Performance sharing in risky portfolios:

The case of hedge fund returns and fees

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Leverage and short sale restrictions imposed on investors challenge the premise of the Markowitz's (1952) Modern Portfolio Theory and, more specifically, Tobin's (1958) two-fund separation theorem, which underlies the Capital Asset Pricing Model (CAPM). Within that framework, every investor should freely access the unrestricted market portfolio (possibly with short positions in some securities, as shown by Ross (1977)) and then leverage it according to her own risk preference. An individual investor's homemade leverage or short sale of securities, although theoretically easy to grasp, is not easily achieved under realistic borrowing constraints either through credit rationing or because of a lending spread (Sorensen et al. 2007; Baker et al. 2011). Aversion to leverage or risk barriers might also prevent homemade portfolio construction (Jacobs and Levy, 2012). As a consequence, many individual investors who wish to build a high-risk/high-expected return-portfolio cannot achieve it on their own. In this context, the availability of the mutual or hedge funds offered by institutional asset managers represents a valuable alternative.

Even in the institutional investors' world, however, not everyone receives equal treatment regarding investment restrictions. Baker, Bradley and Wurgler (2011) show that investors such as those of pension funds or mutual funds are generally reluctant to inflate their risk levels by shorting stocks and increasing leverage. These authors hypothetically relate such behavior to borrowing and trading costs, tight tracking error and the benchmarking constraints that they must meet. Nevertheless, actors exist, mostly in the alternative investment universe, who are much less exposed, if at all, to portfolio construction constraints. Through securities shorting and gearing, these actors can build risky portfolios that are otherwise inaccessible to their peers. Thus, in risk-return terms, they can achieve Sharpe ratios that restricted investors cannot reach.

Institutional investors who suffer from leverage constraints might therefore turn to alternative investments such as hedge funds to allocate part of their investments in a levered and less constrained "satellite". In fact, Jank and Smajbegovic (2015) indicate that hedge fund asset managers (who are the least constrained investors) "bet against beta (BAB)" and demonstrate a significant positive exposure to the BAB factor of Frazzini and Pedersen (2014). This explanation attributes hedge funds' superior performance to their active short selling of high-beta stocks.

The above findings raise a legitimate, pragmatic question: If some investors have an appetite for high-risk portfolios, and if only a subset of institutional asset managers, mostly those investing in hedge funds, can deliver performance superior to all others, then do these hedge fund managers keep the extra returns for themselves, or do they share it with their clients? This question is the major topic of this article.

In a similar fashion to what is commonly observed with regard to stock and bond returns, we show that the leverage restrictions of institutional investors create a volatility anomaly in the net-of-fee equity of long/short funds. However, we go one step further by associating, at least partly, this anomaly with the practice of hedge fund asset managers who inflate their fees with their risk level. Thus, the source of the anomaly does not lie in the advantage of managing a low risk portfolio. Rather, it is the *dis*advantage of some investors who are searching for optimal high-risk portfolios under constraints that creates the distortion in realized net performance.

Two types of explanations exist that are not mutually exclusive for this curbed relationship between net-of-fee equity long/short funds' Sharpe ratios and volatilities. Realizing that they enjoy a privileged position, hedge fund managers might voluntarily not transfer as much performance to their investors as they would under a perfectly competitive framework. Because of their restrictions, most investors cannot apply arbitrage to this anomaly, and they have no effective defense against this behavior.

Another explanation is related to the remuneration of the service delivered by hedge funds beyond their ability to generate alpha. In fact, short selling restrictions have important consequences for the asset management industry. Boehmer and Wu (2013) use high-frequency data to demonstrate the important role played by short sellers in the price discovery process and informational efficiency in financial markets. Sorensen et al. (2007) show that short selling constraints lead to sub-optimal asset allocation and higher idiosyncratic risk. Clarke et al. (2002) use a simulation analysis to estimate the cost induced by short selling restrictions. Jacobs and Levy (2007, 2013) demonstrate the importance of short selling in active portfolio management and the need to account for leverage risk aversion in a mean-variance portfolio optimization. Recent literature has shown that such a constrained and sub-optimal situation might create a low volatility anomaly where safer assets tend to outperform on a risk-adjusted return basis (Asness, Frazzini and Pedersen, 2012). If this explanation held true, then part of a hedge fund manager's fee would represent a form of compensation for her contribution to the well-functioning of the asset management industry.

Both interpretations, either the extraction of a situational rent or the compensation for enhancing the functioning of markets, are valid. Regardless of which one prevails, however, the evidence of a clear link between long/short equity hedge fund risk levels and net-of-fee Sharpe ratios has deep implications regarding the functioning of the asset management industry. First, this link contributes to the resolution of the low volatility puzzle by associating the lower performance of riskier investment strategies, at least in part, with the performance rent captured by the least constrained investors.

From this point of view, we should talk about a “high volatility anomaly”. Second, it suggests that the borrowing and short sales restrictions imposed (internally or externally) on asset managers restrain competition. Such restrictions lead to transfer value to actors who can escape them. The extra fee of high-risk funds is not entirely returned to shareholders. Less tight benchmarking, wider mandates regarding risk budgets, and more flexible regulations might contribute to improving the competitive landscape at the benefit of individual investors, to whom a larger fraction of the fund performance could be returned.

A framework for understanding long/short hedge fund performance

Background

In the context of Markowitz’s (1952) Modern Portfolio Theory, the total risk of each portfolio is measured by the standard deviation (volatility) of returns, and the expected return reflects the portfolio value creation. Using this risk-expected return framework, the efficient frontier represents the concave and increasing curve, plotting each combination of assets that cannot be simultaneously dominated by any other on both the risk and return dimensions. The Capital Asset Pricing Model (CAPM) of Sharpe (1964), Lintner (1965) and Mossin (1966) assumes that every rational and risk-averse investor invests along a tangent line of the efficient frontier whose intercept is the risk-free rate. The tangency portfolio is called the market portfolio. To reach a portfolio with higher volatility, investors should apply leverage to this market portfolio rather than overweighting their portfolio with high-volatility stocks. This two-fund separation theorem, a fundamental result derived by Tobin (1958), dissociates the investment decision (i.e., acquisition of the market portfolio) from the financing decision by combining this market portfolio with the riskless asset. Such a result entails a linear relation between volatility and the expected return of portfolios held at equilibrium, whose equation is given by the Capital Market Line (CML). Consequently, every optimal portfolio located along the CML has the same reward-to-variability ratio (i.e., the slope of the CML).

