim to being the industry leader in PE consulting, and therefore, must be privy to a large amount of data. But the benchmark is neither transparent nor frame-able – no one knows what is in it. The coverage is unproven because only 1290 U.S. Venture and 858 Buyout funds are used in the benchmark and there is neither transparency on the components, nor quantitative substantiation of the claims of the coverage of that set. There is selection bias in those funds that choose to pay Cambridge consulting fees.

Illustrating the Extra Value in a Good Benchmark

For a concrete example of how differences could illuminate underlying issues, consider a hypothetical investor considering an investment in an equity market neutral hedge fund. While there are a number of hedge fund index providers, one of the most popular equity market neutral indices was the Credit Suisse/Tremont Equity Market Neutral Index (CSFB EMN). Hedge fund indices can be equal weighted, asset weighted or medians. The CSFB EMN is an asset weighted index. This in itself may not be of great concern, until one considers the constituents of the index prior to the collapse of Bernard Madoff's ponzi scheme in 2009. As described in Schneeweis and Szado [2010], a large portion of the assets under management of the CSFB EMN index was composed of Madoff feeder funds. Therefore the performance of the index was largely influenced by Madoff's reported returns, which arguably had little relationship with returns to the equity market neutral strategy. In fact, Schneeweis and Szado point out that, for the period of 2005-9/2009, the average correlation of the five Madoff feeder funds in the study with the CSFB EMN index was .32, while the average correlations with the HFRI and CISDM EMN hedge fund indices were -.05 and .06 respectively. Clearly the use of the CSFB EMN index could lead to questionable conclusions when considering a true equity market neutral hedge fund manager.

Preqin Index

The Preqin Performance Benchmarks module offers comprehensive benchmarking tools for the private equity industry. The benchmarks are calculated using performance returns for over 4,800 funds and 15,000 data points from their Performance Analyst database. Preqin claims that in terms of aggregate value, this represents around 70% of all capital ever raised, but there is no clear substantiation for that claim.

Unlike Cambridge, the benchmark does breakdown by product (e.g., venture, buyout, mezzanine, distressed, special situations, real estate, natural resources, fund-of-funds, secondary), but not by other factors like geography or industry focus. The biggest advantage of the Preqin Benchmark is its transparency in component and in methodology. However, the benchmark is not frame-able because it is unclear why a fund is or is not in the benchmark. An investor has no understanding of what a comparison to the Preqin benchmark implies. The benchmark (like all benchmarks in PE) is not investible and while Preqin makes a claim on coverage, it is not substantiated by any data.

State Street Index

State Street provides its own PE index called the State Street Private Equity Index. The index is based on the latest quarterly statistics from State Street Investment Analytics' Private Edge Group and includes more than 1,500 private equity partnerships with aggregate commitments of approximately $1.5 trillion. State Street's Private Edge Group provides detailed analyses of private equity investments for a diverse client base including public and private pensions,

endowments and foundations, representing nearly 5,000 commitments totaling approximately $200 billion. State Street's benchmark provides some measure of coverage by disclosing the total AUM of its clients and the number of clients it supports. While this is not a complete specification, it is far superior to the prior two benchmarks on coverage.

However, State Street's benchmark is neither **transparent** nor **frame-able** in **components**, price, or methodology. The State Street benchmark is not investible either, as is true with all of private equity. Thus, it fails most of the requirements of proper construction.

We choose not to elaborate on the recently released Northern Trust-"Private" index in this paper because the benchmark shows no fundamental difference in properties to the State Street Index. Therefore, other than noting that the particular benchmark being based on an accounting vendor's confidential customer data as opposed to a financial institution's confidential customer data, there is nothing that requires a separate discussion or examination that State Street's benchmark does not already address.

The Global LPE Index

The Global LPE Index is designed to track the performance of private equity firms which are publicly traded on any nationally recognized exchange worldwide. These companies invest in, lend capital to, or provide services to privately held businesses. The Index is comprised of 40 to 60 public companies representing a means of diversified exposure to private equity firms. The securities of the Index are selected and rebalanced quarterly per modified market capitalization weights. Market capitalization may be adjusted to represent a means of diversified exposure to private equity firms, as well as the consolidated exposure of the underlying portfolio investments. Considerations for diversification include the consolidated stage of investment (e.g., early, mid, late), type of capital (e.g., equity, debt, mezzanine, etc.), sector (e.g., energy, industrials, technology, etc.), and geography.

The Global LPE Index is the only PE index that is investible through investment products such as the PSP Powershares ETF. Additionally, it is completely transparent in its construction. Unfortunately, it also has serious shortcomings, as it is neither appropriate nor does it have sufficient coverage. There are very few (less than 100) PE firms/funds that are publicly traded and they in no way represent the majority of the thousands of PE firms/funds that compromise the industry.

AARM FOIA Index

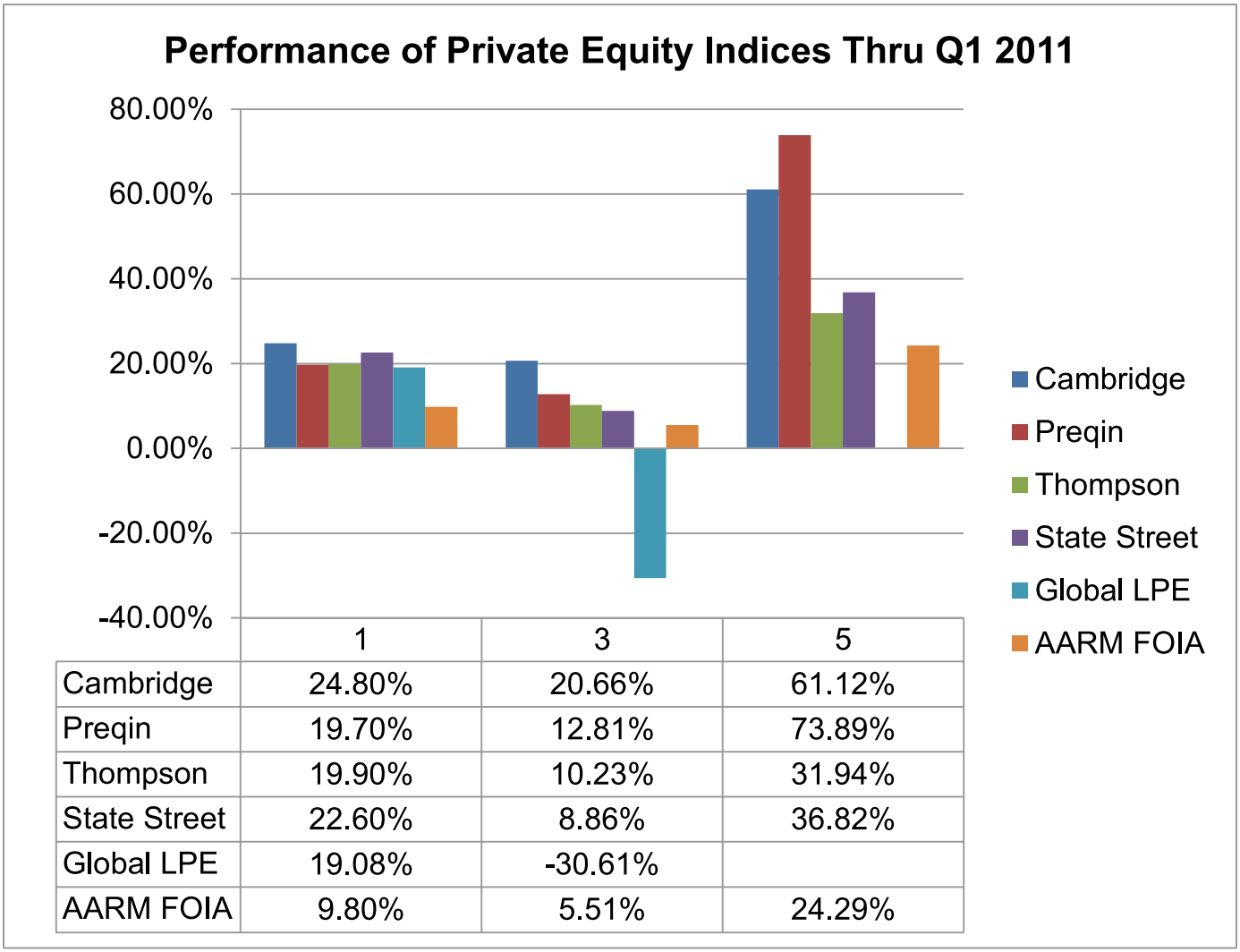
The AARM FOIA Global PE Benchmark is completely **transparent** and **unambiguous** on **components**, **price**, and **methodology**. The index comprises fund performance data of LPs with the largest portfolios of alternative asset investments. Since fund data is collected from public data sources – websites of the public pension funds and university endowments, AARM limits components to those invested in by LPs that disclose their portfolio performance. Data from LPs currently included in the AARM Index include several hundred of PE firms from 20 Major International LPs such as Calpers, Calstrs, Florida, New York, and Wisconsin, all of which are fully disclosed.

The AARM Index is also completely transparent and unambiguous in the methodology for construction and lays out rules for aggregation. For example, if multiple LPs invest in the same fund, the average performance statistics for that fund are constructed using simple averaging. If both Washington State Investment Board and Oregon State

Treasury invested in KKR 1982 Fund, then KKR 1982 Fund Capital Committed Amount = average (Washington State Investment Board KKR 1982 Fund Capital Committed Amount, Oregon State Treasury KKR 1982 Fund Capital Committed Amount). The AARM Benchmark is weighted by capital commitment and is available by product, industry, and geography and fund size.

The **frame-ability** and **customize-ability** that AARM provides as a result of its on-demand productized approach set it apart from all the other benchmarks. AARM allows the user to dynamically customize on all possible dimensions to select the most appropriate benchmark for their investment objective.

Exhibit 6: Performance of Private Equity Benchmarks



	1	3	5
Cambridge	24.80%	20.66%	61.12%
Preqin	19.70%	12.81%	73.89%
Thompson	19.90%	10.23%	31.94%
State Street	22.60%	8.86%	36.82%
Global LPE	19.08%	-30.61%	
AARM FOIA	9.80%	5.51%	24.29%

Source: Listed in Reference Section of Paper, 2011

Like most other PE benchmarks, the AARM Benchmark is not investible. However, it is completely **appropriate** and **representative** and does have a very high **coverage** of space with nearly 6000 funds in its dataset. The Index includes a similar number of funds and more data-points than Preqin but it defines quantitative coverage as a percent of all available funds (as defined by individual regional PE groups such as NVCA, BVCA, etc.). Out of all available PE benchmarks, the AARM FOIA probably best meets the previously outlined ideal benchmark practices by construction but it is also the newest, dating back to 2008, and least prevalent in the industry.

Exhibit 7: Performance of Private Equity Benchmarks

	Cambridge	Preqin	State Street	Global LPE	AARM FOIA
Transparency and Un-ambiguity	NO	YES	NO	YES	YES
Frame-ability and Measurability	NO	PARTIAL	NO	PARTIAL	YES
Appropriateness and Coverage	PARTIAL	PARTIAL	YES	NO	YES
Invest-ability	NO	NO	NO	YES	NO

Conclusions

This article provides a framework for creating ideal benchmarks with emphasis on benchmarks for private equity funds. In reality, all benchmarks involve some deviations away from this ideal. It is important for the end user to determine which of the characteristics are of primary importance and choose a benchmark accordingly. In addition, it is of vital importance that benchmarks are not viewed in isolation. This is particularly true of benchmarks with limited transparency. Typically, multiple benchmarks are available to track a particular asset class or investment style. A comparison of the available benchmarks can provide some insight into the impact of benchmark choice for the investment in consideration. The comparison may also indicate the existence of critical limitations (or advantages) of a particular benchmark as a valid comparison for the investment in question. If the indices under consideration exhibit different return patterns or factor exposures, further investigation may be warranted. The differences may not be due to faults in the indices, but rather due to a particular focus or exposure. Understanding these differences can provide further insight into the appropriateness of each index for the purpose at hand.

The authors would like to thank Professor Nitin Nohria, Harvard Business School, who provided us the initial vision, ideas and encouragement to design proper benchmarks for the alternative asset industry.

