Hedge Funds and (Re)insurance: A Risk-Based Analysis

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by

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ABSTRACT

Hedge funds have shown heightened interest in the (re)insurance sector, seemingly drawn to prospects of superior returns with insignificant increases in systematic risk. In particular, market observers see (re)insurance assets, which witnesses return patterns largely uncorrelated with equities and debt markets, as diversifying investments. To benchmark the performance of portfolios composed of (re)insurance-linked investments, as well as to reveal the nature and quantity of risk associated with this strategy, we use asset-based style factors to link the returns of hedge fund strategies to observed market prices. This paper proposes a model that associates the returns of an index composed of 32 equally-weighted funds with explicit allocations to non-life insurance-linked investments with an asset-based style factor based on Swiss Re's Catastrophe (CAT) Bond Performance Indices. The model, with strong predictive ability, is able to explain the majority of the monthly return variations of the insurance-linked index. Analyses also demonstrates that a (re)insurance-focused investment strategy can deliver investors non-correlated, low volatility returns to an otherwise diversified portfolio, and that doing so would add only marginal tail risk.

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INTRODUCTION

RATIONALE

The hedge fund reinsurance model, wherein reinsurance companies partner with alternative asset managers, has become increasingly popular. For reinsurers, which take on risks from primary insurers, the trend has emerged against the backdrop of a soft underwriting cycle and intense industry competition. Benign catastrophe losses in concert with a flood of new capital into an already well-capitalized industry have seen reinsurance rates fall precipitously in recent years. Market dynamics have pushed reinsurers to pursue a strategy either of consolidation through mergers and acquisitions as a way to remain relevant to brokers; or to explore ways of boosting investment returns as underwriting opportunities grow less appealing. Meanwhile, hedge funds and alternative asset managers, at the mercy of fickle investors who withdraw money at the first sign of deteriorating results, are in search of a more stable base of capital, and reinsurance provides that. Indeed, reinsurance capital grants the asset manager the ability to earn returns on both the reinsurer's underwriting and investment activities. Reinsurance risks are also largely uncorrelated with market risk. The appeal of the relationship therefore seems obvious. The reinsurer is admitted high-yield asset management in a challenging rate environment, while hedge funds receive access to a permanent capital base.

Such a partnership, however, is not without risk. The reinsurance industry, as mentioned, suffers fundamental challenges from a pricing perspective, and traditionally lucrative lines of business have since fallen out of favor due to competitive pressures. Hedge funds pursuing a reinsurance investment strategy may find it difficult to generate long-term positive returns investing in assets whose underlying business may not be adequately-priced. In addition, some argue that the source of cash reinsurers draw on is largely borrowed. While policyholders, which provide significant

capital for reinsurers, can't withdraw their premiums, some observers worry that, in the event of a major catastrophe, companies will be forced to pay claims at the same time their investment portfolios are hit.[1]

How can we quantify the risk factors associated with reinsurance-focused investment strategies? Traditionally, indices based on peer-group averages have been used, but such an approach is far from ideal. Fung and Hsieh 2002 proposed using "asset-based style factors" instead to link returns of hedge fund strategies to observed market prices.[2] These style factors, Fung argues, are transparent and can be used to benchmark fund performance on a risk-adjusted basis. Style factors have been developed for a number of hedge fund approaches, including for mutual funds strategies and for trend-following strategies. Reinsurance strategies, however, have not yet been subject to such an analysis. As hedge funds invest further in reinsurers, asset managers and market observers will want to consider closely the nature and quantity of risk associated. My thesis, then, will examine the risk inherent to a reinsurance-focused investment strategy; examine the realized returns associated; and propose a related style factor. Ultimately, we will consider how the risk accompanying reinsurance-focused hedge funds strategies are similar or dissimilar to other asset-based investment strategies.

This topic is interesting not because it is new, but because it is inherently controversial. A.M. Best, the U.S.-based agency which rates insurance companies, has stated that until market conditions and models are appropriately tested, it will not rate any new hedge-fund backed reinsurance

[1] Cohn, Carolyn. "Hedge Funds Muscle into Reinsurance, Attracting Doubters." Reuters UK. Reuters, 29 Oct. 2014. Web. 15 Oct. 2015.
[2] Fung, William, and David A. Hsieh. "Asset-Based Style Factors for Hedge Funds." Financial Analysts Journal 58.5 (2002): 16-27. Web.

vehicles.[3] In addition, hedge funds with exposure to reinsurance assets face increasing scrutiny by U.S. regulators, who claim such investment schemes are merely a creative way of avoiding taxes and other reporting requirements. And, if a bill introduced in June 2015 by Ron Wyden, the top Democrat on the Senate Finance Committee, finds support, a company would not be able to qualify as an insurer for tax purposes if insurance liabilities are less than 10 percent of its assets.[4]

HYPOTHESES

I posit three hypotheses. First, that, c*eteris paribus*, hedge fund managers employing a (re)insurance-focused investment strategy will generate returns uncorrelated with the returns of funds with exposure to traditional asset classes. Second, that, *ceteris paribus*, a majority of the monthly return variations of hedge funds with exposure to (re)insurance asset investments can be explained by asset-based style factors derived from out-of-the-money put options. And finally, that, *ceteris paribus*, the Sharpe ratio of a well-diversified investment portfolio will be higher with increasing exposure to (re)insurance-focused investments.

Rudimentary methods may be used to study the first hypothesis. Some literature suggests that, given the nature of the underlying risks, a (re)insurance-focused hedge fund strategy can generate positive returns with almost no correlation to stock and bond markets. Therefore, it has been proposed that such investments can be classed as alternatives. The second hypothesis can be tested by factor analysis of returns data. Using the methods originally proposed by Fung & Hsieh in 1997, an asset-based style factor will be developed for the reinsurance-focused investment strategy.

[3] DeRose, Robert. "A.M. Best's Focus Remains on the Credit Fundamentals of Hedge Fund Reinsurers." Best's Insurance News & Analysis. A.M. Best Company, Inc., 21 Sept. 2015. Web. 18 Oct. 2015.
[4] Basak, Sonali, and Selina Wang. "Hedge Funds Targeted by Senate's Wyden in Reinsurance Tax Bill." Bloomberg. Bloomberg LP, 25 June 2015. Web. 15 Oct. 2015.

These asset-based style factors are useful as they allow us to relate a seemingly complex group of trading strategies to observable asset returns "without having to exact the detailed working of the strategies themselves."[5] Thus, once an asset-based style factor has been created, we can compare the returns of one asset-based index to that of another index—say, for example, the S&P 500 or the NASDAQ—to see how a reinsurance-focused strategy is similar or different from other strategies. The long-tailed risk inherent to most reinsurance assets (especially for reinsurers whose book of business is mostly property-casualty products) leads us to believe the returns of such an investment strategy would most closely resemble those of other tail risk-focused strategies, such as for out-of-the-money put options, or for volatility-focused funds. As for the third hypothesis, of certain consequence to this endeavor is how adding a reinsurance investment scheme to an S&P 500 portfolio or comparable affects its Sharpe ratio. In addition, by studying the regression coefficients, as well as by examining the moments of the portfolio returns, we can glean to what extent, if any, including a reinsurance strategy adds to the diversity of the portfolio. Our logic here is largely similar to that offered for the first hypothesis, as we believe the uncorrelated returns of the (re)insurance assets should dampen the volatility of the portfolio returns, but still generate positive performance.

[5] Fung, William, and David A. Hsieh. "Asset-Based Style Factors for Hedge Funds." Financial Analysts Journal 58.5 (2002): 16-27. Web.

ECONOMIC OVERVIEW

INSURANCE AND REINSURANCE

The insurance and reinsurance industry is under tremendous competitive pressure. A soft market—characterized by low rates, high limits and widespread availability of coverage[6]—has plagued the sector now for many years, with buyers seeking premium savings as natural catastrophe losses remain low. Although there are some signs that demand for reinsurance is growing (ostensibly driven by increased regulation in western markets), structural challenges loom still.[7] Capital supply is overabundant, demand for coverage across most lines of business in both insurance and reinsurance markets is subdued at best, and historically low interest rates have dampened yields. Reinsurers and insurers continue to be profitable, but these results have been propped up in many cases by prior year reserve releases and a lack of major catastrophe losses.

The worry for market stakeholders is the long-term viability of the insurance and reinsurance industry. Some prominent faces have voiced concerns about the prospects of the reinsurance business in general. Among them is Warren Buffett, the chairman of Berkshire Hathaway Inc.—a company whose property-casualty insurance and reinsurance operations have traditionally been the engine of growth for the firm at large—who claimed the fortunes of the business "have turned for the worse and there's not much [that can be done] about it."[8] Even on the investment side, which has benefited modestly from a rise in interest rates, skepticism is present, as anxieties persevere about dislocation in high-yield bond markets.

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[6] "Soft Market." Insurance Glossary. International Risk Management Institute, Inc., n.d. Web. 25 Apr. 2016.
[7] "Willis Re 1st View: Will Demand Growth Ease the Pain." (2016): 1-8. Willis Re Inc., 1 Apr. 2016. Web. 15 Apr. 2016.
[8] Scism, Leslie, and Anupreeta Das. "Warren Buffett Re-Examines Reinsurance." The Wall Street Journal. Dow Jones & Company, Inc., 2 July 2015. Web. 26 Apr. 2016.

In the midst of these difficulties, new capital continues to enter the marketplace. This is especially true in the reinsurance space. While, according to the Aon Benfield Aggregate report, global reinsurance capital was $USD 575 billion, down 2% relative to 2014, alternative capital rose 12% to $USD 72 billion.[9] The rise of alternative capital, sourced mainly from hedge funds, mutual funds, sovereign wealth funds, pensions and institutional investors, has been cited as a key driver of the downward pressure on (re)insurance rates and the underlying earnings for (re)insurers.

