Hedge Fund Compensation Structures and their Relation to Performance, Risk, and Diversification

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ABSTRACT

Hedge fund fees vary across the industry, although there are some standard pricing conventions. This paper examines the relationship between these fees and performance (as measured by the Sharpe Ratio), volatility (as measured by standard deviation of returns), and diversification (as measured by correlation to the MSCI index). Findings are mostly consistent with previous studies of both hedge funds and mutual funds. Higher incentive fees lead to better risk adjusted returns. However unlike previous studies of hedge funds incentive fees seemed to increase the volatility of returns for hedge funds. Correlation and fees are also strongly inversely correlated indicating that investors pay a premium for diversification.

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1 Introduction

The growth of the hedge fund industry since its inception 50 years ago has been well documented in both academic texts and the popular press. Public interest in this class of investment vehicle further grew following the much publicized bailout of Long Term Capital Management. This analysis will examine one particular aspect of this increasingly prominent class of investment vehicle: fee structures. This study will attempt to explain what investors actually buy when they pay higher fees.

Hedge funds utilize a variety of fee structures. The most common fee structure is 1% of assets under management and a 20% incentive fee, but this common pricing structure represents only a third of the funds in the dataset examined in this paper. When one considers the other factors that impact the effective fees, such as high-water marks and lock up periods, there is even less uniformity among fee structures. This paper will attempt to explain this variety by examining relationships between the fee structure and management performance, risk taking and correlation with a broad index. The source of the data is the TASS database provided by the Tremont Company. Professor Stephen J. Brown of New York University provided me with access to this database for the expressed purpose of writing this paper.

The two most common fees are management and incentive fee. A management fee represents a percentage of assets under management charged by the fund to manage the firm's assets. The incentive fee is a performance based fee that is a fund's claim on a portion of the total profits of the investments. Additionally, many hedge funds include a high-water mark provision in their contracts. A high-watermark is generally a hurdle rate of return the fund must achieve before the incentive fees are paid out to the managers. High-water mark contracts pay the manager a bonus only when investors make a profit, and in addition, require that the manager make up earlier losses before becoming eligible for the bonus payment. In this sample dataset, 1103 of 3188 funds indicated that they had some sort of a high-water mark.

Incentives fees are thought to align the interests of managers with those of investors, but theory suggests that incentive contract terms can encourage managers to take on extreme risk, particularly when their incentive contracts are deep out of the money. However, previous studies have found little evidence that managers in fact take on excess risk in response to incentives.

The lack of an observed increase in risk is possibly explained by other common features of hedge funds.

Hedge funds are frequently organized as limited partnerships or limited liability companies. Fund managers are therefore exposed to unlimited (or at least substantial) personal liability. Hedge funds are also frequently characterized by large investments by the fund managers. These features, in part, aim to restrain managers who have the ability to take very risky and highly levered positions with their investors' capital. In this regard, hedge funds differ from mutual funds. SEC regulation limits mutual funds' usage of risky investments such as short selling, leverage, concentrated investments and derivatives in an effort to protect investors from high risk strategies. Hedge fund investors, on the other hand, are left largely to their own devices.

Once an investor meets the established investment minimums for a hedge fund set forth in the National Securities Markets Improvement Act of 1996 (minimum net worth requirement of $5 million for an individual investor and minimum institution capital of $25 million) there is less regulation designed to protect them. Under the Exchange Act, a hedge fund must file with the SEC if it has at least 500 shareholders and $10 million in assets. Depending on their activities, in addition to complying with the federal securities laws, laws pertaining to money laundering, and certain state laws, hedge funds and their advisors may have to comply with other laws including the Commodity Exchange Act ("CEA"), rules of the National Association of Securities Dealers ("NASD"), and provisions of the Employment Retirement Income Securities Act ("ERISA").

When examining the fee structures of hedge funds it is important to note the two features that potentially make hedge funds attractive investments. First, hedge funds can be considered broad bets on managerial skill. High fees would pay for access to superior money managers in this case. Second, hedge funds are potentially attractive investment vehicles because they have a low correlation with broader markets. Hedge funds began as investment partnerships that took offsetting long and short positions, positions that were designed to make money regardless of the general direction of the equity markets. They have evolved and now encompass a greater variety of fund styles. Still, many funds have low correlations with broad indices due to the fact that they engage in different forms of arbitrage and risk neutral investing. This low correlation can create value for investors by offering diversification for their portfolio.

The first portion of the thesis will examine whether funds which outperform their peers on a risk adjusted basis enjoy higher management and incentive fees. The second portion will examine whether funds with high incentive fees tend to experience greater variation in returns. The third portion will examine whether funds receive higher management and incentive fees for providing lower correlation with a broad equity index. The first two portions will be direct follow ups to previous studies, while the third will be an empirical test of theories mentioned in previous studies.

2 Literature Review

Numerous studies have analyzed hedge fund performance. Ackermann, McEally and Ravenscraft (1999), Brown and Goetzmann (2001), Brown, Goetzmann, and Ibbotson (1999), Kao (2002) and Liang (1999, 2001) all examined return characteristics for hedge funds using a variety of databases. Among Ackermann, McEally and Ravenscraft's key findings were hedge funds' Sharpe ratios were higher than those of comparable mutual funds. Liang (2001) also concluded that hedge funds had sizable returns, less volatility, and higher Sharpe ratios than mutual funds. Brown, Goetzmann, and Ibbotson found that the industry suffers from a high attrition of funds but had positive risk adjusted performance when measured by Sharpe ratio. A lack of evidence that there is performance persistence indicated that there was no apparent difference in managerial skill. Kao (2002) also recommended not chasing high performers in the hedge fund industry. Contrastingly, among mutual funds, Chevalier and Ellison (1999) found some subsets of mutual fund managers tend to outperform their peers.

Several papers focus on the potential pitfalls of these analyses including Brown, Goetzmann, Ibbotson, and Ross (1992), Fung and Hsieh (2002) and Weisman (2002). Brown, Goetzmann, Ibbotson, and Ross found that survivorship bias gave rise to apparent performance persistence. Poorly performing managers seemed to be immune from performance review. B. Liang (2001) estimated the survivorship bias for returns was approximately 2.4% per year. Fung and Hsieh (2002) estimated that survivorship bias in hedge funds to be about 3% per year and backfilling bias to be 1.4% per year. Perhaps most alarmingly, Weisman (2002) showed that three types of "informationless investing strategies" can mislead many performance metrics. St. Petersburg investing (doubling up) which mathematically guarantees bankruptcy, short volatility profile which systematically maximizes a future period loss, and illiquid security trading which inaccurately leads investors to believe a fund has high stable returns are all capable of creating misleading performance metrics. Statistics such as Sharpe ratios and volatility of returns are among those misled by these potentially devastating strategies.

Brown and Goetzmann (2001) found a large portions of cross sectional variability of fund returns can be explained by fund style, consistent with Ackermann et al.. Furthermore, Brown and Goetzmann (2001) found that although self reported style characterizations can suffer from strategic misclassification, they appear to be reasonably accurate. Accordingly, this paper will take fund style into account when attempting to explain the behavior of fund returns.

Implications of incentive fees and contract structures for hedge funds are examined in Ackermann, McEally and Ravenscraft (1999) Brown, Goetzmann, and Park (2001) and Goetzmann, Ingersoll, and Ross (2003). Liang (1999) found funds with high-water marks performed better than their peers. Goetzmann, Ingersoll, and Ross (2003) provide a closed form solution to the high-water mark contract under certain conditions, allowing for the valuation of a hedge fund manager contract. The equation indicates that although managers have an incentive to increase risk, the contract can be fairly priced regardless of the fund's volatility.

Brown, Goetzmann, and Park, (2001) show that the apparent incentive to increase risk when managers are below high-water mark does not seem to materialize. Managers are apparently concerned about their future in the industry and there is little evidence that funds increase risk to take advantage of incentive contract terms. Ackermann et al. also found incentive fees improve the Sharpe ratio but do not seem to increase the volatility of fund returns.

Conversely, several studies found that mutual fund managers do respond to incentives by taking on excess risk. Brown, Harlow, and Starks (1996) and Chevalier and Ellison (1997) both concluded that mutual funds seem to increase risk when they are underperforming. Elton, Gruber, and Blake (2003) found that incentive-fee mutual funds take more risk and increase risk after poor performance. However, evidence indicated higher incentive fees attracted better stock pickers and obtained lower overall expense ratios.

In a working paper, Getmansky (2004) found that funds seem to have optimal sizes and limited opportunity sets. Goetzmann, Ingersoll, and Ross (2003) also concluded that small funds tend to grow, while large funds tend to shrink. Consequently, unlike their mutual fund counterparts, hedge fund managers cannot increase their compensation by growing assets under management. The paper speculates that this is probably due to decreasing returns to scale in the industry and limits on hedge fund technology and arbitrage.

Finally, Liang (1999) and Ackermann et al. (1999) found funds provide diversification opportunity due to low correlation. Ackermann et al. (1999) concluded that hedge funds always enhance a portfolio containing any of the 8 indices considered in their study. This paper will test whether lower correlation, and thus greater diversification, results in higher fees.

3 Data Description

The sample data set is the TASS database compiled by the Tremont Company. The TASS database is a reasonably comprehensive hedge fund database and serves as the foundation for the CSFB/Tremont Hedge Fund Index. This particular dataset consists of all funds that existed in the database between **January 1998** and August 2002. Funds that are no longer "Live" at the end of the period are included. For example, hedge funds that have stopped reporting their performance, are liquidated, closed to new investment, restructured, or merged with other hedge funds are no longer considered "Live." Tremont follows a policy of removing funds from the "Live" category when its managers have not heard from a fund or were not able to contact the fund managers over 6-8 month period. The inclusion of funds that failed reduces the survival bias that has been addressed in previous literature. The dataset contains all previous reporting periods for each hedge fund, the earliest starting in February 1977, through August 2002 (or failure).

The dataset is subject to self selection bias and backfill bias. Inclusion in the database is voluntary and when a fund decides to be listed, all of its prior history is incorporated in the TASS database. One potential motivation for funds to report is to attract investor interest. Sampling in such a manner can create biases in the data. However, since the funds will be evaluated primarily in relation to each other, rather than other investment vehicles, the impact should be somewhat mitigated. Additionally, a sub database correcting for the backfill bias will be considered and compared to the overall dataset. The reader will be explicitly told when this data set is being considered.

The initial dataset contained 3399 funds. However, several filters reduced the ultimate number of funds examined for the analysis of this paper. Only hedge funds that report monthly net-of-fee returns are included. Funds with 0 incentive fee and 0 management fee were excluded, as were funds with less than 8 months of observations. Although this may create a new survivorship bias, statistics such as correlation and standard deviation have very little meaning when there are too few data points. This last filter removed a total of 100 funds with 1 to 7 months of observation from the dataset. The resulting subset after all the filters consisted of 3188 funds.

Paper by both Brown and Goetzmann (2001) and Ackermann, McEnally and Ravenscraft (1999) found that a large portion of cross sectional variability of fund returns can be explained by style. Brown and Goetzmann went on to determine that self reported characterizations appear to be reasonably accurate. The TASS database considers 11 different investment style categories, all voluntarily self reported. The styles are described in detail in Appendix A.2. These style categories will be considered when fitting models.

Fee structures are also voluntarily reported. The Tremont database only provides a single value for management fee and incentive fee, respectively. Therefore, the data does not recognize the possibility that either fee changed throughout the life of the hedge fund. However, Ackermann, McEnally, and Ravenscraft (1999) and Liang (2001) found that incentive and management fees rarely change during the lives of hedge funds. When this dataset was compared to an older TASS dataset from February 2001, only 54 of 1331 funds reported different fees, some only fractions of a percentage point different.

It is also worth noting that the fee structures at hedge funds are also not necessarily rigid. An investor with a considerable amount of investing capital may be able to negotiate a reduction in the management fee, for instance. The data has no way of accounting for the variability of fees within a hedge fund, whether per investor or through time. The data, therefore, should be interpreted as the most recent and common fee structure provided to the database by the fund managers. While this complicates the findings, the fact that the fees do not change often should reduce the potential impact. The reader should, however, be aware of a possible variability in the explanatory variables.

The management fees range from 0 to 8%, while the incentive fees range from 0 to 50%. Approximately one third of the hedge funds in the sample had fees of 1% management and 20% incentive. The three most common fee structures together represented 58% of the funds in the sample. However, after these three common structures, the variety increases. Of the remaining 217 fee structures, no single one represents more than 3% of the overall sample of hedge funds.

A summary fee structures is presented in Table A.1 and graphically in Figure A.1, A.2. Table A.2 presents a summary of fee structures by fund style.

The primary interest will be predicting the Sharpe Ratio, standard deviation in returns, and correlation to the MSCI, relative to the management and incentive fees. The standard deviation of returns was logged (base e) in order to transform it to a normal distribution. Other variables, such as average leverage and dummy variables such as, primary type of fund, high-water mark, personal capital, etc. will be used for controlling the results.

Averages and standard deviations (in parentheses) of monthly returns, standard deviations, Sharpe ratios, correlations with the MSCI, and number of observations per fund are presented by investment style in Table A.3. Histograms of each key variable are presented in Figure A.3-A.6.

It is worth mentioning that no models used incentive fee or management fee as the target variable. The nature of the distributions (see Figure A.7-A.8) led to linear models that severely violated assumptions, such as normally distributed residuals. Models that used incentive fee and management fee as predictors, however, were much better behaved and still shed light on the relationships.

4 Performance-Fee Relationship

Numerous studies have analyzed the Sharpe ratios of hedge funds, among them Ackermann, McEally and Ravenscraft (1999), Brown, Goetzmann, and Ibbotson (1999), and Liang (1999, 2001). In their study, Ackermann, McEally and Ravenscraft determined that an increase from 0 to 20 in incentive fee on average increases the expected Sharpe ratio by 66%. This section will check those findings against this dataset. Also, the analysis will focus on the outliers and examine them in detail.

The reader should be aware that Weisman (2002) showed Sharpe ratios are susceptible to "informationless investing strategies." Sharpe ratios can underestimate the risk of investments when certain trading strategies are employed. The analysis will nevertheless examine the relationship between fees and Sharpe ratios.

4.1 Hypothesis

Hypothesis 1: Hedge funds that charge premium fees achieve superior risk adjusted performance, as measured by the Sharpe Ratio.

4.2 Methodology

Sharpe Ratio's were calculated in the following manner. The risk free rate was approximated using the yield of 10 year U.S. Treasury Notes. Data consisted of monthly yields of on-the-run Treasuries obtained from Yahoo.com. The annual yield was divided by 12, in order to approximate a monthly yield rate. Although it would be more accurate to take the twelfth root of the annual yield in order to account for compounding, at low interest rates the difference between these two methods is negligible (See Appendix Table A.4 for an example). Each monthly yield was then subtracted from the corresponding monthly return of each hedge fund. This value is referred to as the "Risky Portion of the Return" (henceforth "RPR").

$$RPR = Monthly\_Return_{month} - (Yield\_10YrTreasury_{month}/12) \quad (1)$$

The mean and standard deviation of the RPR were then calculated using Minitab software for each fund. The standard deviation was verified by calculating it using formula (3) in Microsoft Excel.

$$Mean(RPR)_{fund} = \Sigma(RPR_{fund}) / (\text{number of observations for each fund}) \quad (2)$$

$$StandardDeviation(RPR)_{fund} = [E(RPR_{fund,\ month}{}^{2}) - (E(RPR_{fund}))^{2}] / (\text{number of observations for each fund})]^{1/2} \quad (3)$$

Finally, the Sharpe ratio was obtained by dividing the Mean of RPR by the Standard Deviation of RPR.

$$SharpeRatio_{fund} = Mean(RPR)_{fund} / StandardDeviation(RPR)_{fund} \quad (4)$$

Again, to ensure that the number was meaningful, fund with less than 8 observations were excluded. The reader should be aware that eliminating the 100 funds with less than 8 observations introduces an upward bias and therefore the value of the Sharpe ratios should be interpreted with caution. However, the purpose of this analysis is to examine the relative levels of Sharpe ratios with fund of different fee structures, so the actual value of the Sharpe ratio is of less import than the relative value.

Best subsets regression and the corrected Akaike information criterion were used in selecting appropriate models for the regression. First, a broad model was considered with 22 parameters. The broad model is a linear specification of the following equation:

$$\textit{Sharpe Ratio} = f(\text{months of observation, management fee, incentive fee, high-water mark, style categories, trading characteristics}) \tag{5}$$

The parameters are listed and explained in Appendix Table A.5.

Best subsets regression in Minitab was then used to select the best models per number of parameters. The output of this regression is in Appendix Table A.6. Then the corrected Akaike information criterion was used to select the number of parameters see Appendix Table A.7 for a table of Akaike information criterion values and an explanation of the calculation.

The reason for this model selection process was to identify the most parsimonious model. The Akaike criterion only retains variables that appear to add information to the regression of the target variable. Ultimately this process selected the following 13 parameter model:

$$\begin{aligned} \textit{SharpeRatio}_i = {} & \beta_0 + \beta_1 \text{NumberofObservations}_i + \beta_2 \text{IncentiveFee}_i + \beta_3 \text{HighWaterMark}_i + \\ & \beta_4 \text{ InvestsinManagedAccounts}_i + \beta_5 \text{ConvertibleArbFund}_i + \beta_6 \text{LongShortFund}_i + \\ & \beta_7 \text{EmergingMktsFund}_i + \beta_8 \text{EventDrivenFund}_i + \beta_9 \text{MktNuetralFund}_i + \\ & \beta_{10} \text{ShortBiasFund}_i + \beta_{11} \text{ManagedFuturesFund}_i + \beta_{12} \text{FundofFunds}_i + \\ & \beta_{13} \text{GlobalMacroFund}_i + \varepsilon_i \end{aligned} \tag{6}$$

4.3 Results

The selected model only uses 13 of the 22 variables that we first considered. "Other" fund style was considered the default fund style (all fund style variables equal zero). All of the style variables are included in this model except "Fixed Income Arbitrage," indicating that there is little difference in Sharpe ratios between funds classified as "Other" and "Fixed Income Arbitrage." Management fee was left out of the model, indicating that it added little useful information when attempting to predict the Sharpe ratio. Aside from whether the funds invest in managed accounts, the types of securities utilized by the firm also did not add any additional information when attempting to predict the Sharpe ratio.

