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The Volatility of Active Management

*“People who don’t take risks generally make about two big mistakes a year.
People who do take risks generally make about two big mistakes a year.”*

- Peter Drucker

EXECUTIVE SUMMARY

The long-term returns of active funds and their relationship to passive alternatives have been the subject of celebrated studies, famous bets, and endless debate. But returns are only one part of the picture; **proponents of active investing increasingly emphasize their capacity for *risk management***, as opposed to return generation.

This paper examines the merits of such claims, along with **how individual funds achieve higher or lower volatility than their benchmarks—and whether these tilts are persistent**. Our focus is on the volatility of mutual funds available across Europe and the U.S. The general record shows that:

- 1) Typically, active funds offered higher risk than comparable benchmarks—although not always and not in every fund category.
- 2) There is persistence in relative fund volatility, particularly for the most and least volatile funds.
- 3) The performance of high-volatility funds appears to stem from a bias toward higher-beta stocks.
- 4) The performance of low-volatility funds appears to be driven by large cash allocations.

We have relied on the extensive database built over 14 years and across four continents through S&P Dow Jones Indices’ S&P Index Versus Active (SPIVA[®]) Scorecards. This is the first time S&P Dow Jones Indices has published solely on fund volatility, but the subject has strong echoes in the studies of the performance of active funds provided in our global SPIVA Scorecards.

INTRODUCTION: THE ARITHMETIC OF RISK MANAGEMENT

Average fund risk is theoretically and practically different from average fund returns.

Since—as is standard—we shall use volatility of returns as an appropriate measure of risk, it is important to note the potential for average fund volatilities to show surprising behavior. **The arithmetic of active volatility is different, so to speak, from the arithmetic of active returns.**¹

In a general sense, volatility is similar to return: the volatility of a group of funds must be reflective of the universe in which those funds operate. But this comparison only goes so far, as managers overweight and underweight securities within their universe. For every active portfolio that overweights a certain stock, another active portfolio must be underweight. This argument is familiar in the context of active fund returns and usually concludes by observing that the average (capitalization-weighted) fund return is expected to match that of the benchmark, minus expenses. **The same is *not* true of volatility: it is possible for *all* active portfolios to be more volatile, or less volatile, than their composite portfolio (or benchmark).**

Funds may achieve higher volatility simply through **higher concentration**, which can lead to **lower diversification**. If all funds are reasonably concentrated, then the resultant lack of diversification makes it possible for every fund to be more volatile than its benchmark, even if the average fund is not biased towards more risky securities.²

It is possible for *all* active portfolios to be more volatile, or all to be less volatile, than the composite.

Conversely, it is a surprising fact that funds *can* share an average volatility that is *less* than that of their asset-weighted composite—a counterintuitive possibility given the principle of diversification. Intriguingly, the concept's very unfamiliarity may be a result of the rarity of persistent outperformance by active funds. A thought experiment, provided in Appendix A, illustrates how **the persistence of skill** might create such a scenario.

Of course, both fund return and fund volatility may be subject to variations that arise through the ownership of securities outside their stated benchmark. For example, most funds hold some allocation to cash or cash equivalents for operational purposes, and the amount held will affect both performance and volatility, as will, e.g., the propensity for U.S. domestic equity funds to hold some positions in international stocks.³ Excluding cash allocations, to the extent that such out-of-benchmark investing is prevalent, it may be understood as a form of fund **category misclassification**.

¹ William F. Sharpe describes the average returns for active investors in "[The Arithmetic of Active Management](#)," *Financial Analysts Journal*, January/February 1991.

² The potential impact of higher concentration on active portfolios is examined further in Edwards, Tim and Craig J. Lazzara, "[Fooled by Conviction](#)," July 2016.

³ See Constable & Kadnar, "[Is Skill Dead?](#)" GMO (2015) and in particular Exhibit 6, which suggests that the allocation to cash, international equities, and small-cap stocks may be sufficient to explain most mutual fund performances.