Reinsurers have responded to these market undercurrents in a number of ways. Consolidation, primarily by way of mergers and acquisition (M&A), has taken hold, with an increase in deal volume of 37% over the previous year in 2015.[10] The deals themselves have sought primarily to exploit economies of scale, realize operating efficiencies, and to broaden product and geographic offerings. Though M&A, reinsurers seek to increase their scale to remain relevant in an increasingly competitive market where size is becoming of critical importance, especially as brokers, too, undergo consolidation and alternative capital disrupts the sector.[11]

[9] Slooten, Mike Van. "The Aon Benfield Aggregate." (n.d.): n. pag. Aon Benfield. Aon Plc, 2016. Web. 28 Apr. 2016.
[10] Lukan, Boris. “2016 Insurance M&A Outlook: A year of continuing exuberance.” Deloitte. Deloitte Development LLC, 2016. Web. 28 Apr. 2016.
[11] Vincent, Scott. "XL Catlin: On the Front Foot in the Battle for Relevance." XL Catlin: On the Front Foot in the Battle for Relevance. Informa UK Limited, 13 Jan. 2015. Web. 30 Apr. 2016.

Other (re)insurers have attempted to address the aforementioned market deficiencies by embracing the increasing trend of alternative capital. Alternative capital arrangements, wherein (re)insurers offset risks on their balance sheet by transferring them to investors in capital markets, are not recent inventions. Their use can in fact be traced to the mid- to late-1990s, in the aftermath of a number of large natural disasters that raised questions about the ability of traditional reinsurance to cover catastrophe losses.[12] These alternative capital transactions can vary widely in their structure, from industry loss warranties, to reinsurance sidecars, to insurance-linked securities more broadly. However, in general, the focus of the deals for the (re)insurer is to expand capacity so as to protect the carrier from losses arising from rare, extreme events.

Investors, meanwhile, are attracted to the reinsurance market because much of the underlying business is uncorrelated with the performance potential of more traditional financial instruments, like stocks and bonds. This is particularly the case with catastrophe risks, which have proved especially popular with reinsurance investors, as they have occurrence patterns that are stochastic in nature.[13] Simply put, a wind and thunderstorm event can hit at any time, and that incident would be independent of conditions in financial markets. As one example, it is not likely that a hurricane will hit Florida at the same time as a major downward spiral in stocks or bonds. Therefore, investors surmise that, as reinsurance assets are alternative, uncorrelated investments, holding them can help to reduce the variance of returns in their portfolio.[14] Such a strategy should prove especially useful when financial markets are volatile, as has been the case for much of the past

[12] Hartwig, Robert P., Ph.D. "Alternative Capital and Its Impact on Insurance and Reinsurance Markets." (n.d.): 2-29. Insurance Information Institute, Mar. 2015. Web. 15 Oct. 2015.
[13] *Ibid*.

year. Given this backdrop, it is unsurprising that, even as the industry faces many hurdles, the (re)insurance sector has attracted non-traditional investors.

Capital markets can, and sometimes do, underwrite any sort of risk on a (re)insurer's balance sheet. However, other lines of business are more closely correlated with the economy, especially when compared to catastrophe risk. As one example, workers' compensation claim frequency fell during the financial crisis of 2008, as workers feared reporting injuries to insurers would threaten their jobs.[15] Catastrophe reinsurance is also appealing to investors because losses arising from claims are typically known with relative certainty and settled quickly, whereas liability lines can see claims paid out over decades. In addition, catastrophe losses can be modeled more precisely than other risks, with the models able to estimate the amount of insured losses, the location of the loss, and even the frequency of loss. Investors ultimately use this data to benchmark an insurance-linked security against more traditional investments, or against other insurance risks.

The reaction by reinsurers to alternative capital has been mixed. As we pointed out, some reinsurers have welcomed the influx of new capital to their market and have even partnered with capital markets investors by forming special purpose vehicles in which they underwrite reinsurance business on behalf of investors and share the profits. Everest Re's Mt. Logan Re and Renaissance Re's DaVinci Re, two of the largest such facilities, manage nearly $2 billion in assets between them on behalf of third-party investors, deploying that capital in standard reinsurance markets.[16] Others have resisted alternative capital or remain highly skeptical, believing its

[15] Antonello, Kathy. "State of the Line: Analysis of Workers Compensation Results." Annual Issues Symposium (2015): 2-9. National Council on Compensation Insurance. NCCI Holdings Inc., 2015. Web. 28 Apr. 2016.
[16] "Mt Logan Surpasses $900mn AuM." Trading Risk. Euromoney Trading Limited, 27 Apr. 2016. Web. 30 Apr. 2016.

advantages are overstated and that its presence serves only to further depress reinsurance rates. Some even suggest that alternative capital investors are fair-weather friends, who will flee at the strike of a major catastrophe loss or many smaller losses in short order, or will shift their investments back to traditional asset classes when interest rates rise. Although there is plentiful evidence for the existence of low reinsurance rates and that alternative capital in the market has some effect in this respect, little credible research exists to validate the other claims beyond mere speculation.[17]

In a 2013 paper, McKinsey & Company summarized the key advantages of alternative capital in insurance and reinsurance markets as threefold, and we include that list here as summary.[18]

- Reduced counterparty credit risk, particularly when third-party vehicles are collateralized.
- Greater diversification, as insurers can spread coverage across more markets, rather than be concentrated with just a few reinsurers that often reinsure one another through retrocession agreements.
- Alternative capital allows insurers the ability to lock in rate structures for many years. Catastrophe bonds generally have durations of longer than two years, and can help primary carriers manage interest rate risk.

[17] "Global Property Catastrophe Rate-On-Line Index." GCCapitalIdeas.com. Guy Carpenter & Company LLC, 8 Jan. 2015. Web. 30 Apr. 2016.
[18] Bradicich, Kevin. "Could Third-Party Capital Transform Reinsurance Markets." (n.d.): n. pag. McKinsey & Company. McKinsey & Company, Sept. 2013. Web. 30 Apr. 2016.

Similarly, we provide the list of the major drawbacks associated with alternative capital arrangements.

- The source of capital may not be available over a long time horizon. In other words, alternative capital may not be as permanent as traditional reinsurance capital, as investors can exit quickly in the event of a loss-producing event.
- Alternative agreements do not perfectly replicate traditional reinsurance treaties.
- Insurers benefit from reinsurers' knowledge of the marketplace, expertise which alternative capital providers often lack.

HEDGE FUNDS AND INVESTMENTS IN THE (RE)INSURANCE INDUSTRY

Hedge funds are extensive in their use and in the variety of their strategies, but the structural foundation of such funds has remained largely untouched. Hedge funds are highly liquid investment vehicles, typically formed as part of a limited partnership or a limited liability company, that pool capital from accredited high net-worth individuals or institutional investors. The funds are actively managed and, using complex portfolio construction techniques, take positions in a variety of high-risk assets that are "hedged" with holdings in more traditional assets, like stocks and fixed-income maturities. In addition, hedge funds generally allow for investors to redeem capital at regular intervals, subject to certain notice requirements.

Regulatory burdens and a tendency toward deleveraged balance sheets in the banking sector have prompted managers to pursue ways of structuring funds that ensure the capital base is longer-term. Specifically, managers seek a permanent capital structure that prevents any risk of premature redemptions. Reinsurance is one such form of capital that has found favor with hedge fund managers in recent years. Notably, hedge fund managers adding reinsurance investments to their

portfolio are admitted a "live" business whose profits are tax-deferred rather than taxed as ordinary income or capital gains. Reinsurance vehicles, especially of the publicly-listed variety, eliminate the need for managers to fundraise from limited partners, an effort that can be extremely time-consuming. Finally, the manager can earn returns on both the underwriting and investment results of the reinsurance company. This is because reinsurers are not required to pay out claims if a loss does not occur, and so can invest the premiums from policyholders and earn a high rate of return over time. Accordingly, hedge funds are offered the prospect of management and incentive fees based on capital that is, for all intents and purposes, free and which does not need conventional fundraising means. Reinsurance capital therefore offers management a liquid yet stable capital base whose returns are tax-advantaged and minimally correlated with other risk assets.[19]

Investors in hedge funds with exposure to (re)insurance risk face difficulty in approximating their performance. Hedge funds are deliberately obscure in their operations, disclosing minimal information to fund participants and even less to regulators. This lack of transparency makes it hard for one to assess the long-term performance patterns of hedge fund returns, or to determine how to incorporate a hedge fund strategy to a broader portfolio. Peer-group averages, which are broad-based indices of hedge funds, have commonly been used as risk factors to model hedge fund risk. However, such an approach is inherently problematic. Fung and Hsieh 2004 summarized the key issues of this method to be selection bias, as the funds in a hedge fund database may not be a representative sample; survivorship bias, as databases tend to track only live funds, whose performance is typically better than funds which have ceased operation; instant history bias, insofar as only well-performing funds would seek to enter hedge fund databases to attract

[19] Tocco, Alessandra. "Lasting Foundations: Hedge Fund Reinsurance Structures and Permanent Capital." (2013): 2-6. J.P. Morgan Chase and Co., 2013. Web. 30 May 2016.

investors; the fact that sampling differences are common across hedge fund databases; a short history, which makes it impossible for observers to determine how hedge funds would perform during other market environments; a lack of transparency, as hedge funds tend to disclose only historical return statistics to data vendors; and, finally, often arbitrary choices of index weights.[20]

To surmount these obstacles, Fung and Hsieh 2004 suggested that, instead of constructing benchmarks based on the returns of hedge funds, asset returns should be used. The result is a transparent and rules-based asset-based style factor that associates the common components of hedge fund returns to market risk factors that can be readily observed. We discuss in detail the relevant methodology in the next section, in which we develop an asset-based style factor for (re)insurance-focused hedge fund strategies.

[20] Fung, William, and David A. Hsieh. "Hedge Fund Benchmarks: A Risk-Based Approach." Financial Analysts Journal 60.5 (2004): 65-80. Web.