The following table presents the coefficients and *p*-values of the variables in the final model:

Table Sharpe Ratio Model

Predictor	Coef	SE Coef	T	P
Intercept	0.06534	0.02867	2.28	0.023
Number of Observations	0.0014653	0.0001239	11.82	0.000
Incentive Fee	0.0030285	0.0008531	3.55	0.000
HighWaterMark	0.05062	0.0115	4.4	0.000
InvestsInManagedAccounts	-0.03136	0.02221	-1.41	0.158
ConvArb	0.12446	0.0331	3.76	0.000
LongShort	-0.10835	0.02299	-4.71	0.000
Emerging	-0.12594	0.02852	-4.42	0.000
EventDriven	-0.05764	0.02722	-2.12	0.034
MktNeutral	-0.11218	0.03046	-3.68	0.000
ShortBias	-0.24295	0.05841	-4.16	0.000
ManagedFutures	-0.23382	0.02562	-9.13	0.000
Fund of Funds	-0.14532	0.02706	-5.37	0.000
GlobalMacro	-0.20954	0.03094	-6.77	0.000
R squared				11.4%
adjusted R squared				11.1%
Standard deviation of forecast				0.28190

The large t-statistics for the style variables is in keeping with the findings of Brown and Goetzmann (2001) and Ackermann, McEnally and Ravenscraft (1999). Clearly, they appear to have a very strong impact on expected Sharpe ratios. The positive coefficient and low p-score of the incentive fee variable is also consistent with Ackermann et al.. Ackermann et al. determined a Sharpe ratio of 0.145 for the sample period of 2 years, a standard deviation of 0.330 and a slope coeffiecnt of 0.007 on sample size 547. This study determined an average Sharpe ratio of 0.101 and a standard deviation of 0.299 and a slope of 0.003. Essentially this study finds a similar result in terms of impact on funds' Sharpe ratios. An increase in incentive fees from 0 to 20%

would be the equivalent of a two standard deviation shift in expectations of the Sharpe ratio, or a 60% increase if the fund was starting at the average Sharpe ratio.

An additional regression was performed after removing the first 18 observations from each fund. This attempt to correct for backfilling bias effectively made the minimum age of a fund 26 months (removing the first 18 observations then removing funds with less than 8 observations). This filter reduced the number of funds to 2440. The coefficients are presented in the following table, but do not differ significantly from the previous regression.

Backfill Correcting Model for Sharpe Ratio

Predictor	Coef	SE Coef	T	P
Intercept	0.13894	0.02659	5.23	0.000
Number of Observations	0.0006543	0.0001194	5.48	0.000
Incentive Fee	0.0023996	0.0007481	3.21	0.001
HighWaterMark	0.07349	0.01123	6.54	0.000
InvestsInManagedAccounts	-0.05562	0.0201	-2.77	0.006
ConvArb	0.12585	0.0314	4.01	0.000
LongShort	-0.08508	0.02248	-3.78	0.000
Emerging	-0.14445	0.02697	-5.36	0.000
EventDriven	-0.02295	0.02592	-0.89	0.376
MktNeutral	-0.05961	0.03062	-1.95	0.052
ShortBias	-0.23742	0.05281	-4.5	0.000
ManagedFutures	-0.19578	0.02457	-7.97	0.000
Fund of Funds	-0.09123	0.02611	-3.49	0.000
GlobalMacro	-0.19206	0.03	-6.4	0.000
Number of Observations				2440
R squared				13.2%
adjusted R squared				12.8%
Standard deviation of forecast				0.23204

Henceforth there will be no further mention of the backfill correcting model, and the analysis will continue to examine the original model with all 3188 funds and all reported returns

Regression diagnostics indicate the presence of several large outliers (see Appendix Figure A.9). A detailed examination of these outliers leads to a few interesting insights. A regression with 3200 observations should reasonably expect the largest standardized residuals to be about ±3.6. A total of 15 funds had standardized residuals of 3.8 or greater while 10 funds had below -3.6. Fund names are presented in Appendix Table A.8.

An examination of the “notes” provided by these funds reveals some telling comments. Firstly, the best performing fund by far was IIG Trade Opportunities Fund managed by Jim Culver. IIG Trade Opportunities fund seems to have discovered an underserved niche where “the assets of the portfolio are self-liquidating trade transactions.” At present there is only one interview with Jim Culver (dated January 1999) on the internet at marhedge.com, in which he states “There is more business out there than we can do.”

Three of the funds that had the best Sharpe ratios were funds that focused on mortgage backed securities, indicating that perhaps MBS funds earned considerably higher Sharpe ratios than their counter parts. Also, two convertible arbitrage funds managed by John Miller were outliers, indicating that perhaps he is a superior fund manger.

However, not all the positive outliers tell good stories. Samaritan Global Fund Trading I LP stated in its notes that “the Fund engages in mutual fund timing,” a practice that is under increasing scrutiny. Another fund had the following note "TASS have removed this fund from the TASS Fund Database until further enquires are made regarding the performance data. (March 2000). (The numbers maybe fraudulent)”. One final suspicious entry stated, “the Investment Manager will concentrate in trading and taking positions in assets in respect of which it believes the quality of its research and/or relevant knowledge more than compensates for trading costs.” This fund is perhaps an example of Sharpe ratio being fooled by illiquid security trading as mentioned by Weisman (2002).

Most extremely negative outlier had relatively few observations. While this could cause the significantly lower Sharpe ratios, if Sharpe ratio is taken as a metric of manager’s skill, funds with low Sharpe ratios could lead to a low number of observations (since they would go out of business). The most telling comment by a negative outlier was: "Average Annual Portfolio Turnover: 1000% Very short-term trading. Avg. hold of two days." Perhaps this lends further credence to the “buy and hold strategy” and bodes poorly for day-traders.

5 Volatility-Fee Relationship

Several studies have examined the relationship between portfolio risk and incentives for mutual funds. Brown, Harlow, and Starks (1996) found mutual funds seem to increase risk when they are underperforming. Elton, Gruber, and Blake (2003) examined mutual funds with incentive-fees and also noted an increase risk after poor performance. Chevalier and Ellison (1997) found mutual funds respond to incentive schemes and alter portfolios before reporting periods.

The same relationship has been studied for hedge funds. Goetzmann, Ingersoll, and Ross (2003) provided a closed form expression for the value of a hedge fund manager contract under certain conditions. The equation provided fair values for incentive fees given a funds volatility. Ackermann, McEally and Ravenscraft (1999) found incentive fees do not seem to increase the volatility of fund returns. Brown, Goetzmann, and Park (2001) also found that there is littlex evidence that funds increase risk to take advantage of incentive contract terms. In their analysis, risk taking was more likely driven by peer performance and the relationship between volatility and termination. The authors interpreted the behavior as strong manager concern about their future in the industry. Lastly, the reader should once again be aware that Weisman's (2002) "informationless investing strategies" can also cast doubt on standard deviation of returns as accurate measures of a fund's risk.

5.1 Hypothesis

Hypothesis 2: Hedge funds that with larger incentive fees have a riskier portfolio, as measured by the volatility in monthly returns.

5.2 Methodology

Standard deviations of monthly returns for hedge funds were calculated in the following manner. The risky portion of the return was calculated in the same manner as it was when calculating the Sharpe ratios. The standard deviation was then calculated using Minitab software for each fund. The standard deviation was verified by calculating it using formula (3) in Microsoft Excel.

Again, to ensure that the number was meaningful, fund with less than 8 observations were excluded. A histogram indicated a long right tail to the distribution. In order to have a better fitting regression model, the log (base e) of every standard deviation was calculated. Appendix Figure A.4 and Figure A.5 present both histograms.

Best subsets regression and the corrected Akaike information criterion were once again used in selecting appropriate models for the regression. First, a broad model was considered with 25 parameters. The broad model is a linear specification of the following equation:

$$LogStdDev = f(\text{months of observation, management fee, incentive fee, high-water mark, style categories, trading characteristics}) \tag{7}$$

The parameters are explained in Appendix Table A.9.

Best subsets regression in Minitab was then used to select the best models per number of parameters. The output of this regression is in Appendix Table A.10. Then the Akaike information criterion was used to select the number of parameters see Appendix Table A.11 for a table of Akaike information criterion values. Ultimately this process selected the following 19 parameter model:

$$\begin{aligned} \mathit{LogStdDeviation}_i = {} & \beta_0 + \beta_1 \text{NumberofObservations}_i + \beta_2 \text{ManagementFee}_i + \beta_3 \text{IncentiveFee}_i + \\ & \beta_4 \text{HighWaterMark}_i + \beta_5 \text{AvgLeverage}_i + \beta_6 \text{TradesOnMargin}_i + \beta_7 \text{UtilizesFXCredit}_i + \\ & \beta_8 \text{InvestsPersonalCapital}_i + \beta_9 \text{InvestsinManagedAccounts}_i + \beta_{10} \text{InvestsinOtherFunds}_i + \\ & \beta_{11} \text{ConvertibleArbFund}_i + \beta_{12} \text{LongShortFund}_i + \beta_{13} \text{EmergingMktsFund}_i + \\ & \beta_{14} \text{EventDrivenFund}_i + \beta_{15} \text{MktNuetralFund}_i + \beta_{16} \text{ShortBiasFund}_i + \\ & \beta_{17} \text{ManagedFuturesFund}_i + \beta_{18} \text{GlobalMacroFund}_i + \beta_{19} \text{FixedIncomeAribtrage}_i + \varepsilon_i \end{aligned} \tag{8}$$

5.3 Results

The selected model uses 19 of the 25 variables that we first considered. “Other” fund style was once again considered the default fund style (all fund style variables equal to zero). All of the style variables are included in this model except “Fund of funds” indicating that there is little difference in standard deviations between funds classified as “Other” and “Fund of funds.” Additionally the inclusion of variables “Invests in other funds” and “Invests in Managed Accounts” probably captured the information concerning volatility found in the “Fund of Funds” variable as well as additional information. Therefore the importance of style variables in explaining returns was once again demonstrated.

The regression used 3079 cases, with 109 cases missing values. The following table presents the coefficients and *p*-values of the variables in the final model:

Table Log Standard Deviation Model

Predictor	Coef	SE Coef	T	P
Intercept	0.73882	0.0761	9.71	0.000
Number of Observations	0.0017415	0.0003075	5.66	0.000
MangementFee	0.06584	0.01677	3.93	0.000
Incentive	0.006032	0.002137	2.82	0.005
HighWaterMark	-0.17825	0.02948	-6.05	0.000
AvgLeverage	-0.000175	7.284E-05	-2.41	0.016
Margin	0.10828	0.027	4.01	0.000
FXCredit	-0.09977	0.04367	-2.28	0.022
PersonalCapital	0.05537	0.02604	2.13	0.034
InvestsInManagedAccounts	0.14834	0.0544	2.73	0.006
InvestsInOtherFunds	-0.18649	0.0586	-3.18	0.001
ConvArb	-0.63559	0.08411	-7.56	0.000
LongShort	0.57296	0.06059	9.46	0.000
Emerging	0.75256	0.0684	11	0.000
EventDriven	-0.26902	0.07119	-3.78	0.000
MktNeutral	-0.12288	0.07867	-1.56	0.118
ShortBias	0.9494	0.148	6.41	0.000
ManagedFutures	0.48214	0.06586	7.32	0.000
GlobalMacro	0.40993	0.0794	5.16	0.000
FIArb	-0.34713	0.08607	-4.03	0.000
R squared				29.8%
adjusted R squared				29.3%
Standard deviation of forecast				0.68094

High-water marks significantly reduced the log of standard deviation while trading on margin increased it. Investing in other funds also significantly reduced volatility. However, several surprising results surfaced. Average leverage (p-score 1.6%) had an inverse relationship with the standard deviation of returns although it was not significant at the 1% level. Also, personal capital investment by the fund managers (p-score 3.4%) and investment in managed accounts seemed to increase risk, rather than reduce it (as one would expect).

Management fee and incentive fee both had positive and statistically significant relationships with the volatility of returns. The direction of the management fee and incentive fee is consistent with the findings of Ackermann, McEally and Ravenscraft (1999), although the incentive fee was not statistically significant in their paper. The statistical significance of the incentive fee variable is also contrary to the findings of Brown, Goetzmann, and Park (2001). Brown et al. theorized that the reputation costs of taking excessive risk restrained managers. Perhaps this slight but statistically significant relationship is an indication that the growth of the industry has increased the anonymity of fund managers to a point where they are no longer ignoring the clear incentive to take on excess risk with higher incentive fees. Several studies have found mutual fund managers respond to incentives in a similar fashion. However, the magnitude of the coefficient indicates that the relationship is very weak, perhaps indicating that there is still considerable restraint on the part of managers to recklessly assume risk in response to incentives.

The idea that investors would pay a premium for additional risk runs contrary to the assumption in finance that investors are risk averse. Therefore, it is more natural to assume that the higher incentive fees are leading to higher volatility. Previous literature has also established that incentive fees create an incentive for mangers to take on additional risk, so the direction of causation has a basis in theory.

An additional regression was performed after removing the first 18 observations from each fund. This attempt to correct for backfilling bias effectively made the minimum age of a fund 26 months (removing the first 18 observations then removing funds with less than 8 observations). This filter reduced the number of funds to 2440. Missing values further reduced the number of funds to 2406. The coefficients are presented in the following table, but do not differ significantly from the previous regression.

Table	**Backfill Correcting Model for Log Standard Deviation**			
Predictor	Coef	SE Coef	T	P
Intercept	0.6809	0.08511	8	0.000
Number of Observations	0.0023792	0.0003634	6.55	0.000
MangementFee	0.07014	0.01867	3.76	0.000
Incentive	0.004822	0.002334	2.07	0.039
HighWaterMark	-0.15555	0.03534	-4.4	0.000
AvgLeverage	-0.000222	7.744E-05	-2.87	0.004
Margin	0.12394	0.03136	3.95	0.000
FXCredit	-0.04003	0.05047	-0.79	0.428
PersonalCapital	0.06448	0.02993	2.15	0.031
InvestsInManagedAccounts	0.12905	0.0606	2.13	0.033
InvestsInOtherFunds	-0.19869	0.06639	-2.99	0.003
ConvArb	-0.58829	0.09638	-6.1	0.000
LongShort	0.5474	0.0695	7.88	0.000
Emerging	0.75602	0.07631	9.91	0.000
EventDriven	-0.31909	0.08057	-3.96	0.000
MktNeutral	-0.2572	0.09376	-2.74	0.006
ShortBias	0.8884	0.1654	5.37	0.000
ManagedFutures	0.50199	0.07506	6.69	0.000
GlobalMacro	0.33689	0.0923	3.65	0.000
FIArb	-0.4327	0.1021	-4.24	0.000
R squared				30.0%
adjusted R squared				29.4%
Standard deviation of forecast				0.69500

Henceforth there will be no further mention of the backfill correcting model, and the analysis will continue to examine the original model with all 3079 funds and all reported returns.

Regression diagnostics indicate that there is one large outlier on the low end of volatility. Once again IIG Trade Opportunities Fund managed by Jim Culver was the outlier. Aside from that one outlier, the regression diagnostics indicate a sound model. The regression diagnostics are presented in Appendix Figure A.10.

6 Correlation-Fee Relationship

Brown, Goetzmann and Ibbotson (1999) examined the correlations between hedge funds grouped by style and multiple benchmark indices. Liang (1999) and Ackermann et al. (1999) found funds provide diversification opportunity due to low correlation. This paper will attempt to explain the correlation to a major index using explanatory variables including incentive and management fees.

6.1 Hypothesis

Hypothesis 3: Hedge funds that charge premium fees provide greater diversification for their investors.

6.2 Methodology

This portion of the analysis required the selection of an appropriate benchmark to test correlation. The rationale behind selecting the MSCI World index was that it would best replicate the equity investment options available to the sophisticated investors of hedge funds. A US based index would fail to reflect the wide range of investment options available to wealthy individuals and institutional investors.

Although the MSCI index attempts to capture the range of equity investment options across the globe, it does not reflect fixed income options (or alternative investments such as antiques or paintings) available to these investors. The data for the MSCI also only extends to 1982, which means that hedge fund data prior to 1982 was not used in calculating the correlation. Fortunately, only 14 funds had any performance data dating before 1982.

Correlations were calculated in the following manner. The actual monthly return (as opposed to risky portion of return) for each fund was paired with a corresponding monthly return for the MSCI index. The product of each of these pairs was then calculated and will be referred to as $X_{fund}\ X_{MSCI}$. The mean and standard deviation of the funds returns and the MSCI index for the appropriate period were calculated. The mean of the fund returns will be referred to as μ_{fund} and the mean of the MSCI returns over the same period will be referred to as μ_{MSCI}. The standard deviations over the same period will be referred to as σ_{fund} and σ_{MSCI}. Using these components, the correlation was then calculated as follows:

$$\rho = [E(X_{fund}\ X_{MSCI}) - \mu_{fund}\ \mu_{MSCI}] / \sigma_{fund}\sigma_{MSCI} \tag{9}$$

Again, to ensure that the number was meaningful, fund with less than 8 observations were excluded. A histogram of the data is presented in Appendix Figure A.6. It should be noted that the correlation cannot vary beyond ±1. This natural limit introduces an inherent flaw in the model. The model expects normally distributed shocks, but the natural limits of -1 and 1 on the correlation create a violation of this assumption. Nevertheless, a regression may still yield insights into the relationships between the variables.

Best subsets regression and the corrected Akaike information criterion were once again used in selecting appropriate models for the regression. The first broad model considered consisted of 20 potential parameters. The broad model is a linear specification of the following equation:

$$\textit{Correlation to MSCI} = f(\text{months of observation, management fee, incentive fee, style categories, trading characteristics}) \tag{10}$$

The parameters are explained in Appendix Table A.12.

Best subsets regression in Minitab was then used to select the best models per number of parameters. The output of this regression is in Appendix Table A.13. Then the Akaike information criterion was used to select the number of parameters, see Appendix A.14 for table of Akaike information criterion values. Ultimately this process selected the following 9 parameter model:

$$\begin{aligned} \textit{CorrelationToMSCI}_i = {} & \beta_0 + \beta_1 \text{ManagementFee}_i + \beta_2 \text{IncentiveFee}_i + \beta_3 \text{ConvertibleArbFund}_i + \\ & \beta_4 \text{MktNuetralFund}_i + \beta_5 \text{ShortBiasFund}_i + \beta_6 \text{ManagedFuturesFund}_i + \beta_7 \text{FundofFunds}_i + \\ & \beta_8 \text{GlobalMacroFund}_i + \beta_9 \text{FixedIncomeAribtrage}_i + \varepsilon_i \end{aligned} \tag{11}$$

6.3 Results

The selected model uses 9 of the 20 variables that we first considered. Fortunately, fund characteristics that one would not expect to explain correlation did not make it into the final model. Apparently, none of the variables relating to the trading instruments utilized by the funds added any information when attempting to predict the correlation. This result is consistent with expectations. It would be difficult to explain why a fund that uses leverage should have a greater or lesser correlation with the index, for example.   Luckily the model selection process eliminated this task.

"Other" fund style was once again considered the default fund style (all fund style variables equal zero). This time 3 fund styles were left out of the model indicating that they did not have significantly different information regarding correlation than "Other" fund style. These styles were long/short, emerging market, and event driven.