OBSERVED VOLATILITIES IN U.S. AND EUROPEAN MUTUAL FUNDS

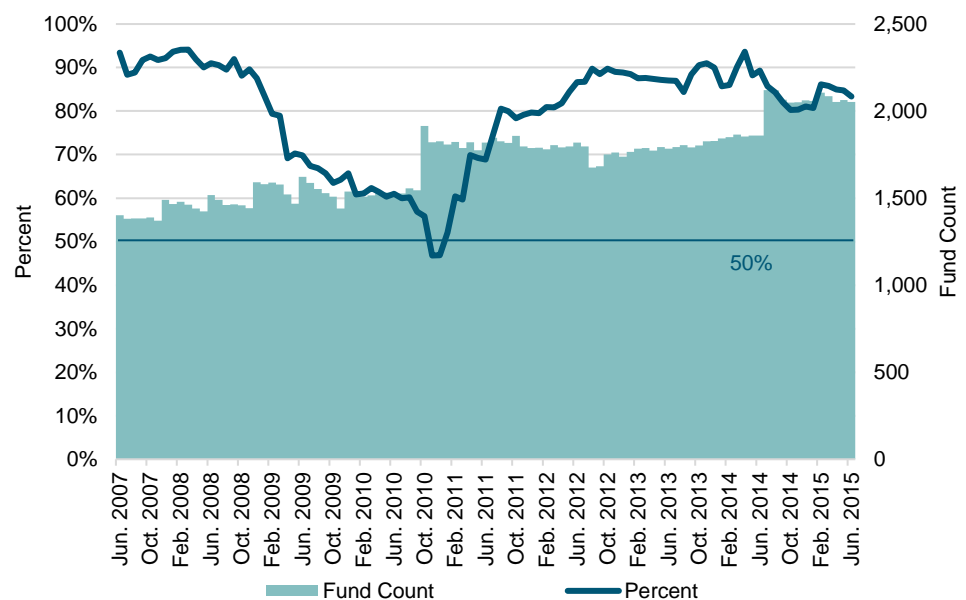
The underlying data for the following exhibits cover mutual funds available in Europe and in the U.S., with assets, fund categories, and performance sourced respectively from Morningstar Europe and the University of Chicago’s Center for Research in Security Prices (CRSP).

We “clean” the fund data to exclude leveraged and passive funds, and to ensure that only the largest share class of funds with multiple share classes is included.⁴ As in our SPIVA Scorecards, the initial data are free of “survivorship bias,” meaning we include those funds that were available at the start of the period even if they were liquidated or merged during the period of study.

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Exhibit 1 encompasses U.S. domestic funds (large cap, mid cap, small cap, growth, value, and broad) and shows the percentage of funds with volatility less than their category benchmark, as well as the number of funds included at each point in each of the five 24-month sample periods.⁵ We can easily perceive a general trend of higher fund volatility.

Exhibit 1: Percentage of U.S. Domestic Fund Categories With Higher Volatility Than Benchmark