METHODOLOGY AND DISCUSSION OF RESULTS

DATA SOURCES

To produce a hedge fund risk factor for a reinsurance-focused investment strategy, we relied on a number of data sources. Principally, we examined the returns of pure reinsurance strategy hedge funds and / or hedge funds with exposure to reinsurance assets. These data were sourced largely from the Eurekahedge ILS Advisers Index, an equally-weighted index of 32 constituent funds.[21] The index itself is "designed to provide a broad measure of the performance of underlying hedge fund managers who explicitly allocate to insurance-linked investments," as well as have at least 70% of their portfolio invested in non-life risk.[22] While the sample of 32 constituent funds is indeed small, the ILS Advisers Index is one of the few available composites for the performance of insurance-linked investments.. Given the obvious difficulty and expense required to otherwise obtain returns data for hedge funds with insurance-linked investment allocations, and because of Eurekahedge's noted reputation for providing hedge fund data, the index is considered to be a reasonablbe proxy for the insurance-linked securities (ILS) market. All relevant data is monthly and spans from December 2005 to December 2015, as 2005 is the earliest date available for the ILS Advisers Index. We used Bloomberg for monthly returns on the S&P 500 NASDAQ and other indexes, while the Federal Reserve furnished the monthly treasury and corporate bond yields needed for our analysis. Bloomberg also provided access to the returns for the Swiss Re Cat Bond Indexes (to be discussed in more detail later) studied in this paper.

[21] A list of these constituent funds in provided in **APPENDIX B**.
[22] "Eurekahedge ILS Advisers Index." Eurekahedge. Eurekahedge Pte Ltd., 2015. Web. 14 Dec. 2015.

DISCUSSION

We endeavor to replicate the returns of a(n) (re)insurance-focused hedge fund investment strategy using observable asset prices. Simultaneously, we discern whether or not insurance-linked assets could be classed as alternative investments, insofar as they can be uncorrelated with traditional asset classes and investment strategies derived from traditional asset classes. Our method follows closely that proposed by Fung and Hsieh in 2002, and seeks to find an appropriate asset-based style factor comprised of observable market prices that can explain the risk associated with insurance-linked investment strategies.[23] Later, in 2004, Fung and Hsieh distinguished return-based factors from asset-based factors. A return-based style factor are those common components extracted from hedge fund returns using a statistic procedure known as principal components. This can, of course, be done manually by assuming correlated funds will have the same investment strategy, and then extracting their common component. Alternatively, one can, as we have chosen to do, rely on hedge fund data vendors to classify correlated hedge funds as having similar styles, and then verify that the constituent funds trade using a similar style using the procedure of principal components. We use Eurekahedge's ILS Advisers Index as our return-based style factor, which tracks the returns of 32 equally-weighted hedge funds allocating explicitly to non-life insurance and reinsurance risks. Comparing the average returns of the ILS Advisers Index to the returns of the Standard and Poor's 500 index (S&P 500) as **Table 1** shows in Appendix A, we glean some characteristics of note.

Table 1 was constructed in a manner very similar to Fung and Hsieh 2002. We divide the monthly returns of the S&P 500 Index for December 2005 through to December 2015 into five

[23] Fung, William, and David A. Hsieh. "Asset-Based Style Factors for Hedge Funds." Financial Analysts Journal 58.5 (2002): 16-27. Web.

representative states. State 1 includes the worst months of the S&P 500, wherein returns are more than 1.8 standard deviations below the mean return. State 2, meanwhile, comprises the next worst months of the S&P 500, wherein returns are 1.8 to 0.33 standard deviations below the mean return. State 3 consists of those months of the S&P 500 in which returns are 0.33 standard deviations above and below the mean return. State 4 contains the better months of the S&P 500, for which returns are 0.33 to 1.8 standard deviations above the mean. Finally, State 5 includes the best months of the S&P 500, wherein returns are more than 1.8 standard deviations above the mean return. For each of these states, **Table 1** provides the mean monthly return of the S&P 500, ILS Advisers Index, and the asset-based ILS style factor. We provide more detail on the construction of the asset-based style factor later on, but what **Table 1** shows is that, during negative periods for equity markets, the insurance-linked style factors return generally low positive results, but have somewhat muted upside potential in better times for the S&P 500. Now, if we limit our study to just those periods of significant declines in equity markets, as shown in **Table 2**, then this relatively positive performance becomes more pronounced; the insurance-linked factors return only slightly negative results during the most extreme decline in the S&P 500 covered in our sample.

We now attempt to find a strategy which, from observable market prices, can approximate the returns of the ILS Advisers Index. In so doing, we also attempt to see if insurance-linked securities are alternative investments. Initially, we regressed the insurance-linked index's returns on the nine hedge fund risk factors used in Fung and Hsieh 2004.[24] The results, shown in **Table 3**, are not meaningful: the R^2, at 0.10, is low, and only one factor, the "credit spread factor" ('CREDSPR') is statistically significant at the 5% level. Even upon removing all other portfolios, the regression

[24] Fung, William, and David A. Hsieh. "Hedge Fund Benchmarks: A Risk-Based Approach." Financial Analysts Journal 60.5 (2004): 65-80. Web.

remains unconvincing. This is not at all surprising. Indeed, the factor model is "designed to assess the exposure of a diversified portfolio of hedge funds," and, besides, the model is not meant to "explain the performance of niche styles." The constituents which comprise the ILS Advisers Index are hedge funds investing exclusively in non-life insurance and reinsurance risk, and so embody a niche, non-diversified style. Fung and Hsieh even foresaw that, "as one moves away from a well-diversified portfolio of hedge funds to more specific hedge fund styles," it may be necessary to construct additional risk factors that are endemic to certain styles. This looks to be the case here. Practically, as well, one would not expect the returns of insurance-linked investments to be correlated with the model's factors, as the nature of property-casualty risk, which we detailed earlier, is altogether different from the risk associated with equity-linked investments, trend-following funds, and fixed income instruments. These assets are driven less by movements in financial markets, and more by natural events, like earthquakes and hurricanes. A cursory check of the correlations between the ILS index and the Fung and Hsieh's risk factors, demonstrated in **Table 4**, demonstrates the weak relationship that exists between equities and insurance markets.

Insurance-focused investments, then, may very well be an alternative asset class, but we should not conclude this just yet. We note that the return profile shown in **Figure 1** seemingly resembles that of a protective put or an at-the-money call option on the S&P 500 index. Consequently, it may be useful to examine if other such factors can explain the returns of the ILS Advisers Index. Agarwal and Naik 2004 considered "the systematic risk exposures of hedge funds using buy-and-hold and option based strategies," and, in their research, created a number of risk factors to mimic the returns of equity-oriented hedge fund strategies. Vikas Agarwal was kind enough to provide the returns for the four option-based strategies he created with Narayan Naik through July 2013,

which consist of "highly liquid" at-the-money and out-of-the-money call and put options on the S&P 500 composite index trading on the Chicago Mercantile Exchange.[25] As we did for Fung and Hsieh's factor model, we regress the returns of the ILS Advisers Index on the four options-based risk factors. The results of the regression are shown in **Table 5**, and suggest the risk factors do not meaningfully explain the returns of insurance-linked hedge fund strategies. Likewise, examining correlations of the ILS index with these same options-based factors, shown in **Table 6**, confirms the relationship is low to negative. Recall we hypothesized that an investment strategy composed of out-of-the-money put options could explain the returns of the insurance-linked index. Notice that the coefficient for the out-of-the-money put options strategy is statistically insignificant, and that the returns of the strategy itself are inversely correlated with the returns of the ILS Advisers Index. A regression of the ILS index on the out-of-the-money put options strategy alone (the results of which are provided in **Table 7**) shows explicitly that the out-of-the-money put options-focused strategy does not explain the returns of the index.

Increasingly, the evidence seems to support that insurance-linked investments are an alternative asset class, but we did study two other groups of risk factors, including the "carry" factors proposed by Koijen, Moskowitz, Pedersen et al. 2015, as well as Frazzini and Pedersen 2013's "betting against beta" factors.[26] [27] We examined the "betting against beta" factors, in particular, because, according to Frazzini and Pedersen, these strategy portfolio returns explain the performance of Berkshire Hathaway, an investment company with significant insurance and reinsurance

[25] Agarwal, Vikas, and Narayan Y. Naik. "Risks and Portfolio Decisions Involving Hedge Funds." Rev. Financ. Stud. Review of Financial Studies 17.1 (2003): 63-98. Web.
[26] In their 2015 paper, Koijen, Moskowitz, Pedersen et al. proposed "broadening and [applying] the concept of carry," to any asset.[26] An asset's "carry" is defined by the authors as its "return assuming model conditions stay the same."
[27] Koijen, Ralph S.j., Tobias Moskowitz, Lasse Heje Pedersen, and Evert Vrugt. "Carry." (2015): n. pag. Social Science Research Network. Web.

holdings.[28] For Pedersen's proposed factors, we assumed (re)insurers seek tail risks that have substantial carry in expected returns before risks materialize. Results for the "carry" risk factors were essentially similar to those observed for previous risk factors. The regression results of the "betting against beta" risk factors demonstrated more explanatory power, with an R^2 of 0.52. An automated stepwise regression procedure is able to pare the model down to 14 predictor variables, resulting in an R^2 of 0.44. The truncated factor model exhibits adequate predictive ability, but, as many of the variables are not statistically significant, and because the model itself is very large, we suspect that the model may be overfitting the data. We should therefore seek a more parsimonious way to explain the returns of the index. The regression results for the ILS Advisers Index on the "carry" factors are displayed in **Table 8**, whereas the correlations are given in **Table 9**. Meanwhile, the correlation of the returns of the "betting against beta" factors versus the Index are shown in **Table 10**, and the regression results, for both the complete and truncated model, are in **Table 11** and **Table 12**, respectively.