For the two-fund separation theorem to hold for every investor, one key assumption underlying the CAPM must be met: the investor's ability to lend and borrow without limitation at the same risk-free interest rate. Blume and Friend (1973) show that an investor with a higher borrowing than lending rate only has access to a curvilinear mean-variance space, and several efficient portfolios can be held at equilibrium. For such a constrained investor, the CML is not unique. Two portfolios can be distinguished: one that involves lending (at a low loan rate) and one that involves borrowing (at a higher funding cost). The former delivers a superior risk-to-variability ratio than the latter. Ex-post, this will also lead to higher average Sharpe ratios when they are measured with realized returns.

Despite this natural and intuitive result, Brennan (1971) claims that "*one is inclined to wonder whether this curvilinearity could not be arbitraged by a few privileged investors with borrowing rates equal to the lending rate*" (p. 1198). He shows that when *different* investors have *different* borrowing and lending rates (thus some being favored over others), a version of the CAPM still holds. The equilibrium expected rates of return of securities are linear functions of the return of a single value-weighted portfolio. The asset pricing equation that he obtains is similar to Black's (1972) so-called "zero-beta" version of the model.

Brennan's point about equilibrium rates of returns is important: the CAPM still holds in this context. This is confirmed by Black (1972), who shows that low-beta assets outperform high-beta assets on a risk-adjusted basis. His findings lend support to his (and, thus, Brennan's) version of the model. Frazzini and Pedersen (2014) find similar evidence in the bond markets as well as international stock markets. At the same time, the equilibrium relation coexists with the fact that restricted investors do not have access to the same equilibrium portfolios as the unconstrained investors.

This dive into the history of finance research underlines a portfolio management issue that is alive and well. According to Frazzini and Pedersen (2014), leverage restrictions explain why investors tend to overweight high volatility stocks to achieve a target high risk-return tradeoff. The consequences are twofold. First, it explains the so-called low volatility anomaly and the tendency to favor risk parity strategies to redefine the tangent portfolio (Asness, Frazzini and Pedersen, 2012) exactly as anticipated by Brennan. Second, it suggests that in general, unsophisticated or financially constrained investors can only achieve an overall lower efficient frontier and a flatter CML than would be reachable when applying unrestricted leverage. The consequence is the emergence of arbitrage opportunities between low and high volatility stocks (Frazzini and Pedersen, 2014).

However, this discussion does not explain what occurs on the high end of the risk spectrum. Some people, despite the difficulty of achieving attractive reward-to-variability ratios, might still wish to trade off a high level of risk in exchange for the promise of a high expected return. After all, individual investors' risk profiles are heterogeneous, and many have a particularly high tolerance for risk, a particularly long investment horizon, or both. They desire for aggressive portfolio allocations, and might want to mandate professional asset managers to satisfy their objectives. What is, for them, the consequence of the coexistence of different sets of constraints in the asset management industry?

Investor categories

The theoretical background suggests that a financial market in which investors have unequal access to leverage potentially enables the most unconstrained investors to extract a rent from their funding advantage. We now translate this argument from a practical point of view into the context of the institutional asset management landscape.

The market for financial securities features three categories of investors. For the sake of simplicity, "*unsophisticated personal investors*" (henceforth UPIs) are fully constrained individuals in that they have neither access to short selling nor unlimited leverage at a reasonable cost (i.e., the risk-free rate).

At the other extreme, "*sophisticated institutional investors*" (SIIs) are fully unconstrained institutional asset managers. Here, we make a clear association with hedge funds, and in particular with their largest category (by historical standards): long/short equity hedge funds. In general, their managers' strategy lies in their superior ability to access any combination of long, short, and leveraged stock positions under the risk-return framework. Allocating long/short hedge fund managers to the category of sophisticated institutional investors is therefore a natural choice, and the fact that it represents a homogenous group is helpful from an empirical perspective.

Finally, "*unsophisticated institutional investors*" (UIIs) such as insurers, pension funds or mutual funds are somewhere in the middle between UPIs and SIIs. For this type of investor, gearing and short-sales constraints are less severe because of their easier access to financial markets than UPIs; however, they do not have the same investment possibilities because of mandate or regulatory restrictions as SIIs. They offer asset management products that are "unsophisticated", not because of any lack of skill or expertise but because their mission is to propose portfolios whose construction involves a limited degree of complexity to investors who are themselves mostly non-sophisticated (e.g., retail investors).

To keep this argument simple, all investors have access to homogenous information, and they are mean-variance rational risk averters. Institutional investors act as the agents of the individuals, with a contract whose remuneration is their management (and, if applicable, their performance) fee. Consistent with the CAPM, they attempt to select the portfolio achieving the best possible Sharpe ratio, regardless of its volatility level, because they can freely wander along the CML. By contrast, personal investors aim to maximize their expected utility consistent with their risk-tolerance level. To do so, they must choose between entering the agency relation or performing homemade (constrained) risk-return optimization with different lending and borrowing rates.[i]

Performance sharing under the constrained CAPM

Long/short equity hedge fund managers can shift the efficient frontier to the left by combining long and short positions (i.e., implementing double alpha strategies). Jank and Smajlbegovic (2015) showed that hedge fund managers, as the least constrained investors, "bet against beta" and short sell high-beta stocks. Because they can directly offer high volatility portfolios to individuals with low-risk aversion, they compete with constrained institutional asset managers and individuals on the high-risk segment. Their greater access to leverage through better gearing possibilities and unrestricted short sales grants them the possibility to increase their fees to the point where their net-of-fee Sharpe ratio equals that of their competitors. The arbitrage profit that they can extract is represented in Figure 1.

< Insert Figure 1 >

Figure 1 illustrates the shortfall of the Sharpe ratio achieved by UPIs, who are the fully constrained long-only investors. Their mean-variance efficient frontier lies below that of the fully unrestricted SII, and their CML is flatter on the upper portion because of higher borrowing costs versus the leveraged (dotted) portion of the straight line that continues the long-only CML, starting from the risk-free rate (Friend and Blume, 1973). The advantageous situation of the equity long/short hedge fund managers (belonging to the SII group) over UPIs entails that their net-of-fee Sharpe ratio exceeds one of the long-only efficient frontiers. This implication is the first testable aspect of our framework.