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An Introduction to Risk Parity

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Introduction

In the aftermath of the financial crisis, investors and asset allocators have started the usual ritual of rethinking the way they approached asset allocation and risk management. Academic/Practitioner journals are full of articles that are supposed to show investors what went wrong and how they can adjust their models and theories in order to protect themselves against substantial losses the next time equity and credit markets experience significant losses. Most of these recommendations should be viewed with a great deal of skepticism as they are bound to incorporate a healthy dose of data snooping and over fitting biases. For example, both Barclay Capital Global Bond Index and MSCI World Equity Index have earned about 7% annual nominal return since 1990, with volatility of the bond index being about 1/3 of the volatility of the equity index. Clearly, going forward it is all but impossible for the bond index to repeat the performance of the last 20 years.[1] Therefore, any model that would recommend a significant allocation to fixed instruments should be carefully analyzed and its assumptions should be questioned.

The so-called risk parity approach to asset allocation has enjoyed a revival during the last few years because such a portfolio would have outperformed the "normal" portfolios with their typical significant allocations to equities. In this note, we discuss the risk parity approach to asset allocation and examine its underlying assumptions. The central idea of the risk parity approach is that in a well-diversified portfolio all asset classes should have the same marginal contribution to the total risk of the portfolio. For example, as shown below, in a typical 60/40 portfolio, equity risk accounts for almost 90% of the total risk of the portfolio, which is significantly higher than its 60% weight. Under the risk parity approach, there is generally a significant allocation to low risk asset classes. Allocations to equities and other risky assets are typically below what we normally observe for most diversified institutional quality portfolios. Therefore, we want to know if this approach is based on sound economic and financial reasoning or if it is just another attempt to extrapolate the results of the last ten years into the future.

Basics of the Risk Parity Approach

The risk parity approach defines a well-diversified portfolio as one where all asset classes have the same marginal contribution to the total risk of the portfolio. In this sense, a risk parity portfolio is an equally weighted portfolio, where the weights refer to risk rather than dollar amount invested in each asset. This approach highlights three different issues. First, to apply the risk parity approach, we need a definition of the total risk of a portfolio. Second, we need a method to measure the marginal contribution of each asset class to the total risk of the portfolio. Third, to employ this approach, we do not need an estimate of expected returns to implement the risk parity approach. The last point is one of the advantages of this approach because as we have seen during the last two decades, forecasting returns is a risky business. On the other hand, the risk parity approach requires accurate estimates of volatility and other measures of risk, which have been shown to be relatively stable and therefore can be predicted with a good deal of accuracy.

[1] In theory, bonds could still offer significant returns in real term if one were to assume that a period of significant deflation lies ahead.

Total risk is typically measured by the volatility of the rate of return on the portfolio. This means that risk parity works within the same framework as Harry Markowitz's mean-variance approach. Alternatively, one could use VaR as a measure of total risk. The advantage of using VaR as a measure of total risk is that one can incorporate skewness and kurtosis in the measure of total risk. For the purpose of this introductory note, we will use standard deviation as a measure of total risk.

Once we have decided to use standard deviation as the measure of total risk, the contribution of each asset class to the total risk of the portfolio is well defined and can be easily calculated. The general definition of marginal contribution of an asset class to the total risk of a portfolio is given by the following expression:

$$MC_i = \left(\text{Weight of Asset Class } i\right) \times \frac{\Delta\text{Total Risk of Portfolio}}{\Delta\text{Weight of Asset Class } i}$$

Here, MC_i is the marginal contribution of asset class i to the total risk of the portfolio. The last term determines the change in the total risk of the portfolio if there is a very small change in the weight of asset class i. It turns out that the total risk of the portfolio is then equal to the sum of the marginal contributions. That is, if there are N assets in the portfolio, then

$$\text{Total Risk} = MC_1 + MC_2 + \cdots + MC_N$$

To see how this works, let us consider the case of only two risky assets. The rate of return and the standard deviation of the rate of return on this portfolio, $E[R_p]$ and $\sigma[R_p]$, are:

$$E\left[R_p\right] = w_1 E\left[R_1\right] + w_2 E\left[R_2\right]$$

$$\sigma\left[R_p\right] = \sqrt{w_1^2 \sigma\left[R_1\right]^2 + w_2^2 \sigma\left[R_2\right]^2 + 2 w_1 w_2 Cov\left[R_1, R_2\right]}$$

Where, w_1 and w_2 are the weights of the two assets (they add up to one), $E\left[R_1\right]$ and $E\left[R_2\right]$ are expected returns on the two assets, $\sigma\left[R_1\right]$ and $\sigma\left[R_2\right]$ are standard deviations of the rates of return on the two assets, and $Cov\left[R_1, R_2\right]$ is the covariance between the two assets. The marginal contributions of the two assets to the total risk of the portfolio are:

$$MC_1 = w_1 \times \left(\frac{\Delta\sigma\left[R_p\right]}{\Delta w_1}\right) = w_1 \times \left(\frac{w_1 \sigma\left[R_1\right]^2 + w_2 Cov\left[R_1, R_2\right]}{\sigma\left[R_p\right]}\right)$$

$$MC_2 = w_2 \times \left(\frac{\Delta\sigma\left[R_p\right]}{\Delta w_2}\right) = w_2 \times \left(\frac{w_2 \sigma\left[R_2\right]^2 + w_1 Cov\left[R_1, R_2\right]}{\sigma\left[R_p\right]}\right)$$

Exhibit 1 provides all the information we need to calculate the marginal contributions of Barclay Capital Global Bond Index and MSCI World Equity Index to the total risk of a portfolio consisting of 60% in equity and 40% in fixed income.

Exhibit 1: Standard Deviations for Marginal Contribution Calculation

1990-2011	***MSCI World Index***	***Barclays Capital Global Aggregate***	***60/40 Portfolio***
Monthly Standard Deviation	4.50%	1.62%	2.95%
Covariance Between the Two	0.021%		

Given the above table, the marginal contributions are:

$$MC_{MSCI} = 60\% \times \left(\frac{60\% \times (4.50\%)^2 + 40\% \times 0.021\%}{2.95\%} \right) = 2.64\%$$

$$MC_{BarCap} = 40\% \times \left(\frac{40\% \times (1.62\%)^2 + 60\% \times 0.021\%}{2.95\%} \right) = 0.31\%$$

We can see that equity contributes 2.64% to the total risk of 2.95%, while the rest, 0.31%, is contributed by fixed income. In addition, we can see that although the weight of equity is 60%, its contribution to the total risk is 89.34% (2.64%/2.95%). Given the poor performance of equities during the last 10 years, one may wonder if it is sensible to allocate so much of a portfolio's total risk to equity risk.

The general formula for calculating the marginal contribution of each asset to the total volatility of a portfolio when there are more than two assets is:

$$MC_i = w_i \times \frac{\sum_{j=1}^{N} w_j Cov\left[R_i, R_j\right]}{\sigma\left[R_p\right]}$$

$$= w_i \times \beta_i \times \sigma\left[R_p\right]$$

The second line is a rather simple method for calculating the marginal contribution of an asset class. It states that the marginal contribution is equal to the weight of the asset times the beta of the asset with respect to the portfolio times the total risk of the portfolio. Here beta is defined as:

$$\beta_i = \frac{Cov\left[R_i, R_p\right]}{\sigma\left[R_p\right]^2}$$

where $Cov\left[R_i, R_p\right]$ is the covariance between the portfolio and the rate of return on asset i.

In the previous example, the betas of equity and fixed income assets with respect to the portfolio are 1.49 and 0.27, respectively. For instance, the marginal contribution of equity is then equal to:

2.64% = 60% x 1.49 x 2.95%

To create a portfolio using the risk parity approach, we need to adjust the weights until the marginal contributions of the two asset classes are equal.[2] Using trial and error or an optimization package such as Microsoft Excel's Solver, one can show that when 26.45% is allocated to equity and 73.55% to fixed income, risk parity is achieved.

Exhibit 2: Risk Parity Weights

1990-2011	*MSCI World Index*	*Barclays Capital Global Aggregate*	*Total Risk of Risk Parity Portfolio*
Weights	26.45%	73.55%	1.91%
Marginal Contribution in Risk Parity Port	0.955%	0.955%	

As expected, risk parity requires a significant allocation to fixed income and as stated in the introduction, this portfolio would have performed very well during the last 20 years with an annualized rate of return of 7.12%. This is roughly equal to the annualized rate of return on the 60/40 portfolio with a volatility that is 50% smaller than that of the 60/40 portfolio. Given such an impressive result, it is no wonder that several risk parity based investment products have recently appeared in markets.

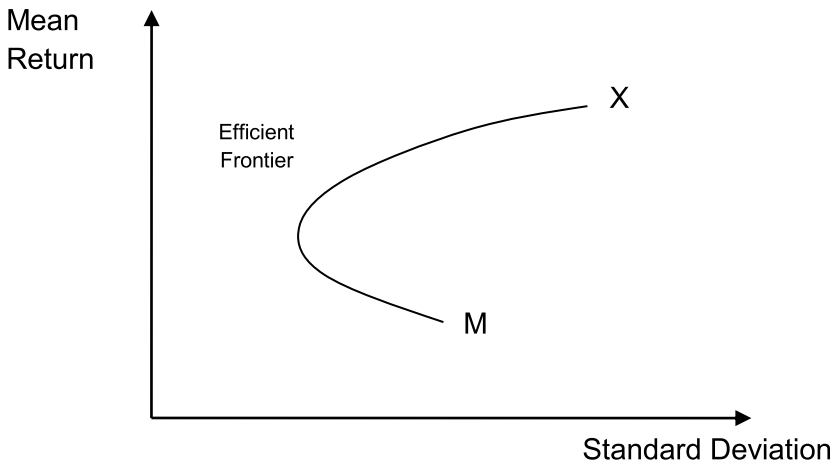
Economic Foundation of Risk Parity Approach

As discussed above, risk parity portfolios make relatively large allocations to low risk asset classes. Notwithstanding the performance of such portfolios over the last 20 years, it is safe to say that going forward a portfolio with a monthly standard deviation of 1.91% is not likely to provide a rate of return required by most investors. Given this, is there a reason to use this approach to asset allocation? It turns out that if one is willing to use leverage, there is a rather strong economic reason to expect a risk parity portfolio to perform rather well and even outperform a typical portfolio where relatively large allocations are made to risky assets.

To see this, we need to go back to the fundamental results of Modern Portfolio Theory and specifically, the results reported by Markowitz and then later by Sharpe and others. According to Markowitz's original results, if investors care only about mean and variance of their portfolios, then they should invest only in portfolios that plot on the efficient frontier. These portfolios have the lowest risk for a given level of expected return. Exhibit 3 displays the familiar efficient frontier.

[2] This can bed done using Solver tool of Microsoft Excel

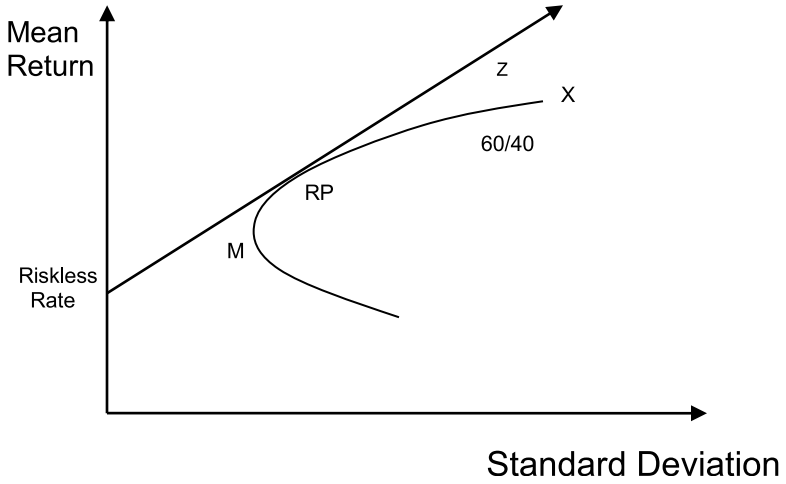
Exhibit 3: Efficient Frontier



According to Markowitz, investors should pick a portfolio that falls on the line segment MX. Investors who are willing to take some risk will pick a portfolio close to X and those who are more risk averse would select a portfolio close to M. Even though the 60/40 portfolio is not likely to be on the efficient frontier, it is likely to be closer to X than to M. On the other hand, the risk parity portfolio is likely to be closer to M. Again, there is no reason to believe that the risk parity portfolio is an efficient portfolio.