Equity-driven risk factors, as well as those motivated by bonds, commodities and foreign exchange have, largely, shown little correlation with the returns of hedge funds allocating to insurance investments. Options-based investing strategies, as well as some more unique equities-based strategies, have, likewise, failed to do the same. Our study, then, supports our initial hypothesis that insurance-linked investments are an alternative asset class, insofar as they are uncorrelated with traditional asset classes and investment strategies derived from traditional asset classes. A major caveat is the extremely narrow scope of this paper. A myriad of risk factors exists beyond

[28] Frazzini, Andrea, and Lasse Heje Pedersen. Betting Against Beta. Diss. New York U Stern School of Business, 2013. New York: New York U Stern School of Business, 2013. Print.

those we examined here; however, it was not practical to examine all of these in detail, and so we selected the groups of risk factors we believed to be most relevant to the analysis at hand.

An obvious next step is to turn away from risk factors derived from more traditional assets, and toward those motivated by the same events which affect the insurance and reinsurance industry. Recall that our primary goal in this paper is to find a strategy which, by way of observable market prices, can approximate the returns of the ILS Advisers Index. An obvious choice would be to examine the returns of traded catastrophe bonds (CAT bonds). CAT bonds allow for the transfer of a specific set of risks (normally, but not always, catastrophe and natural disaster risks) from an issuer or sponsor to investors. The sponsor, generally, is an insurance or reinsurance company, seeking to offset some of the risk on their balance sheet to capital markets. Similar to any other bond, the investor will receive a return on his investment in the form of coupon payments. However, should some qualifying catastrophe or other event occur during the time in which the bond is outstanding, then the investor will lose the principal they invested. Conversely, the issuer will receive that money to cover the losses incurred.[29] While some CAT bonds are publicly-traded (mostly those originating outside of North America), in the U.S., almost all offerings are structured as private placements. A secondary market does exist in which CAT bonds are transferred among qualified institutional buyers, facilitated by a market maker, based in the U.S. on the Securities and Exchange Commission's (SEC's) Rule 144A exemption. Under Rule 144A, CAT bond placements are not subject to the SEC's registration and disclosure requirements for public offerings, though an offering document is almost always made available, and CAT bonds are eligible to be traded on most electronic trading systems.[30] Consequently, while CAT bonds are not

[29] Evans, Steve. "What Is a Catastrophe Bond (or Cat Bond)?" Artemis. Steve Evans Ltd., 20. Web. 30 Mar. 2016.
[30] "ILS Glossary." (2015): 3-4. Willis Capital Markets & Advisory, 15 Oct. 2015. Web. 30 Mar. 2016.

completely transparent financial instruments—in that public disclosure is minimal and they are out of reach of most retail investors—, their particulars are at the least available to accredited investors. Moreover, there does exist a publicly-available point of reference for CAT bond returns in the form of Swiss Re's CAT Bond Performance Indices (the "Indices"). The Indices are divided into five "baskets," and, for each, the Indices track the Coupon Return, which represents the accrued stated spread plus collateral return; the Price Return, which measures the movement of secondary bid indications as provided by Swiss Re Capital Markets; and the Total Return, which is the composite of coupon and price returns.[31] The five aforementioned "baskets" are as follows:

- **Swiss Re USD CAT Bond Performance Index**: This index tracks the aggregate performance of USD-denominated CAT bonds offered under Rule 144A.
- **Swiss Re BB CAT Bond Performance Index**: This index tracks the aggregate performance of USD-denominated, BB-rated CAT bonds rated by Moody's and S&P. According to Swiss Re, the bonds in this index generally have "lower modeled expected losses than the other indices."
- **Swiss Re U.S. Wind CAT Bond Performance Index**: This index tracks the aggregate performance of USD-denominated CAT bonds exposed exclusively to hurricanes originating in the U.S. Atlantic Ocean.
- **Swiss Re Global CAT Bond Performance Index**: This index tracks the aggregate performance of all catastrophe bonds issued under Rule 144A, and captures bonds denominated in any currency, as well as all rated and unrated bonds. In addition, the index covers all outstanding perils and triggers.

[31] Nussbaum, Nathaniel, Scott Brody, and Philippe Kremer. "Swiss Re Cat Bond Indices Methodology." (n.d.): 2-4. Swiss Re Capital Markets. Swiss Reinsurance Company Ltd., 1 Aug. 2014. Web. 12 Mar. 2016.

- **Swiss Re Global Unhedged CAT Bond Performance Index**: This index tracks the aggregate performance of all catastrophe bonds offered under Rule 144A, and, in particular, captures the full movement in exchange rates for non-USD-denominated bonds.[32]

We suspect, then, that, while they might not be ideal, CAT bonds tracked by the Swiss Re CAT Bond performance Indices, a publicly-available source, could be a good proxy for the returns of the ILS Advisers Index.

For our purposes, we opted to study only the total return indices provided by Swiss Re, as these are most directly comparable to the ILS index provided by Eurekahedge. We find that, for the period from January 2006 to December 2015, the regression of the ILS Advisers Index on the five indices tracked by Swiss Re, shown in **Table 13**, has an R^2 of 0.78. Consequently, we see that the Swiss Re indices have high explanatory power for the returns of hedge funds with insurance- and reinsurance-linked holdings. In addition, the data for two of the indices are statistically significant: namely, the *p*-value is very low for the U.S. Wind CAT Bond Total Return Performance Index ('SRWTRR'), and is low also for the BB CAT Bond Total Return Performance Index ('SRBBTRR'). These relationships are confirmed by examining the correlations between the ILS Advisers Index and the Swiss Re CAT Bond Performance Indices, shown in **Table 14**. Using a stepwise regression method, we removed the three indices that were not statistically significant and used the average of the two remaining total return indices as the return to our asset-based style factor of an insurance-linked investment strategy. The two factors comprising our style factor,

[32] *Ibid*.

specifically, are the Global CAT Bond Total Return Performance Index ('SRGLTRR') and the BB CAT Bond Total Return Performance Index ('SRBBTRR').[33]

To test the predictive ability of the asset-based style factor, we removed the most recent 48 months of data from the sample and ran the regression again on the coefficients we pared down from the complete sample. The results of this regression are shown in **Table 15**. Next, we forecasted the ILS Advisers Index from January 2006 to December 2015 using the three coefficients from the regression on the constrained sample. **Figure 2** graphs the actual and forecasted ILS Advisers Index. For most periods, the asset-based style factor is able to predict the returns of the index with reasonable accuracy, and the graph provides evidence that CAT bond returns are strongly correlated with returns of hedge funds with investments in property-casualty risk. In other words, we have demonstrated a compelling link between the returns of the peer-group-based Eurekahedge ILS Advisers Index and the asset-based style factor based on Swiss Re's CAT Bond Performance Indices.

Similar to Fung and Hsieh 2002's analysis of trend-following hedge fund strategies, we also compared the state-dependent returns of the asset-based insurance-linked index with the returns of the S&P 500. The results of this study are shown in the last line of **Table 1**, and indicate that the asset-based insurance-linked style factor has a return pattern very similar to that of the ILS Advisers Index. Of possible consequence is that the asset-based style factor appears to have

[33] The coefficient corresponding to the BB CAT Bond Total Return Performance Index ('SRBBTRR') had a lower *p*-value in the initial regression, which comprised all of the indices. However, that factor was ultimately eliminated when a stepwise regression procedure was applied, which successively removed variables based on the *t*-statistics of their estimated coefficients.

slightly less upside potential during more significant declines in equities markets (for example, in state 1), whereas, in positive states (for example, states 4 and 5), returns are nearly identical.

Fung and Hsieh 2002 also examined the returns of asset-based strategies during extreme downturns in the stock market. This analysis is particularly useful for institutional investors, who seek diversifying financial instruments to counteract declines in equities. Our study of the asset-based ILS factor during such periods is shown in the last column of **Table 2**. Again, the asset-based factor exhibits return characteristics similar to the ILS Advisers Index. One slight deviation is during the period from September to November 2008, when the asset-based factor's return is nearly twice as negative as that of the ILS Advisers Index.

We carried out similar analyses using the returns of the NASDAQ Composite Index instead of the S&P 500. The results of the states based on the NASDAQ are shown in **Table 16**. The returns of the asset-based factor during these states are extremely similar to those of the ILS index for most states observed. An exception is state 1, where the asset-based index is negative while the insurance-linked index is slightly positive. We suspect that our asset-based factor may be overestimating the downside risk associated with (re)insurance-focused investing strategies. **Table 17**, on the other hand, presents the results for the worst periods suffered by the NASDAQ, and here, again, the performance of the asset-based style factor is comparable to the ILS Advisers Index.

Finally, we study how adding a portfolio of insurance-linked investments can affect the risk-adjusted returns of a well-diversified portfolio. For our purposes, that "well-diversified portfolio"

will be S&P 500 portfolios of various weights, and we use the asset-based style factor we developed using the Swiss Re CAT Bond Indices as a proxy for the returns of a portfolio comprised of insurance- and reinsurance-linked investments. To calculate the risk-adjusted returns of a group of investments comprised of varied parts equities and (re)insurance risk, we will use the Sharpe ratio, an index which quantifies the excess return of a fund per unit of volatility.[34]

Table 18 gives the moments and Sharpe ratios for the returns of a number of portfolios with varied weights in the S&P 500 and in a portfolio comprised of (re)insurance-linked investments. Of particular note is the extent to which the fat-tailedness of the distribution of returns reduces by forming a mixed portfolio. For example, observe how much lower the Kurtosis is for a portfolio comprised of 25% in the S&P 500 versus a portfolio composed exclusively of (re)insurance-linked assets. Conversely, the table demonstrates that the risk-adjusted returns of an otherwise well-diversified portfolio can be significantly improved by adding (re)insurance risk without any major increase in skewness or kurtosis. The analysis is similar when we look at portfolios composed originally of NASDAQ components, as shown in **Table 19**. Our study suggests (re)insurance risk would likely be an appealing alternative asset class for investors seeking to add non-correlated, low-volatility returns to a diversified portfolio, especially as doing so would seemingly add minimal tail risk.