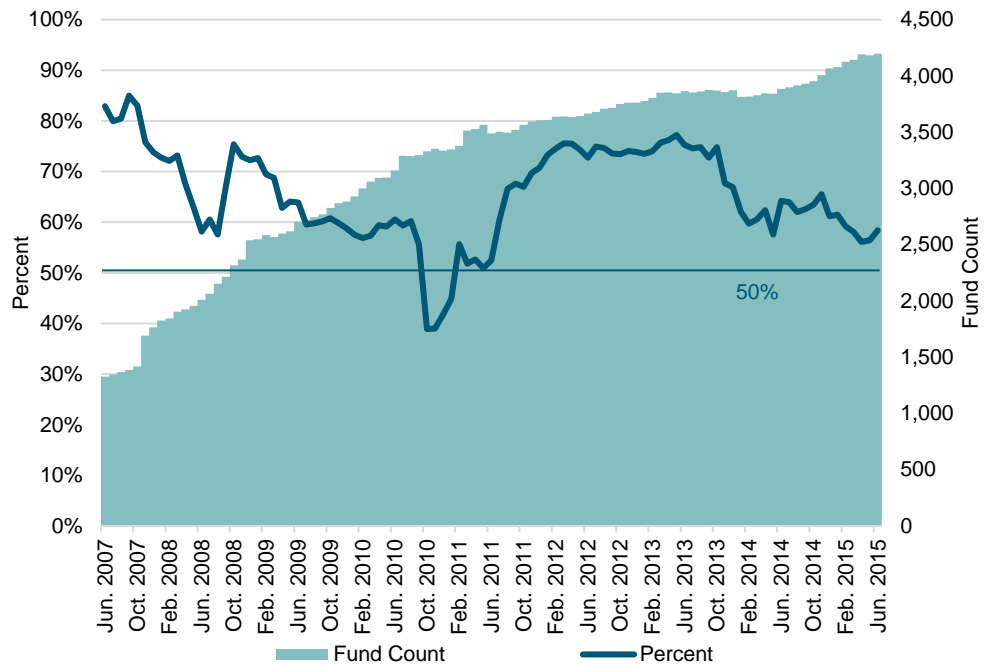
Sources: CRSP, S&P Dow Jones Indices LLC. Data from June 2007 to June 2015. Chart is provided for illustrative purposes. Past performance is no guarantee of future results. At the end of each month in the period, the monthly volatility of all funds with an extant two-year performance and unchanged style classification was compared to the volatility of their respective benchmarks. The percentage with higher volatility is plotted in the exhibit.

⁴ For further details, see the [SPIVA U.S. Scorecard Mid-Year 2015](#) and [SPIVA Europe Scorecard Mid-Year 2015](#).

⁵ A full list of fund categories, their benchmarks, and the respective volatilities in each of the five distinct 24-month periods included within this study is provided in Appendix B.

Exhibit 2 provides the same data for European funds, aggregated across the four largest categories: pan-European equity, U.K. domestic equities, global equities, and emerging market equities.

Exhibit 2: Percentage of Major European Fund Categories With Higher Volatility Than Benchmark



Over the full sample period, an average of 80% of U.S. funds and 65% of European funds demonstrated greater volatility than their category benchmarks.

Sources: Morningstar Europe, S&P Dow Jones Indices LLC. Data from June 2007 to June 2015. Chart is provided for illustrative purposes. Past performance is no guarantee of future results. At the end of each month in the period, the monthly volatility of all funds with an extant two-year performance and unchanged style classification was compared to the volatility of their respective benchmark. The percentage with higher volatility is plotted in the exhibit.

The record demonstrates that funds in both regions were more volatile than their benchmarks. Over the full sample period, an average of 80% of U.S. funds and 65% of European funds demonstrated greater volatility than their category benchmarks.⁶

Exhibits 1 and 2 demonstrate a similar pattern over time: a reduction in the fraction of more volatile active funds, which bottomed in November 2010, approximately two years (corresponding to the 24-month trailing volatility) after the worst of the global financial crisis. **This pattern is illustrative of several industry trends:** many of the more aggressive funds were discontinued in the aftermath of the crisis, as the fund industry launched newer, less risky, alternatives. The data are also consistent with reports, prevalent during the post-crisis period, that fund managers frequently held a higher allocation in cash and cash equivalents than theretofore typical.