In Exhibit 4, we have plotted hypothetical portfolios M, X, 60/40, and risk parity. We have plotted the riskless rate as well.

Exhibit 4: Portfolio Plots and Efficient Frontier



The tangent line originating from the riskless rate is known as the capital market line. It identifies a set of portfolios that can be constructed as the combination of two portfolios/assets: (a) the riskless asset and (b) the efficient portfolio that lies on the tangency point. For example a portfolio that lies between points RP and the riskless rate can be created using a combination of investments in these two assets. On other hand, a portfolio that lies above RP can be created through borrowing at the riskless (using leverage) and investing the proceeds in portfolio RP.

Now that the riskless rate has been introduced, we can see that one can make a case for investing a low risk portfolio and then using leverage to increase the risk and hopefully the expected return on the portfolio. In the above figure, we have assumed that both the risk parity portfolio and the 60/40 portfolio are on the original efficient frontier. We can see that portfolio Z, which is a combination of the risk parity portfolio and leverage, has the same risk as the 60/40 portfolio but with a higher expected rate of return. This appears to present a compelling reason for using a risk parity approach to asset allocation. However, there needs to be a word of caution: if the risk parity portfolio is far away from the efficient frontier, the leveraged approach to risk parity asset allocation may lead to poor performance. In other words, it is critical for the risk parity portfolio to be close to the efficient frontier. In addition, leverage represents a source of risk that many institutional investors may not wish to assume. Exhibit 5 summarizes the results for the risk parity portfolio and its leveraged version.

Exhibit 5: Risk Parity Portfolio Performance

1990-2011	***60/40 Portfolio***	***Risk Parity Portfolio (Unlevered)***	***Risk Parity Portfolio (Levered)***
Monthly Mean	0.59%	0.59%	0.73%
Monthly Standard Deviation	2.95%	1.91%	2.95%
Monthly Information Ratio	0.201	0.310	0.247
Monthly Sharpe Ratio	0.085	0.131	0.131

It is important to note that to raise the volatility of the rate of return on the risk parity portfolio to the same level as the volatility of the rate of return on the 60/40 portfolio one needs to employ 154% leverage. That is, for each $100 capital, one needs to borrow $54 and then to invest $154 in the risk parity portfolio. This leverage figure is given by:

$$\text{Leverage} = \frac{\text{Volatility Target}}{\text{Volatility of Unlevered Portfolio}} - 1$$
$$= \frac{2.95\%}{1.91\%} - 1$$

This level of leverage may be too high for many institutional investors. However, in practice it may not be necessary to use that much leverage to reach reasonable expected returns. Of course, given historical performances of equity and bond indices, no amount of leverage was needed to achieve the same rate of return as the 60/40 portfolio because the unlevered risk parity portfolio already has the same average return as the 60/40 over 1990-2011 period (both earned 0.59% per month).

Other Related Approaches

The idea of leveraging up a relatively low volatility portfolio to generate a given expected rate of return can be applied to other portfolios as well. Risk parity is one approach to creating a low volatility portfolio. Any approach that leads to a low volatility well-diversified portfolio can be used to create higher expected returns using leverage. The key is for the low volatility portfolio to have a Sharpe ratio that is higher than the 60/40 or other high volatility portfolios. If the Sharpe ratio of the low volatility portfolio is lower than the riskier portfolio, then leverage will actually

lead to a portfolio that will be inferior to the riskier portfolio. This is the key: for risk parity to work it has to lead to a relatively high Sharpe ratio and the investor should be able and willing to use some degree of leverage.

One simple approach to creating a low volatility portfolio is to use an equally weighted portfolio. This portfolio is by definition rather well diversified and is likely to have relatively high allocations to less risky assets. The other approach would be to use an optimization package to identify the minimum variance portfolio. This portfolio is created by finding the weights that minimize the volatility of the rate of return on the portfolio. Portfolio M on the efficient frontier displayed in the above graph is such a portfolio. Finally, a volatility-weighted portfolio can be used to create a low volatility portfolio. In this approach the weight of each asset class is given by:

$$w_i = \frac{\frac{1}{\sigma[R_i]}}{\sum_{j=1}^{N} \frac{1}{\sigma[R_j]}}$$

This means the weight of each asset class is proportional to the inverse of its volatility. This approach is in fact identical to the risk parity approach when we have only two assets and it will be the same as risk parity in the more general case if correlations between asset returns are the same. We are going to use our numerical example to demonstrate this approach.

Exhibit 6: Variance Weighted Portfolio

	MSCI World Index	***Barclays Capital Global Aggregate***
Monthly Standard Deviation	4.50%	1.62%
Weights	26.46%	73.54%

Here:

$$26.46\% = \frac{\frac{1}{4.50\%}}{\frac{1}{4.50\%} + \frac{1}{1.62\%}}$$

$$73.54\% = \frac{\frac{1}{1.62\%}}{\frac{1}{4.50\%} + \frac{1}{1.62\%}}$$

Since we have only two asset classes, it can be seen that the weights are the same as in the risk parity portfolio.

Risk Parity and Alternative Investments

To the degree that alternative investments tend to have low volatility and low correlations with other asset classes, the allocations to alternative investments will be relatively high in a risk parity portfolio. However, many institutional investors may have a difficult time accepting relatively large allocations to alternative investments. Let us use a numerical example to demonstrate this. We are going to consider three asset classes: Barclay Capital Global Bond Index, MSCI World Index, and HFR Hedge Fund Index. Exhibit 7 displays the statistics for these three asset classes as well as those of three different portfolios.

A few observations are in order. First, as expected, both the volatility-weighted and the risk parity portfolios require significant allocations to hedge funds and bonds. Second, the volatility-weighted and the risk parity portfolios are rather similar. Third, both the volatility-weighted and the risk parity portfolios have much higher Sharpe ratios than the 10/50/40 portfolio. This means that if these two low volatility portfolios are levered up to have the same volatility as the 10/50/40 portfolio, they will have higher mean return than the 10/50/40 portfolio.

Exhibit 7: Performance Statistics 1990 to 2011

1990-2011	*HFRI Fund Weighted Composite Index*	*MSCI World Index*	*Barclays Capital Global Aggregate*	*10/50/40 Portfolio*	*Volatility Weighted Portfolio*	*Risk Parity Portfolio*
Monthly Mean	0.99%	0.60%	0.59%	0.63%	0.74%	0.73%
Monthly Standard Deviation	2.03%	4.50%	1.62%	2.66%	1.72%	1.64%
Monthly Sharpe Ratio	0.317	0.056	0.154	0.109	0.230	0.236
Weights in 10/50/40 Portfolio	10%	50%	40%			
Weights in Volatility-Weighted Portfolio	37%	17%	46%			
Weights in Risk Parity Portfolio	35%	14%	51%			

Conclusion

In this article, we introduced the basic ideas behind the risk parity approach to asset allocation and examined its economic foundation. It turns out that risk parity approach is a viable approach to asset allocation and is in fact superior to ad hoc asset allocation models employed by the industry. In the absence of a full optimization approach, risk parity appears to provide a close approximation to the original model of Harry Markowitz. The key in using this approach is the willingness to use leverage and the ability to manage the risks posed by the use of leverage. While risk parity is a viable approach to asset allocation, it does not represent a trading strategy that can be employed by active managers. The reasons are that it does not require any estimate of expected return on an asset class

(potentially a source of skill for active managers) and it always leads to positive weights for asset classes (long/short strategies cannot be implemented). It is a suitable model for institutional and high net worth investors who do not face significant constraints on their asset allocation policies and are able to use leverage. Finally, investors who are able and willing to use derivatives could use these instruments to lever up their risk parity portfolios.

Additional Reading on Risk Parity

"Constructing Risk Parity Portfolios: Rebalance, Leverage, or Both?"
by Oleg Ruban and Dimitris Melas
The Journal of Investing, Spring 2011, Vol. 20, No. 1, pp. 99-107

ABSTRACT: Typical multi-asset-class portfolios can be dominated by equity risk, even when the allocation to equities is relatively modest. Achieving risk parity between equities and fixed income in an unlevered portfolio would require significant rebalancing towards fixed income. While such rebalancing can lead to a reduction in risk, portfolios with high fixed-income allocations have historically underperformed equity-dominated portfolios. However, achieving risk parity through leverage, while keeping the initial asset allocation constant, would typically require substantial levels of leverage and could lead to a significant increase in portfolio volatility. The authors combine rebalancing and leverage to construct risk parity portfolios that target the same expected return and the same portfolio risk as the initial asset allocation and examine the performance of these portfolios in different market conditions.

http://www.iijournals.com/doi/abs/10.3905/joi.2011.20.1.099

"Leverage Aversion and Risk Parity"
by Clifford Asness, Andrea Frazzini, and Lasse H. Pedersen
Forthcoming in Financial Analysts Journal

ABSTRACT: We show that leverage aversion changes the predictions of modern portfolio theory. It causes safer assets to offer higher risk-adjusted returns than riskier assets. Consuming the high risk-adjusted returns offered by safer assets requires leverage, creating an opportunity for investors with the ability and willingness to borrow. A Risk Parity (RP) portfolio exploits this in a simple way, namely by equalizing the risk allocation across asset classes, thus overweighting safer assets relative to their weight in the market portfolio. Consistent with our theory of leverage aversion, we find empirically that RP has outperformed the market over the last century by a statistically and economically significant amount, and provides further evidence across and within countries and asset classes.

http://www.econ.yale.edu/~af227/pdf/AFP_20110112.pdf

"Risk Parity Portfolio Versus Other Asset Allocation Heuristic Portfolios"
by Denis Chaves, Jason Hsu, Feifei Li, and Omid Shakernia
The Journal of Investing Spring 2011, Vol. 20, No. 1, pp. 108-118

ABSTRACT: In this article, the authors conduct a horse race between representative risk parity portfolios and other asset allocation strategies, including equal weighting, minimum variance, mean–variance optimization, and the classic 60/40 equity/ bond portfolio. They find that the traditional risk parity portfolio construction does not consistently outperform (in terms of risk-adjusted return) equal weighting or a model pension fund portfolio anchored to the 60/40 equity/bond portfolio structure. However, it does significantly outperform such optimized allocation strategies as minimum variance and mean–variance efficient portfolios. Over the last 30 years, the Sharpe ratios of the risk parity and the equal-weighting portfolios have been much more stable across decade-long sub-periods than either the 60/40 portfolio or the optimized portfolios. Although risk parity performs on par with equal weighting, it does provide better diversification in terms of risk allocation and thus warrants further consideration as an asset allocation strategy. The authors show, however, that the performance of the risk parity strategy can be highly dependent on the investment universe. Thus, to execute risk parity successfully, the careful selection of asset classes is critical, which, for the time being, remains an art rather than a formulaic exercise based on theory.

http://www.iijournals.com/doi/abs/10.3905/joi.2011.20.1.108

"Balancing Asset Growth and Liability Hedging through Risk Parity"
by Edgar E. Peters
The Journal of Investing Spring 2011, Vol. 20, No. 1, pp. 128-136

ABSTRACT: In this article, the author shows that risk parity strategies offer liability-hedging benefits in addition to exposure to growth assets. Risk parity portfolios are typically levered so that risks can be balanced across asset classes. The effect of doing so effectively levers low-risk assets like bonds and de-levers high-risk assets like stocks. The effective leverage of the bond component increases its duration, giving many risk parity portfolios durations similar to those of defined-benefit plans. This is not liability-directed investment, which targets a particular liability, but it does give liability-hedging properties, which other investment strategies typically do not offer. In addition, this study shows that periods of high and low volatility can affect the ability of a static mix of assets to effectively hedge liabilities.

http://www.iijournals.com/doi/abs/10.3905/joi.2011.20.1.128

"Risk Parity and Diversification"
by Edward Qian
The Journal of Investing, Spring 2011, Vol. 20, No. 1: pp. 119-127

ABSTRACT: Traditional 60/40 asset allocation portfolios are not truly diversified because they have an unbalanced risk allocation to high-risk assets. As a result, their expected risk-adjusted returns are low. Risk parity is a new way to construct asset allocation portfolios based on the principle of risk diversification, achieving both higher risk-adjusted returns and higher total returns than traditional asset allocation approaches. The diversification benefits of risk parity portfolios also include balanced correlations to underlying asset classes and stronger downside protection against severe losses. Risk parity portfolios can also incorporate active views on risk-adjusted returns of different asset classes. All of these features make risk

parity an attractive alternative to traditional asset allocation approaches.