[34] "The Sharpe Ratio Defined." Investing Classroom. Morningstar, Inc., 2015. Web. 05 Apr. 2016.

SUMMARY OF RESULTS

HYPOTHESIS 1

For the first hypothesis, we posited that hedge fund managers employing a (re)insurance-focused investment strategy will generate returns uncorrelated with the returns of funds with exposure to traditional asset classes. Our analysis supports this thesis. Equity-driven risk factors, as well as those motivated by bonds, commodities and foreign exchange showed little correlation with the returns of hedge funds allocating to insurance investments. Options-based investing strategies, as well as some more unique equities-based strategies, likewise, failed to do the same. **Figure 3** summarizes the major correlations.

Our study reinforces observations made in the economic overview that (re)insurance-linked investments are an alternative asset class, as they are essentially uncorrelated with traditional asset classes and investment strategies derived from traditional asset classes. We repeat our earlier qualification, however: many other risk factors exist beyond those examined in this paper. As we could not practically investigate all of these, we chose to limit the scope of our research to a sample of risk factors we believed to be most relevant.

HYPOTHESIS 2

For the second hypothesis, we stated that a majority of the monthly return variations of hedge funds with exposure to (re)insurance asset investments can be explained by asset-based style factors derived from out-of-the-money put options. Our analysis could not support this assertion. In fact, in our regression model comprised of liquid put and call options, the *p*-value associated with the coefficient for the out-of-the-money put options strategy was quite high (over 0.5). This factor, therefore, was deemed to not be statistically significant. Moreover, a regression of the

returns of the ILS Advisers Index on the out-of-the-money put options strategy alone made obvious that this risk factor cannot explain the returns of the insurance-linked index. Thus, we reject the second hypothesis.

While not in the scope of the second hypothesis, we were able to show that asset-based style factors derived from the returns of catastrophe bonds, as tracked by Swiss Re's CAT Bond Performance Indices, can adequately explain the return variations of hedge funds with positions in (re)insurance assets. In particular, a style factor comprised of two components—the Global CAT Bond Total Return Performance Index ('SRGLTRR') and the U.S. Wind CAT Bond Total Return Performance Index ('SRBBTRR')—exhibited strong predictive ability, even during periods of high volatility in equities markets. Thus, we believe that we have uncovered a link between the returns of the peer-group-based Eurekahedge ILS Advisers Index and the asset-based style factor based on Swiss Re's CAT Bond Performance Indices.

HYPOTHESIS 3

For the third hypothesis, we suggested the Sharpe ratio of a well-diversified investment portfolio with increasing exposure to (re)insurance-focused investments will be higher than a portfolio without (re)insurance investments. Our analysis supports this. Portfolios with greater positions in (re)insurance-linked assets exhibited higher Sharpe ratios than those with heavier positions in either an S&P 500 or NASDAQ stocks. Furthermore, we saw that such portfolios can be created with only slightly additional tail risk, as measured by the skewness and kurtosis.

CONCLUSION

Although we were unable to demonstrate any link between the returns of out-of-the-money put options and the ILS Advisers Index, extending our analysis to the study of catastrophe bonds yielded valuable results. Indeed, using Swiss Re's CAT Bond Performance Indices, a publicly-available repository of indices designed to reflect the returns of the catastrophe bond market, we were able to construct a transparent, rules-based description of the return characteristics of (re)insurance-focused investment strategies. Moreover, the nature of the asset-based style factor is such that we can offer a clearer perspective on the economics of such schemes. During periods of high returns for stock markets, the asset-based style factor for (re)insurance funds delivers more muted, but still positive, returns. Meanwhile, for phases of high volatility or times when returns for equities are lower, performance for the asset-based style factor remains mostly positive. **Figure 4** provides visual evidence of the relative stability of the returns of the asset-based style factor.

The returns of the asset-based factor coincide with our finding that (re)insurance-linked investments are an alternative asset class, as they are essentially uncorrelated with traditional assets and investment strategies derived from traditional asset classes. In fact, closer study reveals that the returns from the ILS Advisers index are more correlated with weather events than stock price movements. For example, in October 2012, the last period the index reported negative returns, (re)insurers were reeling from losses related to Hurricane Sandy. In addition, in March 2011, when the index lost nearly 4%, the Fukushima Daiichi nuclear disaster affected funds with investments in (re)insurers with exposure to Japanese catastrophes. Otherwise, investments in insurance-linked securities appear to provide stable premium income, with a relatively smooth upward return profile. It is important to note that, during both of these periods, the returns for the S&P 500 were

also negative, though slightly less so than the returns associated with the ILS index. If this research were to be extended, it may be useful to see how correlated financial markets are with natural disasters and catastrophe losses in the insurance and reinsurance industry. While our analysis supports independent observations that the (re)insurance industry, in general, produces returns non-correlated with equities, there seems to be evidence to support the intuition that weather-related events themselves weigh on markets in a material way.

By their nature, and as have discussed, insurance-linked securities differ notably from other assets classes as the distribution of returns can be heavily skewed toward the tail. However, our research demonstrated that, when combined with a well-diversified portfolio, the strategy adds meaningful risk diversification. Portfolios formed with various weights in a synthetic asset with a return profile identical to that of the asset-based style factor revealed a higher Sharpe ratio than portfolios which more heavily invested in equities. Most interestingly was that the kurtosis of the combined portfolios was only marginally higher than that associated with the pure-equity portfolios. The key implication is that, given a portfolio initially comprised solely of equity-linked securities, one can improve their risk-adjusted returns for hardly any increase in tail risk by forming a portfolio with exposure to (re)insurance assets.

The advantages of our asset-based style factor are many. We have examined the role such factors serve in addressing many of the problems associated with peer-group-based hedge fund indices, including measurement errors and a lack of transparency. Our asset-based style factor is also useful as it can be used to produce long time series that can simulate the behavior of (re)insurance-focused trading strategies, including for periods where returns data may not be as readily available.

Mitchell and Pulvino 2001 showed this using their merger arbitrage asset-based style factor, simulating returns all the way back to the 1960s.[35] Finally, and more consequentially, the asset-based style factor makes it easier for investors to realize value from insurance-linked investments. Previously, to proxy the performance of the ILS Advisers Index, it would have been necessary to replicate Swiss Re's pure catastrophe bond indices by investing across a balanced portfolio of CAT bonds, considering carefully the weights of investment in each bond. Conversely, the asset-based style factor enables one to track the index as if they were to invest directly in the constituent funds. In other words, it replicates the return patterns of a (re)insurance investment strategy by a transparent, rules-based regression formula that calculates the weight for the constituent funds.

In our case, however, some cautionary notes are necessary. Most pointedly, the scope of our data is relatively narrow. For one, the index we use to approximate the returns of hedge funds with (re)insurance exposure, Eurekahedge's ILS Advisers Index, is based on a sample of only 32 funds. In addition, the index spans just ten years, and focuses only on hedge funds which allocate their investments to non-life insurance and reinsurance risk. While we maintain that the index is a good representation of the returns of hedge funds with exposure to such risks, our study merits further examination in the future within the purview of a longer sampling period. Additionally, the components comprising our asset-based style factor may not be ideal. There is a glut of risk factors beyond those we studied here, but, given the resources and time currently at our disposal, evaluating all of these is an elusive and lofty aspiration. It is our hope and expectation that curiosity will strike another student of (re)insurance, and help to complete this endeavor of deciphering a dynamic, if underappreciated, sect of the investing sphere.

[35] Mitchell, Mark L., and Todd C. Pulvino. "Characteristics of Risk and Return in Risk Arbitrage." SSRN Electronic Journal SSRN Journal (n.d.): n. pag. Web.

APPENDICES

APPENDIX A—TABLES AND FIGURES REFERENCED

Table 1

Average Returns in Five Stock Market Environments Based on the S&P 500, December 2005 - December 2015

Grouping	1	2	3	4	5
S&P 500	-9.98%	-3.21%	0.70%	3.83%	9.37%
ILS Advisers Index	0.05	0.55	0.46	0.63	0.69
Asset-Based ILS Factor	0.00	0.56	0.44	0.65	0.67

SOURCE: Data from Bloomberg and Eurekahedge.

Table 2

Returns During Significant Declines in the S&P 500, December 2005 – December 2015

	S&P 500	ILS Advisers Index	Asset-Based ILS Factor
Jan – Feb 2008	-4.80%	0.84%	0.59%
June 2008	-8.60%	0.53%	0.41%
September – November 2008	-11.17%	-0.35%	-0.62%
January – February 2009	-9.78%	0.29%	0.54%
May – June 2010	-6.79%	0.22%	0.18%
August – September 2011	-6.43%	0.33%	0.58%
May 2012	-6.27%	0.58%	0.72%

SOURCE: Data from Bloomberg and Eurekahedge.

Table 3

Regression Estimates for Asset-Based Style Factor Using David Hsieh's Hedge Fund Risk Factors (Jan 06-Oct 15)

	ILS Advisers Index	
	Estimate (standard error)	Pr(>|t|)
SANDP	0.028	0.056 *
	(0.015)	
SCLC	-0.00001	0.992
	(0.001)	
TENYR	0.110*	0.092 *
	(0.065)	
CREDSPR	-0.182	0.011 **
	(0.070)	
PTFSBD	0.004	0.321
	(0.004)	
PTFSFX	-0.003	0.402
	(0.003)	
PTFSCOM	0.003	0.496
	(0.004)	
PTFSIR	-0.0004	0.496
	(0.002)	
PTFSSTK	0.001	0.896
	(0.004)	
Constant	0.004	0.282
	(0.004)	
Observations	118	
R^2	0.100	
Adjusted R^2	0.025	
Residual Std. Error	0.006 (df = 108)	
F Statistic	1.332 (df = 9; 108)	

Note: *p<0.1; **p<0.05; ***p<0.01

See notes for **Table 4** for explanations of acronyms.