Next, consider UIIs. These are the investors who are in the middle of the asset management spectrum. They comply with a mandate that is much narrower than that of hedge fund managers. In terms of investment opportunities, this translates into two limitations. First, it is impossible for them to obtain full access to short sales. We should therefore locate their opportunity set somewhere between the long-only and the long/short efficient frontier. Second, although they can leverage their portfolio to a certain extent, they face restrictions (e.g., borrowing cap and growing interest rates) that progressively reduce their risk-return trade-off with the level of portfolio risk, leading the relation between expected returns and volatility to become increasingly concave rather than linear. The constraints faced by UIIs with regard to short sales and gearing restrict their achievable performance to the constrained long/short Capital Market Curve (CMC) depicted in Figure 2.

< Insert Figure 2 >

Because they compete with traditional asset managers from the mutual fund industry, hedge fund managers have no incentive to transfer the full performance of highly volatile funds to their investors. If no leverage or short sales restrictions existed, then low and high volatility funds should deliver the same Sharpe ratio just by moving along the efficient line. Although a constant Sharpe-volatility relation might hold at the gross returns level, the constraints placed on UIIs permit hedge fund managers to charge higher fees. This effect induces a negative relation between the net-of-fees Sharpe ratios offered to final investors and the level of volatility achieved by the fund.

A comparison of Figures 1 and 2 reveals an *a priori* undetermined comparison between the slopes of the unconstrained long-only CML (Figure 1) and the constrained long/short CMC (Figure 2). When volatility becomes large, the constraints affecting the high-risk mutual funds of UIIs might be so strict that they make it impossible for them to beat even the leveraged market portfolio. As such, the unconstrained long/short funds of SIIs might stand in a position to charge even higher fees beyond a certain volatility level. Given this reasoning, fund managers who take higher risks can charge higher fees. Thus, not only is the relation between the fund's risk and its net-of-fee (risk-adjusted) performance likely to decrease, but it is also presumably concave. This negative and concave relation between net performance and volatility is the second testable implication of our framework.

Eventually, our story entails that we find an associated positive relationship between a hedge fund's volatility and its level of fees. Taken in isolation, the positive relationship between volatility and management, performance, or both types of fees does not represent evidence *per se* of a rent extraction mechanism. For instance, this effect might be explained by the fair compensation for higher operational risks induced by higher leverage or by the larger cost of risk management for highly leveraged funds. However, it would then go along with a concomitantly higher gross performance that justifies the cost or the risk premium. By contrast, if we also find a relation between volatility that is simultaneously negative with the net-of-fee Sharpe ratio and positive with the fee level of hedge funds, then it is unlikely to be a coincidence. This finding would represent, in our view, substantive evidence of a voluntary shift in the sharing of gross performance between SII hedge fund managers and USI individuals to the benefit of the former.

To summarize, the hypothesis that high-risk, fully unconstrained equity long/short hedge fund managers extract a rent from their favorable situation will be supported if we observe three phenomena simultaneously:

- Their net-of-fees Sharpe ratios are higher than those of long-only portfolios
- Their net-of-fees Sharpe ratios decrease (more than proportionally) with their volatilities
- Their management, performance, or both types of fees increase with their volatilities

The next section offers empirical evidence to support our conjectures.

Empirical evidence regarding individual funds

Data

We use data for individual hedge funds between March 1997 and October 2012 from Lipper Tass. We require the funds to report their performance over at least 36 months, with a minimum of 2 reporting Net Asset Value (NAV), i.e., at least one return. From 3,911 funds, we eliminate 1,171 without sufficient data to perform the analysis. Our final sample includes 1,938 hedge funds, after further excluding funds that did not report USD net-of-fees NAV from the analysis. Data on the market portfolio (denoted *M*) were retrieved from K. French's data library.

< Insert Table 1 >

Table 2 displays the descriptive statistics for the defined variables. Each variable is measured at time t on a window of 36 lagged observations, leading to a panel size of 1,938 hedge funds x 152 three-year windows = 294,576 potential observations.

< Insert Table 2 >

Table 2 shows a strong enhancement effect (provided by long/short equity funds) over the Sharpe ratios of long-only investments. Although the Sharpe ratio and the volatility of the benchmark are stable over this period, these measures vary strongly for the individual hedge funds included in our sample. The distribution of the individual Sharpe ratio over time is skewed to the left with occurrences of poor Sharpe ratio values. Management fees and performance fees range by 100 and 200 basis points, respectively, across time and funds.

Long/short equity vs. long-only Sharpe ratios

To examine whether individual long/short equity hedge funds significantly outperformed the long-only efficient frontier across time, we carry out a linear regression (without an intercept) of the estimated Sharpe ratios for each of the 1,938 funds against the Sharpe ratio of the market portfolio:

$$S_{j,t} = \theta_{j1} S_{M,t} + \epsilon_{j,t} \tag{1}$$

where $\epsilon_{j,t}$ = an error term for the individual fund j at month t. The risk-free rate corresponds to the 1-month T-Bill return from Ibbotson and Associates, Inc., as downloaded from French's data library.

We observe that the "Sharpe ratio multiplier" (coefficient θ_{j1}) is significantly positive for 1,116 funds (out of 1,938) but significantly negative for only 218. Figure 3 shows the distribution of funds according to the level of the Sharpe multiplier. The multiplier is standardized because it corresponds to the t-stat of the coefficient on the benchmark's Sharpe ratio in equation (1).

< Insert Figure 3 >

The histogram of the Sharpe multiplier is right-skewed, which confirms the leverage effect of the Sharpe ratio for the large number of individual funds. However, the average cross-sectional coefficient among the 1,938 funds is equal to 2.93 with a t-stat of 1.49, which is not significant at the usual confidence threshold. Thus, Figure 3 suggests that although the *number* of outperforming funds is much larger than that of underperforming funds, the *magnitude* of this outperformance is not overwhelming.