The regression used 3187 funds (one fund contained a missing value). The following table presents the coefficients and *p*-values of the variables in the final model:

Table Correlation Model

Predictor	Coef	SE Coef	T	P
Intercept	0.50921	0.01723	29.55	0.000
MangementFee	-0.040954	0.006313	-6.49	0.000
Incentive Fee	-0.006235	0.0007789	-8.00	0.000
ConvArb	-0.16169	0.02441	-6.62	0.000
MktNeutral	-0.28395	0.0213	-13.33	0.000
ShortBias	-0.87422	0.05083	-17.20	0.000
ManagedFutures	-0.3084	0.01604	-19.23	0.000
FoFs	-0.09198	0.01467	-6.27	0.000
GlobalMacro	-0.26331	0.02192	-12.01	0.000
FIArb	-0.25724	0.02492	-10.32	0.000
R squared				27.5%
adjusted R squared				27.3%
Standard deviation of forecast				0.26193

Consistent with the hypothesis, both management fee and incentive fee have inverse relationships with correlation. An increase from 0 to 20% for incentive fee corresponds with an expected decrease in correlation of 0.12469. The mean of correlation for all funds is 0.234, with a standard deviation of 0.307, so this decrease in the expected value would be approximately equivalent to a one half standard deviation decrease. This relationship lends empirical evidence to the theory that hedge fund investors value funds that provide greater diversification for their portfolio.

Not surprisingly the short bias variable had the most negative coefficient. One would expect that short bias funds would have the lowest correlation with the MSCI index. All the variables had highly statistically significant T scores, but the aforementioned problems regarding the model make these statistics less reliable.

An additional regression was performed after removing the first 18 observations from each fund, even though there is less need to adjust for backfill bias in this case. The coefficients are presented in the following table, but do not differ significantly from the previous regression.

Table	**Backfill Correcting Model for Correlation**			
Predictor	Coef	SE Coef	T	P
Intercept	0.50407	0.0192	26.25	0.000
MangementFee	-0.031637	0.007204	-4.39	0.000
Incentive Fee	-0.005366	0.000865	-6.20	0.000
ConvArb	-0.1998	0.02865	-6.97	0.000
MktNeutral	-0.30802	0.02752	-11.19	0.000
ShortBias	-0.94206	0.05744	-16.40	0.000
ManagedFutures	-0.35313	0.01893	-18.65	0.000
FoFs	-0.10348	0.017	-6.09	0.000
GlobalMacro	-0.25927	0.02658	-9.76	0.000
FIArb	-0.27287	0.03069	-8.89	0.000
R squared				28.8%
adjusted R squared				28.5%
Standard deviation of forecast				0.27293

Henceforth there will be no further mention of the backfill correcting model, and the analysis will continue to examine the original model with all 3187 funds and all reported returns.

Regression diagnostics indicate that there are potential problems with the model. The errors do not appear normally distributed and have a long left tail. The regression diagnostics are presented in Appendix Figure A.11.

Despite the shortcomings of the model, the observed relationship between incentive fee, management fee and correlation is observable through other methods. Scatter plots of incentive fee and management fee versus correlation seem to verify that there is an inverse relationship between the variables. See Appendix Figure A.12 and A.13 for the fitted line scatter plots.

Finally, the relationship between management fee, incentive fee and correlation was examined for each fund style separately. A summary of the output is presented in Table A.14. Residual plots are presented in Appendix Figures A.14 through A.24.

Interestingly the incentive fee has a positive slope with correlation to the MSCI for fixed income arbitrage funds. Fixed income and equity markets often move in opposite directions, so a positive correlation with the MSCI should in some sense correspond to a negative correlation with world bond indices. This finding may indicate that investors in fixed income arbitrage funds are paying a premium for diversification in relation to bond funds. Several of the variables had 0% adjusted R^2 indicating that a relationship may not be present for fees and correlation to the MSCI for these styles. Once again, perhaps a correlation to a more appropriate index would yield a relationship.

7 Conclusions

This paper explores the variation in fee structures among hedge funds, and attempts to explain that variation. Although roughly 57% of funds were represented by 3 distinct fee structures, the dataset of 3188 funds exhibited over 222 different fee structures. Three relationships that were examined were fee structures vs. performance, fee structures vs. volatility, and fee structures vs. correlation. Models corrected for variation in investment style, trading characteristics and other potentially significant differences.

Models were selected using the corrected Akaike information criterion. Predictor variables that apparently did not contain information about the target variable were automatically removed from the model as a result. Notably, every model retained the investment style characteristics, which verifies previous findings that fund style was important in explaining variation in fund returns.

Consistent with previous finding, funds with higher Sharpe ratios had higher fees. Interpreting the Sharpe ratio as a measure of managerial skill, this finding indicates that investors pay a premium for better risk adjusted performance. However, the potential for Sharpe ratios to misrepresent managerial skill casts some doubt on this interpretation. Nevertheless this model yielded an interesting result; Sharpe ratio outliers can flag new investment opportunities as well as fraudulent returns and practices.

The model examining the volatility of fund returns also yielded a potentially interesting result. Unlike previous findings, funds with higher incentive fees seemed to exhibit more volatile returns. Interpreting volatility in returns as a measure of risk, and assuming that investors are risk averse, this result indicates that managers seem to be responding to incentive fees by increasing risk. A previous paper by Brown, Goetzmann, and Park (2001) theorized that the reputation costs of taking excessive risk restrained managers despite apparent incentives to take on risk. The slight but statistically significant relationship observed in this study may be an indication that the growth of the industry has decreased the restraint of managers or perhaps reduced the reputation costs. Additional research regarding the relationship between incentive fees and volatility should shed light on whether the hedge fund industry is in fact moving more towards less restrained risk taking.

Finally, the analysis empirically tested the theory that investors pay a premium for increased diversification of returns. The correlation was measured relative to the MSCI World index in order to replicate the wealth of equity investment options available to sophisticated hedge fund investors. The resulting model found that correlation to the MSCI had a negative and highly statistically significant relationship with both incentive fee and management fee. This finding implies that investors pay a premium for diversification. Examining this relationship individually for each investment style added further nuance. Fixed income arbitrage funds exhibited a positive relationship between incentive fee and correlation. This finding could be an indication that investors seek diversification relative to similar investments. A world wide bond index might be a more appropriate index in the case of fixed income arbitrage funds, for example. Further examination of the relationship between fees and correlation using different indices might provide an even greater understanding of the variation in fees.

A Appendix

A.1 Tables and Figures

Fee Structure (Management, Incentive)	Observations Number of Funds	Percentage %	Fee Structure (Management, Incentive)	Observations Number of Funds	Percentage %
(1, 20)	1068	33.50%	(0, 25)	15	0.47%
(2, 20)	385	12.08%	(6, 15)	15	0.47%
(1.5, 20)	373	11.70%	(0.5, 0)	14	0.44%
(1, 15)	89	2.79%	(1, 5)	13	0.41%
(1.5, 0)	84	2.63%	(0.75, 10)	10	0.31%
(1, 10)	68	2.13%	(1.2, 10)	10	0.31%
(3, 20)	55	1.73%	(3, 15)	10	0.31%
(1, 0)	50	1.57%	(1.25, 10)	9	0.28%
(1.5, 10)	47	1.47%	(2.5, 25)	8	0.25%
(2, 0)	46	1.44%	(4, 25)	8	0.25%
(1.25, 20)	44	1.38%	(0, 15)	7	0.22%
(0, 20)	43	1.35%	(1.25, 15)	7	0.22%
(2, 25)	43	1.35%	(1.75, 0)	7	0.22%
(1.5, 15)	34	1.07%	(1.8, 10)	7	0.22%
(4, 20)	30	0.94%	(2, 18)	7	0.22%
(2, 10)	29	0.91%	(3, 0)	7	0.22%
(1.5, 25)	26	0.82%	(0.5, 15)	6	0.19%
(1, 25)	23	0.72%	(6, 20)	6	0.19%
(3, 25)	23	0.72%	(0, 10)	5	0.16%
(4, 15)	23	0.72%	(0, 50)	5	0.16%
(1.75, 20)	21	0.66%	(0.75, 20)	5	0.16%
(0.75, 0)	20	0.63%	(0.8, 10)	5	0.16%
(1.5, 5)	20	0.63%	(1.5, 7.5)	5	0.16%
(1.25, 0)	19	0.60%	(1.65, 10)	5	0.16%
(2, 15)	19	0.60%	(2, 22)	5	0.16%
(0.5, 20)	17	0.53%	(2.5, 0)	5	0.16%
(1.2, 20)	16	0.50%	Other	251	7.87%
(2.5, 20)	16	0.50%	Total	3188	100%

Table A.1: This table presents the number of funds with each fee structure using the TASS Database from January 2001 to August 2002.

Table A.2 **Summary Statistics of Fee Structures by Self Reported Investment Styles**

	Convertible Arbitrage	Long/Short Equity	Emerging Market	Event Driven	Other	Equity Market Neutral	Short Bias	Managed Futures	Fund of Funds	Global Macro	Fixed Income Arbitrage	Overall
Average Incentive Fee	18.286	19.027	16.544	19.163	18.421	19.558	19.185	18.342	10.301	18.780	20.454	17.277
Standard Deviation of Incentive Fee	5.201	4.391	7.184	5.047	6.294	5.176	2.625	6.827	7.846	5.808	5.874	6.798
Average Management Fee	1.291	1.168	1.443	1.287	1.325	1.240	1.248	2.331	1.575	1.649	1.334	1.462
Standard Deviation of Management Fee	0.484	0.401	0.463	0.542	0.470	0.473	0.532	1.384	0.815	0.844	0.698	0.823
Number of Funds	124	1056	227	282	57	167	27	412	558	159	119	3188

Table A.2: This table presents the average and standard deviations of fees according to fund style using the TASS Database from January 2001 to August 2002.

Table A.3 **Summary Statistics on Self Reported Investment Styles**

	Convertible Arbitrage	Long/Short Equity	Emerging Market	Event Driven	Other	Equity Market Neutral	Short Bias	Managed Futures	Fund of Funds	Global Macro	Fixed Income Arbitrage	Overall
Average Arithmetic	0.467	0.650	0.331	0.392	0.035	0.247	0.115	0.116	0.098	0.310	0.275	0.364
Mean Risky Return	(0.528)	(1.326)	(1.686)	(0.825)	(1.774)	(0.851)	(0.784)	(1.768)	(0.652)	(2.191)	(0.960)	(1.327)
Average Standard	1.887	6.006	7.734	3.026	4.943	2.885	8.138	6.075	3.112	6.102	2.696	4.924
Deviation of Risky Returns	(1.462)	(4.110)	(5.094)	(2.973)	(5.439)	(1.877)	(4.633)	(5.195)	(2.571)	(10.94)	(2.467)	(4.796)
Average	0.355	0.116	0.085	0.192	0.213	0.100	0.021	-0.00	0.053	0.013	0.221	0.101
Sharpe Ratio	(0.427)	(0.260)	(0.319)	(0.277)	(0.438)	(0.325)	(0.102)	(0.232)	(0.281)	(0.238)	(0.411)	(0.299)
Average Correlation	0.180	0.347	0.379	0.299	0.319	0.052	-0.53	-0.00	0.289	0.061	0.069	0.234
with MSCI	(0.215)	(0.287)	(0.202)	(0.207)	(0.351)	(0.309)	(0.197)	(0.266)	(0.271)	(0.260)	(0.217)	(0.307)
Average Number of	60.50	53.46	59.65	71.70	42.43	45.17	78.33	67.88	67.93	62.47	54.36	60.25
Observations Per Fund	(36.65)	(38.39)	(32.64)	(51.10)	(25.47)	(33.97)	(51.98)	(48.83)	(47.04)	(46.23)	(35.96)	(43.1)
Number of Funds	124	1056	227	282	57	167	27	412	558	159	119	3188

Table A.3: This table presents the averages of several variables of interest according to fund style using the TASS Database from January 2001 to August 2002. Standard deviations of these variables are in parentheses below the averages.

Table A.4 Risk Free Rate Approximation Difference

Interest rate	Twelfth Root	Divided by Twelve	% error
1.0%	0.083%	0.083%	0.458%
2.0%	0.165%	0.167%	0.913%
3.0%	0.247%	0.250%	1.368%
4.0%	0.327%	0.333%	1.820%
5.0%	0.407%	0.417%	2.271%
6.0%	0.487%	0.500%	2.721%
7.0%	0.565%	0.583%	3.169%
8.0%	0.643%	0.667%	3.616%
9.0%	0.721%	0.750%	4.061%
10.0%	0.797%	0.833%	4.504%
11.0%	0.873%	0.917%	4.947%
12.0%	0.949%	1.000%	5.387%
13.0%	1.024%	1.083%	5.827%
14.0%	1.098%	1.167%	6.265%

Table A.4: This table presents the difference between taking the twelfth root of the interest rate and dividing the interest rate by 12 at different levels. For most common interest rate levels, these errors are negligible.

Table A.5 Explanation of variables considered for Sharpe ratio model

Variable	Type	Interpretation
Number of Observations	Numeric	The age of the fund. Represents the total months of observations.
Management Fee	Numeric	A percentage of assets charged to investors by the fund.
Incentive Fee	Numeric	A percentage of total profits charged to investors by the fund.
High-Water Mark	Nominal	A dummy variable where 1 indicates the presence of a high-water mark provision.
Levered	Nominal	A dummy variable where 1 indicates the fund utilizes leverage.
Average Leverage	Numeric	A percentage representing the average level of leverage at the fund.
Trades Futures	Nominal	A dummy variable where 1 indicates the fund leverages using futures.
Trades Derivatives	Nominal	A dummy variable where 1 indicates the fund leverages using derivatives.
Trades Margin	Nominal	A dummy variable where 1 indicates the fund leverages using margin borrowing.
Uses Foreign Exchange Credit	Nominal	A dummy variable where 1 indicates the fund leverages using foreign exchange credit.
Invests In Managed Accounts	Nominal	A dummy variable where 1 indicates the fund invests in managed accounts.
Invests In Other Funds	Nominal	A dummy variable where 1 indicates the fund invests in other hedge funds.
Style - Convertible Arbitrage	Nominal	Dummy variables where 1 indicates the primary fund style reported by the hedge fund. All zeros represents "Other" fund style.
Style - Long/Short Equity	Nominal	
Style - Emerging Market	Nominal	
Style - Event Driven	Nominal	
Style - Equity Market Neutral	Nominal	
Style - Short Bias	Nominal	
Style - Managed Futures	Nominal	
Style - Fund of Funds	Nominal	
Style - Global Macro	Nominal	
Style - Fixed Income Arbitrage	Nominal	

Table A.5: This table presents the 22 variables considered for the Sharpe ratio model as well as explanations of the variables.

Table A.6 **Best Subsets Regression for Sharpe Ratio**

Number of Parameters	R Squared	R Squared (adj)	Mallows C-p	Standard Deviation	Number of Observations	MangementFee	IncentiveFee	HighWaterMark	Levered	AvgLeverage	Trades Futures	Trades Derivatives	Trades Margin	Uses FXCredit	InvestsInManagedAccounts	InvestsInOtherFunds	Style - Convertible Arbitrage	Style - Long/Short Equity	Style - Emerging Market	Style - Event Driven	Style - Equity Market Neutral	Style - Short Bias	Style - Managed Futures	Style - Fund of Funds	Style - Global Macro	Style - Fixed Income
1	3	3	295.2	0.2907													X									
2	5.4	5.3	216.2	0.28724	X												X									
3	7.5	7.4	143.1	0.28398	X												X						X			
4	8.8	8.6	102.3	0.28213	X			X									X						X			
5	9.5	9.4	78.1	0.28101	X		X	X									X						X			
6	10.1	9.9	59.7	0.28015	X		X	X									X						X		X	
7	10.5	10.3	47.1	0.27953	X		X	X									X						X		X	X
8	10.9	10.7	35.9	0.27898	X		X	X									X			X			X		X	X
9	11.2	10.9	28.7	0.27862	X		X	X							X		X			X			X		X	X
10	11.3	11	25.9	0.27845	X		X	X							X		X			X		X	X		X	X
11	11.4	11.1	24.1	0.27832	X		X	X									X	X	X		X	X	X	X	X	
12	11.5	11.2	21.6	0.27816	X		X	X							X		X	X	X		X	X	X	X	X	
13	11.7	11.3	19.9	0.27804	X		X	X							X		X	X	X	X	X	X	X	X	X	
14	11.7	11.3	18.5	0.27793	X		X	X	X				X				X	X	X	X	X	X	X	X	X	
15	11.9	11.4	17	0.27781	X		X	X	X				X		X		X	X	X	X	X	X	X	X	X	
16	11.9	11.5	16.6	0.27775	X		X	X	X	X			X		X		X	X	X	X	X	X	X	X	X	
17	12	11.5	16.4	0.2777	X	X	X	X	X	X			X		X		X	X	X	X	X	X	X	X	X	
18	12	11.5	16.7	0.27767	X	X	X	X	X	X	X		X		X		X	X	X	X	X	X	X	X	X	
19	12	11.5	18	0.27768	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X	
20	12.1	11.5	19.4	0.2777	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	
21	12.1	11.5	21	0.27773	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
22	12.1	11.4	23	0.27777	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table A.6: This table presents the output of the best subsets regression for the 22 variables considered for the Sharpe ratio model. The best model per number of parameters is selected. An "X" indicates the variable is in the model. The number of parameters, R^2, adjusted R^2, Mallow C-p and the standard deviation of the prediction are presented in the columns on the left.

The corrected Akaike information criterion is calculated in the following manner:

$$AICc = -2\log[\text{likelihood}(p)] + 2(p+1)(n)/(n-p-2)$$

Where p is the number of parameters, n is the number of observations, and likelihood(p) is the residual sum of squares for the model. The log base is e. To select the most parsimonious model, the value of AICc should be minimized.

Table A.7 Corrected Akaike Information Criterion Scores for each number of parameters

Residual Sum of Squares	Number of parameters	Observations	AICc
235.79	22	3079	-4781.804
235.79	21	3079	-4783.835
235.82	20	3079	-4785.492
235.87	19	3079	-4786.869
235.92	18	3079	-4788.209
236.05	17	3079	-4788.524
236.23	16	3080	-4790.880
236.41	15	3080	-4790.547
236.68	14	3080	-4789.066
252.22	**13**	**3188**	**-4867.256**
252.58	12	3188	-4864.775
252.74	11	3188	-4864.818
253.45	10	3188	-4857.908
253.89	9	3188	-4854.307
254.46	8	3188	-4849.154
255.41	7	3188	-4839.387
256.62	6	3188	-4826.218
258.20	5	3188	-4808.764
261.01	4	3188	-4776.206
263.84	3	3188	-4743.854
269.55	2	3188	-4677.638
276.51	1	3188	-4598.358
284.81	0	3188	-4506.083

Table A.7: This table presents the AICc for each of the models identified in the best subsets regression. The value of AICc is minimized at 13 parameters indicating that this model contains the most information per number of variables when predicting the Sharpe ratio.