Table 4

Correlation between the ILS Advisers Index and Hedge Fund Risk Factors

	SANDP	SCLC	TENYR	CREDSPR	PTFSBD	PTFSFX	PTFSCOM	PTFSIR	PTFSSTK
ILS Advisers Index	0.18	-0.02	0.01	-0.21	-0.04	-0.07	0.02	-0.04	-0.04

SOURCE: Data from Bloomberg and Eurekahedge. Returns data for trend following risk factors for David Hsieh's Data Library.
NOTES: "SANDP" is the equity market factor, and is the returns for the Standard & Poors 500 index monthly total return; "SCLC" is the size spread factor, and is the difference between the Russell 2000 index monthly total return and the Standard & Poors 500 monthly total return; "TENYR" is the monthly change in the 10-year treasury constant maturity yield (month end-to-month end), as reported by the U.S. Federal Reserve Bank; "CREDSPR" is the monthly change in Moody's Baa yield less the 10-year treasury constant maturity yield (month end-to-month end); whereas "PTFSBD", "PTFSFX." "PTFSCOM," "PTFSIR," and "PTFSSTK" are the trend-following factors, constructed by William Fung and David A. Hsieh in their 2001 paper, "The Risk in Hedge Fund Strategies: Theory and Evidence from Trend Followers."

Table 5

Regression Estimates for Asset-Based Style Factor Using Call and Put Option Factors (Jan 06-July 13)

	ILS Advisers Index	
	Estimate (standard error)	Pr(>|t|)
ATM.CALL	1.129	0.355
	(1.213)	
OTM.CALL	-1.010	0.383
	(1.153)	
ATM.PUT	1.611	0.553
	(2.706)	
OTM.PUT	-1.599	0.533
	(2.553)	
Constant	0.540	6.85e-10 ***
	(0.078)	
Observations	91	
R^2	0.041	
Adjusted R^2	-0.004	
Residual Std. Error	0.666 (df = 86)	
F Statistic	0.921 (df = 4; 86)	
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 6

Correlation between the ILS Advisers Index and Option-Based Risk Factors

	S&P 500 at-the-money call	S&P 500 out-of-the-money call	S&P 500 at-the-money put	S&P 500 out-of-the-money put
ILS Advisers Index	0.12	0.11	-0.16	-0.16

SOURCE: Options returns used with permission from Vikas Agarwal. ILS index data from Eurekahedge.

Table 7

Regression Estimates for Asset-Based Style Factor Using Out-of-the-Money Put Option Factor (Jan 06-July 13)

	ILS Advisers Index	
	Estimate (standard error)	Pr(>|t|)
OTM.PUT	0.101	0.121
	(0.077)	
Constant	0.549	6.02e-12 ***
	(0.069)	
Observations	91	
R^2	0.027	
Adjusted R^2	0.016	
Residual Std. Error	0.660 (df = 89)	
F Statistic	2.448 (df = 1; 89)	
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 8

Regression Estimates for Asset-Based Style Factor Using Carry Factors (Jan 06-Jan 12)

	ILS Advisers Index	
	Estimate (standard error)	Pr(>|t|)
EQ	-0.011	0.816
	(0.046)	
FI	0.106	0.232
	(0.088)	
FI.SL	-0.113	0.848
	(0.586)	
TREAS	-0.757	0.351
	(0.805)	
COMM	0.016	0.437
	(0.021)	
FX	-0.004	0.921
	(0.044)	
CREDITS	0.454	0.234
	(0.377)	
OPTIONS.CALLS	-0.001	0.731
	(0.002)	
OPTIONS.PUTS	0.001	0.837
	(0.004)	
GCF		
Constant	0.510	5.82e-05 ***
Observations	73	
R^2	0.092	
Adjusted R^2	-0.038	
Residual Std. Error	0.732 (df = 63)	
F Statistic	0.708 (df = 9; 63)	
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 9

Correlation between the ILS Advisers Index and "Carry" Risk Factors

	Equity	Fixed Income 10Y Global	Fixed Income 10Y - 2Y Global	US Treasuries	Commodities	Currencies	Credit	Options calls	Options Puts	Global Carry Factor
ILS Advisers Index	0.05	0.13	-0.03	-0.14	0.13	0.16	0.14	-0.11	0.09	0.15

SOURCE: "Carry" factor returns used with permission from Lasse Pederson. ILS index data from Eurekahedge.

Table 10

Correlation between the ILS Advisers Index and "Betting Against Beta" Risk Factors

	U.S. Equities	**International Equities**	**AUS Equities**	**AUT Equities**	**BEL Equities**	**CAN Equities**	**CHE Equities**	**DEU Equities**	**DNK Equities**	**ESP Equities**
ILS Advisers Index	0.06	0.07	0.06	0.02	-0.29	-0.02	0.04	-0.04	0.06	-0.01

	FIN Equities	**FRA Equities**	**GBR Equities**	**HKG Equities**	**ITA Equities**	**JPN Equities**	**NLD Equities**	**NOR Equities**	**NZL Equities**	**SGP Equities**
ILS Advisers Index	0.14	0.05	0.20	0.18	-0.06	-0.06	-0.21	0.27	-0.05	0.26

	SWE Equities	**U.S. Treasury Bonds**	**U.S. Credit Indices**	**U.S. Credit Indices (hedged)**	**U.S. Corporate Bonds**	**Equity Indices**	**Country Bonds**	**Foreign Exchange**	**Commodities**	**All Assets**
ILS Advisers Index	0.16	0.13	-0.01	0.00	-0.02	0.06	-0.05	0.07	-0.04	0.15

SOURCE: "Betting against beta" factor returns used with permission from Lasse Pederson. ILS index data from Eurekahedge.

Table 11

Regression Estimates for Asset-Based Style Factor Using "Betting Against Beta" Factors

	ILS Advisers Index			ILS Advisers Index	
	Estimate (standard error)	Pr(>|t|)		Estimate (standard error)	Pr(>|t|)
US.E	-0.070	0.187	JPN.E	0.021	0.690
	(0.052)			(0.052)	
INTL.E	-0.390	0.671	NLD.E	-0.040	0.506
	(0.914)			(0.060)	
AUS.E	-0.022	0.758	NOR.E	0.059	0.238
	(0.070)			(0.049)	
AUT.E	0.007	0.859	NZL.E	0.006	0.909
	(0.042)			(0.053)	
BEL.E	-0.028	0.581	SGP.E	0.086	0.162
	(0.051)			(0.061)	
CAN.E	-0.0002	0.998.	SWE.E	0.046	0.450
	(0.061)			(0.060)	
CHE.E	0.055	0.242	US.TB	0.110	0.397
	(0.047)			(0.128)	
DEU.E	-0.047	0.446	US.CI	-0.305	0.347
	(0.062)			(0.321)	
DNK.E	0.055	0..357	US.CI.H	0.207	0.531
	(0.059)			(0.328)	
ESP.E	0.055	0.333	US.CB	0.033	0.348
	(0.056)			(0.035)	
FIN.E	0.053	0.261	EI	-0.003	0.948
	(0.047)			(0.047)	
FRA.E	0.071	0.203	CB	0.036	0.863
	(0.055)			(0.210)	
GBR.E	0.029	0.586	FX	0.012	0.831
	(0.053)			(0.055)	
HKG.E	0.049	0.345	COMMODS	-0.003	0.862
	(0.052)			(0.019)	
ITA.E	-0.067	0.310	Constant	0.005***	4.1e-05 ***
	(0.065)			(0.001)	
Observations	75				
R^2	0.517				
Adjusted R^2	0.206				
Residual Std. Error	0.006 (df = 45)				
F Statistic	1.662* (df = 29; 45)				
Note:	*p<0.1; **p<0.05; ***p<0.01				

Table 12

Regression Estimates for Asset-Based Style Factor Using Truncated "Betting Against Beta" Factors

	ILS Advisers Index	
	Estimate (standard error)	Pr(>|t|)
US.E	-0.051	0.149
	(0.035)	
INTL.E	-0.300**	0.023 *
	(0.128)	
CHE.E	0.036	0.132
	(0.024)	
DNK.E	0.039	0.119
	(0.024)	
ESP.E	0.052**	0.047 *
	(0.026)	
FIN.E	0.049***	0.004 **
	(0.016)	
FRA.E	0.037	0.197
	(0.028)	
GBR.E	0.035	0.120
	(0.022)	
HKG.E	0.041**	0.044 *
	(0.020)	
ITA.E	-0.063	0.103
	(0.038)	
NLD.E	-0.060***	0.006 **
	(0.021)	
NOR.E	0.058***	0.006 **
	(0.021)	
SGP.E	0.096***	0.003 **
	(0.031)	
US.CB	0.025	0.263
	(0.022)	
Constant	0.005***	
	(0.001)	
Observations	75	
R^2	0.437	
Adjusted R^2	0.302	
Residual Std. Error	0.006 (df = 58)	
F Statistic	3.221*** (df = 14; 58)	

Note: *p<0.1; **p<0.05; ***p<0.01

Table 13

Regression Estimates for Asset-Based Style Factor Using Swiss Re Cat Bond Indexes (Jan 06-Dec 15)

	ILS Advisers Index	
	Estimate (standard error)	Pr(>|t|)
SRGLTRR	0.790	0.101
	(0.490)	
SRUSWTRR	-0.170	1.5e-4 ***
	(0.043)	
SRCATTRR	-0.222	0.619
	(0.445)	
SRBBTRR	0.244	0.038 **
	(0.116)	
SRGLUTRR	0.009	0.906
	(0.073)	
Constant	0.001	0.015 **
	(0.0004)	
Observations	120	
R^2	0.788	
Adjusted R^2	0.779	
Residual Std. Error	0.003 (df = 114)	
F Statistic	84.973^{***} (df = 5; 114)	
Note:	$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$	

Table 14

Correlation between the ILS Advisers Index and Swiss Re CAT Bond Performance Indices

	SRGLTRR	SRGLUTRR	SRCATTRR	SRBBTRR	SRUSWTRR
ILS Advisers Index	0.862526	0.79819	0.85586	0.860587	0.58928

SOURCE: Swiss Re CAT Bond Performance Indices data from Swiss Re Capital Markets. ILS index data from Eurekahedge.