Long/short equity Sharpe ratios and volatilities

The mixed support that we find for equation (1) calls for further investigation. From a performance sharing perspective, the superiority of their riskier investment set enables SIIs to extract a higher rent from their position, thereby reducing their net-of-fee Sharpe ratio. As such, we include the funds' and market risk levels in the analysis by extending the linear regression of equation (1) to include the following volatility levels:

$$S_{j,t} = \theta_{j1} S_{M,t} + \theta_{j2} \sigma_{j,t} + \theta'_{j2} \sigma_{M,t} + \epsilon_{j,t} \tag{2}$$

To support our conjecture of an inverse relation between fund volatility and performance, we expect θ_{j2} to be negative. Applying equation (2) to individual long/short equity fund data, we show that the relation between a fund's Sharpe ratio and its return volatility is significantly negative for 857 funds but significantly positive for 412 funds. Figure 4 illustrates the left-skewed distribution of the Sharpe-volatility relation.

< Insert Figure 4 >

The average cross-sectional coefficient among the 1,938 funds is equal to -1.92, with a t-stat of -11.99. Evidence strongly supports a negative relation between individual funds' Sharpe ratios and their volatility across time.[ii]

Fund fees and volatility

The third piece of evidence that would support the performance sharing hypothesis is the direct positive connection between fee levels and volatilities. This effect is simply measured on a fund-by-fund basis using equations (3) (for performance fees) and (4) (for management fees):

$$Pfee_{j,t} = \theta_{j3} \sigma_{j,t} + \epsilon_{j,t} \tag{3}$$

$$Mfee_{j,t} = \theta'_{j3} \sigma_{j,t} + \epsilon_{j,t} \tag{4}$$

A positive coefficient for equation (3) would be particularly in line with our explanation of rent extraction because the performance fee measures a fraction of the excess return over the hurdle rate, regardless of its level or the riskiness of the fund. However, equation (4) might also reveal that the manager artificially inflates her fixed fee level in addition to the variable rate as a way to "spread" the rent throughout both components of the remuneration. The evidence of a simultaneous positive effect of volatility on both the performance and management fees is consistent with the manager's attitude of deliberately raising her share of performance more proportionally than her efforts to generate it.

The relation between performance fees and volatility is positive among 469 of the 1,938 funds (compared with 203 funds showing a negative relation). Figure 5 shows the slight positive skewed distribution of the relation between volatility and performance fee.

< Insert Figure 5 >

The average cross-sectional coefficient among the 1,938 funds is equal to 0.738, with a t-stat of 11.63, which supports a strong positive relation between performance fee and volatility.

The relation between management fees and volatility is significantly positive among 544 of the 1,938 funds (compared with 270 funds showing a negative relation). Figure 6 displays the slightly positive skewed distribution of the relation between volatility and management fees. The average cross-sectional coefficient among the 1,938 funds is equal to 0.858, with a t-stat of 9.90. Again, this result supports a strong positive relation between management fees and volatility.

< Insert Figure 6 >

Aggregate evidence on panel data

While fund-by-fund analysis enables us to detect relations that would be broadly shared across the market, the large heterogeneity of the funds in the sample does not allow us to draw systematic evidence at the market-wide level. We thus aggregate our data into a panel and perform fixed-effect regressions. Evidence obtained with such analysis would enable us to identify common effects that correspond to a global market phenomenon.

Regarding the link between long/short equity and long-only Sharpe ratios, equation (1) remains essentially unchanged but with a single coefficient that applies for all funds:

$$S_{j,t} = \theta_1 S_{M,t} + \epsilon_{j,t} \tag{5}$$

As before, we can interpret coefficient θ_1 in the regression as the "Sharpe ratio multiplier" (i.e., a multiplier of the long-only portfolio performance).

Using the panel data, the treatment of the relation between long/short equity Sharpe ratios and volatilities differs from that performed with individual funds. Starting with equation (2), we obtain equation (6). Next, equation (7) adds a potentially nonlinear relation between the Sharpe ratio multiplier and the level of volatility:[iii]

$$S_{j,t} = \theta_1 S_{M,t} + \theta_2 \sigma_{j,t} + \epsilon_{j,t} \tag{6}$$

$$S_{j,t} = \theta_1 S_{M,t} + \theta_2 \sigma_{j,t} + \theta''_2 S_{M,t} 1_{\sigma > 1.4\%} + \epsilon_{j,t} \tag{7}$$

The last term of equation (7) introduces a dummy variable that equals 1 if the fund's monthly volatility exceeds 1.4% and 0 otherwise. The volatility threshold is defined empirically (see below). This equation enables us to simultaneously test whether a fund's Sharpe ratio decreases with volatility (coefficient θ_2), and whether it does so in a more pronounced way when the fund's volatility becomes high (coefficient θ'_2), as suggested in Figure 2.

Finally, the tests for the positive relations between fee levels and volatilities are directly derived from equations (3) and (4) in the panel context:

$$Pfee_{j,t} = \theta_3 \sigma_{j,t} + \epsilon_{j,t} \tag{8}$$

$$Mfee_{j,t} = \theta'_3 \sigma_{j,t} + \epsilon_{j,t} \tag{9}$$

Table 3 displays the results of panel equations (5) through (9), estimated with fixed effects.

< Insert Table 3 >

According to equation (5), equity long/short funds present an average performance multiplier of approximately 4 times the performance of the benchmark as measured by the Sharpe ratio. This finding broadly confirms the relevance of our framework.

To gather more insight into the evolution of the Sharpe ratio multiplier with fund risk, we re-run equation (5) conditional with volatility breakpoints, starting with observations for which 1% < $\sigma_{j,t}$ ≤ 1.1%, then when 1.1% < $\sigma_{j,t}$ ≤ 1.2%, and so on. Figure 7 illustrates the negative effect of volatility on the Sharpe multiplier.

< Insert Figure 7 >

The leveraged performance is high for low levels of volatility but vanishes as the volatility of the fund increased. A substantial drop is observed between 1.25 and 1.5% volatility, and an even greater one is observed between 1.5 and 1.75%. We observe a threshold in the Sharpe ratio multiplier equal to 4 for these levels of volatility. This finding suggests that the tendency of hedge fund managers to capture a higher share of performance is expected to be more pronounced above a certain threshold.

According to panel equation (6), there is a significant negative relation between the Sharpe ratio of a long/short fund and its volatility: θ_2 is significantly negative at the 99% confidence level. However, the relation between the funds' Sharpe ratio and their volatility is non-linear (concave; see Figure 8 below), where equation (6) is re-estimated based on conditional volatility breakpoints.