http://www.iijournals.com/doi/abs/10.3905/joi.2011.20.1.119

"The Dangers of Risk Parity"
by Ben Inker
The Journal of Investing, Spring 2011, Vol. 20, No. 1, pp. 90-98

ABSTRACT: Risk parity is a portfolio construction methodology that is extremely attractive if standard deviation is a good estimate of the risk of asset classes and if there is a wide variety of asset classes that are likely to offer fairly uncorrelated risk premia. In reality, however, standard deviation is a dangerously limited estimate of the true risk of an asset class and there may well be very few risk premia that are truly available to be exploited. Adding to the problem is the fact that bond yields today are at generational lows and sovereign debt loads are at extremely high levels, making the risk of significantly negative bond returns or even sovereign default much higher than history would suggest. The traditional 65/35 portfolio, while far from ideal, at least seems overwhelmingly likely to offer a decent premium over cash in the long run and should be able to survive either economic depression or sovereign default.

http://www.iijournals.com/doi/abs/10.3905/joi.2011.20.1.090

"Risk Parity: Rewards, Risks, and Research Opportunities"
by S. Ramu Thiagarajan and Barry Schachter
The Journal of Investing Spring 2011, Vol. 20, No. 1, pp. 79-89

ABSTRACT: Mean–variance optimization has recently come under great criticism based on the poor performance experienced by asset managers during the global financial crisis. In response, an alternative approach, called risk parity, which proceeds by equalizing risk contributions, has garnered much interest. The authors summarize the work of a group of leading researchers on risk parity chosen for this special issue. They survey more generally what is known about this approach. Although risk parity has intuitive appeal and has performed well over some historical time periods, it is premature to claim the superiority of risk parity over other asset allocation approaches. The authors raise several conceptual and practical questions about risk parity that they think are worthy of additional research.

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"Beyond Risk Parity"
by Vineer Bhansali
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ABSTRACT: Risk parity is an approach to portfolio construction that focuses on the balance of risks within a portfolio. In this article, the author explores the benefits and shortcomings of the traditional way risk parity is implemented and suggests extensions using a risk-factor based approach.

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20 years of VIX: Implications for Alternative Investment Strategies

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The complete paper is available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1597904

Introduction

Whaley (1993) introduced the VIX index. In the same year, the Chicago Board Options Exchange (CBOE) introduced the CBOE Volatility Index and it quickly became the benchmark for stock market volatility and, more broadly, investor sentiment. The original VIX was a weighted measure of the implied volatility with 30 days to expiration of eight S&P 100 at-the-money put and call options. Ten years later, the methodology was updated. The new VIX methodology is based on a broader index, the S&P 500, and includes further out-of-the-money options which allows for a more accurate view of investors' expectations on future market volatility. The historical time series of the new methodology VIX index has been calculated back to the start of 1990. On March 26, 2004, the first trading in futures on the VIX index began on the CBOE.

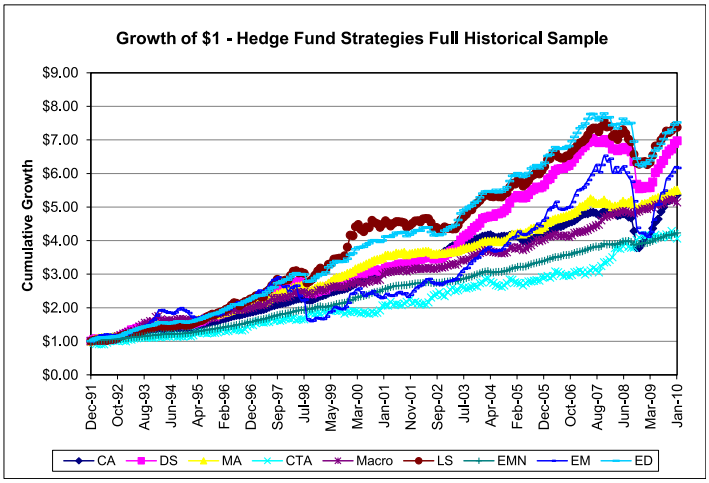
Munenzon (2010) demonstrates that varying levels of VIX are associated with very different return and risk characteristics of traditional asset classes. This article extends this analysis to nine common alternative investment strategies as convertible arbitrage (CA), distressed (DS), merger arbitrage (MA), commodity trading advisor (CTA), macro, equity long/short (LS), equity market neutral (EMN), emerging markets (EM), event driven (ED). This paper also evaluates relationships between traditional assets and alternative investment strategies.

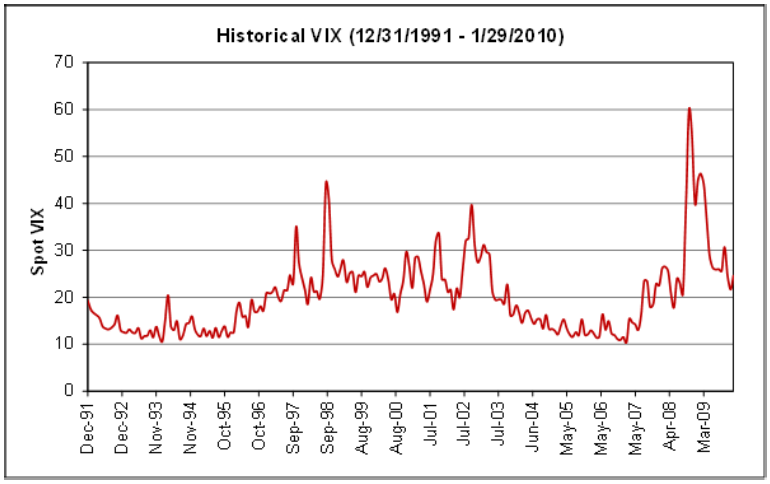
Data and Methodology

This study uses data for the following traditional asset classes: equities – S&P 500 Total Return Index (SPX); bonds - JPM Morgan Aggregate Bond Total Return Index (JPMAGG); commodities – SP GSCI Commodities Index (GSCI); real estate – FTSE EPRA/NAREIT US Total Return Index (NAREIT).[1] Performance data for alternative investment strategies are Center for International Securities and Derivatives Markets (CISDM) indices.

[1] Some investors consider commodities and real estate alternative asset classes, as compared to stocks and bonds. However, for the purposes of this analysis, I consider all such asset classes to be traditional ingredients in an investment program.

Exhibit 1: Full Period Performance Hedge Fund Strategies and VIX





The monthly data for the indices was downloaded via Bloomberg and covers the period from 12/31/1991 to 1/29/2010. The full historical sample is divided into six groups based on the level of VIX to evaluate any differences in results, assuming one remains invested only when VIX is in that particular state.

Key Empirical Results

Exhibit 1 shows the historical level of VIX and cumulative return graphs for the hedge fund strategies. Though VIX begins and ends the period at nearly the same level, the range of VIX over the period is very wide; one also finds that there are extended periods of high and low volatility. The figure also suggests that crashes don't just happen – they are generally preceded by periods of increasing market tension and turbulence, which ultimately push markets over the edge.

Exhibit 2 presents key statistics for traditional asset classes, VIX, and the alternative investment strategies for the full period of study. For all the asset classes and strategies, cumulative returns are strongly positive, particularly for real estate[2]. However, statistical results vary widely across strategies. As expected, and similar to traditional asset classes, the strategies' returns are strongly non-normal. The assumption that returns follow a normal distribution, one of the fundamental assumptions of classical finance, can be strongly rejected for all strategies[3].

Not only does one not observe normality, but one also finds serial correlation for most of the time series[4], which is inconsistent with a random walk model. In classical finance, correlation[5], a linear measure of dependency, plays a key role in portfolio risk measurement and optimization.

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[2] Secular decline in long term interest rates and the subsequent real estate bubble, which is still being resolved, also played key roles.
[3] For a normal distribution, skewness should be 0 and kurtosis should be 3.
[4] Positive returns are likely to be followed by positive returns and negative returns are likely to be followed by negative returns.
[5] Throughout the paper, correlation refers to what is more formally known as Pearson product-moment correlation coefficient, which is used extensively by practitioners and academics to model dependence.

Exhibit 2: Summary Statistics Dec. 31, 1991 to Jan 31, 2010

12/31/1991 - 1/31/2010	CA	DS	MA	CTA	Macro	LS	EMN	EM	ED
monthly data									
Arithmetic Avg Return	0.8%	0.9%	0.8%	0.7%	0.8%	1.0%	0.7%	0.9%	1.0%
Compounded Avg Return	0.8%	0.9%	0.8%	0.7%	0.8%	0.9%	0.7%	0.8%	0.9%
Max Monthly Return	4.7%	5.3%	4.7%	7.9%	8.6%	9.4%	2.8%	12.1%	4.8%
Min Monthly Return	-11.5%	-10.6%	-5.6%	-5.4%	-5.4%	-9.4%	-2.1%	-26.3%	-7.3%
Monthly Standard Deviation	1.4%	1.8%	1.1%	2.5%	1.6%	2.2%	0.6%	3.8%	1.7%
Skewness	-3.9	-1.9	-0.8	0.4	1.2	-0.2	-0.4	-2.1	-1.6
Kurtosis	33.6	13.4	8.7	3.0	7.6	5.7	6.3	16.0	9.4
Normality at 95% confidence level?	No	No	No	No	No	No	No	No	No
P-Value	0.1%	0.1%	0.1%	4.5%	0.1%	0.1%	0.1%	0.1%	0.1%
No serial correlation at 95% confidence level?	No	No	No	Yes	No	Yes	No	No	No
P-Value	0%	0%	0%	20%	4%	7%	0%	0%	0%
VaR (95%)	-1.0%	-1.5%	-1.0%	-3.3%	-1.2%	-2.4%	-0.1%	-4.4%	-1.5%
VaR (99%)	-4.4%	-6.0%	-2.4%	-4.4%	-2.5%	-4.5%	-1.1%	-12.6%	-6.9%
CVaR(95%)	-3.1%	-3.9%	-2.0%	-4.0%	-2.2%	-3.9%	-0.7%	-9.2%	-3.7%
CVaR(99%)	-7.4%	-8.1%	-3.5%	-4.8%	-3.6%	-6.3%	-1.5%	-17.6%	-7.1%
Cumulative Return for Full Period	435%	597%	451%	306%	414%	637%	323%	516%	652%
% of Months with Positive Returns	85.7%	79.7%	86.2%	55.3%	71.0%	70.0%	92.2%	71.4%	80.2%

12/31/1991 - 1/31/2010	SPX	GSCI	NAREIT	JPMAGG	VIX
monthly data					
Arithmetic Avg Return	0.7%	0.7%	1.1%	0.5%	1.5%
Compounded Avg Return	0.6%	0.5%	0.9%	0.5%	0.1%
Max Monthly Return	9.8%	21.1%	31.7%	4.6%	90.8%
Min Monthly Return	-16.8%	-27.8%	-32.2%	-3.5%	-32.7%
Monthly Standard Deviation	4.3%	6.1%	6.0%	1.2%	17.9%
Skewness	-0.8	-0.3	-0.9	-0.2	1.4
Kurtosis	4.4	5.2	11.6	3.9	6.8
Normality at 95% confidence level?	No	No	No	No	No
P-Value	0.1%	0.1%	0.1%	2.3%	0.1%
No serial correlation at 95% confidence level?	Yes	No	No	Yes	No
P-Value	69%	0%	0%	51%	35%
VaR (95%)	-7.6%	-9.4%	-7.8%	-1.4%	-21.1%
VaR (99%)	-12.1%	-14.3%	-22.3%	-2.7%	-29.9%
CVaR(95%)	-10.1%	-12.9%	-15.0%	-2.1%	-26.4%
CVaR(99%)	-14.0%	-19.2%	-25.9%	-2.9%	-31.1%
Cumulative Return for Full Period	269%	175%	605%	215%	28%
% of Months with Positive Returns	64.1%	56.2%	65.0%	68.2%	46.5%

Notes: Jarque-Bera test was used to evaluate normality of a time series; null hypothesis is stated in the question.