Table A.8 **Fund information for firms with high standardized residuals**

Standardized Residual	Product Reference Number	Number of Observations	Fund Name	Possible Reason for Being an Outlier
11.7331	2142	49	IIG - Trade Opportunities Fund NV	Niche arbitrage
9.0585	4148	70	Argent Classic Convertible Arbitrage Fund LP (Class C)	Fund Manager
8.424	4146	60	Argent Classic Convertible Arbitrage Fund (Bermuda) LP (Class C)	Fund Manager
7.0343	33351	19	Mortgage Opportunity Fund V LP	Mortgage Backed Securities
5.5644	4647	15	Henderson European Absolute Return Fund Ltd (Euro)	-
5.4506	3854	9	Oxford Alternative Strategy Fund (Class B)	Too few observations
5.309	5024	15	Henderson European Absolute Return Fund Ltd (USD)	Too few observations
4.8645	1076	69	Lexington Trust	Mortgage Backed Securities
4.42	4649	21	Spinnaker Global Emerging Markets Fund	Illiquid Security Investing
4.2058	4619	20	Laurus Offshore Fund Ltd	-
4.1819	2309	60	Cambridge Partners II LP	Fraudulent returns
4.0925	1972	19	Samaritan Global Fund Trading I LP	Mutual fund timing
4.0824	1982	64	Themis Partners LP	-
3.9233	5018	18	Clinton Multistrategy Fund Ltd (Class A)	Too few observations
3.8207	5197	35	Y2K Finance Inc.	-
3.6016	2074	63	Fletcher Income Arbitrage Fund Ltd	-
-3.6015	33640	20	Madaket Partners LP	Too few observations
-3.6354	900	11	GNI Fractal Fund Ltd	Too few observations
-3.664	4419	17	Man-Glenwood Select Limited - USD	Too few observations
-3.704	33973	9	Global Zip Fund Ltd	Too few observations
-3.704	34609	9	Global Zip Fund LP	Too few observations
-3.9676	33405	14	DUNBAR Capital International Ltd	Too few observations
-4.2137	5010	12	Sarasin Thematic Hedge Fund	Too few observations
-4.4334	33653	8	TLB Short-Term Equities LLC	Excessive portfolio turnover
-4.5685	33941	21	Coronation Global Opportunities Fund	Too few observations
-4.8205	33791	8	Barep Long/Short Equity	Too few observations

Table A.8: This table presents fund names of the Sharpe ratio model outliers. A possible explanation for the fund's status as an outlier is presented in the rightmost column. A blank value in this column indicates that the fund's notes gave little indication as to why the fund would be an outlier.

Table A.9 **Explanation of variables considered for Log Standard Deviation Model**

Variable	Type	Interpretation
Number of Observations	Numeric	The age of the fund. Represents the total months of observations.
Management Fee	Numeric	A percentage of assets charged to investors by the fund.
Incentive Fee	Numeric	A percentage of total profits charged to investors by the fund.
High-Water Mark	Nominal	A dummy variable where 1 indicates the presence of a high-water mark provision.
Levered	Nominal	A dummy variable where 1 indicates the fund utilizes leverage.
Average Leverage	Numeric	A percentage representing the average level of leverage at the fund.
Trades Futures	Nominal	A dummy variable where 1 indicates the fund leverages using futures.
Trades Derivatives	Nominal	A dummy variable where 1 indicates the fund leverages using derivatives.
Trades Margin	Nominal	A dummy variable where 1 indicates the fund leverages using margin borrowing.
Uses Foreign Exchange Credit	Nominal	A dummy variable where 1 indicates the fund leverages using foreign exchange credit.
Invests PersonalCapital	Nominal	A dummy variable where 1 indicates the principals have invested money.
Invests In Managed Accounts	Nominal	A dummy variable where 1 indicates the fund invests in managed accounts.
Invests In Other Funds	Nominal	A dummy variable where 1 indicates the fund invests in other hedge funds.
Open to Public	Nominal	A dummy variable where 1 indicates the fund is open to the public.
Accepts Managed Accounts	Nominal	A dummy variable where 1 indicates the fund accepts managed accounts
Style - Convertible Arbitrage	Nominal	Dummy variables where 1 indicates the primary fund style reported by the hedge fund. All zeros represents "Other" fund style.
Style - Long/Short Equity	Nominal	
Style - Emerging Market	Nominal	
Style - Event Driven	Nominal	
Style - Equity Market Neutral	Nominal	
Style - Short Bias	Nominal	
Style - Managed Futures	Nominal	
Style - Fund of Funds	Nominal	
Style - Global Macro	Nominal	
Style - Fixed Income Arbitrage	Nominal	

Table A.5: This table presents the 25 variables considered for the log standard deviation model as well as explanations of the variables. The only additional variables were ones that pertained to fund access and personal investment.

Table A.10 **Best Subsets Regression for LogStandardDeviation Risky Return**

Number of Parameters	R Squared	R Squared (adj)	Mallows C-p	Standard Deviation	Number of Observations	MangementFee	IncentiveFee	HighWaterMark	Levered	AvgLeverage	Trades Futures	Trades Derivatives	Trades Margin	Uses FXCredit	Invests PersonalCapital	InvestsInManagedAccounts	InvestsInOtherFunds	OpentoPublic	AcceptsManagedAccounts	Style - Convertible Arbitrage	Style - Long/Short Equity	Style - Emerging Market	Style - Event Driven	Style - Equity Market Neutral	Style - Short Bias	Style - Managed Futures	Style - Fund of Fund	Style - Glob	Sty
1	6.9	6.9	977.8	0.78164																	X								
2	12.3	12.3	743.7	0.75866																	X	X							
3	19.9	19.8	418.1	0.72548																	X	X				X			
4	22.4	22.3	311.8	0.71425																	X	X				X		X	
5	24.3	24.2	230.3	0.70549																X			X	X			X		X
6	26	25.9	156.7	0.69747				X												X			X	X			X		X
7	27.1	26.9	112.6	0.69257				X												X	X	X			X	X		X	
8	27.7	27.5	87	0.68966	X			X												X	X	X			X	X		X	
9	28.2	28	68.7	0.68755	X	X		X												X	X	X			X	X		X	
10	28.5	28.2	58.3	0.6863	X	X		X					X							X	X	X			X	X		X	
11	28.7	28.4	50.9	0.68538	X	X		X					X							X	X	X			X	X		X	X
12	28.9	28.6	44.5	0.68456	X	X	X	X					X							X	X	X			X	X		X	X
13	29.1	28.8	37	0.68362	X	X	X	X					X							X	X	X	X		X	X		X	X
14	29.2	28.9	33.2	0.68309	X	X	X	X		X			X							X	X	X	X		X	X		X	X
15	29.4	29	28.6	0.68247	X	X	X	X					X			X	X			X	X	X	X		X	X		X	X
16	29.5	29.1	24.6	0.68192	X	X	X	X		X			X			X	X			X	X	X	X		X	X		X	X
17	29.6	29.2	21.7	0.68148	X	X	X	X		X			X	X		X	X			X	X	X	X		X	X		X	X
18	29.7	29.3	19.3	0.6811	X	X	X	X		X			X	X	X	X	X			X	X	X	X		X	X		X	X
19	29.8	29.3	18.9	0.68094	X	X	X	X		X			X	X	X	X	X			X	X	X	X	X	X	X		X	X
20	29.8	29.4	19.1	0.68086	X	X	X	X		X			X	X	X	X	X			X	X	X	X	X	X	X	X	X	X
21	29.8	29.4	20	0.68084	X	X	X	X		X			X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X
22	29.9	29.4	20.7	0.68081	X	X	X	X	X	X			X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X
23	29.9	29.4	22.2	0.68087	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X
24	29.9	29.3	24	0.68096	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
25	29.9	29.3	26	0.68107	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table A.10: This table presents the output of the best subsets regression for the 25 variables considered for the log standard deviation of returns model. The best model per number of parameters is selected. An "X" indicates the variable is in the model. The number of parameters, R^2, adjusted R^2, Mallow C-p and the standard deviation of the prediction are presented in the columns on the left. The variables regarding fund access quickly fell off, but the personal capital variable survived until the 17 parameter model.

Table A.11 **Corrected Akaike Information Criterion Scores for each number of parameters**

Residual Sum of Squares	Number of parameters	Observations	AICc
1416.15	25	3079	744.194
1416.17	24	3079	742.187
1416.24	23	3079	740.300
1416.47	22	3079	738.785
1417.07	21	3079	738.036
1417.61	20	3079	737.182
1418.40	**19**	**3079**	**736.878**
1419.53	18	3079	737.306
1421.58	17	3079	739.717
1423.87	16	3079	742.645
1426.65	15	3079	746.632
1429.68	14	3079	751.134
1432.39	13	3079	754.949
1436.81	12	3079	762.395
1440.71	11	3079	768.730
1445.07	10	3079	776.020
1535.84	9	3187	884.574
1545.91	8	3188	902.663
1562.67	7	3188	935.040
1581.50	6	3188	971.213
1626.37	5	3188	1058.384
1664.37	4	3188	1130.004
1718.45	3	3188	1229.935
1881.70	2	3188	1517.247
2003.98	1	3188	1715.956
2153.84	0	3188	1943.861

Table A.11: This table presents the AICc for each of the models identified in the best subsets regression. The value of AICc is minimized at 13 parameters indicating that this model contains the most information per number of variables when predicting the log standard deviation of returns.

Table A.12 Explanation of variables considered for Correlation Model

Variable	Type	Interpretation
Number of Observations	Numeric	The age of the fund. Represents the total months of observations.
Management Fee	Numeric	A percentage of assets charged to investors by the fund.
Incentive Fee	Numeric	A percentage of total profits charged to investors by the fund.
Levered	Nominal	A dummy variable where 1 indicates the fund utilizes leverage.
Trades Futures	Nominal	A dummy variable where 1 indicates the fund leverages using futures.
Trades Derivatives	Nominal	A dummy variable where 1 indicates the fund leverages using derivatives.
Trades Margin	Nominal	A dummy variable where 1 indicates the fund leverages using margin borrowing.
Uses Foreign Exchange Credit	Nominal	A dummy variable where 1 indicates the fund leverages using foreign exchange credit.
Invests In Managed Accounts	Nominal	A dummy variable where 1 indicates the fund invests in managed accounts.
Invests In Other Funds	Nominal	A dummy variable where 1 indicates the fund invests in other hedge funds.
Style - Convertible Arbitrage	Nominal	Dummy variables where 1 indicates the primary fund style reported by the hedge fund. All zeros represents "Other" fund style.
Style - Long/Short Equity	Nominal	
Style - Emerging Market	Nominal	
Style - Event Driven	Nominal	
Style - Equity Market Neutral	Nominal	
Style - Short Bias	Nominal	
Style - Managed Futures	Nominal	
Style - Fund of Funds	Nominal	
Style - Global Macro	Nominal	
Style - Fixed Income Arbitrage	Nominal	

Table A.12: This table presents the 20 variables considered for the correlation model as well as explanations of the variables. Less parameters were considered in this model because some of the variables were irrelevant, such as personal capital investment by the principals.

Table A.13 Best Subsets Regression for Correlation to the MSCI World index

Number of Parameters	R Squared	R Squared (adj)	Mallows C-p	Standard Deviation	Number of Observations	MangementFee	IncentiveFee	Levered	Trades Futures	Trades Derivatives	Trades Margin	Uses FXCredit	InvestsInManagedAccounts	InvestsInOtherFunds	Style - Convertible Arbitrage	Style - Long/Short Equity	Style - Emerging Market	Style - Event Driven	Style - Equity Market Neutral	Style - Short Bias	Style - Managed Futures	Style - Fund of Funds	Style - Global Macro	Style - Fixed Income Arbitrage
1	9.7	9.7	847.1	0.29082																	X			
2	15.7	15.6	590.4	0.28111																X	X			
3	18.7	18.6	460.3	0.27604												X				X	X			
4	21.8	21.7	327.7	0.27077			X									X				X	X			
5	24	23.9	232.4	0.26691															X	X	X		X	X
6	25.6	25.4	167.1	0.26422		X										X	X	X		X		X		
7	27.1	27	101.7	0.26149		X	X									X	X	X		X		X		
8	27.8	27.6	75.3	0.26036		X	X		X							X	X	X		X		X		
9	28.3	28.1	56.8	0.25955		X	X								X				X	X	X	X	X	X
10	28.6	28.3	45.7	0.25904		X	X		X						X				X	X	X	X	X	X
11	28.8	28.6	35.6	0.25858	X	X	X		X						X				X	X	X	X	X	X
12	29.1	28.9	24.6	0.25808	X	X	X		X						X	X	X		X	X	X		X	X
13	29.4	29.1	17.4	0.25773	X	X	X		X				X		X	X	X		X	X	X		X	X
14	29.4	29.1	15.5	0.25761	X	X	X		X	X			X		X	X	X		X	X	X		X	X
15	29.5	29.2	15.2	0.25756	X	X	X		X	X	X		X		X	X	X		X	X	X		X	X
16	29.5	29.2	15.4	0.25752	X	X	X		X	X	X	X	X		X	X	X		X	X	X		X	X
17	29.6	29.2	16.8	0.25754	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X		X	X
18	29.6	29.2	17.6	0.25753	X	X	X		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
19	29.6	29.2	19	0.25755	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
20	29.6	29.1	21	0.25759	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table A.13: This table presents the output of the best subsets regression for the 20 variables considered for the correlation model. The best model per number of parameters is selected. An "X" indicates the variable is in the model. The number of parameters, R^2, adjusted R^2, Mallow C-p and the standard deviation of the prediction are presented in the columns on the left.

Table A.14 **Corrected Akaike Information Criterion Scores for each number of parameters**

Residual Sum of Squares	Number of parameters	Observations	AICc
202.91	20	3079	-5248.322
202.91	19	3079	-5250.348
202.95	18	3079	-5251.764
203.03	17	3079	-5252.579
203.07	16	3079	-5254.001
203.19	15	3079	-5254.241
203.34	14	3079	-5253.935
203.59	13	3079	-5252.093
204.21	12	3079	-5244.840
205.07	11	3079	-5233.875
205.88	10	3079	-5223.841
217.96	**9**	**3187**	**-5338.136**
208.10	8	3079	-5194.776
222.57	7	3187	-5275.487
226.63	6	3187	-5219.774
229.91	5	3188	-5178.704
238.52	4	3188	-5063.426
247.22	3	3188	-4951.289
255.24	2	3188	-4851.505
272.97	1	3188	-4639.389
301.04	0	3188	-4329.394

Table A.14: This table presents the AICc for each of the models identified in the best subsets regression. The value of AICc is minimized at 9 parameters indicating that this model contains the most information per number of variables when predicting the correlation to the MSCI World Index.

Table A.15 Regression Summaries for Correlation to the MSCI World Index by Fund Style

	Convertible Arbitrage	Long/Short Equity	Emerging Market	Event Driven	Equity Market Neutral	Short Bias	Managed Futures	Fund of Funds	Global Macro	Fixed Income Arbitrage	Other
Intercept	0.4179	0.5931	0.4904	0.4007	0.0968	-0.3700	0.1917	0.4635	0.3215	0.0733	0.2642
Management Fee Coefficeint	-0.0318	-0.1031	-0.0406	-0.0568	0.0090	0.0034	-0.0172	-0.0674	-0.0392	-0.0348	0.0074
Management Fee T-statistic	-0.81	-4.72	-1.40	-2.51	0.18	0.03	-1.86	-4.83	-1.64	-1.21	0.07
Incentive Fee Coefficeint	-0.01073	-0.00661	-0.00318	-0.00148	-0.00284	-0.00886	-0.00876	-0.00667	-0.01041	0.00210	0.00248
Incentive Fee T-Statistic	-2.95	-3.31	-1.71	-0.61	-0.61	-0.41	-4.68	-4.61	-3.01	0.61	0.33
R squared	7.2%	2.9%	2.2%	2.3%	0.2%	1.6%	6.1%	10.1%	7.6%	1.7%	0.2%
adusted R squared	5.6%	2.7%	1.3%	1.6%	0.0%	0.0%	5.7%	9.8%	6.4%	0.0%	0.0%
Standard deviation of Prediction	0.2105	0.2838	0.2016	0.2062	0.3115	0.2074	0.2589	0.2572	0.2525	0.2185	0.3672

Table A.15: This table presents a summary of the regressions of management fee and incentive fee vs. correlation to the MSCI index for every fund style.

Figure A.1

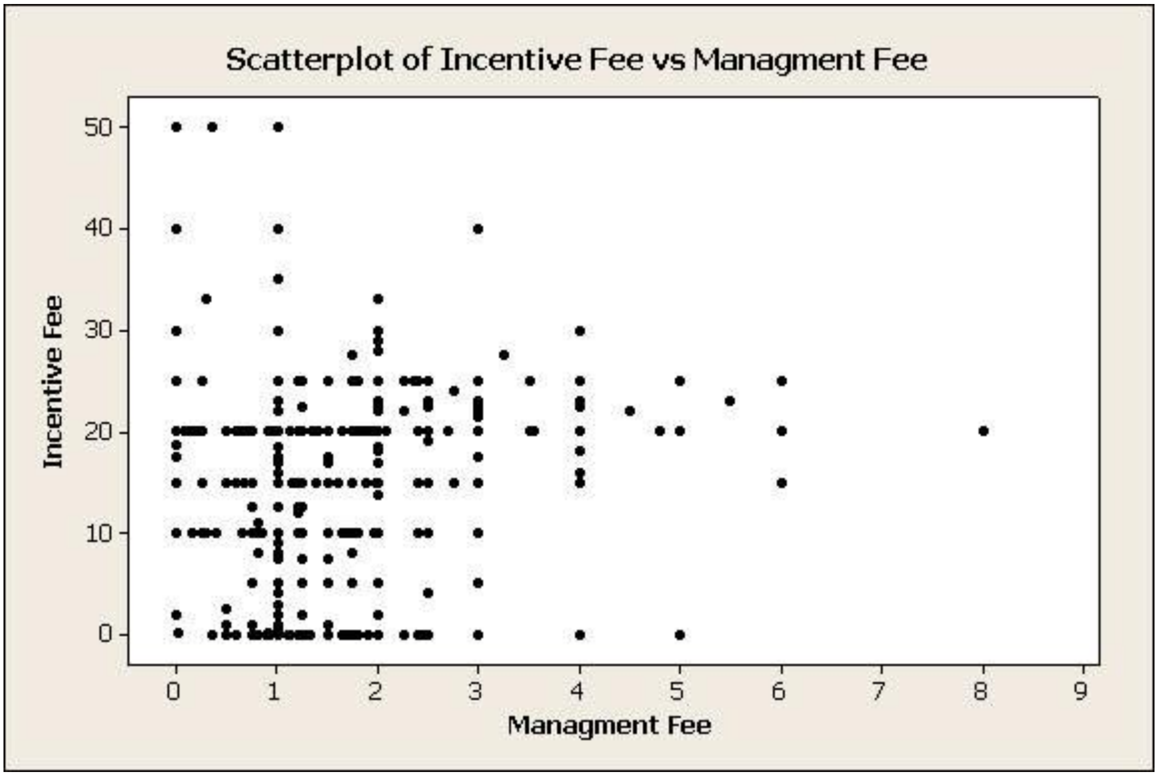


Figure A.1: A graphical representation of the 222 different combinations of incentive fees and management fees in the TASS Database from January 2001 to August 2002.