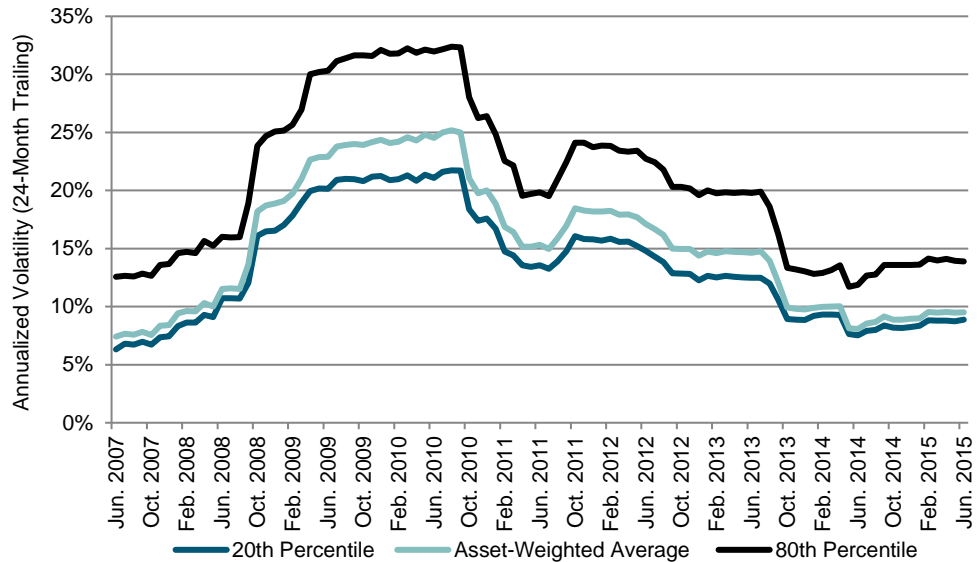
⁶ Note that there is a potential hidden factor in European funds: their superior record is potentially improved by currency hedging within multi-country funds, a subtlety not available to the U.S. domestic equity manager, and one that can act to reduce the volatility of international equity exposures.

FUND VOLATILITY RANGES

Exhibits 3 and 4 indicate the range of volatility levels among funds by plotting the trailing level of volatility required for a fund to be in 20th and 80th percentile rank among all funds. Exhibit 3 shows the inter-quintile range for all domestic U.S. funds, while Exhibit 4 shows the same for all pan-European funds.

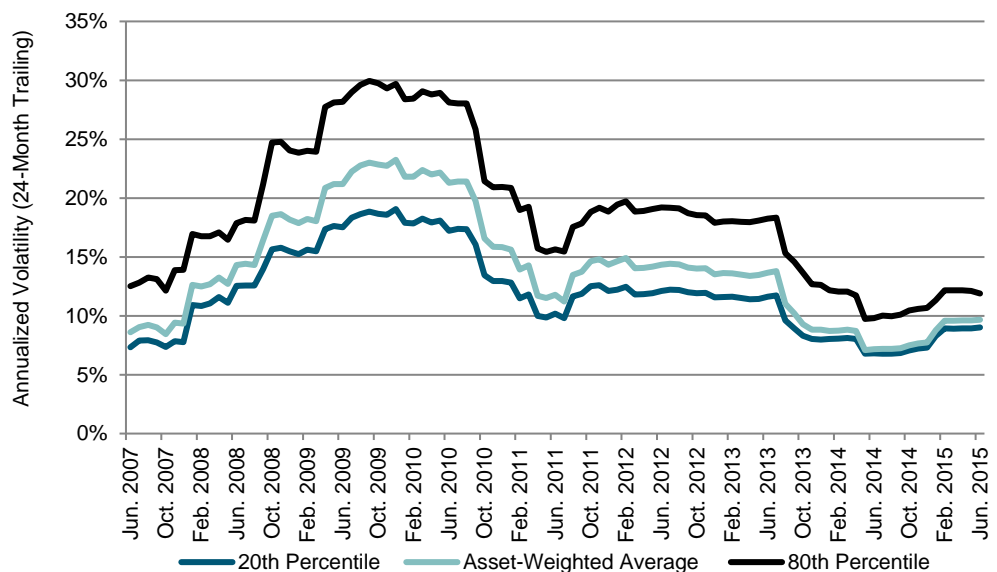
Exhibit 3 shows the inter-quintile range for all domestic U.S. funds, while Exhibit 4 shows the same for all pan-European funds.