Table 15

Regression Estimates for Asset-Based Style Factor Using Swiss Re Cat Bond Indexes, After Stepwise Regression (Jan 06-Dec 11)

	ILS Advisers Index	
	Estimate (standard error)	Pr(>|t|)
SRGLTRR	0.969	< 2e-16 ***
	(0.069)	
SRUSWTRR	-0.260	3.94e-06 ***
	(0.052)	
Constant	0.0004	0.365
Observations	72	
R^2	0.818	
Adjusted R^2	0.813	
Residual Std. Error	0.003 (df = 69)	
F Statistic	154.843*** (df = 2; 69)	
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 16

Average Returns in Five Stock Market Environments Based on the NASDAQ, December 2005 - December 2015

Grouping	1	2	3	4	5
NASDAQ	-11.83%	-3.66%	0.60%	4.55%	11.62%
ILS Advisers Index	0.08%	0.47%	0.51%	0.60%	0.69%
Asset-Based Factor	-0.14%	0.50%	0.56%	0.59%	0.67%

SOURCE: Data from Bloomberg and Eurekahedge.

Table 17

Returns During Significant Declines in the NASDAQ, December 2005 – December 2015

	NASDAQ	ILS Advisers Index	Asset-Based ILS Factor
November – February 2008	-5.53%	0.77%	0.65%
September – November 2008	-13.38%	-0.35%	-0.62%
January – February 2009	-6.53%	0.29%	0.54%
July – September 2011	-4.47%	0.45%	0.64%
July – September 2015	-5.07%	0.93%	0.75%

SOURCE: Data from Bloomberg and Eurekahedge.

Table 18

Analysis of Moments and Sharpe Ratios for Portfolios of Various Weights in the S&P 500 and the Asset-Based Factor Return

	S&P 500 Return	Asset-Based Factor Return	Combined Portfolio 1	Combined Portfolio 2	Combined Portfolio 3
Weight in S&P 500	100%	0%	75%	25%	50%
Mean	0.06	0.06	0.06	0.06	0.06
Standard Deviation	0.15	0.02	0.11	0.04	0.08
Skewness	(0.22)	(0.84)	(0.23)	(0.32)	(0.25)
Kurtosis	0.15	1.48	0.16	0.25	0.19
Sharpe Ratio	0.40	3.14	0.54	1.44	0.80

SOURCE: Data from Bloomberg and Swiss Re Capital Markets.

Table 19

Analysis of Moments and Sharpe Ratios for Portfolios of Various Weights in the NASDAQ and the Asset-Based Factor Return

	NASDAQ Return	Asset-Based Factor Return	Combined Portfolio 1	Combined Portfolio 2	Combined Portfolio 3
Weight in NASDAQ	100%	0%	75%	25%	50%
Mean	0.10	0.06	0.09	0.07	0.08
Standard Deviation	0.18	0.02	0.13	0.05	0.09
Skewness	(0.17)	(0.84)	(0.17)	(0.26)	(0.19)
Kurtosis	0.08	1.48	0.09	0.17	0.11
Sharpe Ratio	0.56	3.14	0.67	1.45	0.89

SOURCE: Data from Bloomberg and Swiss Re Capital Markets.

Figure 1

Average Monthly Returns of S&P 500 and ILS Advisers Index in Five States of the S&P 500