Figure A.2

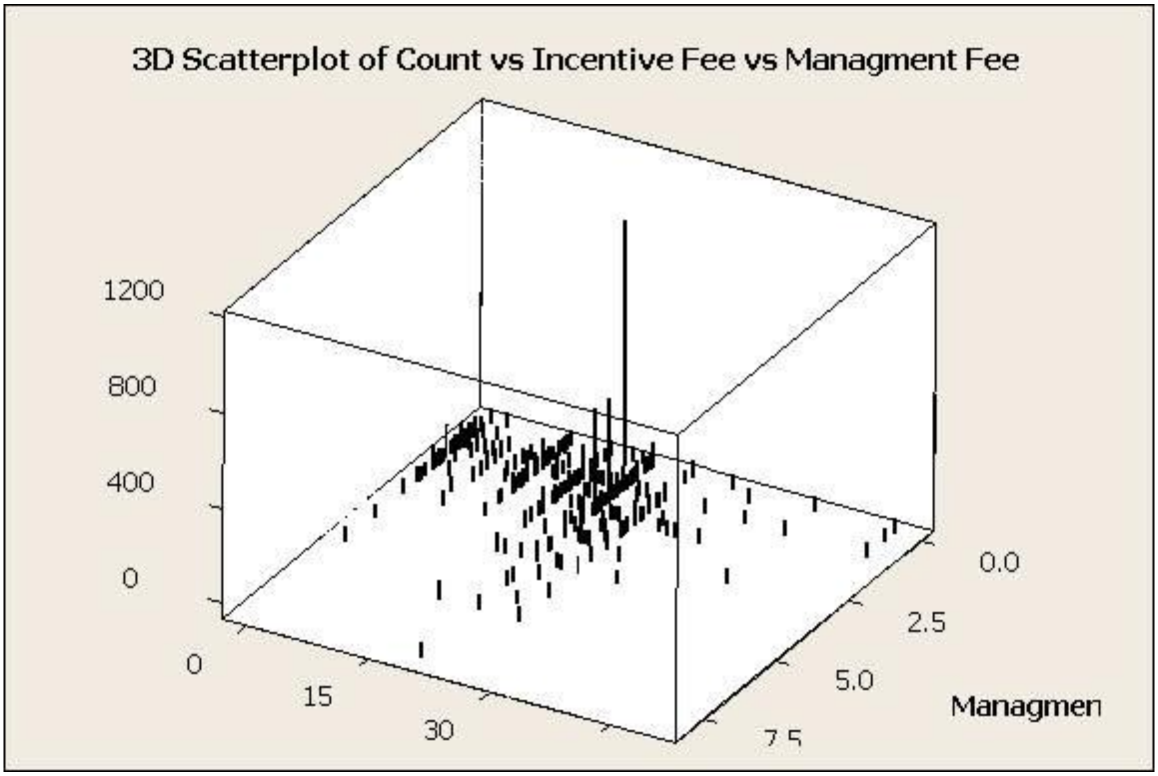


Figure A.2: A graphical representation of the number of funds with each fee structure using the TASS Database from January 2001 to August 2002. The dominant bar represents the most common fee structure of 1% management fee, 20% incentive fee.

Figure A.3

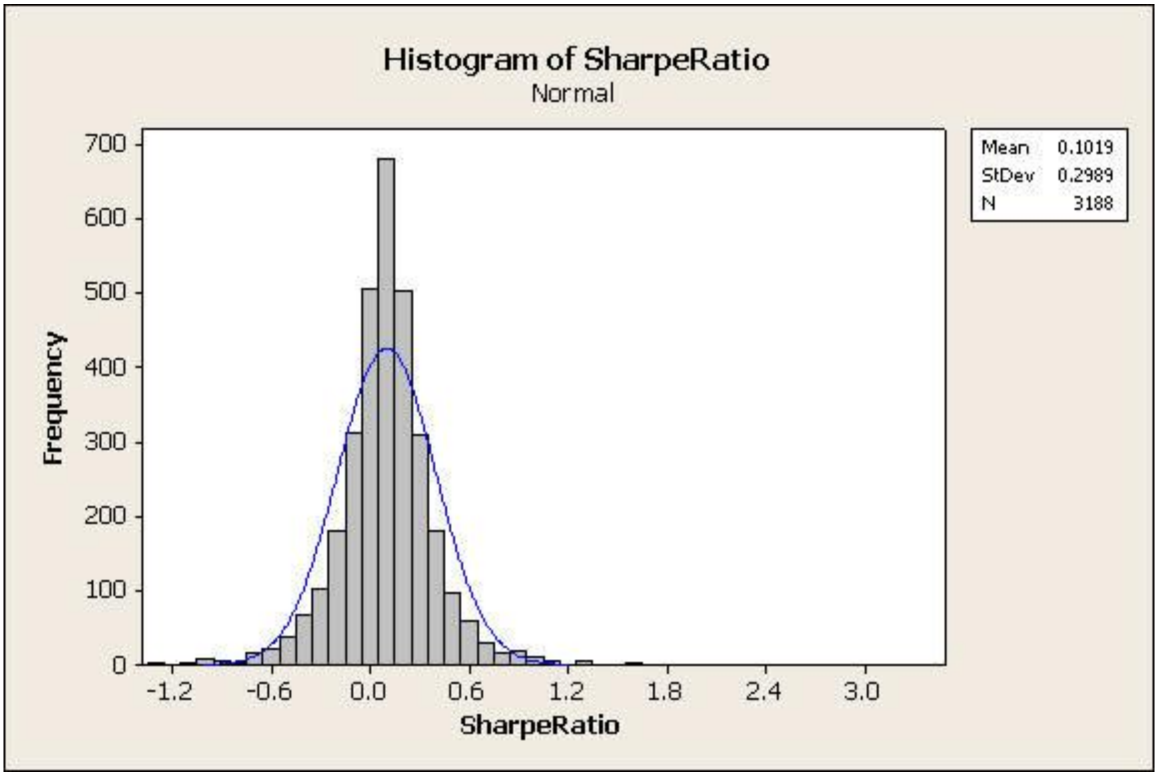


Figure A.3: A histogram of Sharpe ratios using the TASS Database from January 2001 to August 2002.

Figure A.4

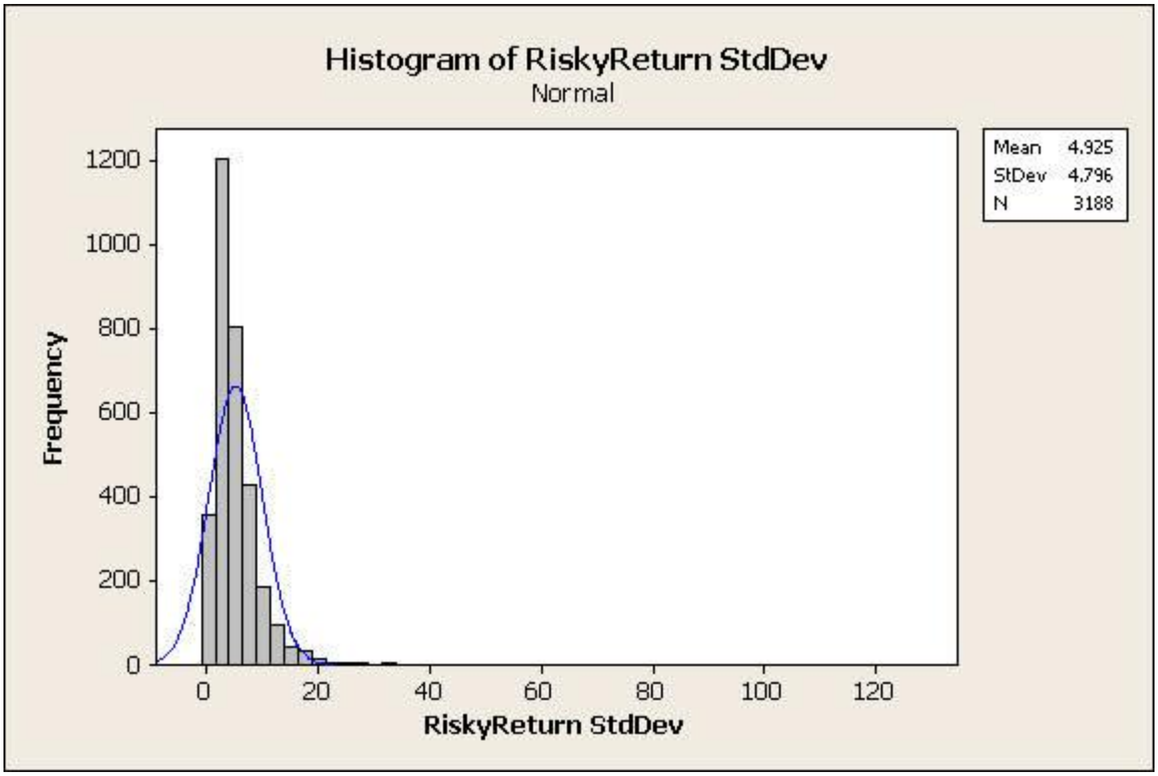


Figure A.4: A histogram of standard deviation of returns using the TASS Database from January 2001 to August 2002. The long right tail of the data indicates that a log transformation may be appropriate.

Figure A.5

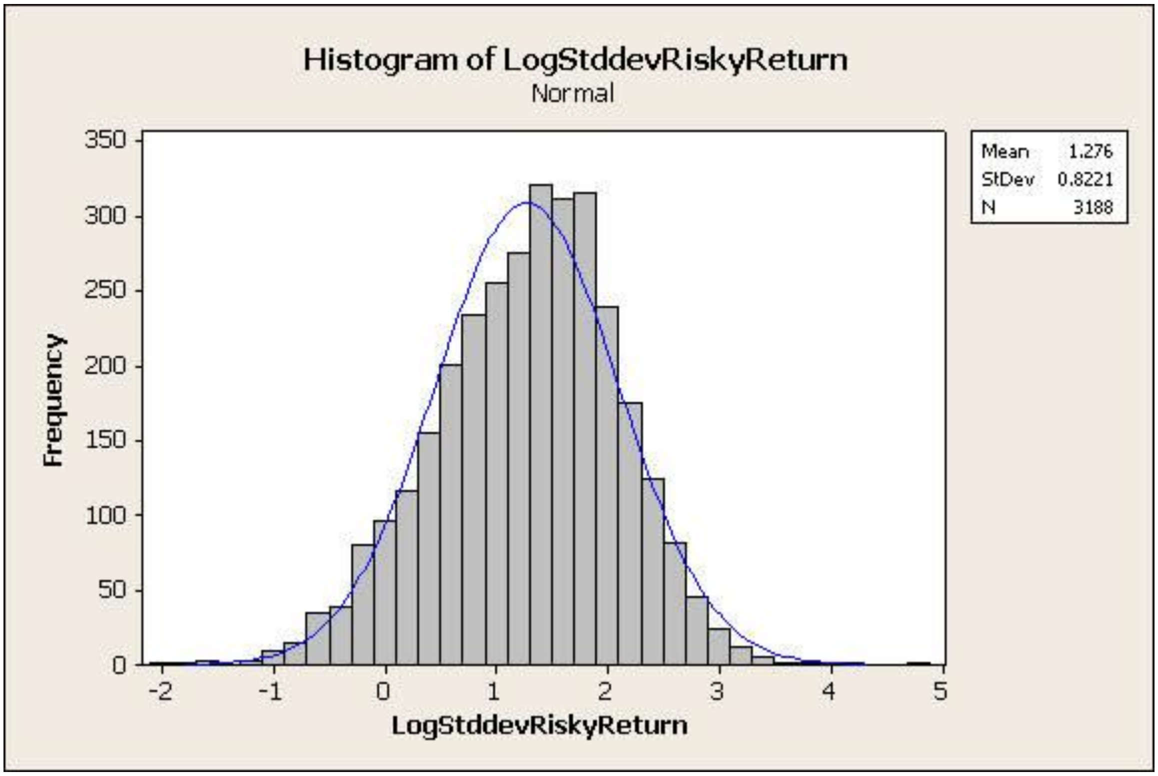
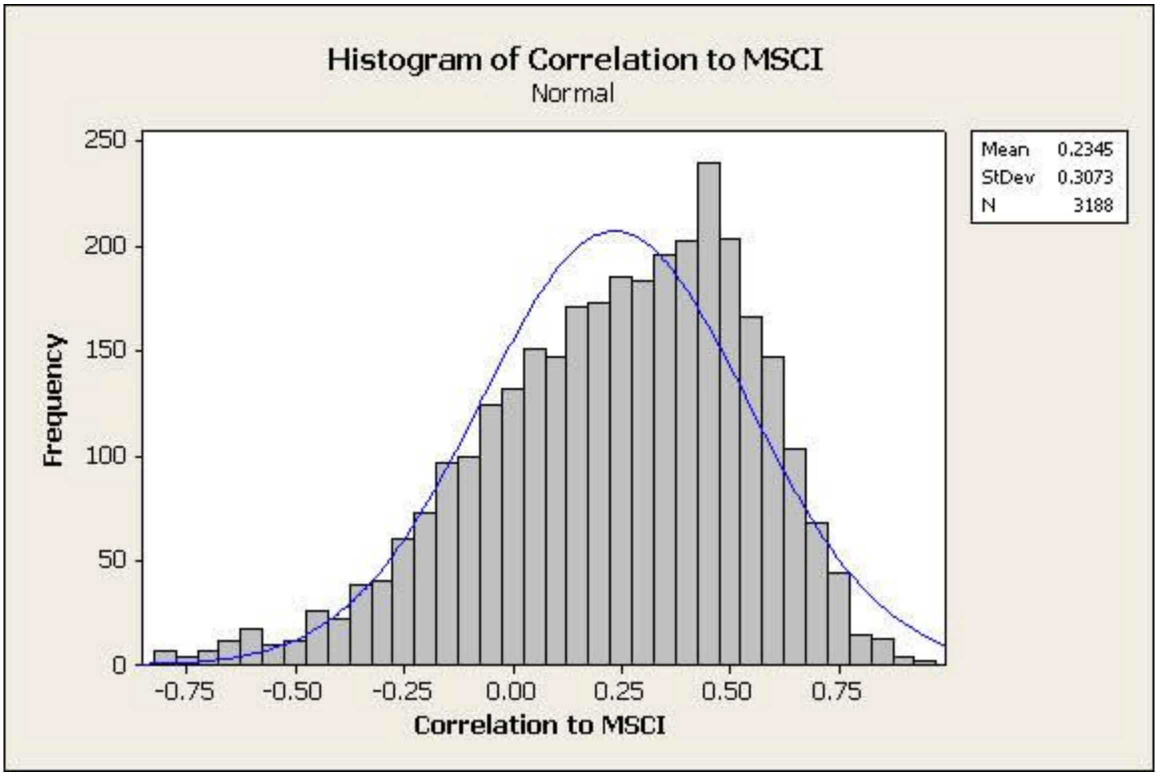


Figure A.5: A histogram of the natural logarithm of standard deviation of returns using the TASS Database from January 2001 to August 2002. The log transformation clearly results in a more normal distribution, which will result in improved linear regressions.

Figure A.6



Mean	Std. Deviation	Minimum	Q1	Median	Q3	Maximum
0.234	0.30734	-0.81631	0.03094	0.27255	0.46843	0.92773

Figure A.6: A histogram of the correlations with the MSCI index using the TASS Database from January 2001 to August 2002. The correlation can only vary between -1 and 1.

Figure A.7

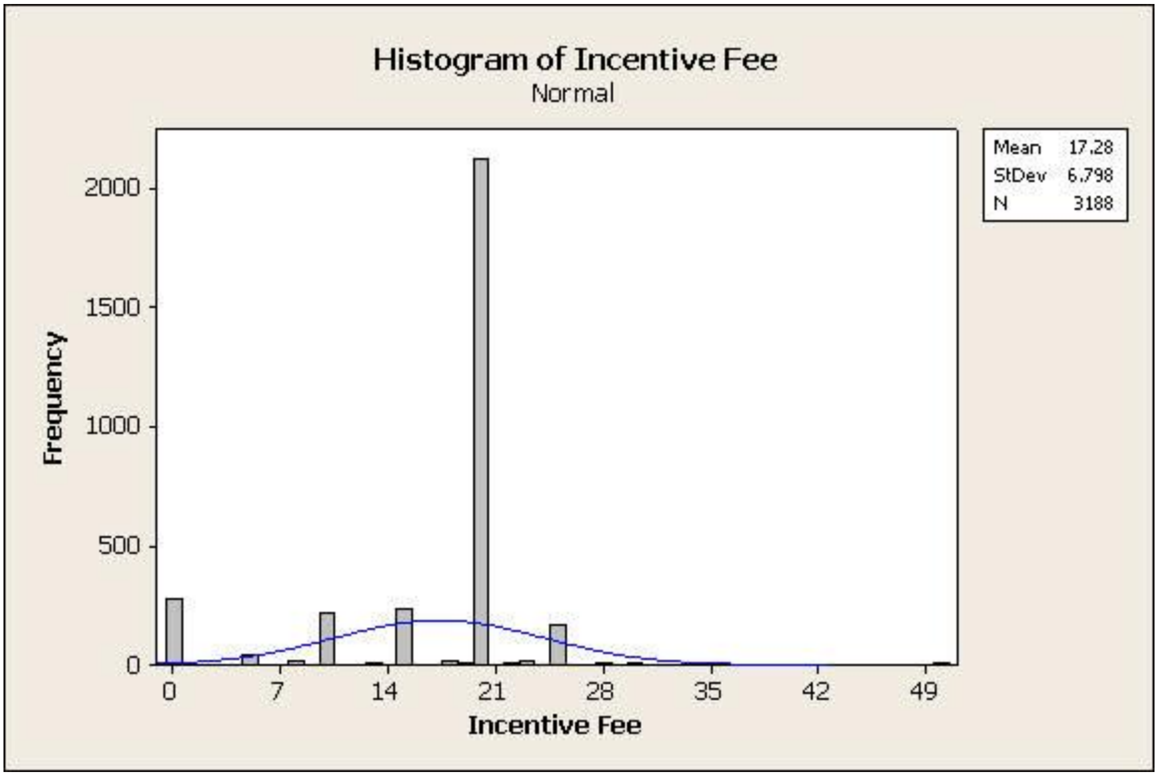


Figure A.7: A histogram of the incentive fees using the TASS Database from January 2001 to August 2002. This distribution does not lend itself to linear regression, and would lead to model assumption violations.