Exhibit 3: U.S. Domestic Fund Category Volatility Ranges



Sources: S&P Dow Jones Indices LLC, CRSP. Data from June 2005 through June 2015. Chart is provided for illustrative purposes. Past performance is no guarantee of future results.

Exhibit 4: Pan-European Fund Category Volatility Ranges



Sources: S&P Dow Jones Indices LLC, CRSP. Data from June 2005 through June 2015. Chart is provided for illustrative purposes. Past performance is no guarantee of future results.

Exhibits 3 and 4 were constructed by considering the distribution of trailing two-year fund volatilities at each point in time. What the exhibits do not

show is whether the higher-volatility funds are a more-or-less random selection of (perhaps unlucky) funds, or whether there is a fairly fixed set of funds that are typically more (or less) volatile than their peers.

THE PERSISTENCE OF VOLATILITY RANKINGS

It is a well-documented fact (and an even more widely repeated aphorism) that past performance is a poor guide to the future returns of active funds.⁷ But what of fund volatility?

Exhibits 5 and 6 confirm that there is a strong tendency for fund volatility to persist. For example, 70% of U.S.-domiciled funds in the least volatile quintile in a given two-year period are in the two lowest volatility quintiles in the subsequent two-year period; 66% of the most volatile quintile stay in the two top-volatility quintiles. The European results are similar. Past performance may not predict future returns, but past volatility was a meaningful guide to the future volatility of active funds.

For purposes of comparison, if the ranking of funds by volatility were a random process, then all of the entries in Exhibits 5 and 6 would be around 20%. Conversely, if each fund always maintained the same volatility ranking among its peers, the entries in the transition matrices would be all zero except for the leading diagonal entries, which would all be 100%.

Past performance may not predict future returns, but past volatility was a meaningful guide to future volatility of active funds.

Exhibit 5: U.S. Mutual Fund Volatility Transition Matrix

		QUINTILE, SUBSEQUENT 24-MONTH PERIOD				
		1	2	3	4	5
QUINTILE, PRIOR 24-MONTH PERIOD	1	47%	23%	14%	7%	8%
	2	21%	29%	23%	16%	11%
	3	12%	22%	27%	24%	14%
	4	9%	14%	23%	31%	24%
	5	7%	12%	14%	23%	43%

Sources: CRSP, S&P Dow Jones Indices LLC. Fund-weighted average quintile transition matrix for the five consecutive 24-month periods from June 2005 through June 2015. Table is provided for illustrative purposes. Past performance is no guarantee of future results. All U.S. funds that reported returns and remained in the same fund classification any consecutive 24-month period were included in the sample.

⁷ According to the August 2016 edition of the [S&P Persistence Scorecard](#), out of 641 domestic equity funds that were in the top quartile as of March 2014, only 7.33% managed to stay in the top quartile by the end of March 2016. Furthermore, 8.50% of the large-cap funds, 3.26% of the mid-cap funds, and 0.68% of the small-cap funds remained in the top quartile.

Exhibit 6: European Mutual Fund Volatility Transition Matrix

		QUINTILE, SUBSEQUENT 24-MONTH PERIOD				
		1	2	3	4	5
QUINTILE, PRIOR 24- MONTH PERIOD	1	47%	22%	16%	9%	6%
	2	20%	32%	23%	18%	8%
	3	14%	22%	27%	23%	13%
	4	10%	13%	24%	25%	28%
	5	8%	7%	13%	25%	48%

Sources: Morningstar Europe, S&P Dow Jones Indices LLC. Fund-weighted average quintile transition matrix for the five consecutive 24-month periods from June 2005 through June 2015. Table is provided for illustrative purposes. Past performance is no guarantee of future results. All pan-European equity funds that reported returns and remained in the same fund classification any consecutive 24-month periods were included in the sample.

The data in Exhibits 5 and 6 are indicative of some, but not complete, persistence; the most and least volatile funds are particularly likely to stay that way.⁸

This is convenient, since it means that one may speak sensibly of such a thing as a volatile fund, or a low-volatility fund, and these can become interesting objects of study. The next section examines the characteristics of the most and least volatile funds in order to estimate what factors cause them to become more or less volatile.