< Insert Figure 8 >

Figure 5 shows a U-shaped relation between long/short equity hedge funds' Sharpe ratios and their volatility levels. The negative link between net performance and risk is graphically supported for a level of volatility beyond 1.15%. Beyond this threshold, the relation becomes negative, although the amplitude of the negative relation between the performance of the fund (as measured via the Sharpe ratio) and its volatility decreases in absolute values for volatility levels above 1.4%.

This observation of a U-shaped behavior explains why we use a threshold of $\sigma_{j,t} = 1.4\%$ for the binary variable in equation (7). The results of this regression, after controlling for fund volatility, clearly show a kinked relation in the Sharpe multiplier for levels of monthly volatility greater than 1.4%. The multiple of performance is the highest for volatility levels lower than this threshold at a level of 5.3x.

Finally, fund managers' tendency to increase their remuneration with risk level is confirmed using the coefficient estimates in equations (8) and (9). Thus, taken together, the evidence from the various panels shows that riskier funds deliver lower net performance but extract higher fees on average.

Conclusions: As in nature, finance abhors a vacuum

Based on the seminal work regarding the CAPM with leverage restrictions, we conjectured in this paper that fund managers who are not subject to constraints on short sales or borrowing conditions (e.g., the majority of long/short equity hedge funds) are in a position to extract a "rent" from their investors. This rent becomes larger as the fund's risk level rises, and it is extracted in the form of performance, management, or both types of fees. Without disregard for the low volatility puzzle emphasized in the literature, we uncover a "high volatility puzzle" in the asset management industry and provide a credible explanation for this effect.

Our dataset of 1,938 funds provides clear support for a high volatility anomaly in long/short equity hedge funds. We relate this anomaly in after-fee returns to the institutional investors' leverage restrictions and equity long/short managers' fee practices. Our empirical evidence shows that although equity long/short hedge fund managers offer to leverage the performance of traditional passive portfolios, they do not transfer the full added value of their expanded efficient frontier. This decision creates a negative relation between the net-of-fee Sharpe ratios of equity long/short funds and their volatility levels.

The natural explanation for this diverging evolution between decreasing risk-adjusted net returns and increasing fees is voluntary. Because some investors demand high-risk portfolios, hedge fund managers who are able to deliver them at the lowest costs have no reason to give away more return than they need (i.e., what is necessary to protect their position from more constrained asset managers). As in the natural world, the finance profession abhors a vacuum: as long as an appetite exists for high-risk portfolios, the least constrained managers have incentive to align their net-of-fee returns to what their peers can achieve and keep the surplus for themselves. In this sense, aggressive long/short equity fund managers contribute to the completion of portfolio offerings on financial markets, and a portion of their fees compensate them for this service.

Obviously, the length of our sample time window indicates that this phenomenon is neither new nor short-lived. If one wants to shift the bargaining power to the final individual investor, then constraining hedge fund managers to reduce their performance and management fees does not appear to be a workable solution. First, hedge funds are, by definition, more loosely regulated than mutual funds are; thus, the former can achieve higher returns for high risk. Imposing strong limitations on their fees would be in total opposition with their *raison d'être*. Second, this solution would be the wrong way to address this problem. The problem is much less about hedge funds benefitting from a strong position than about mutual funds suffering from a weak one. Our paper emphasizes that preventing a level-playing field for the high-risk segment of the asset management spectrum generates inefficiencies and that eventually, it is the individual investor who pays for it. Evolving toward a lift of constraints imposed on traditional asset managers while still offering strong protections to retail investors (e.g., through efficient risk management and more transparency) would undoubtedly help enhance the risk-return trade-off for investors, which should ultimately be the goal of asset management professionals.

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Endnotes

[i] Brennan (1971) shows that borrowing restrictions lead to the same type of results. Therefore, we use differential interest rates for simplicity.

[ii] Note that the individual fund-by-fund regression does not allow us to investigate the concavity of the relation between hedge fund Sharpe ratios and volatilities.

[iii] The market volatility variable is removed from the equation because of the introduction of fixed effects in the panel regressions.

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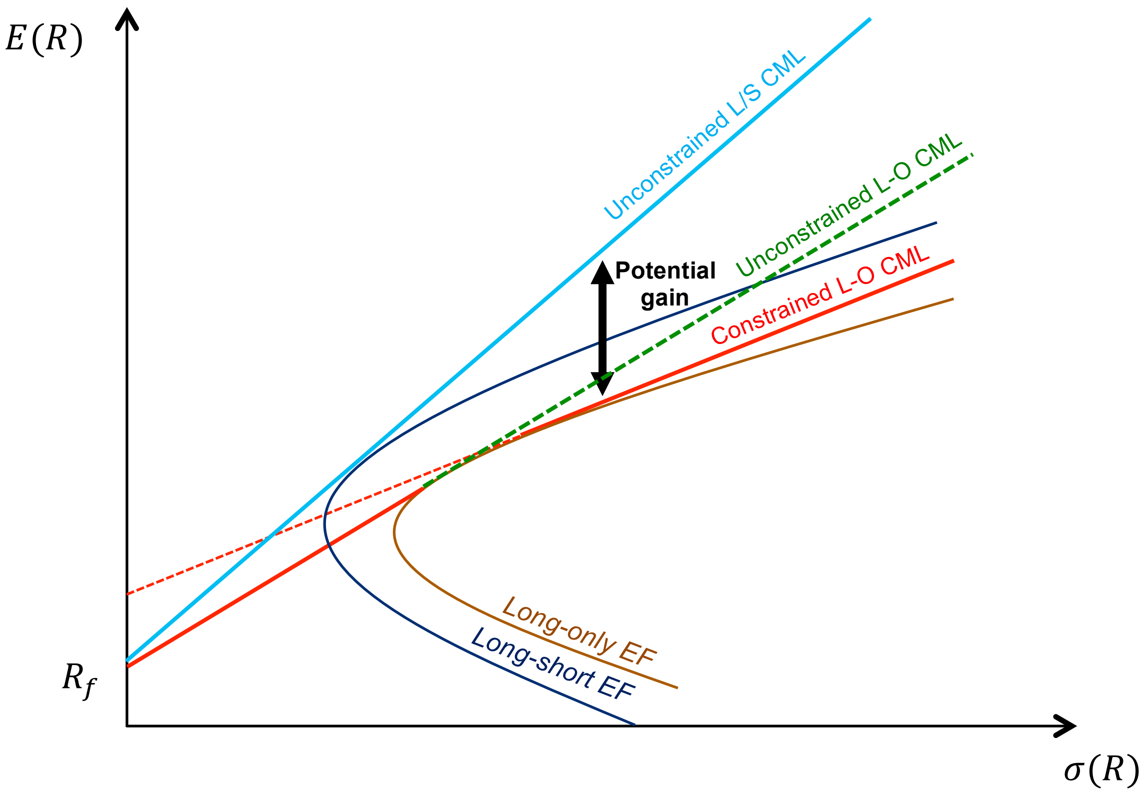