Figure A.8

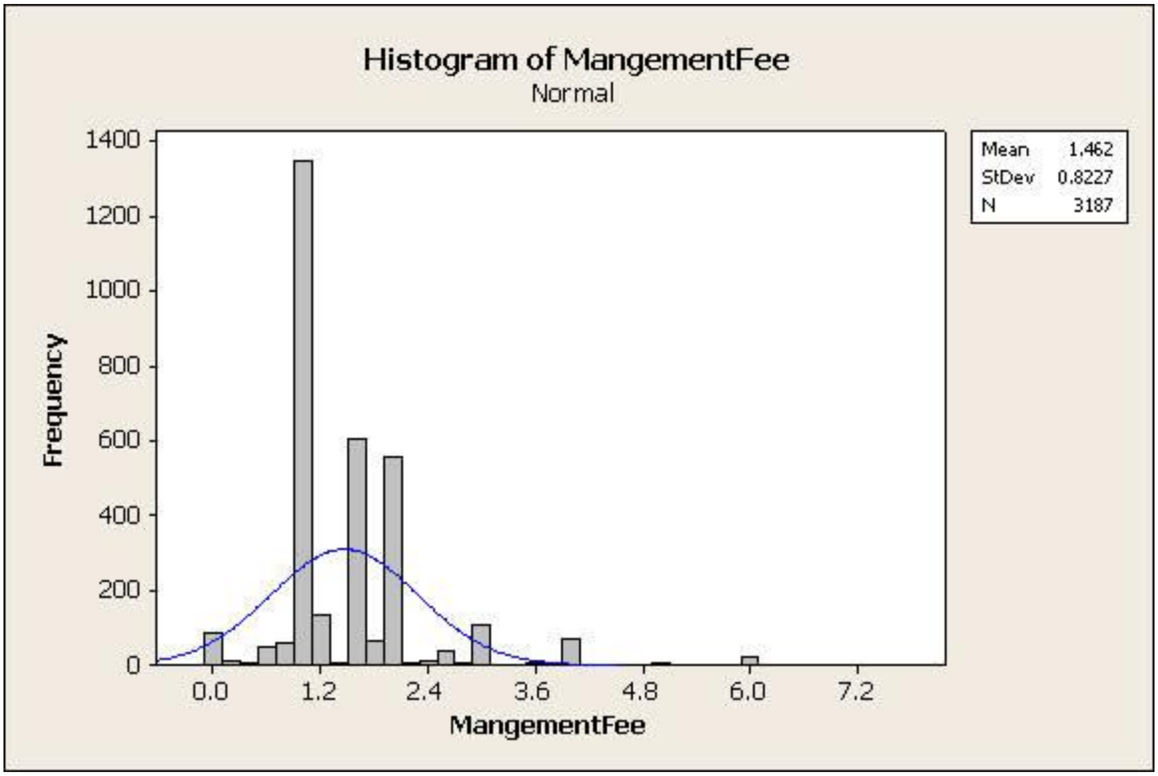


Figure A.8: A histogram of the management fees using the TASS Database from January 2001 to August 2002. This distribution does not lend itself to linear regression, and would lead to model assumption violations.

Figure A.9

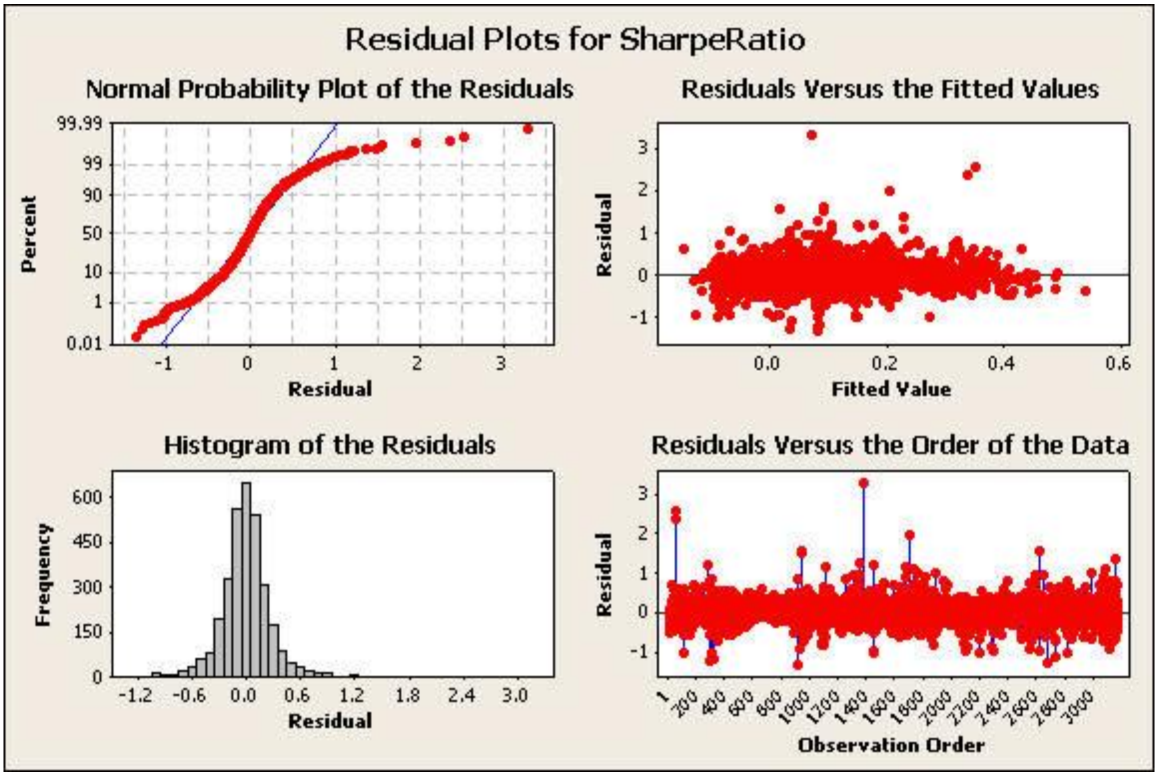


Figure A.9: Four residual plots for the Sharpe ratio model are presented in this figure. The normal probability plot indicates that several residuals are much further out than would be expected for a regression with this many variables. The histogram of residuals reveals a normal distribution, which is consistent with model assumptions. Residuals vs. Fit and Residuals vs. Order both help identify the outliers.

Figure A.10

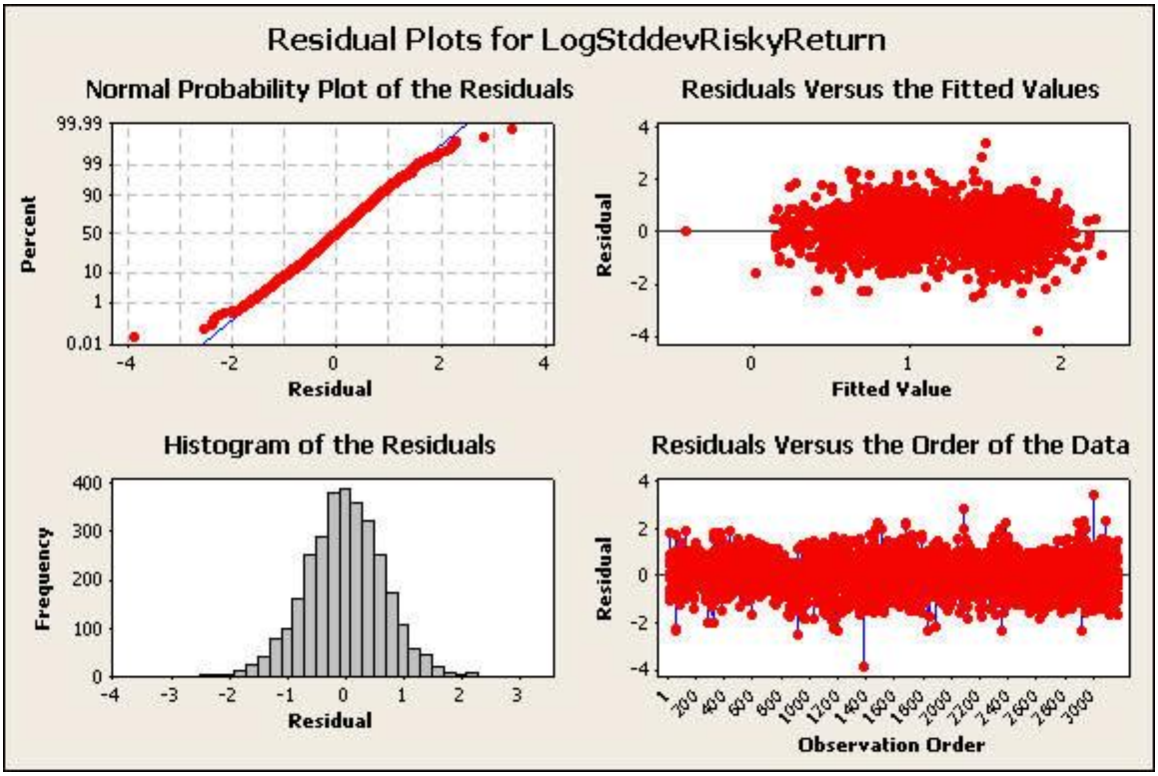


Figure A.10: Four residual plots for the log standard deviation model are presented in this figure. All the plots indicate a reasonably sound regression. Only one outlier appear very significant, and that is once again the IIG Trade Opportunities Fund managed by Jim Culver. The histogram of residuals reveals a relatively normal distribution, which is consistent with model assumptions. Residuals vs. Fit and Residuals vs. Order both look random and evenly distributed.

Figure A.11

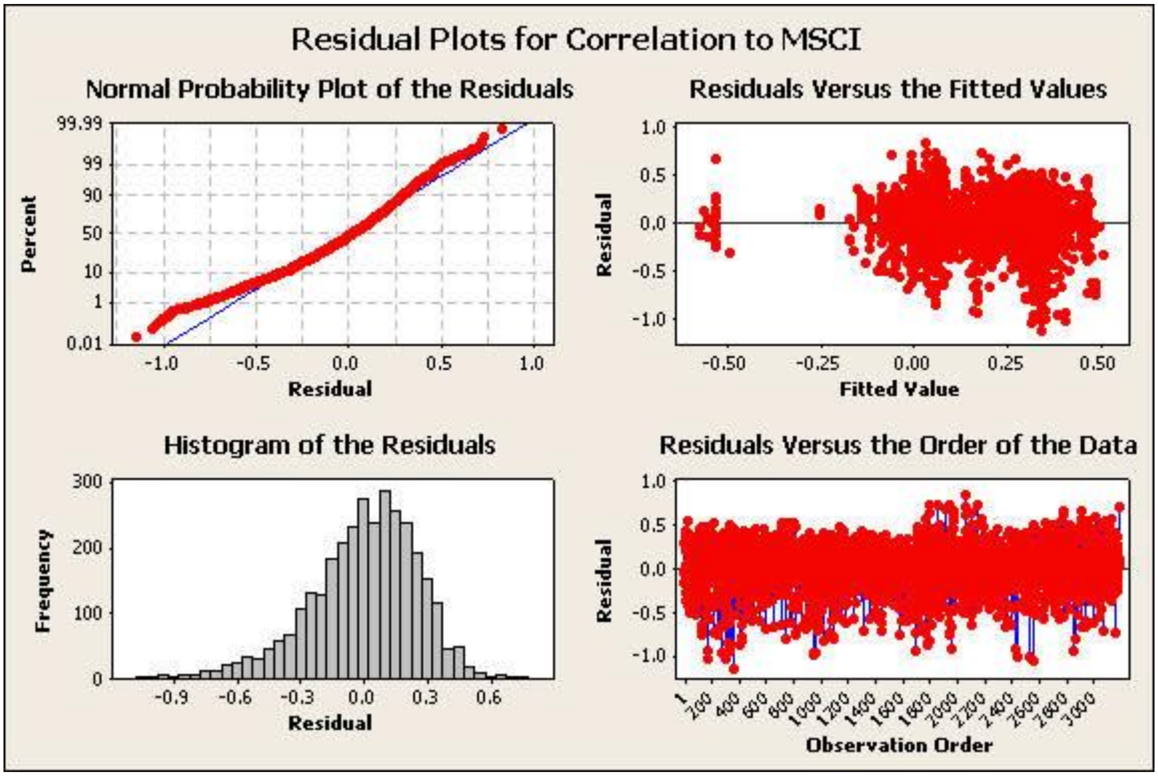


Figure A.11: Four residual plots for the correlation model1 are presented in this figure. The plots indicate some potential problems with the regression. The histogram of residuals and normal probability plot reveal a non normal distribution of residuals, which is contrary to model assumptions. Residuals vs. Fit and Residuals vs. Order also both appear to have some patterns, with certain values systematically over estimated.

Figure A.12 and A.13

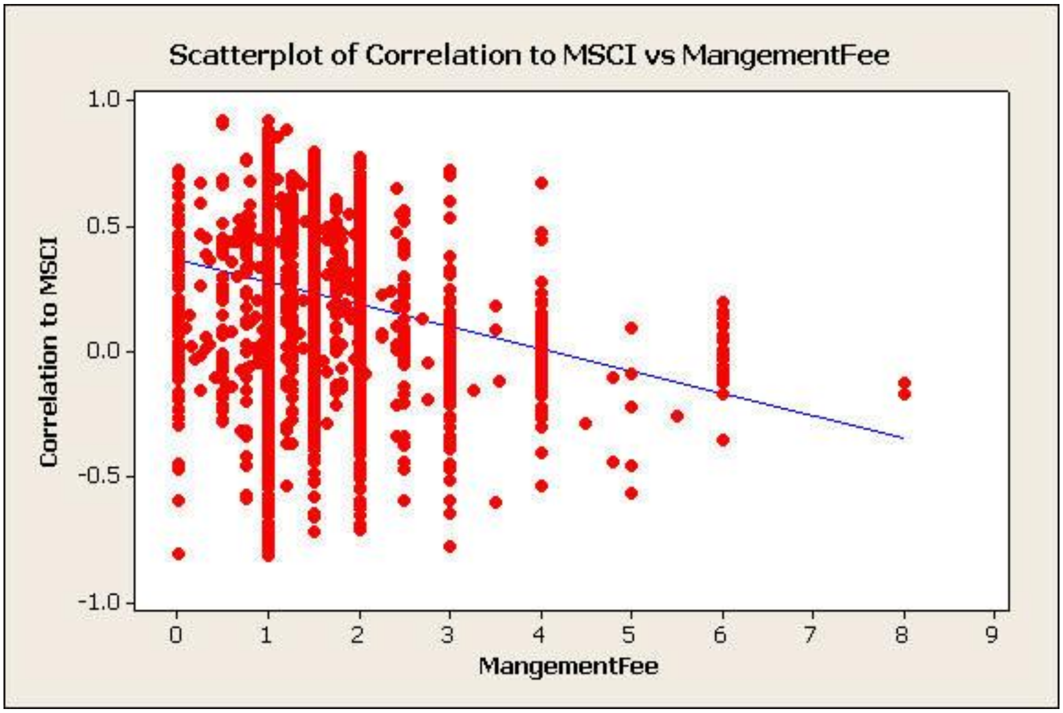


Figure A.12: This fitted line plot of Correlation vs. Management Fee indicates that these two variables alone seem to exhibit an inverse relationship.

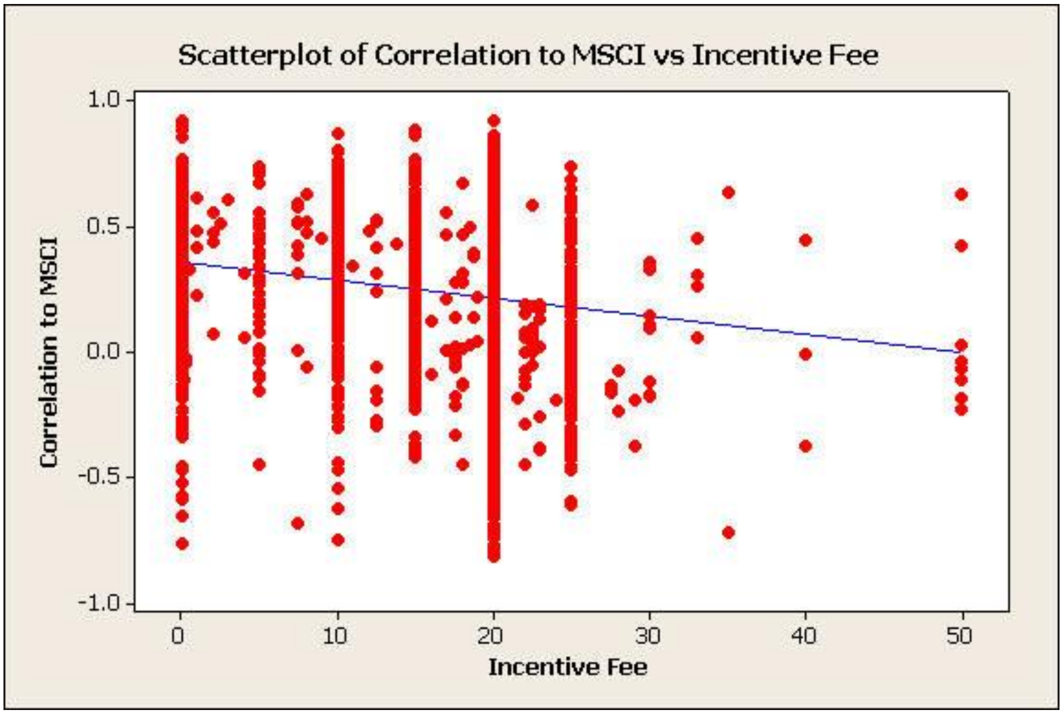


Figure A.13: This fitted line plot of Correlation vs. Incentive Fee indicates that these two variables alone also seem to exhibit an inverse relationship.