Ljung-Box test with 20 lags was used to evaluate serial correlation of a time series;

In Exhibits 5a and 5b, one can see that in the full sample, correlations within and across asset classes and strategies are relatively low (particularly, for SPX vs. GSCI, JPMAGG, CTA, Macro; GSCI vs. Macro; EM vs. CTA; CTA vs. NAREIT, CA, and MA). Similar to traditional asset classes, all strategies with the exception of CTA have significant negative correlation with VIX in the period of study. It is also noteworthy that most strategies do not offer lower correlations with SPX than GSCI or JPAGG; some do not even improve on NAREIT correlation with SPX. Therefore, depending on an investor's goals and scenarios, an addition of a broad basket of alternative strategies to a portfolio may not always provide meaningful incremental diversification benefits as compared to other traditional asset classes, which may be available with lower fees, and higher transparency and liquidity.

Of course, this analysis is performed at the index level. A more selective addition of alternatives at the fund level to one's portfolio may result in greater diversification benefits. Finally, fat tails and negative skewness may result in historical VaR significantly understating losses that one can experience in adverse scenarios, as measured by

historical CVaR[6]. For instance, CA's historical VAR at 95% conference level is 1% but its CVaR (95%) is three times higher at 3.1%. Moreover, high serial correlation suggests that there may be return 'smoothing.' Since smoothed returns bias volatility estimates downward, they also underestimate the true extent of potential tail losses[7]. For example, CA's volatility in the full sample is only a little higher than that of JPMAGG (1.2% vs, 1.4%), but its worst loss is over three times higher (11.5% vs, 3.5%). Similarly, while CA's volatility is slightly lower than that of Macro in the full sample (1.4% vs, 1.6%), its CVaRs and worst losses are much larger.

Six states of VIX are considered. The first state (VIX below 20%) accounted for over 50% of all days in the historical sample due to extended periods of calm in the 90s and, to a lesser extent, in the middle of this decade (Exhibit 3). The first three states (VIX at up to 30%) accounted for over 90% of all days. However, as seen in Exhibit 1, the last decade was far more volatile than the decade of the 90s. As reflected in the transition matrix of Exhibit 3, once in states 1 to 3, VIX is likely to remain in that state for a period of time, as transitions occur gradually. It is not possible to draw strong conclusions with available data for states 4 to 6 as the number of observations in each state is low. However, such a conclusion is supported with daily data [see Munenzon (2010)]. Moreover, even with available data, one can observe that once in a high volatility state, one is likely to remain in one of the high volatility states of 4 to 6.

Exhibit 3: Transition probability matrix for VIX

	Next day State					
Current State	1	2	3	4	5	6
1	88.1%	11.0%	0.8%	0.0%	0.0%	0.0%
2	24.5%	52.8%	13.2%	1.9%	3.8%	1.9%
3	0.0%	37.0%	51.9%	11.1%	0.0%	0.0%
4	0.0%	28.6%	28.6%	28.6%	14.3%	0.0%
5	0.0%	0.0%	40.0%	20.0%	0.0%	40.0%
6	0.0%	0.0%	14.3%	0.0%	28.6%	57.1%

VIX State	Average Duration	Maximum Duration	% of all Months in State
1	8.4	45	54.6%
2	1.8	6	24.1%
3	2.1	5	12.5%
4	1.4	2	3.2%
5	1.0	1	2.3%
6	2.3	3	3.2%

Notes: Based on monthly data. See Munenzon (2010) for the tables above based on daily data.

[6] VaR(a) is defined as the quantity Q such that the probability of a loss is less than or equal to the confidence level of a. Thus, it stops at the start of extreme events and does not analyze the tail. CVaR(a) is defined as the average loss once Q is exceeded, with the confidence level of a. Historical based measures are evaluated based on historical data and thus fully incorporate all features of a distribution of a return series. If one assumes a normal distribution of returns, one can find VaR of a return series via an analytical formula with just its mean and volatility. However, such a measure will understate the realistic extent of losses even more than the historical VaR. For more detail, the reader is referred to Alexander (2008).

[7] Returns can be 'unsmoothed' to produce a more realistic picture of volatility and potential losses. For example, see Davies et al (2005).

How similar are risk/return properties of strategies in various states and relative to the full historical sample? They are very dissimilar (see Exhibit 4). In fact, evidence of consistent, absolute returns in all market cycles is hard to find for alternative strategies.

Only CTA, macro, and EMN (and bonds for traditional asset classes) provide positive cumulative returns across all the states.

Exhibit 4: Summary Statistics by State of VIX

State 1 - VIX <= 20	SPX	GSCI	NAREIT	JPMAGG	VIX	CA	DS	MA	CTA	Macro	LS	EMN	EM	ED
Arithmetic Avg Monthly Return	1.5%	1.4%	1.9%	0.5%	-1.0%	0.8%	1.3%	1.0%	0.7%	1.0%	1.4%	0.7%	1.5%	1.3%
Maximum Monthly Return	7.6%	15.7%	8.6%	3.7%	48.0%	3.0%	5.3%	4.7%	6.2%	8.6%	6.3%	2.2%	8.5%	4.4%
Minimum Monthly Return	-4.4%	-9.9%	-14.0%	-3.5%	-32.7%	-2.5%	-4.2%	-1.0%	-5.4%	-5.4%	-3.4%	-1.3%	-5.8%	-1.6%
Monthly Standard Deviation	2.4%	5.0%	3.7%	1.1%	14.7%	0.8%	1.5%	1.0%	2.3%	1.8%	1.6%	0.5%	2.4%	1.2%
Cumulative Period Return	435.1%	342.0%	697.7%	68.9%	-91.3%	154.3%	340.7%	229.1%	112.9%	211.6%	398.2%	134.8%	463.0%	340.4%
% of Months with Positive Returns	77.1%	62.7%	73.7%	64.4%	40.7%	86.4%	85.6%	91.5%	55.1%	73.7%	79.7%	96.6%	79.7%	86.4%
State 2 - VIX > 20 & <= 25	SPX	GSCI	NAREIT	JPMAGG	VIX	CA	DS	MA	CTA	Macro	LS	EMN	EM	ED
Arithmetic Avg Monthly Return	0.7%	-0.1%	0.7%	0.5%	2.5%	0.8%	0.9%	0.8%	0.1%	0.6%	1.0%	0.7%	1.1%	1.0%
Maximum Monthly Return	9.8%	17.7%	10.8%	2.9%	44.9%	2.7%	3.9%	2.8%	6.1%	5.7%	9.4%	2.8%	12.1%	4.4%
Minimum Monthly Return	-8.4%	-11.9%	-10.9%	-2.0%	-29.0%	-1.6%	-1.5%	-1.9%	-4.5%	-3.0%	-2.4%	-0.7%	-11.3%	-1.6%
Monthly Standard Deviation	4.4%	5.8%	4.7%	1.1%	16.9%	0.9%	1.3%	1.0%	2.3%	1.4%	2.5%	0.7%	3.7%	1.4%
Cumulative Period Return	40.0%	-13.1%	34.9%	32.4%	89.1%	49.3%	59.0%	52.0%	2.3%	34.1%	69.4%	47.0%	68.9%	70.4%
% of Months with Positive Returns	50.9%	45.3%	56.6%	71.7%	49.1%	84.9%	79.2%	86.8%	50.9%	66.0%	64.2%	90.6%	67.9%	79.2%
State 3 - VIX > 25 & <= 30	SPX	GSCI	NAREIT	JPMAGG	VIX	CA	DS	MA	CTA	Macro	LS	EMN	EM	ED
Arithmetic Avg Monthly Return	0.2%	0.9%	2.5%	0.5%	0.2%	1.3%	0.9%	0.6%	1.4%	0.7%	0.4%	0.6%	0.7%	0.9%
Maximum Monthly Return	8.1%	21.1%	14.2%	2.1%	28.8%	4.7%	4.9%	2.6%	7.9%	5.6%	4.8%	2.1%	9.5%	4.8%
Minimum Monthly Return	-9.1%	-16.6%	-4.7%	-2.7%	-31.5%	-2.4%	-2.6%	-1.6%	-4.3%	-2.1%	-4.1%	-1.0%	-6.4%	-3.2%
Monthly Standard Deviation	5.3%	7.5%	4.7%	1.0%	14.1%	1.4%	1.6%	0.9%	3.3%	1.5%	2.4%	0.7%	3.8%	1.7%
Cumulative Period Return	0.4%	16.9%	88.5%	14.7%	-19.8%	43.0%	26.3%	17.1%	43.4%	18.9%	10.1%	16.7%	19.6%	25.3%
% of Months with Positive Returns	51.9%	51.9%	70.4%	74.1%	51.9%	96.3%	74.1%	81.5%	59.3%	74.1%	59.3%	81.5%	63.0%	77.8%
State 4 - VIX > 30 & <= 35	SPX	GSCI	NAREIT	JPMAGG	VIX	CA	DS	MA	CTA	Macro	LS	EMN	EM	ED
Arithmetic Avg Monthly Return	-1.3%	0.4%	-4.3%	1.0%	9.8%	0.8%	0.4%	-0.2%	1.1%	0.1%	-0.8%	0.2%	0.2%	-0.2%
Maximum Monthly Return	8.8%	7.8%	0.2%	2.1%	28.1%	2.1%	1.6%	0.8%	3.2%	1.5%	1.1%	0.8%	2.5%	1.3%
Minimum Monthly Return	-8.1%	-10.5%	-7.3%	-0.3%	-21.5%	-0.7%	-1.3%	-2.0%	-3.3%	-1.8%	-3.4%	-0.3%	-4.0%	-2.9%
Monthly Standard Deviation	5.9%	6.9%	2.4%	0.9%	17.2%	0.8%	1.2%	1.0%	2.7%	1.1%	1.7%	0.4%	2.3%	1.7%
Cumulative Period Return	-9.6%	1.4%	-26.4%	6.9%	77.2%	5.6%	2.9%	-1.6%	7.4%	0.8%	-5.6%	1.6%	1.1%	-1.4%
% of Months with Positive Returns	42.9%	57.1%	14.3%	85.7%	85.7%	85.7%	71.4%	57.1%	71.4%	57.1%	42.9%	85.7%	71.4%	71.4%
State 5 - VIX > 35 & <= 40	SPX	GSCI	NAREIT	JPMAGG	VIX	CA	DS	MA	CTA	Macro	LS	EMN	EM	ED
Arithmetic Avg Monthly Return	-2.5%	-2.4%	8.3%	1.1%	24.1%	0.4%	-0.3%	0.3%	0.5%	0.4%	-0.9%	0.1%	-1.6%	-1.1%
Maximum Monthly Return	9.6%	5.7%	31.7%	3.4%	90.8%	4.6%	3.0%	2.1%	2.5%	1.2%	3.2%	1.2%	8.6%	2.0%
Minimum Monthly Return	-10.9%	-12.1%	-4.3%	-1.1%	-27.6%	-8.4%	-4.4%	-2.6%	-1.2%	-0.2%	-5.4%	-2.1%	-10.1%	-7.3%
Monthly Standard Deviation	8.2%	8.4%	15.6%	1.7%	49.2%	5.1%	2.7%	1.8%	1.7%	0.7%	3.2%	1.3%	6.9%	3.6%
Cumulative Period Return	-13.1%	-12.6%	43.4%	5.8%	112.6%	1.3%	-1.7%	1.2%	2.4%	2.0%	-4.4%	0.4%	-8.8%	-5.8%
% of Months with Positive Returns	40.0%	60.0%	40.0%	80.0%	60.0%	80.0%	60.0%	80.0%	60.0%	60.0%	40.0%	80.0%	40.0%	40.0%
State 6 - VIX > 40	SPX	GSCI	NAREIT	JPMAGG	VIX	CA	DS	MA	CTA	Macro	LS	EMN	EM	ED
Arithmetic Avg Monthly Return	-6.1%	-4.3%	-13.7%	1.2%	18.0%	-1.1%	-3.4%	-0.8%	2.5%	0.1%	-1.8%	0.4%	-6.8%	-2.1%
Maximum Monthly Return	8.8%	12.3%	6.3%	4.6%	78.6%	3.9%	1.1%	1.3%	7.2%	1.1%	1.7%	0.9%	3.5%	1.8%
Minimum Monthly Return	-16.8%	-27.8%	-32.2%	-2.0%	-7.7%	-11.5%	-10.6%	-5.6%	-2.0%	-2.3%	-9.4%	0.0%	-26.3%	-7.3%
Monthly Standard Deviation	9.9%	13.2%	14.3%	2.4%	33.9%	5.0%	4.6%	2.4%	3.4%	1.1%	3.9%	0.3%	10.3%	3.7%
Cumulative Period Return	-37.4%	-31.0%	-67.1%	8.6%	155.7%	-7.9%	-22.2%	-5.7%	18.2%	0.7%	-12.1%	2.9%	-41.2%	-13.9%
% of Months with Positive Returns	28.6%	42.9%	28.6%	57.1%	57.1%	42.9%	28.6%	42.9%	57.1%	71.4%	42.9%	85.7%	14.3%	28.6%

For all strategies, most of the cumulative returns are made in states 1 to 3, particularly state 1; returns are mostly flat to negative in higher states. This finding is very similar to that for traditional asset classes, which are also very sensitive to VIX. However, not all strategies are sensitive to VIX in the same way. While the percentage of positive months for strategies drops significantly as VIX rises (Exhibit 4), CTA responds well to a rising VIX, and Macro and EMN manage to maintain a high positive percentage even at high VIX levels. Finally, generally superior, long term performance of alternative strategies relative to traditional asset classes in the full sample came not from higher returns in good times, but rather in preserving a greater portion of those returns in bad times. For example, LS tracks SPX relatively closely in good times, but the downside is much more limited than SPX as managers have full flexibility to adjust their portfolios to a particular environment. Also, in state 1, SPX outperforms virtually all strategies but its losses are very large at stress points of state 6, which significantly affects its cumulative return ranking in the full sample.