HIGH- AND LOW-VOLATILITY FUND PORTFOLIOS

The most and least volatile funds are particularly likely to stay that way.

In order to examine the characteristics of funds that are persistently ranked at the extremes of volatility, we form two hypothetical fund portfolios as follows.

- The initial universe of funds was all U.S.-domiciled funds classified as either “U.S. all-cap broad” or “U.S. large-cap broad” with reported monthly returns and asset levels during the full sample period of June 2005 to June 2015.
- The “higher-volatility” funds were those with a full-period monthly volatility in the top 20% of all such funds.
- The “lower-volatility” funds were those with a full-period monthly volatility in the bottom 20% of all such funds.
- We constructed a return series for a hypothetical “higher-volatility fund portfolio” (HVFP) and a hypothetical “lower-volatility fund portfolio” (LVFP) via the monthly average returns of the higher- and lower-volatility funds, respectively.

In advance of our analysis, it is important to note that in the formation of the fund portfolios, there are both survivorship and “look-ahead” biases. The

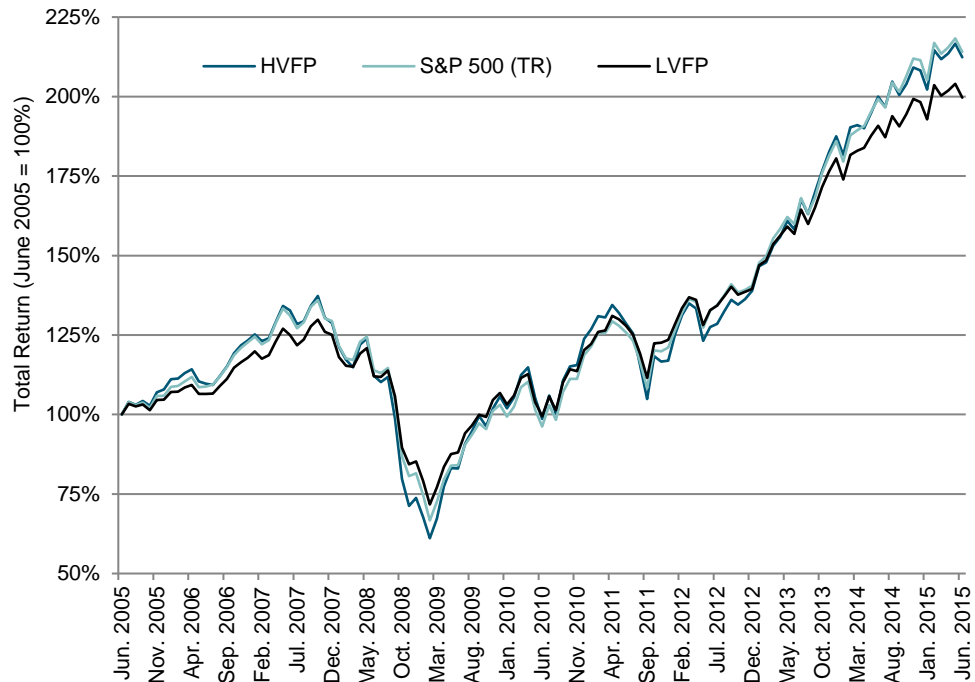
⁸ This is another contrast between risk and return. If *outperformance*, as opposed to greater volatility, were as persistent in funds, then it would be sensible to pick a manager simply based on a proven track record of outperformance.

“high-volatility” funds, for example, may be described as those that **survived and were more volatile over the whole period than other surviving funds.**

Exhibit 7 shows the cumulative total return for the HVFP and LVFP. Note that the volatility shown in the exhibit is for the *portfolio* of funds; it does not represent the average volatility of the component funds themselves.