Figure 1 – The Capital Market Line (CML) under leverage and short sales constraints

Figure 1 illustrates the Efficient Frontier (EF) and Capital Market Line (CML) for constrained long-only investors (respectively the brown and red curves). The green line displays the unconstrained long-only (L-O) CML. Finally, the Efficient Frontier (EF) and Capital Market Line (CML) for unconstrained long-short investors are depicted by the blue curves. $E(R)$ stands for expected return, $\sigma(R)$ for volatility, R_f for the risk-free rate.

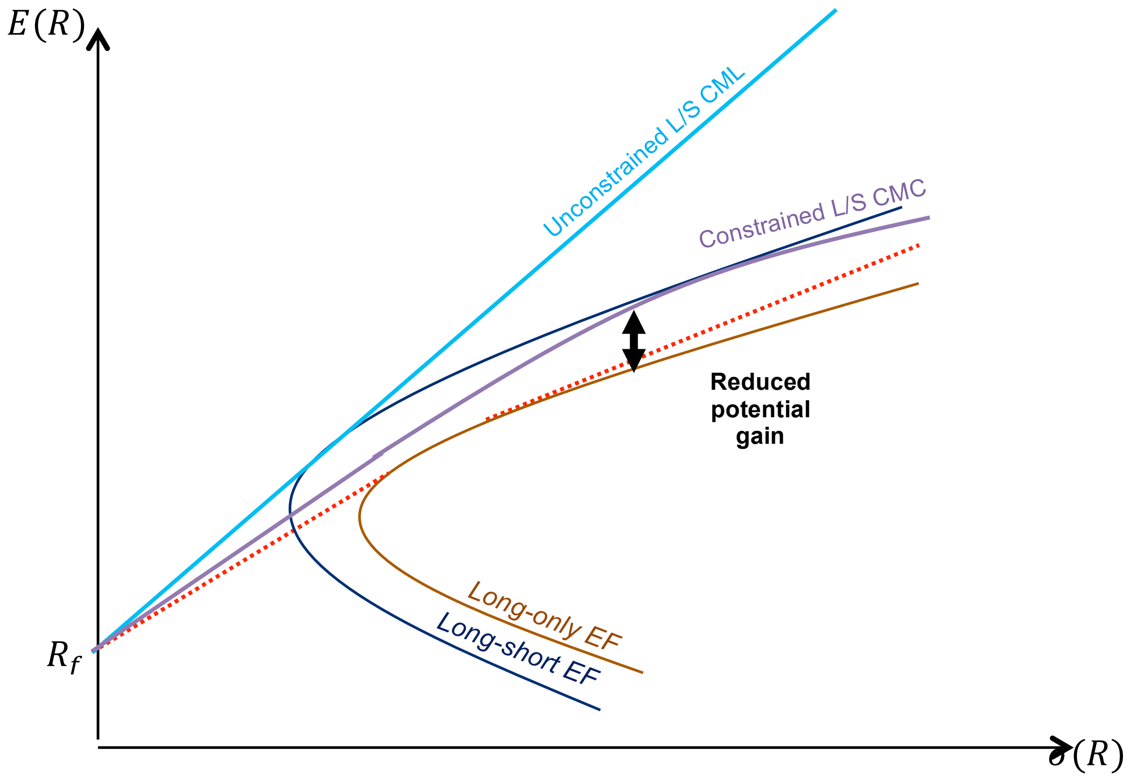

Figure 2 – The Capital Market Curve under partial leverage constraints

Figure 2 illustrates the Efficient Frontier (EF) and Capital Market Curve (CMC) for constrained long-short investors compared to the unconstrained long/short (L/S) Capital Market Line (CML). $E(R)$ stands for expected return, $\sigma(R)$ for volatility, R_f for the risk-free rate.

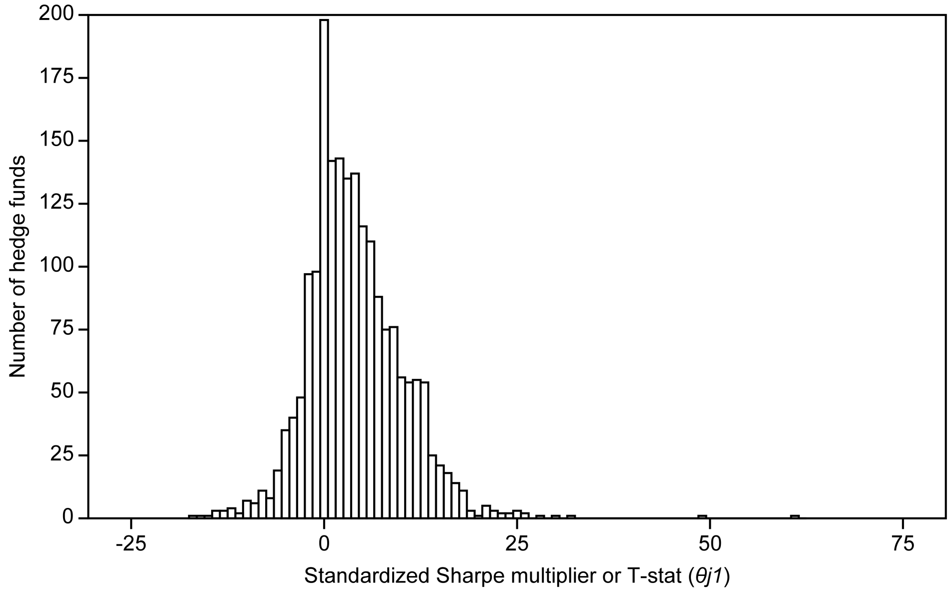

Figure 3 - Histogram of Sharpe multiplier (standardized)

Figure 3 displays the distribution of the standardized Sharpe multiplier, i.e. T-statistics of coefficient θ_{j1} from Fund Equation (1).