How consistent are cumulative returns for asset classes in various states (Exhibit 4)? They are very consistent at the extreme states 1 and 6. In state 1, all are positive, especially EM, ED, DS, and LS. In state 6, CTA is consistently and meaningfully positive; EMN and Macro are very slightly positive; all other strategies are negative. Strategies exhibit a generally consistent behavior in other states as well. For example, EM, ED, and LS generally do not perform well as VIX rises; however, CTA, Macro, and EMN are generally positive across all states.

Given the prior discussion of returns in different states, it is not surprising to find how unstable correlations are across states (Exhibits 5a, 5b). For example, in state 1 (and state 2 to a lesser extent), all indices (traditional assets and strategies) are highly positively correlated. In state 6 (and state 5 to a lesser extent), most indices are also highly positively correlated with the exception of CTA, Macro, EMN, and JPMAGG. In other states, the relationships are mixed.

Evaluation of correlation for the full sample masks such complex behavior. Additionally, such behavior suggests that not only are dependencies among asset classes time varying, but that they are also non-linear. Therefore, correlation may not be an appropriate means of evaluating dependence among asset classes[8]. Moreover, while at points of extreme stress, diversification can provide downside protection, such benefits are evident only for CTA, Macro, and EMN (and bonds for traditional asset classes).

[8] Correlation will correctly describe dependence structure only in very particular cases, such as multivariate normal distributions. Also, at extremes, correlation should be zero for a multivariate normal distribution, which is not empirically supported. For a more detailed critique on the use of correlations to model dependence, see Embrechts et al (2002).

Exhibit 5a: Correlations by State of VIX

Full Sample

	SPX	GSCI	NAREIT	JPMAGG	VIX	CA	DS	MA	CTA	Macro	LS	EMN	EM	ED
SPX	1.00													
GSCI	0.17	1.00												
NAREIT	0.53	0.14	1.00											
JPMAGG	0.05	0.03	0.09	1.00										
VIX	-0.62	-0.16	-0.34	-0.05	1.00									
CA	0.42	0.29	0.39	0.16	-0.38	1.00								
DS	0.58	0.28	0.47	0.02	-0.44	0.67	1.00							
MA	0.52	0.12	0.36	0.03	-0.48	0.51	0.67	1.00						
CTA	-0.12	0.18	-0.05	0.25	0.06	-0.07	-0.15	-0.11	1.00					
Macro	0.34	0.09	0.15	0.18	-0.26	0.23	0.44	0.47	0.26	1.00				
LS	0.72	0.25	0.35	-0.03	-0.50	0.48	0.75	0.67	-0.02	0.55	1.00			
EMN	0.38	0.20	0.24	0.13	-0.25	0.42	0.45	0.54	0.13	0.35	0.61	1.00		
EM	0.57	0.29	0.39	-0.08	-0.46	0.55	0.73	0.59	-0.10	0.42	0.73	0.40	1.00	
ED	0.67	0.29	0.45	-0.03	-0.52	0.68	0.85	0.83	-0.11	0.44	0.81	0.60	0.75	1.00

State 1 - VIX <= 20

	SPX	GSCI	NAREIT	JPMAGG	VIX	CA	DS	MA	CTA	Macro	LS	EMN	EM	ED
SPX	1.00													
GSCI	0.94	1.00												
NAREIT	0.97	0.96	1.00											
JPMAGG	0.95	0.84	0.90	1.00										
VIX	-0.91	-0.82	-0.85	-0.90	1.00									
CA	0.96	0.84	0.90	0.99	-0.89	1.00								
DS	0.99	0.95	0.98	0.96	-0.89	0.96	1.00							
MA	0.98	0.90	0.95	0.99	-0.90	0.99	0.99	1.00						
CTA	0.98	0.90	0.94	0.97	-0.91	0.98	0.98	0.99	1.00					
Macro	0.96	0.87	0.92	0.98	-0.91	0.98	0.97	0.99	0.98	1.00				
LS	1.00	0.93	0.96	0.97	-0.92	0.97	0.99	0.99	0.99	0.98	1.00			
EMN	0.99	0.92	0.96	0.98	-0.91	0.98	0.99	1.00	0.99	0.98	1.00	1.00		
EM	0.98	0.96	0.98	0.93	-0.87	0.94	0.99	0.97	0.97	0.96	0.98	0.98	1.00	
ED	0.99	0.94	0.97	0.97	-0.90	0.97	1.00	0.99	0.99	0.98	1.00	1.00	0.99	1.00

State 2 - VIX > 20 & <=25

	SPX	GSCI	NAREIT	JPMAGG	VIX	CA	DS	MA	CTA	Macro	LS	EMN	EM	ED
SPX	1.00													
GSCI	0.50	1.00												
NAREIT	0.28	-0.38	1.00											
JPMAGG	0.59	0.04	0.66	1.00										
VIX	-0.15	-0.23	0.12	0.42	1.00									
CA	0.81	0.26	0.62	0.91	0.17	1.00								
DS	0.81	0.25	0.62	0.93	0.21	0.99	1.00							
MA	0.86	0.32	0.57	0.87	0.11	0.99	0.98	1.00						
CTA	0.11	0.06	-0.33	-0.47	-0.23	-0.35	-0.33	-0.27	1.00					
Macro	0.82	0.25	0.56	0.94	0.29	0.96	0.98	0.96	-0.25	1.00				
LS	0.89	0.44	0.49	0.83	0.09	0.97	0.97	0.98	-0.25	0.94	1.00			
EMN	0.83	0.30	0.56	0.91	0.20	0.99	0.99	0.99	-0.30	0.98	0.98	1.00		
EM	0.67	0.24	0.66	0.91	0.24	0.94	0.95	0.90	-0.47	0.92	0.91	0.92	1.00	
ED	0.83	0.29	0.60	0.91	0.15	1.00	0.99	0.99	-0.31	0.97	0.98	1.00	0.93	1.00

State 3 - VIX >25 & <= 30

	SPX	GSCI	NAREIT	JPMAGG	VIX	CA	DS	MA	CTA	Macro	LS	EMN	EM	ED
SPX	1.00													
GSCI	-0.51	1.00												
NAREIT	-0.65	0.80	1.00											
JPMAGG	-0.76	0.86	0.91	1.00										
VIX	-0.89	0.17	0.48	0.49	1.00									
CA	-0.68	0.81	0.98	0.92	0.50	1.00								
DS	-0.52	0.79	0.94	0.83	0.34	0.96	1.00							
MA	-0.64	0.41	0.76	0.59	0.65	0.79	0.80	1.00						
CTA	-0.84	0.81	0.90	0.95	0.63	0.93	0.84	0.72	1.00					
Macro	-0.81	0.69	0.91	0.88	0.68	0.94	0.88	0.87	0.95	1.00				
LS	0.71	-0.24	-0.14	-0.41	-0.58	-0.14	0.08	0.05	-0.40	-0.23	1.00			
EMN	-0.81	0.69	0.92	0.87	0.68	0.95	0.89	0.89	0.94	0.99	-0.23	1.00		
EM	0.21	0.50	0.52	0.31	-0.34	0.52	0.70	0.38	0.27	0.33	0.67	0.33	1.00	
ED	-0.50	0.55	0.85	0.67	0.46	0.88	0.93	0.94	0.74	0.87	0.20	0.88	0.63	1.00

Exhibit 5b: Correlations by State of VIX

State 4 - VIX >30 & <= 35

	SPX	GSCI	NAREIT	JPMAGG	VIX	CA	DS	MA	CTA	Macro	LS	EMN	EM	ED
SPX	1.00													
GSCI	-0.11	1.00												
NAREIT	0.06	-0.69	1.00											
JPMAGG	-0.21	0.50	-0.90	1.00										
VIX	-0.80	0.53	-0.58	0.65	1.00									
CA	0.22	0.84	-0.87	0.66	0.33	1.00								
DS	0.24	0.86	-0.76	0.52	0.32	0.96	1.00							
MA	0.66	0.25	-0.23	0.21	-0.28	0.54	0.59	1.00						
CTA	-0.53	0.29	-0.65	0.83	0.72	0.40	0.26	0.06	1.00					
Macro	-0.04	0.69	-0.88	0.82	0.58	0.87	0.84	0.54	0.70	1.00				
LS	0.48	-0.52	0.82	-0.81	-0.73	-0.51	-0.34	0.32	-0.69	-0.54	1.00			
EMN	0.15	0.68	-0.91	0.86	0.40	0.92	0.84	0.60	0.63	0.94	-0.57	1.00		
EM	0.38	0.70	-0.83	0.68	0.24	0.93	0.92	0.68	0.32	0.87	-0.38	0.92	1.00	
ED	0.62	0.58	-0.35	0.10	-0.19	0.74	0.83	0.84	-0.12	0.56	0.20	0.59	0.76	1.00

State 5 - VIX > 35 & <=40

	SPX	GSCI	NAREIT	JPMAGG	VIX	CA	DS	MA	CTA	Macro	LS	EMN	EM	ED
SPX	1.00													
GSCI	0.48	1.00												
NAREIT	0.04	-0.68	1.00											
JPMAGG	-0.38	-0.75	0.76	1.00										
VIX	-0.85	-0.41	-0.15	0.00	1.00									
CA	0.73	0.42	0.29	0.11	-0.93	1.00								
DS	0.85	0.65	0.06	-0.22	-0.90	0.94	1.00							
MA	0.63	0.07	0.52	0.41	-0.90	0.92	0.76	1.00						
CTA	-0.84	-0.69	0.37	0.81	0.50	-0.37	-0.63	-0.14	1.00					
Macro	-0.58	-0.78	0.71	0.97	0.23	-0.07	-0.38	0.20	0.91	1.00				
LS	0.93	0.61	0.03	-0.27	-0.94	0.91	0.98	0.76	-0.72	-0.46	1.00			
EMN	0.85	0.66	-0.02	-0.21	-0.94	0.94	0.98	0.78	-0.62	-0.40	0.98	1.00		
EM	0.92	0.62	0.07	-0.28	-0.90	0.91	0.99	0.74	-0.72	-0.45	0.99	0.97	1.00	
ED	0.81	0.88	-0.39	-0.56	-0.78	0.73	0.89	0.48	-0.79	-0.70	0.91	0.92	0.89	1.00

State 6 - VIX > 40

	SPX	GSCI	NAREIT	JPMAGG	VIX	CA	DS	MA	CTA	Macro	LS	EMN	EM	ED
SPX	1.00													
GSCI	0.95	1.00												
NAREIT	0.99	0.96	1.00											
JPMAGG	-0.67	-0.62	-0.74	1.00										
VIX	-0.94	-0.94	-0.93	0.50	1.00									
CA	0.60	0.79	0.64	-0.38	-0.77	1.00								
DS	0.89	0.94	0.92	-0.69	-0.94	0.87	1.00							
MA	0.37	0.56	0.37	-0.01	-0.61	0.89	0.63	1.00						
CTA	-0.82	-0.88	-0.86	0.70	0.87	-0.87	-0.97	-0.69	1.00					
Macro	-0.87	-0.83	-0.92	0.83	0.84	-0.59	-0.89	-0.24	0.82	1.00				
LS	0.95	0.97	0.94	-0.53	-0.95	0.77	0.92	0.57	-0.84	-0.79	1.00			
EMN	-0.80	-0.72	-0.86	0.88	0.74	-0.49	-0.83	-0.14	0.78	0.97	-0.70	1.00		
EM	0.92	0.95	0.94	-0.69	-0.95	0.84	0.99	0.63	-0.97	-0.88	0.93	-0.81	1.00	
ED	0.87	0.95	0.90	-0.65	-0.91	0.90	0.98	0.70	-0.96	-0.82	0.93	-0.74	0.98	1.00

Conclusions

The level of VIX seems to have important implications for return expectations of all alternative investment strategies. This is particularly true for extreme levels of VIX. Though the historical range of VIX is very broad, it exhibits clustering, which may make it a useful tool for forecasting. The preceding analysis presents evidence that during the historical period used in the article, several important assumptions of classical finance – normal distribution, randomness of data (no serial correlation), and thus the use of correlation to describe dependence – find limited support in empirical data. In the cases of large deviations from normality and in the presence of serial correlation, volatility and VaR metrics fail to capture the risk of losses appropriately. A focus on volatility with alternative strategies may overlook large, potential losses hidden in the tails, which standard deviation does not capture. Therefore, there may be value in incorporating

more realistic assumptions when modeling markets for investment analysis and risk management, such as non-normal distributions incorporating non-zero skew excess kurtosis and copulas which can capture non-linearity of dependencies, particularly in the tails.