Figure A.14

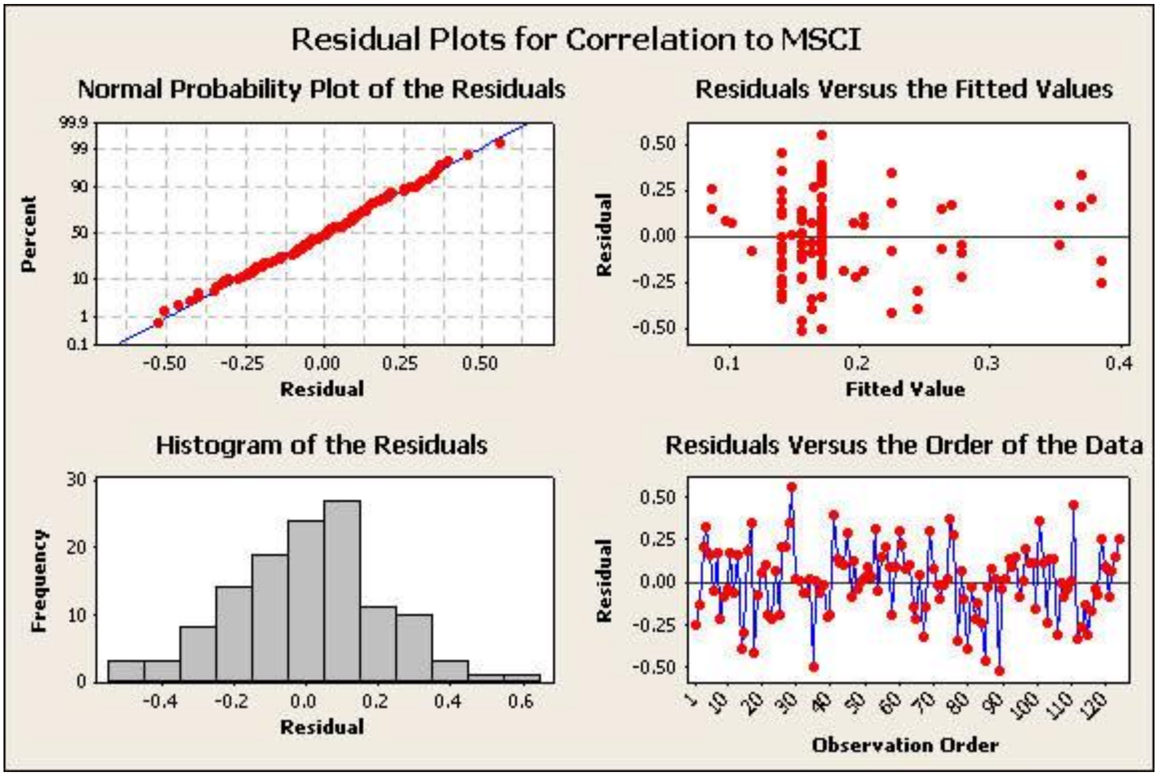


Figure A.14: Four residual plots are for incentive and management fee vs. correlation to the MSCI World index for convertible arbitrage funds only are presented in this figure. The plots indicate a reasonably sound model. The histogram of residuals reveals a relatively normal distribution, which is consistent with model assumptions.

Figure A.15

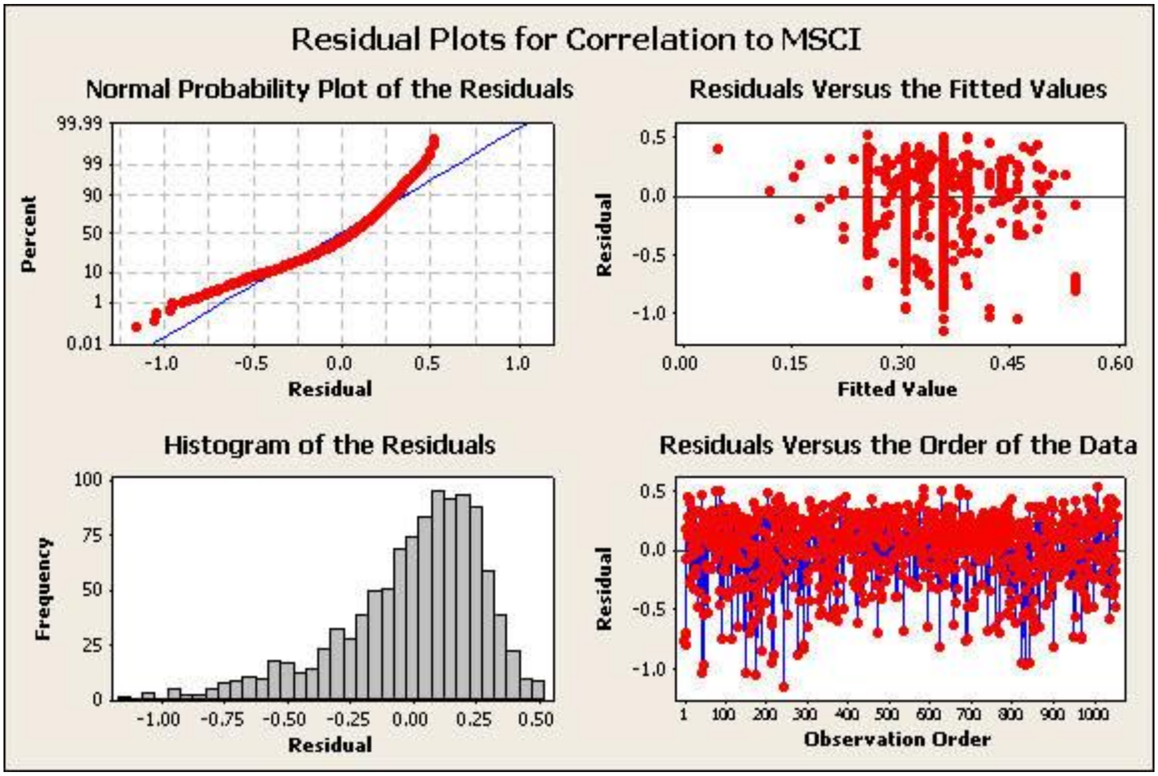


Figure A.15: Four residual plots are for incentive and management fee vs. correlation to the MSCI World index for long/short equity funds only are presented in this figure.

Figure A.16

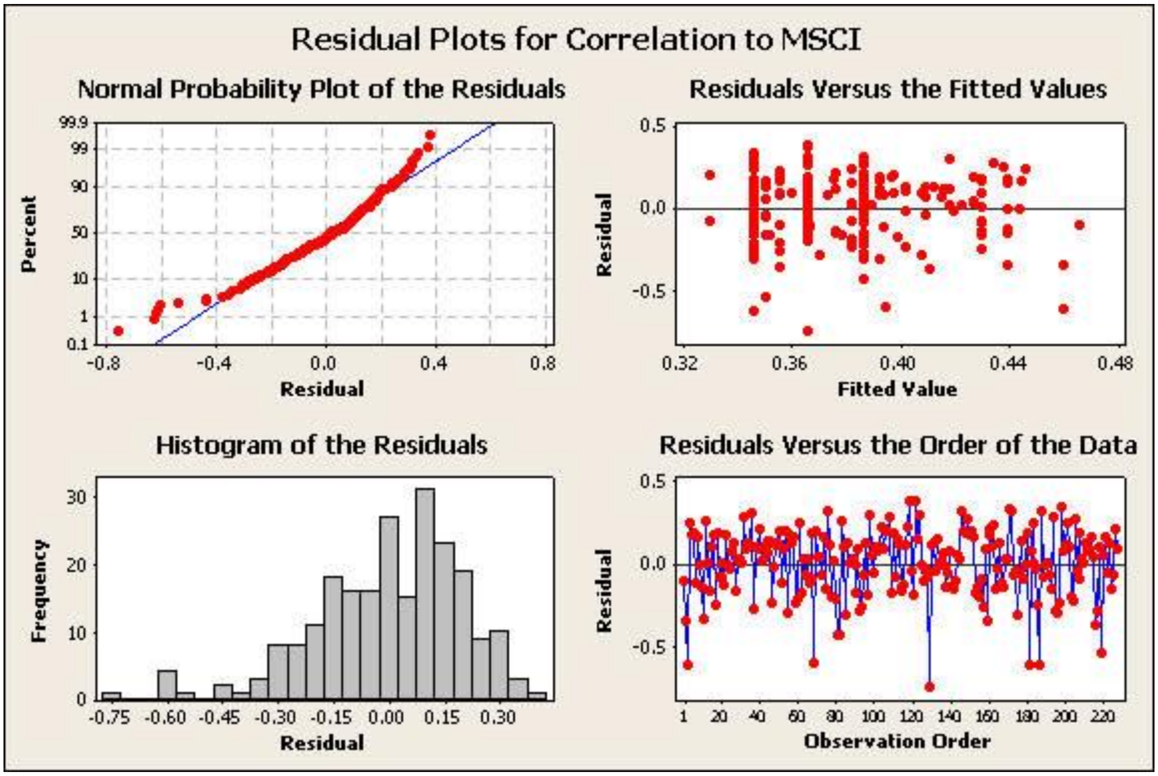


Figure A.16: Four residual plots are for incentive and management fee vs. correlation to the MSCI World index for emerging market funds only are presented in this figure.

Figure A.17

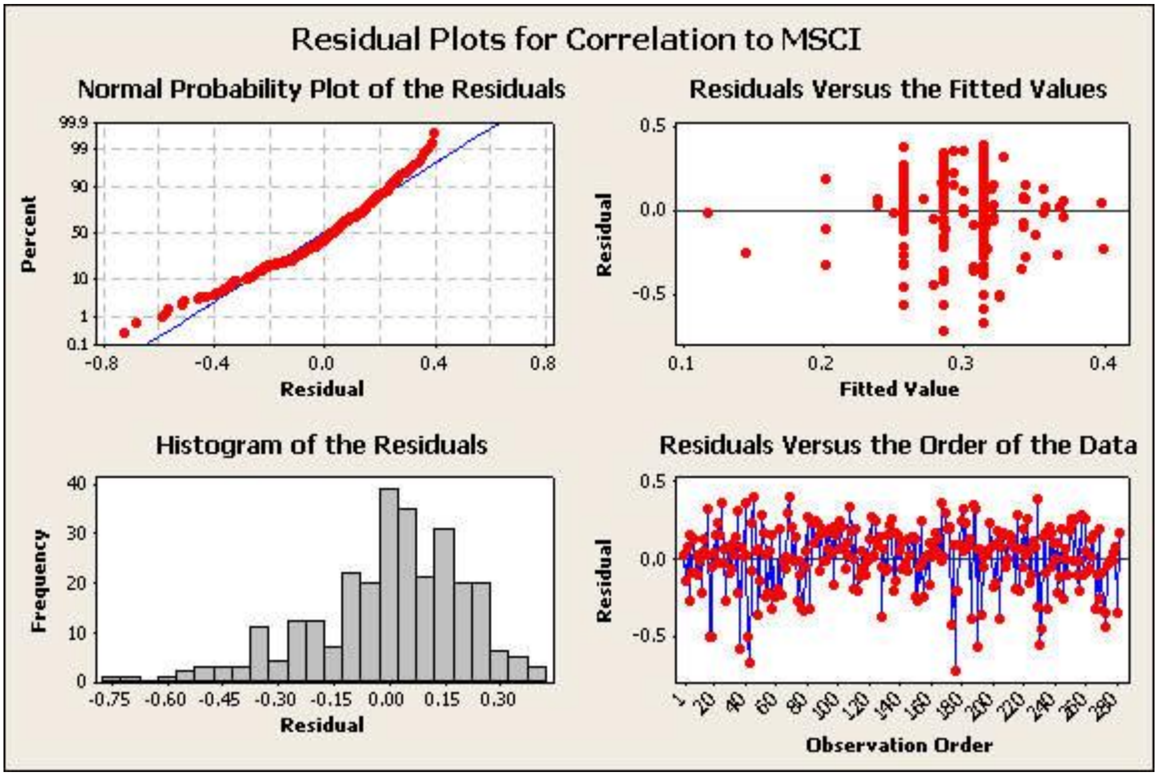


Figure A.17: Four residual plots are for incentive and management fee vs. correlation to the MSCI World index for event driven funds only are presented in this figure.

Figure A.18

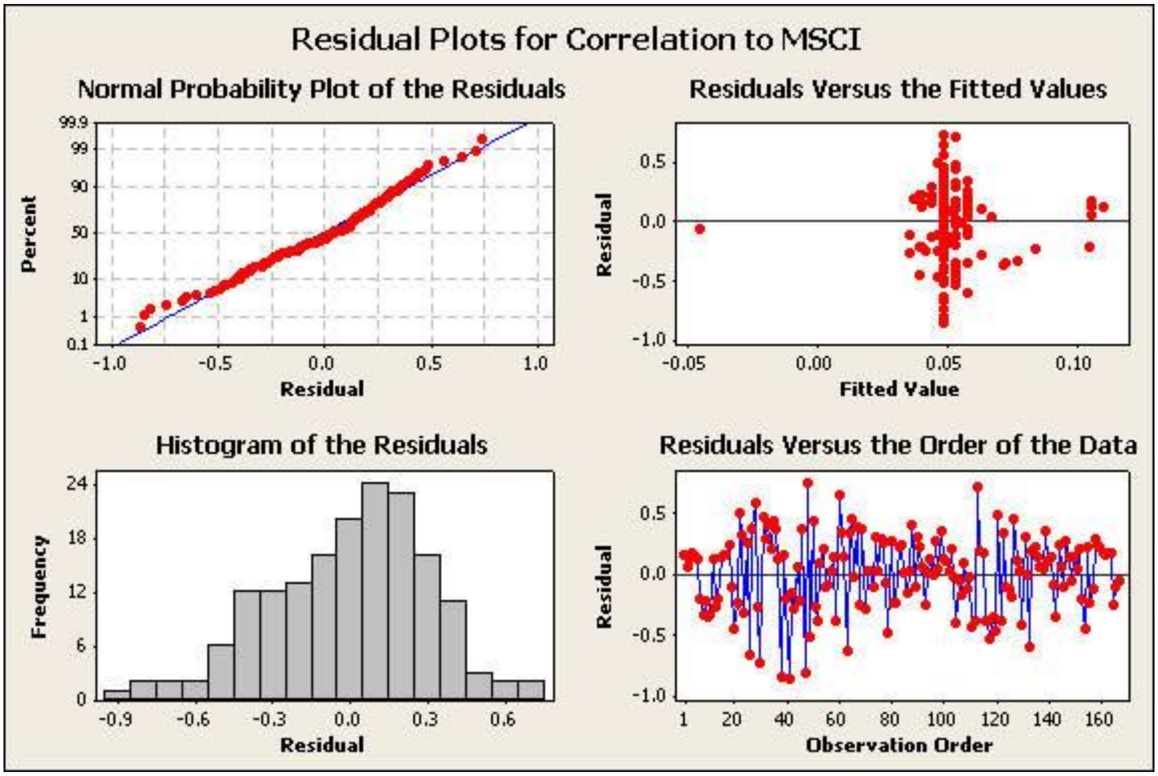


Figure A.18: Four residual plots are for incentive and management fee vs. correlation to the MSCI World index for equity market neutral funds only are presented in this figure. The plots indicate a reasonably sound model. The histogram of residuals reveals a relatively normal distribution, which is consistent with model assumptions.

Figure A.19

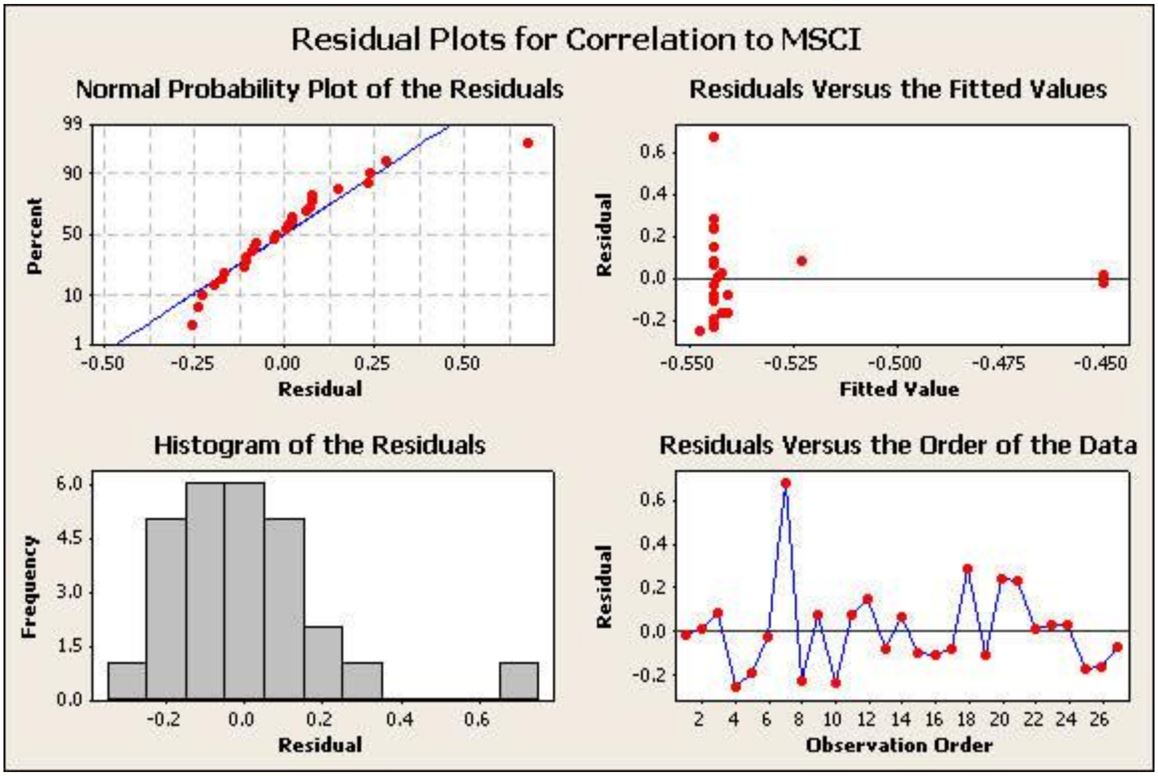


Figure A.19: Four residual plots are for incentive and management fee vs. correlation to the MSCI World index for short bias funds only are presented in this figure.