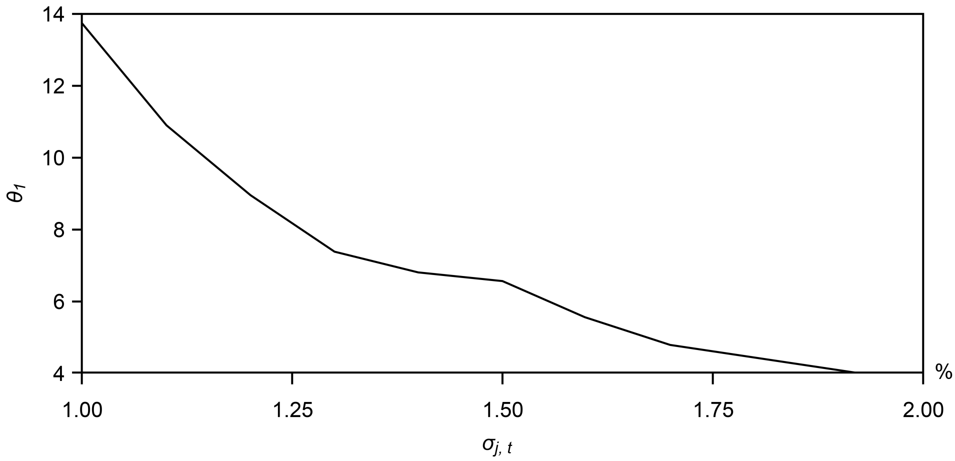

Figure 4 - Conditional evolution of Sharpe multiplier on fund volatilities

Figure 4 depicts the evolution of the Sharpe multiplier conditional on fund volatility. The coefficient is estimated by Panel regression (1).

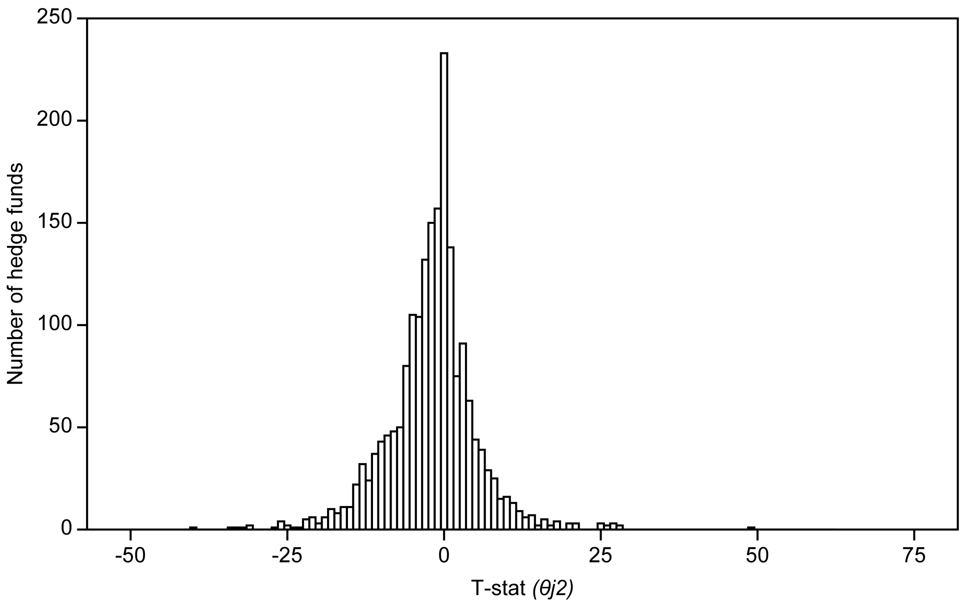

Figure 5 - Histogram of the Sharpe/volatility relationship.

Figure 5 displays the distribution of the T-statistics of coefficient θ_{j2} from Fund Equation (2).

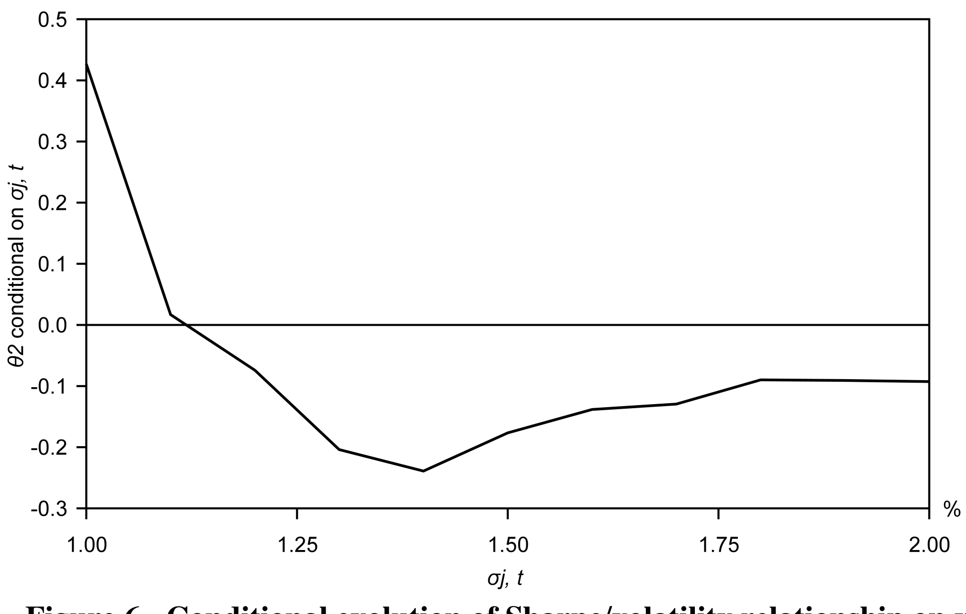

Figure 6 - Conditional evolution of Sharpe/volatility relationship on volatility breakpoints

Figure 6 depicts the evolution of coefficient θ_2 conditional on fund volatility. The coefficient is estimated by Panel regression (2).