Generally speaking, the superior long term performance of alternative strategies relative to traditional asset classes is not due to better returns in good times but rather relatively more contained losses. While the return potential of alternative strategies may have eroded due to the significant rise in assets under management since the early 90s downside management capabilities should remain intact if managers have flexible investment mandates and risk management discipline. Evidence for consistent, absolute returns is limited. Masked within the full sample is the fact that risk/return characteristics of strategies across states of VIX are very different, for example, CTA strongly outperforms in state 6 but EM outperforms in state 1. For most strategies, performance deteriorates rapidly as VIX rises; CTA is the only strategy that responds well to a rising level of VIX. Moreover, alternative strategies are much more highly correlated with each other and traditional asset classes than the full sample may suggest, with almost perfect correlation at the extremes. At stress points, only CTA, Macro, and EMN help preserve and add to capital (particularly, CTA). Interestingly, strategies and assets which are optimal for stressed periods (e.g., bonds, CTA, EMN) are those an investor may want to minimize in a portfolio to optimize returns in a good environment. Also, given the performance characteristics of VIX and its relationship with other assets and strategies, its inclusion in an investment program should provide valuable benefits in risk management.

The analytical framework presented in this article can be refined further by adding more factors deemed important, such as inflation or information about the prior VIX state; it can also be extended to sectors within an asset class and alternative investment strategies. Finally, while we do not know which volatility states will dominate in the future or how long they may last, greater awareness of the current investment environment, its implications for risk adjusted performance, and flexible investment policies to position portfolios appropriately should help investors produce more consistent results.

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The Risk Reducing and Income Enhancing Buy-Write Strategy

A summary of "15 Years of the Russell 2000 Buy-Write" By Nikunj Kapadia and Edward Szado 2011

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The Options Industry Council (OIC), as part of its mission to provide education and research to institutional investors, helped sponsor a paper on the performance of a buy-write strategy on the Russell 2000™ ("RUT") exchange-traded fund (ETF). The study was conducted by Edward Szado, Research Associate, and Nikunj Kapadia, Associate Professor, Isenberg School of Management, University of Massachusetts. Research support for this study was provided by OIC. Research results, however, represent those of the authors and do not necessarily represent the views of OIC. The following pages contain a summary of the study as well as an explanation of the buy-write strategy. The complete study is available at: www.OptionsEducation.org.

Introduction

This summary updates results and analysis of a 2007 paper by Kapadia and Szado[1] now highlighting the 15-year performance of a buy-write strategy on the Russell 2000. The buy-write strategy provided a higher return than a long RUT portfolio while producing a significant reduction of risk. Exhibits 1 and 2 show that over the 182 month period, the 2% out-of-the-money ("OTM") buy-write returned 263% (8.87% annually), while the return on RUT was 226% (8.11% per annum). Over the entire period the annualized standard deviation for the buy-write portfolio was 16.57%, almost 4 ½ percentage points lower than for the RUT portfolio. As is clearly evident by the rolling annualized standard deviation in Exhibit 3, the buy-write implementation's superior returns came with significant risk reductions throughout the entire period. The paper also analyzes the performance for three sub-periods including the 3 ½ year period beginning with the onset of the credit crisis. During the credit crisis sub-period from November 2007 to March 2011, the 2% OTM buy-write strategy had an annualized gain of 2.20% while RUT gained only 1.99% annually. The 2% OTM buy-write added 21 basis points to the annual return but with only four-fifths of the volatility of the RUT.

The study's sub-periods were selected to allow analysis of varying market conditions. Exhibit 4 provides details for the three sub-periods: February 1, 1996 to February 28, 2003; March 1, 2003 to October 31, 2007; and November 1, 2007 to March 31, 2011. As can be observed in the shaded portion in Exhibit 1 the break points were chosen specifically to capture the strong and steady four-plus year run up of the RUT from its low in March 2003 to its pre-crisis high in October 2007.

Buy-Write Strategy in Favorable Market Environment

The period from February 1, 1996 to February 28, 2003 is a somewhat favorable period for the buy-write (relative to the underlying performance). The second half of the period seems particularly favorable for the buy-write since the underlying performance experiences a downward trend. While the period includes some strong run ups, they are not nearly as strong and sustained as in the second (unfavorable) period or in the third (crisis) period. As expected, in this period, the 2% OTM buy-write outperforms the underlying index. The buy-write generates almost twice the return (5.49% vs. 3.28%) at about three-quarters the volatility (16.76% vs. 21.83%).

[1] Nikunj Kapadia and Edward Szado, "The Risk and Return Characteristics of the Buy-Write Strategy on the Russell 2000 Index," Journal of Alternative Investments, Spring 2007, Vol. 9, No. 4, pp. 39-56. Some minor changes in methodology were made from the 2007 analysis but information presented in this summary is consistent in its analysis. The original paper reported monthly data from expiration to expiration. The current update reports monthly data from month-end to month-end. In addition, the current methodology picks the closest strike price to the desired strike price from those options with full data over the life of the option. The previous study chose the closest strike nearer the ATM whereas the current methodology picks the closest strike whether it is further ITM or OTM.

Exhibit 1: Growth of $100 (RUT, 1-Month 2% OTM Buy-Write)

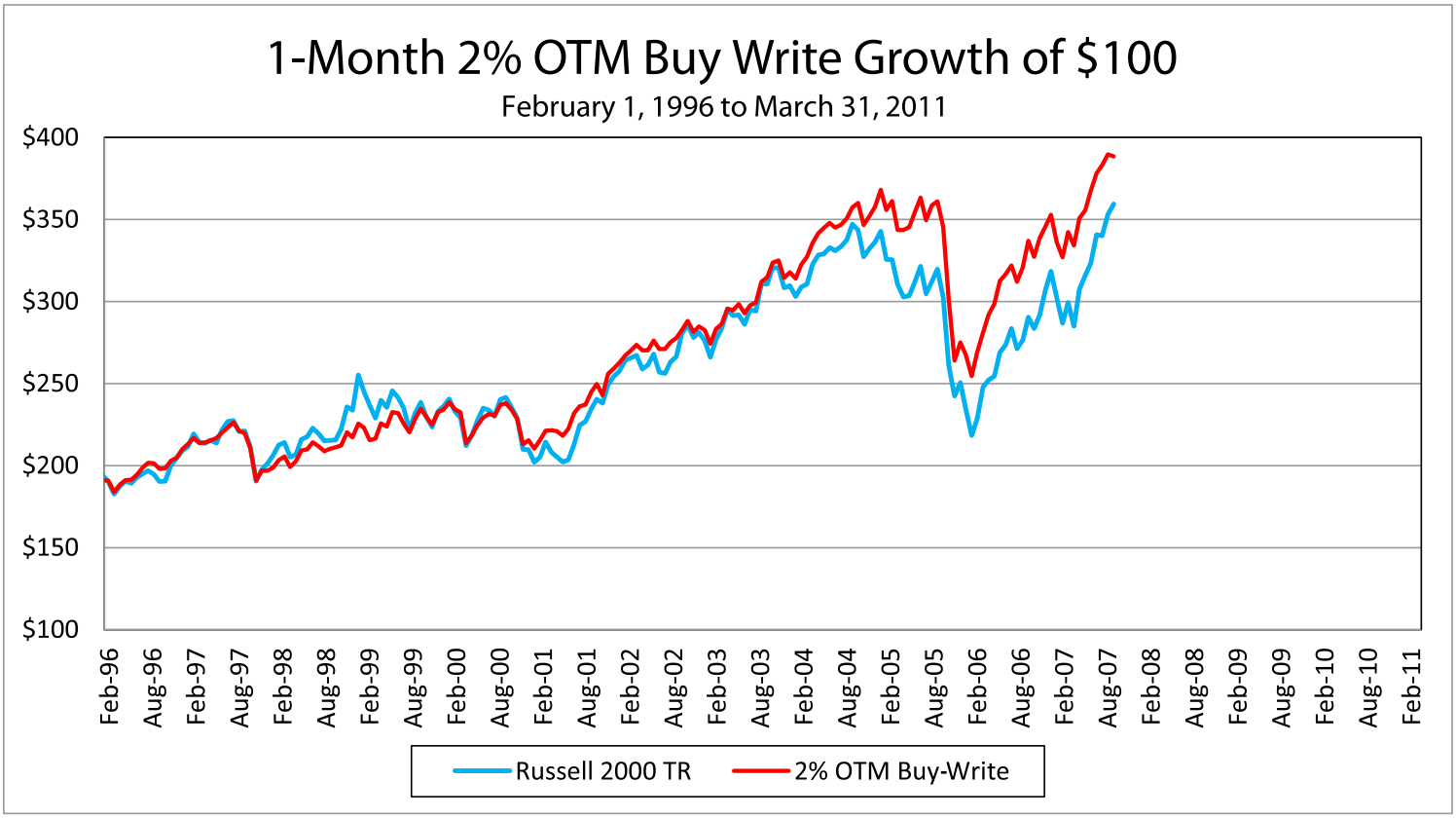
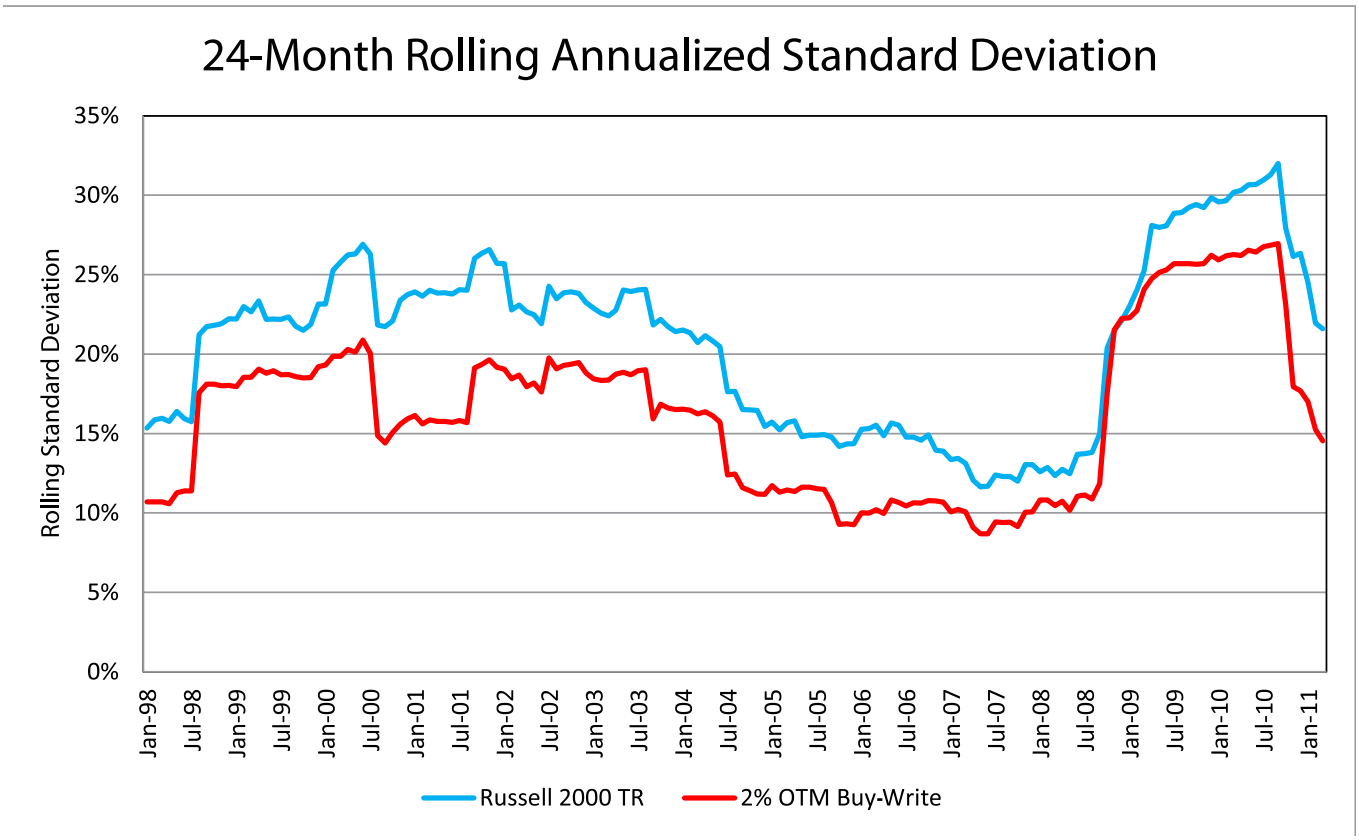