Figure A.20

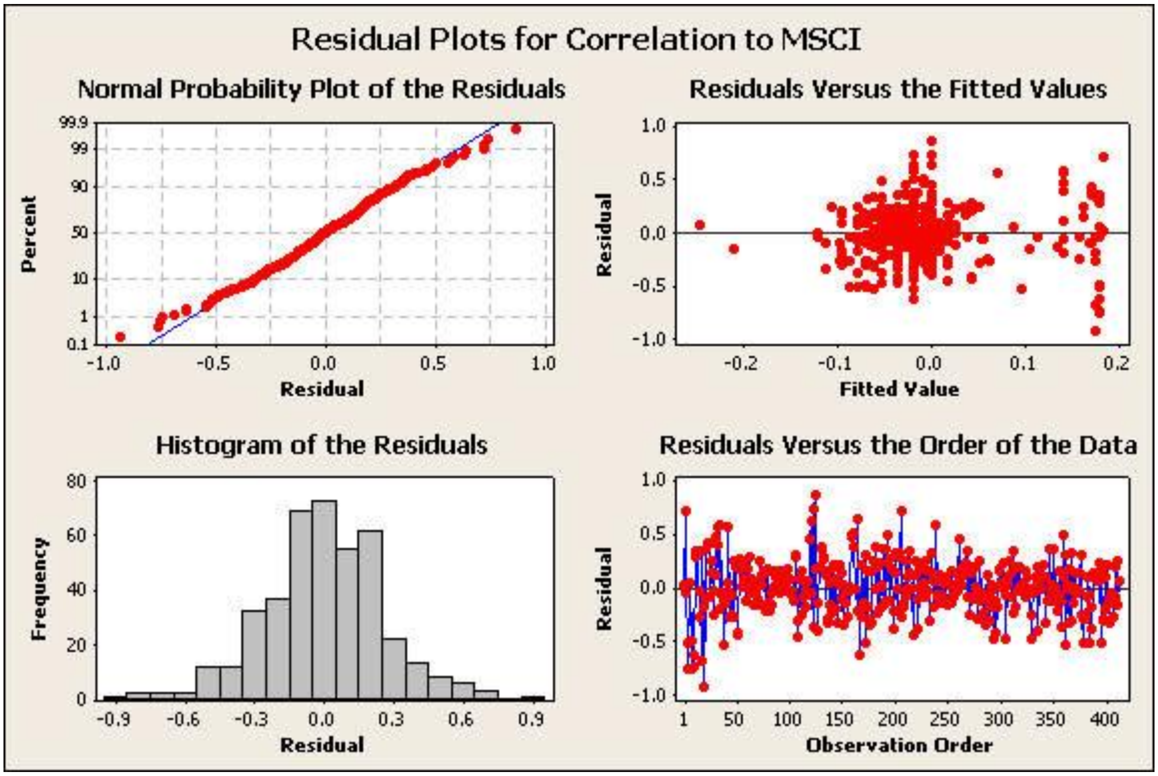


Figure A.20: Four residual plots are for incentive and management fee vs. correlation to the MSCI World index for managed futures funds only are presented in this figure. The plots indicate a reasonably sound model. The histogram of residuals reveals a relatively normal distribution, which is consistent with model assumptions.

Figure A.21

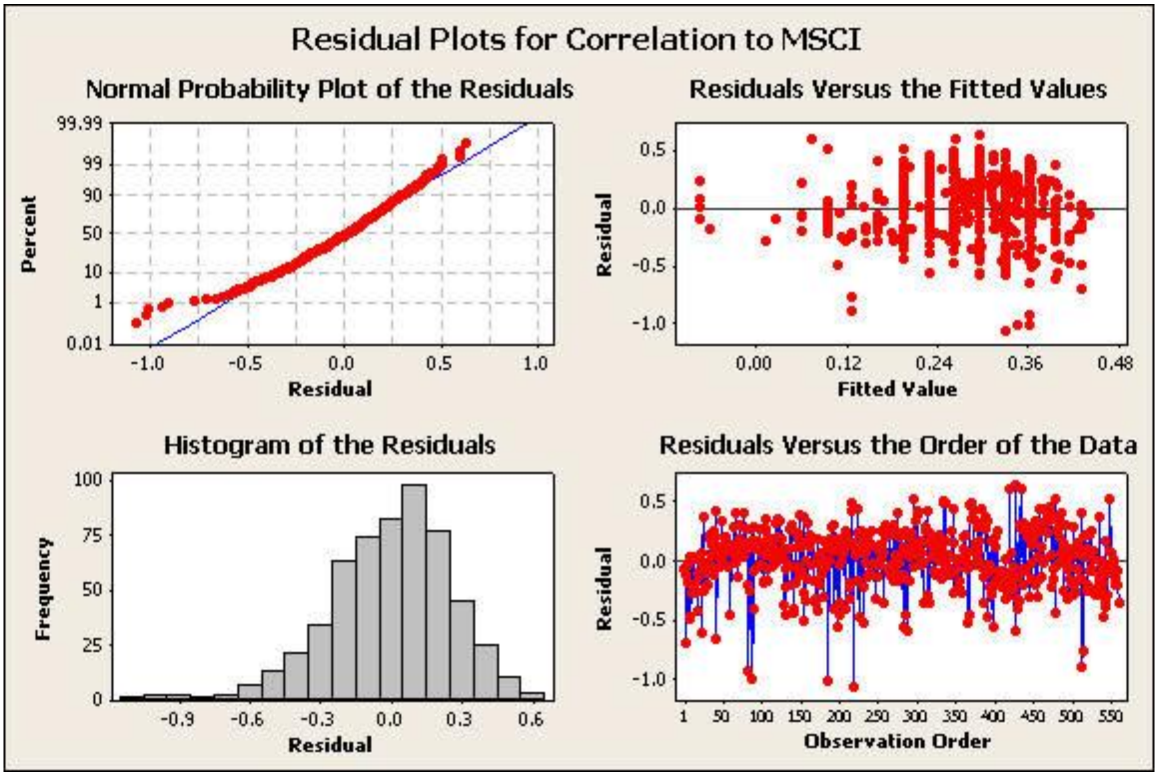


Figure A.21: Four residual plots are for incentive and management fee vs. correlation to the MSCI World index for fund of funds only are presented in this figure. The plots indicate a reasonably sound model. The histogram of residuals reveals a relatively normal distribution, which is consistent with model assumptions.

Figure A.22

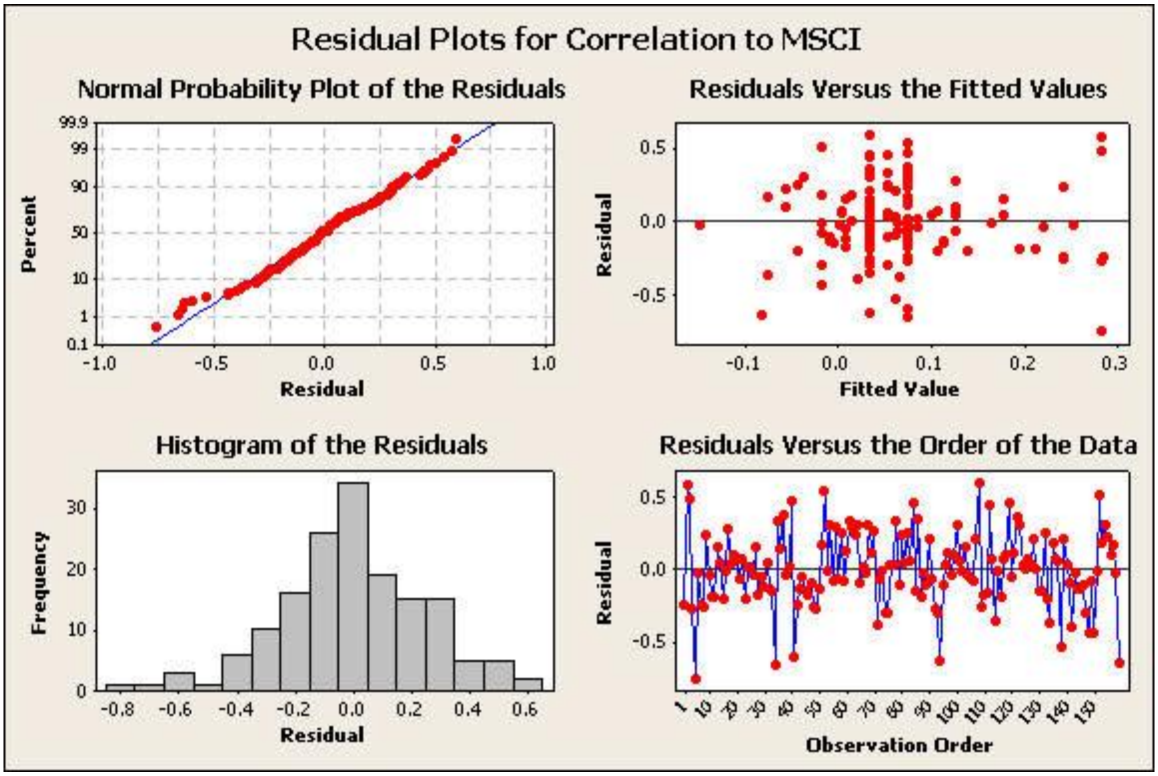


Figure A.22: Four residual plots are for incentive and management fee vs. correlation to the MSCI World index for global macro funds only are presented in this figure. The plots indicate a reasonably sound model. The histogram of residuals reveals a relatively normal distribution, which is consistent with model assumptions.

Figure A.23

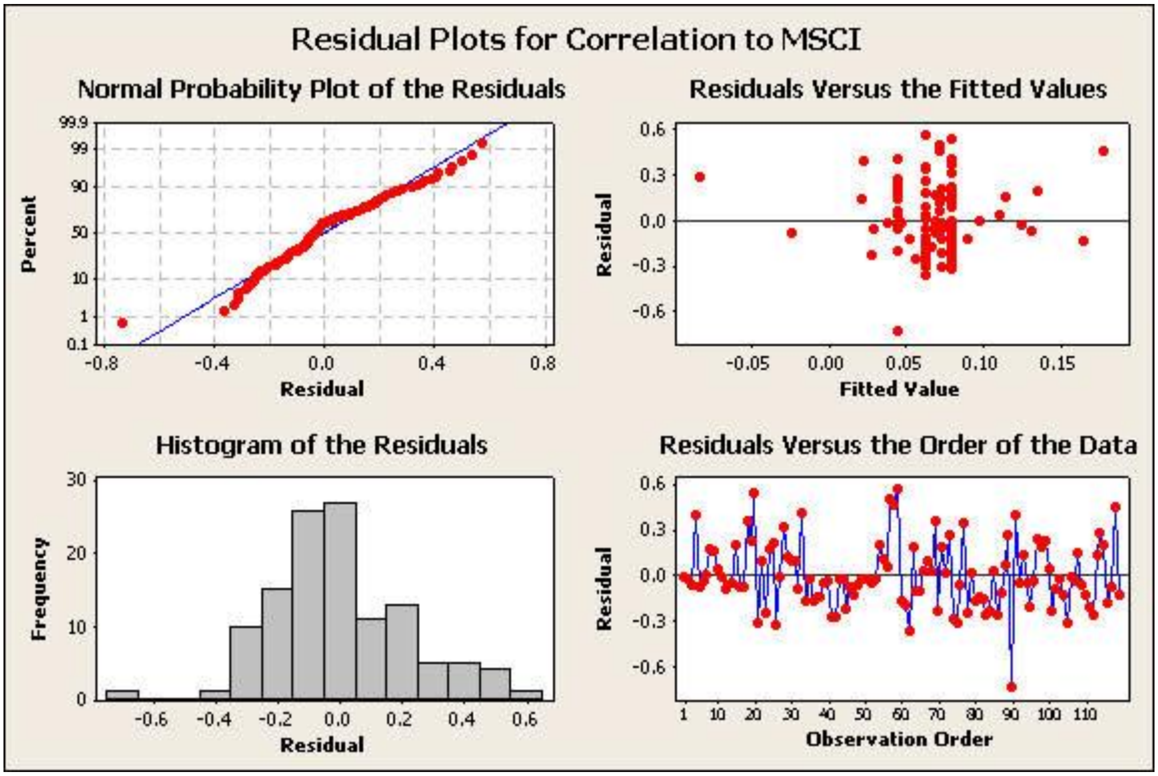


Figure A.23: Four residual plots are for incentive and management fee vs. correlation to the MSCI World index for fixed income arbitrage funds only are presented in this figure. The plots indicate a reasonably sound model. The normal probability plot of residuals reveals a relatively normal distribution, which is consistent with model assumptions.

Figure A.24

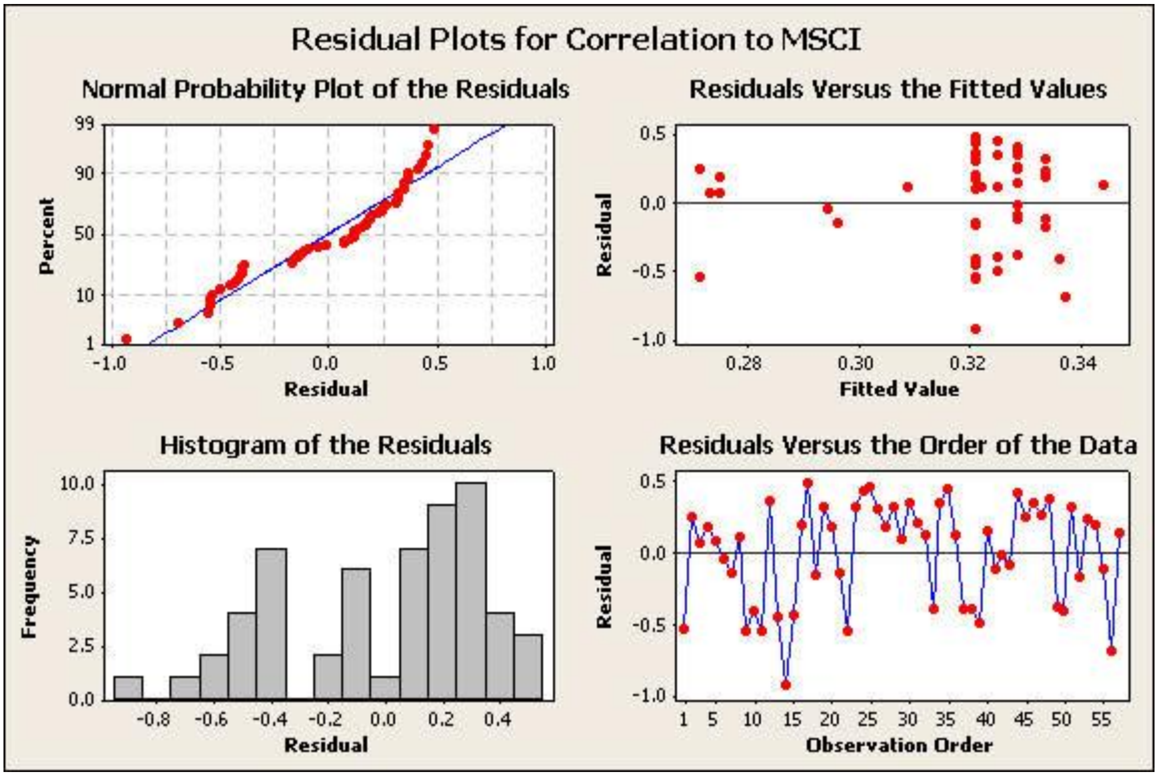


Figure A.24: Four residual plots are for incentive and management fee vs. correlation to the MSCI World index for "other fund style" only are presented in this figure.

A.2 TASS fund Category Definitions

The following is a list of category descriptions, taken directly from TASS documentation, that defines the criteria used by TASS in assigning funds in thei database to one of 11 possible categories.

Convertible Arbitrage
This strategy is identified by hedge investing in the convertible securities of a company. A typical investment is to be long the convertible bond and short the common stock of the same company. Positions are designed to generate profits from the fixed income security as well as the short sale of stock, while protecting principal from market moves.

Dedicated Short Bias
Short biased managers take short positions in mostly equities and derivatives. The short bias of a manager's portfolio must be constantly greater than zero to be classified in this category.

Emerging Markets
This strategy involves equity or fixed income investing in emerging markets around the world. As many emerging markets do not allow short selling, nor offer viable futures or other derivative products with which to hedge, emerging market investing often employs a long-only strategy.

Equity Market Neutral
This investment strategy is designed to exploit equity market inefficiencies and usually involves being simultaneously long and short matched market portfolios of the same size within a country. Market neutral portfolios are designed to be either beta or currency neutral, or both. Well-designed portfolios typically control for industry, sector, market capitalization, and other exposures.

Event-driven
This strategy is defined as “special situation” investing designed to capture price movement generated by a significant pending corporate event such as a merger, corporate restructuring, liquidation, bankruptcy or reorganization. There are three popular sub-categories in event-driven strategies: risk (merger) arbitrage, distressed securities, high yield securities, and Regulation D.

Risk Arbitrage - This strategy is identified by managers investing simultaneously in long and short positions in both companies involved in a merger or acquisition. Merger arbitrageurs are typically long the stock of the company being acquired and short the stock of the acquirer. The principal risk is deal risk, should the deal fail to close.

Distressed Securities - Fund managers invest in the debt, equity or trade claims of companies in financial distress and generally bankrupt. The securities of companies in need of legal action or restructuring to revive financial stability typically trade at substantial discounts to par value and thereby attract investments when managers perceive that a turnaround will materialize.

High Yield - Often called junk bonds, this strategy refers to investing in low-grade fixed-income securities of companies that show significant upside potential. Managers generally buy and hold high yield debt.

Regulation D - This strategy refers to investments in micro and small capitalization public companies that are raising money in private capital markets. Investments usually take the form of a convertible security with an exercise price that floats or is subject to a look-back provision that insulates the investor from a decline in the price of the underlying stock.

Fixed Income Arbitrage
Funds that attempt to limit volatility and generate to profits from price anomalies between related fixed income securities. Most managers trade globally with a goal of generating steady returns with low volatility. This category includes interest rate swap arbitrage, US and non-US government bond arbitrage, forward yield curve arbitrage, and mortgage-backed securities arbitrage. The mortgage-backed market is primarily US-based and over-the-counter.

Fund of Funds
A "Multi Manager" fund will employ the service of two or more trading advisors or Hedge Funds who will be allocated cash by6 the Trading Manager on behalf of the fund.

Global Macro
Global macro managers carry long and short positions in any of the world's major capital or derivative markets. These positions reflect their views on overall market direction as influenced by major economic trends and/or events. The portfolios of these funds can include stocks, bonds, currencies, and commodities in the form of cash or derivatives instruments. Most funds invest globally in both developed and emerging markets.

Long/Short Equity
This directional strategy involves equity-oriented investing on both the long and short sides of the market. The objective is not to be market neutral. Managers have the ability to shift from value to growth, from small to medium to large capitalization stocks, and from a net long position to a net short position. Managers may use futures and options to hedge. The focus may be regional, such as long/short US or European equity, or sector specific, such as long and short technology or healthcare stocks. Long/short equity funds tend to build and hold portfolios that are substantially more concentrated than those of traditional stock funds.

Managed Futures
This strategy invests in listed financial and commodity futures markets and currency markets around the world. The managers are usually referred to as Commodity Trading Advisors, or CTAs. Trading disciplines are generally systematic or discretionary. Systematic traders tend to use price and market specific information (often technical) to make trading decisions, while discretionary managers use a judgmental approach.

Other
This strategy describes hedge funds that cannot be classified in one of the ten listed categories.

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