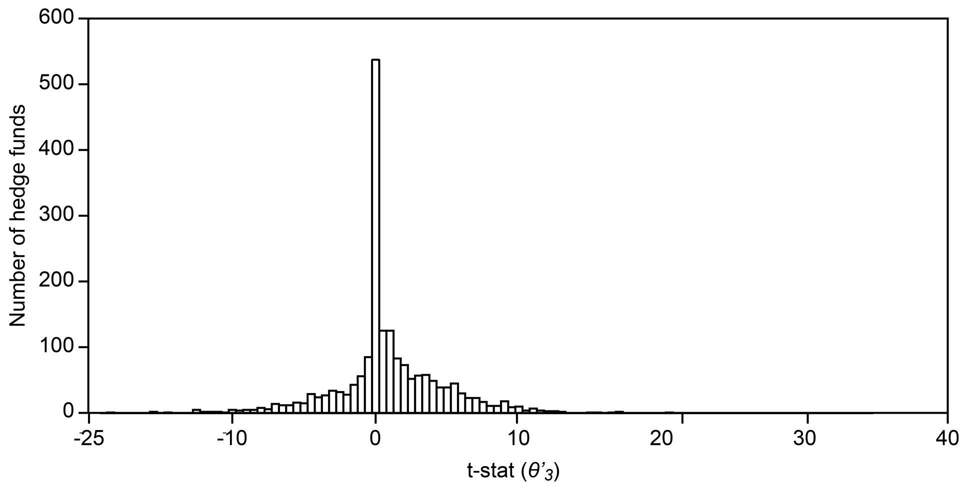

Figure 7 - Histogram of management fee/volatility relationship

Figure 7 displays the distribution of T-statistics of coefficient θ'_{j3} from Fund Equation (4).

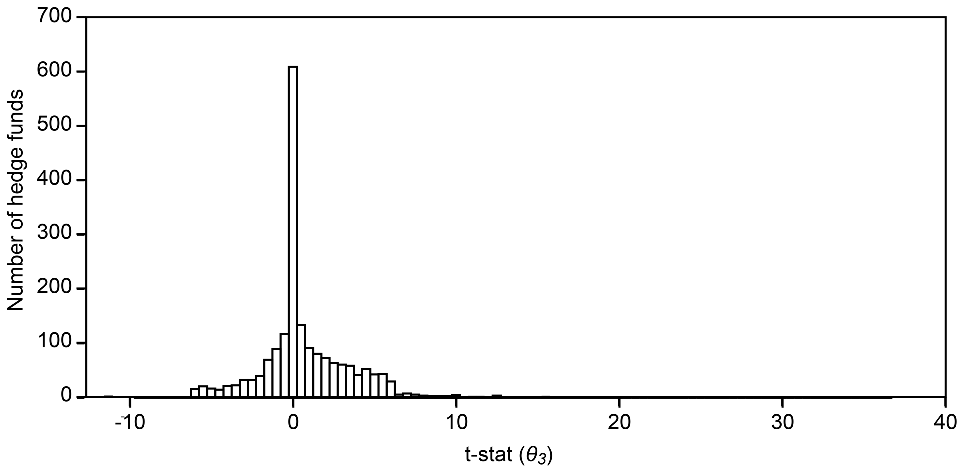

Figure 8 - Histogram of performance fee/volatility relationship

Figure 8 displays the distribution of T-statistics of coefficient θ_{j3} from Fund Equation (3).

List of Tables

Table 1. Definition of variables

$S_{j,t}$	Sharpe ratio of individual fund *j* computed at time *t* over the lagged 36 months
$\sigma_{j,t}$	Volatility of individual fund *j* computed at time *t* over the lagged 36 months
$S_{M,t}$	Sharpe ratio of the benchmark computed at time *t* over the lagged 36 months
$\sigma_{M,t}$	Volatility ratio of the benchmark computed at time *t* over the lagged 36 months
$mfee_{j,t}$	Management fee of the individual fund *j* at time *t*
pfeej,t	Performance fee of the individual fund *j* at time *t*

Table 2. Descriptive statistics of the fund variables across time and funds

	Mean (Sign. level)	Std. Dev.	Min.	Max.	# of observations (j,t)
$S_{j,t}$	0.1942^{**}	0.32%	-16,79	1,912	111,825
$S_{M,t}$	0.0074^{**}	0.06%	-0,3353	0,3401	364,344
$\sigma_{j,t}$	$4.685\%^{**}$	3.43%	0	47.22%	111,876
$\sigma_{M,t}$	$4.675\%^{**}$	0.37%	3.37%	7.95%	364,344
$Mfee_{j,t}$	$1.45\%^{**}$	0.50%	1%	2%	54,273
Pfeej,t	$19.31\%^{**}$	0.34%	18%	20%	54,273

Table 2 presents the descriptive statistics of the fund variables across time and funds (j,t). * stands for * for 5% significance level and ** 1% significance level

Table 3. Panel regressions

	(5)	(6)	(7)	(8)	(9)
Dep. var.	$S_{j,t}$	$S_{j,t}$	$S_{j,t}$	$Pfee_{j,t}$	$Mfee_{j,t}$
/Indep. var.					
$S_{M,t}$	4.006^{**} (0.0426)	3.8591^{**} (0.0421)	4.7237^{**} (0.1018)		
$\sigma_{j,t}$		-0.0177^{**} (0.0003)	-0.0175^{**} (0.0003)	0.0175^{**} (0.0011)	0.0344^{**} (0.0011)
$S_{M,t}1_{\sigma>1.4\%}$			-0.9417^{**} (0.1010)		
Model summary					
F-stat	84.08	88.05	88.12	7.09	51.44
(P-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2 (%)	60.15	59.84	60.18	17.85	64.30
Usable obs.	111,825	111,825	111,821	54,269	54,269
Df	109,885	109,885	109,884	52,330	52,330

Table 3 displays the estimated coefficients for panel regression represented by equations (5) to (9). Dep. (resp. Indep) var. stand for "Dependent" and "Independent" variables. Volatilities of the parameters are displayed in parentheses. *, ** indicate significance at the level of respectively 5% and 1%. *Df* stands for degrees of freedom, obs. for observations.