Exhibit 2: Results of RUT, 1-Month Buy-Write Strategies Feb. 1, 1996 to Mar. 31, 2011

1-Month Call Buy-Write Feb 1, 1996 to Mar 31, 2011	Russell 2000 TR	2% OTM Buy-Write	ATM Buy-Write
Annualized Return Annualized Standard Deviation	8.11% 21.06%	8.87% 16.57%	7.30% 14.66%
Correlation with RUT	1.00	0.92	0.87
Sharpe Ratio Minimum Monthly Return Maximum Monthly Return	0.23 -20.80% 16.51%	0.33 -18.69% 9.68%	0.27 -17.84% 10.16%
Maximum Drawdown Maximum Run Up % Down Months % Up Months	-52.9% 226.2% 38% 62%	-42.9% 264.7% 33% 67%	-37.7% 193.0% 31% 69%
Number of Months	182	182	182
Period Return	226.17%	263.06%	191.13%

Exhibit 3: 24-month Rolling Annualized Standard Deviation



Buy-Write Strategy in Unfavorable Market Environment

The period from March 1, 2003 to October 31, 2007 is perhaps the epitome of an unfavorable environment for the performance of a buy-write strategy (relative to the performance of the underlying index). The annualized return for the Russell over this 56-month period was 20.92%. In addition, the run up occurs with low volatility - the annualized volatility in the March 2003 to October 2007 period is 14.08% compared with 21.83% for the earlier period. Thus, focusing on the results from March 2003 to October 2007 allows one to understand how "badly" the buy-write strategy performed relative to the index in one of the least favorable 56-month periods in the entire sample period. Interestingly, even in this unfavorable market environment, Exhibit 4 shows that the 2% OTM buy-write strategy performs credibly with an annualized return of 19.63%, almost equaling the return of the index (20.92%). The annualized volatility of the strategy was only 10.52% compared to the Russell's volatility of 14.08%. In other words, the buy-write strategy achieved almost the same return as the index at about two-thirds the index volatility.

Buy-Write Strategy during the Financial Crisis

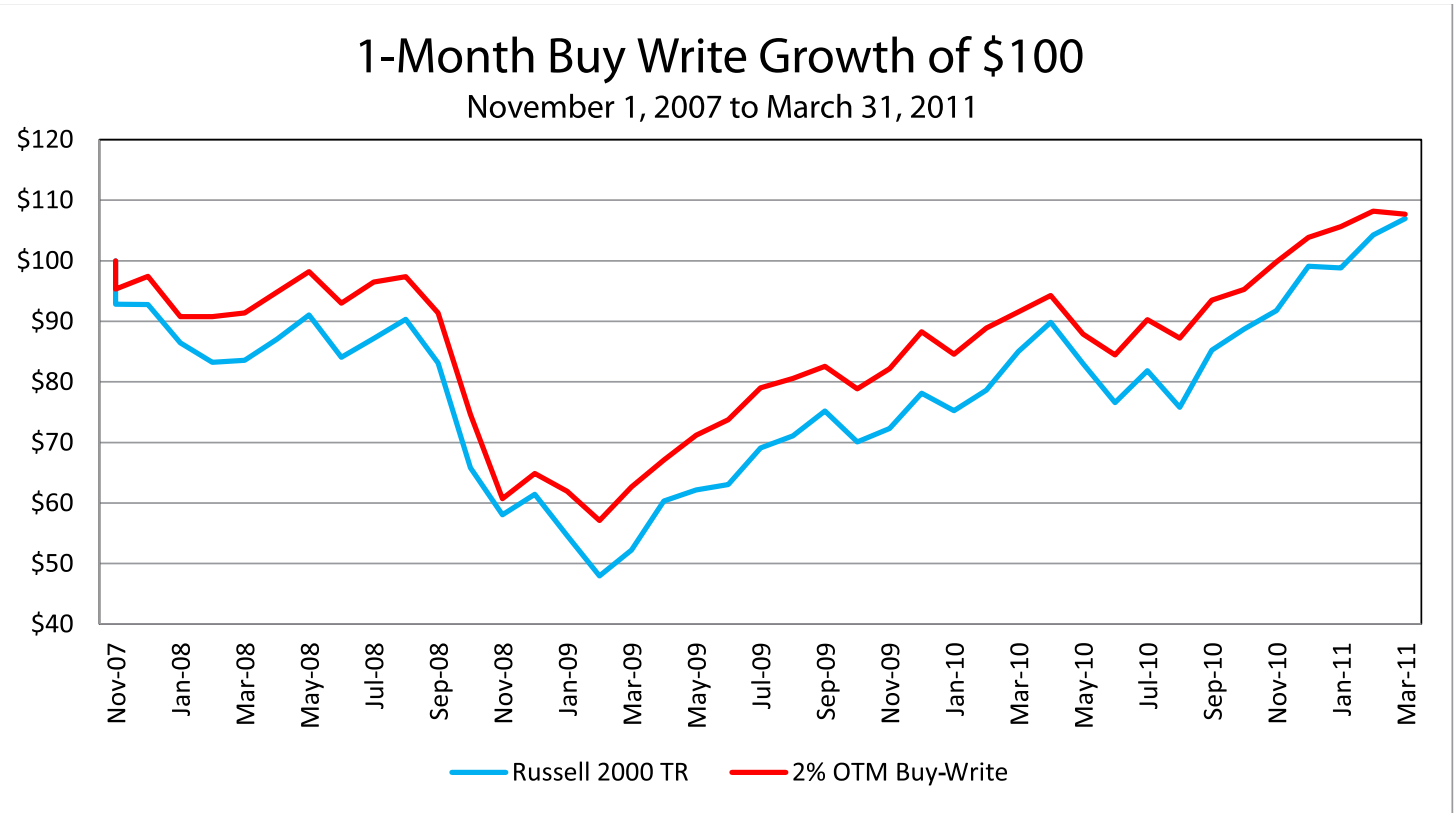
The period from November 1, 2007 to March 31, 2011 covers the financial crisis. In this period, the Russell 2000 exhibited a rapid and very significant loss in value followed by a strong recovery. In addition, the period also exhibited large spikes in realized and implied volatilities. Perhaps the single statistic that best defines the impact of the financial crisis on the Russell 2000 is the maximum drawdown. Over the 41 months of this period, the Russell 2000 experienced a maximum drawdown of -52.0%. In such an environment, one would expect the extra income that call writing generates may have benefited performance by providing a cushion to the drawdowns. However, this benefit is mitigated by the reduced participation in the market recovery. Exhibit 4 shows that the buy-write strategies

did provide a degree of return enhancement over the period with a significant reduction in standard deviation. The 2% OTM buy-write generated a total return of 7.71% (2.20% annually) vs. a total return of 6.95% (1.99% annually) at an annualized standard deviation of 22.07% (26.78% for the underlying). Therefore, the buy-write generated a slightly higher return at about four-fifths the standard deviation. Finally, maximum drawdown was reduced from -52.0% for the underlying to -42.9% for the buy-write. It is interesting to note that only in this period did the ATM buy-write strategy perform better than the 2% OTM buy-write strategy.

Exhibit 4: Results of RUT, 1-Month Buy-Write Strategies Sub-Period Results

	Feb 1, 1996 to Feb 28, 2003			Mar 1, 2003 to Oct 31, 2007			Nov 1, 2007 to Mar 31, 2011		
	Russell 2000 TR	2% OTM Buy Write	ATM Buy Write	Russell 2000 TR	2% OTM Buy Write	ATM Buy Write	Russell 2000 TR	2% OTM Buy Write	ATM Buy Write
Annualized Return	3.28%	5.49%	4.40%	20.92%	19.63%	15.79%	1.99%	2.20%	2.36%
Annualized Standard Deviation	21.83%	16.76%	15.09%	14.08%	10.52%	7.89%	26.78%	22.07%	20.02%
Correlation with RUT	1.00	0.92	0.89	1.00	0.89	0.81	1.00	0.92	0.87
Sharpe Ratio	-0.06	0.05	-0.02	1.27	1.58	1.61	0.03	0.05	0.06
Mean Monthly Return	0.47%	0.57%	0.46%	1.68%	1.55%	1.25%	0.46%	0.39%	0.37%
Median Monthly Return	0.91%	1.25%	1.15%	1.70%	1.94%	1.82%	3.01%	2.21%	1.74%
Minimum Monthly Return	-19.42%	-18.38%	-17.31%	-6.84%	-5.21%	-4.74%	-20.80%	-18.69%	-17.84%
Maximum Monthly Return	16.51%	8.18%	7.33%`	10.73%	9.47%	7.70%	15.46%	9.68%	10.16%
Maximum Drawdown	-35.1%	-28.9%	-26.7%	-10.8%	-7.5%	-5.1%	-52.0%	-42.9%	-37.7%
Maximum Run Up	93.3%	72.1%	59.7%	147.1%	130.8%	98.2%	123.0%	89.5%	75.0%
% Down Months	44%	38%	34%	30%	23%	21%	39%	37%	37%
% Up Months	56%	62%	66%	70%	77%	79%	61%	63%	63%
Number of Months	85	85	85	56	56	56	41	41	41
Period Return	25.66%	46.06%	35.63%	142.68%	130.78%	98.21%	6.95%	7.71%	8.29%

Exhibit 5: Growth of $100 (RUT, 1-Month 2% OTM Buy-Write) Nov. 1, 2007 to Mar. 31, 2011



Conclusion

The updated analysis examined the returns on buy-write strategies on the Russell 2000 over the period of February 1996 to March 2011, extending the analysis of Kapadia and Szado [2007] by approximately five years. Overall, the results suggest that the buy-write strategy can outperform the index under standard performance measures. This risk adjusted outperformance even holds during the unfavorable market conditions of March 2003 to October 2007, where the Russell 2000 was steadily trending upwards. Although the main driver of the return is the underlying index, both transaction costs and the option volatility risk premium (defined as the implied volatility less the realized volatility) are critical to the performance of the strategy. It is clearly evident that the method of execution of the strategy as well as the choice of the options has a large impact on the performance of the strategy. In this light, Szado and Kapadia provided a somewhat conservative analysis of the buy-write strategy's performance, in the sense that the implementation does not allow for an active selection of the moneyness or time to expiration of the calls. There is some evidence in the literature that a more active approach to call selection can result in significantly higher absolute and risk adjusted returns[2].

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[2] See, for example, Renicker and Mallick [2005] and Szado and Schneeweis [2010].

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