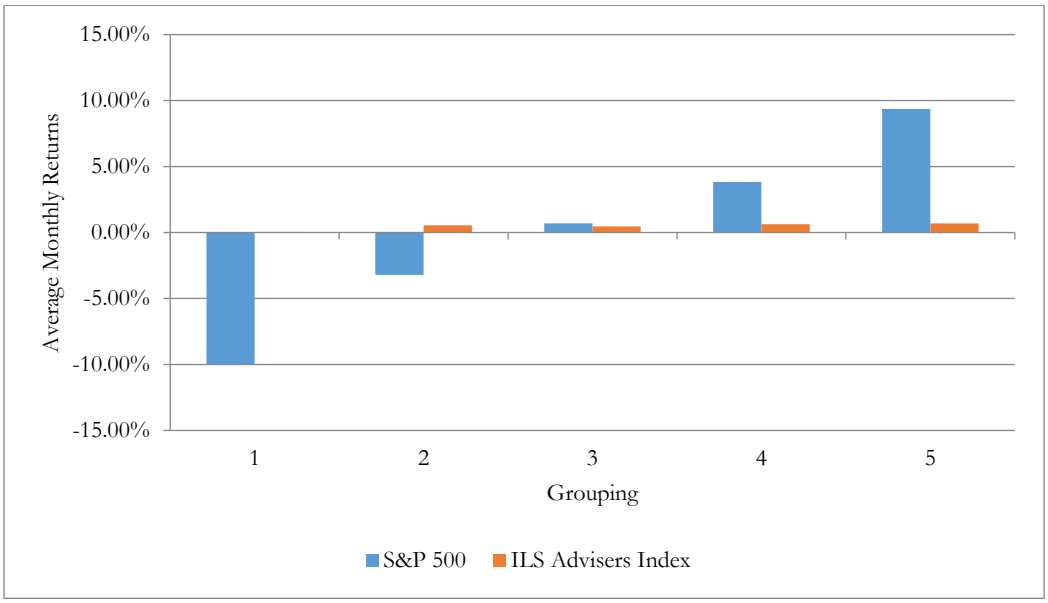


Figure 2

Actual and Forecasted ILS Advisers Index, December 2005 – December 2015

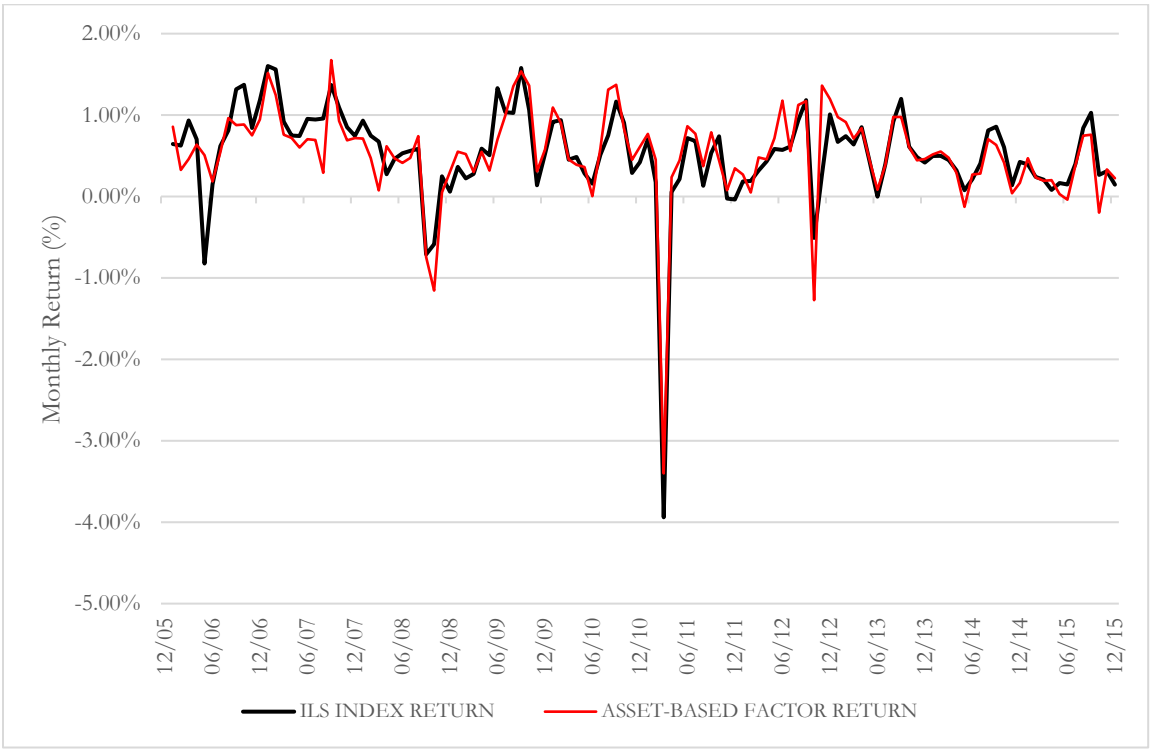


Figure 3

Summary Plot of Correlations

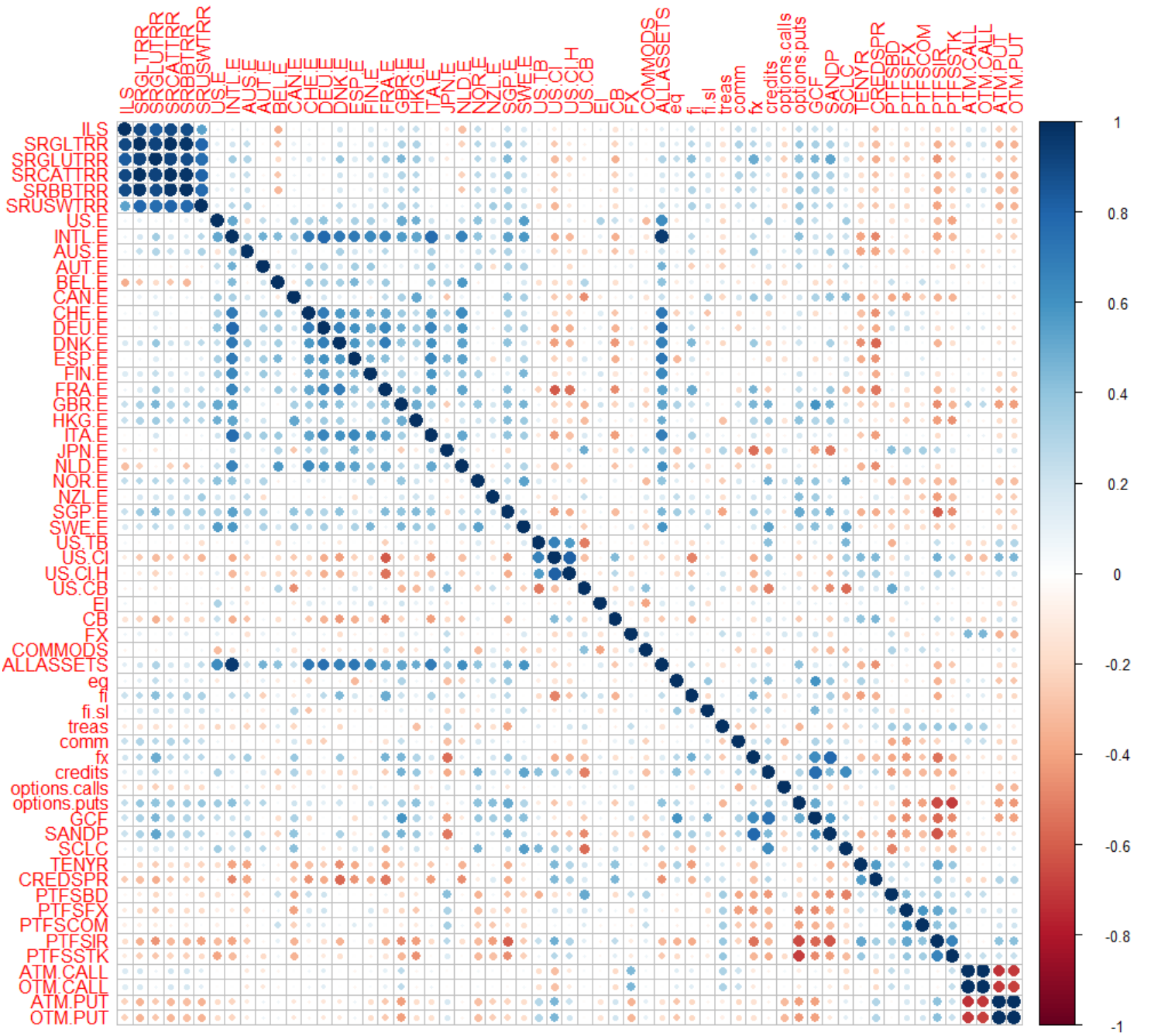
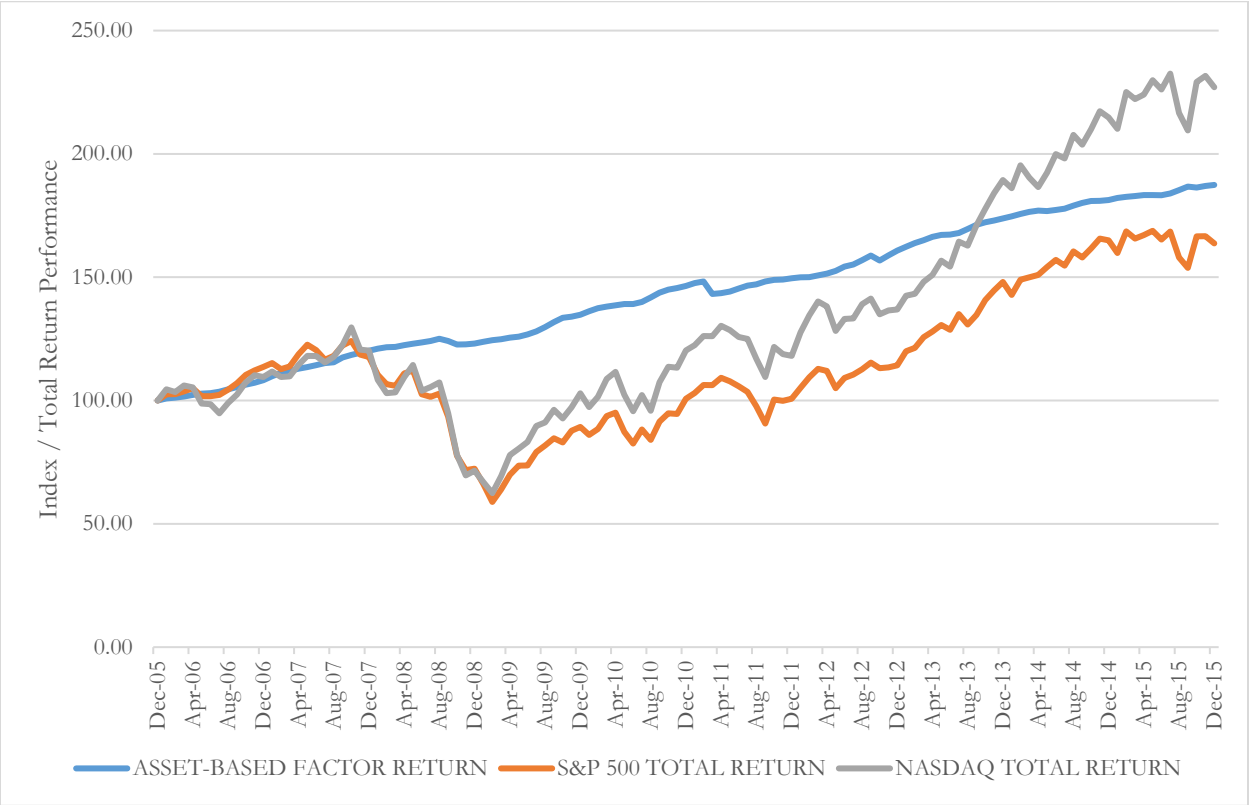


Figure 4

Returns of Asset-Based Style Factor vs. S&P 500 Total Return and NASDAQ Total Return



APPENDIX B—EUREKAHEDGE ILS ADVISERS INDEX CONSTITUENT FUNDS

Fund Name	Date Added	Flagship	Closed	Limited	Dead	ILS Index?	Dec -15 Return(%)
Asuka Insurance Linked Opportunities	Feb-14	Yes	No	No	No	Yes	0.03
Atropos Fund - Class B EUR	Mar-12	Yes	No	No	No	Yes	0.19
AXA IM Novalto - GAIA I C1 USD	Apr-12	Yes	No	No	No	Yes	0.19
Blue Capital Global Reinsurance Fund Ltd	Jan-13	Yes	No	No	No	Yes	0.63
Blue Water Master Fund Ltd - Blue Capital Low Vol Strategy Fund Segregated Account	Sep-14	Yes	No	No	No	Yes	n/a
CATCo Reinsurance Opportunities Fund Ltd	Jan-11	Yes	Yes	No	No	Yes	-1.65
Coriolis CaTpricorn Fund	Dec-04	Yes	No	No	No	Yes	0.24
Coriolis Horizon Fund	Dec-04	Yes	No	No	No	Yes	0.87
CS IRIS Balanced - QI USD	Feb-09	Yes	No	No	No	Yes	0.50
CS IRIS Enhanced - QI CHF	Feb-09	Yes	No	No	No	Yes	0.87
CS IRIS Low Volatility - QI USD	Feb-09	Yes	No	No	No	Yes	0.27
CS IRIS Low Volatility Plus - QI CHF	Apr-12	Yes	No	No	No	Yes	0.10
Eskatos AZ Multistrategy ILS Fund - EUR	Jan-12	Yes	No	No	No	Yes	0.04
Falcon Cat Bond Fund CHF I	Jan-12	Yes	No	No	No	Yes	-0.08
GAM FCM Cat Bond - USD Institutional	Jan-12	Yes	No	No	No	Yes	0.11
GAM Star Cat Bond - EUR Institutional	Jan-12	Yes	No	No	No	Yes	-0.08
Leadenhall Diversified Insurance Linked Investments Fund Plc - Class C USD	Nov-09	Yes	No	No	No	Yes	-0.93
Leadenhall Value Insurance Linked Investments Fund Plc - Class C USD	Nov-09	Yes	No	No	No	Yes	-0.05
LGT (CH) Cat Bond Fund USD A	Oct-12	Yes	No	No	No	Yes	-0.15
LGT (Lux) II ILO Fund USD B2	Apr-13	Yes	No	No	No	Yes	-0.03
LGT (Lux) III - ILS Plus Fund USD B2	Oct-10	Yes	No	No	No	Yes	-0.05
OFI Global Asset Management - Cat Bond	Nov-13	Yes	No	No	No	Yes	0.09
Plenum Cat Bond Fund - Class R USD	Jan-12	Yes	No	No	No	Yes	-0.05
Schroder GAIA Cat Bond - USD IF Acc	Nov-13	Yes	No	No	No	Yes	0.23
Schroder IF Core Insurance-Linked Securities Fund - K Share Class	Mar-14	Yes	No	No	No	Yes	-0.85
Secquaero ILS Fund Ltd - Class Acceleration (USD MF1)	Feb-12	Yes	No	No	No	Yes	n/a
Securis Non-Life Fund - Class A USD	Nov-13	Yes	No	No	No	Yes	0.07
Securis Opportunities Fund - Class A USD	Nov-13	Yes	No	No	No	Yes	0.41
Solidum Cat Bond Fund - USD	Jan-12	Yes	No	No	No	Yes	0.21
Solidum Event Linked Securities Fund Ltd - SAC Fund 2 USD	Jan-12	Yes	No	No	No	Yes	n/a
Twelve-Falcon Insurance Linked Strategy I USD	Jan-12	Yes	No	No	No	Yes	0.08

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