Exhibit 7: HVFP and LVFP Performance

The LVFP slightly underperformed and followed an expected pattern: lagging in bull markets and outperforming in downturns.



Category	HVFP	S&P 500®	LVFP
Annualized Return)	7.82%	7.91%	7.16%
Annualized Volatility	17.2%	14.7%	13.2%
Beta	1.15	1.00	0.89
Correlation	1.00	1.00	0.99

Source: S&P Dow Jones Indices LLC, CRSP. Beta and correlation are to the S&P 500 (TR). Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

The LVFP slightly underperformed and followed an expected pattern: lagging in bull markets and outperforming in downturns. But the most surprising observation drawn from Exhibit 7 is **the near-identical performances of the HVFP and the S&P 500.**

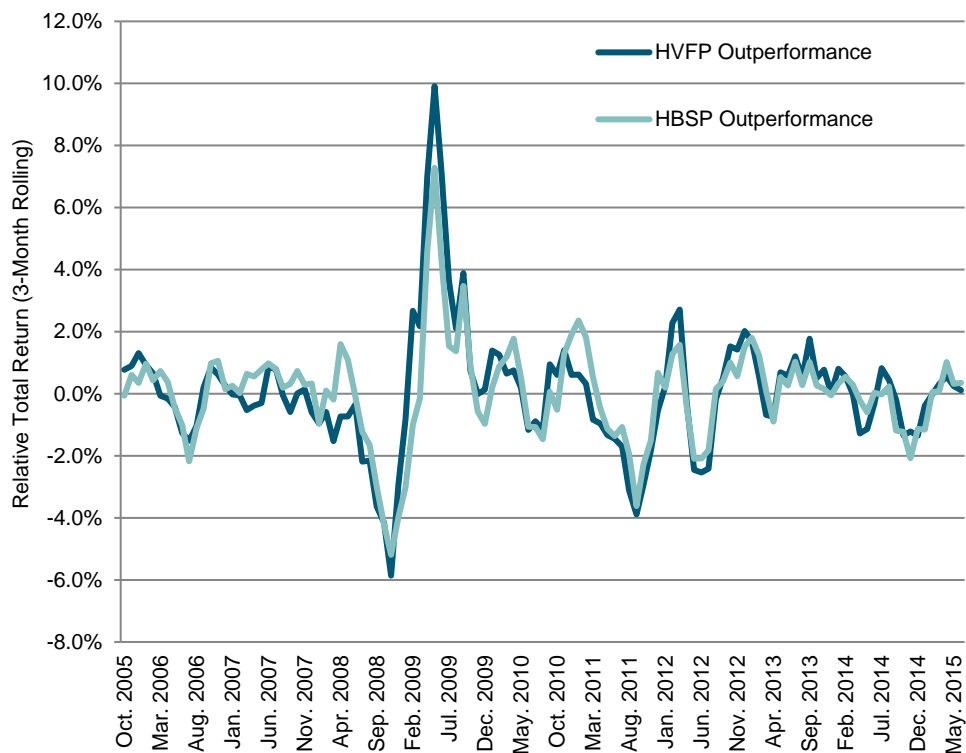
Although the three return series look quite similar overall, there are different mechanics operating in the HVFP and LVFP. We examine the higher-volatility funds first.

PROPERTIES OF HIGHER-VOLATILITY FUNDS

As shown in Exhibit 7, the HVFP demonstrated a market sensitivity (beta) equal to 1.15. Since we have excluded leveraged funds from the sample, it seems reasonable to speculate that **higher-volatility funds share an enthusiasm for higher-beta stocks.**

Exhibit 8 compares the quarterly performance of those funds to a hypothetical higher-beta diversified stock portfolio (HBSP) constructed via existing indices S&P DJI indices. (See Appendix C.) The two series match closely.

Exhibit 8: HVFP and HBSP Relative to the S&P 500



Lower-volatility funds are a simpler case, since a significant cash allocation alone explains their average return.

Sources: CRSP, S&P Dow Jones Indices LLC. Data from October 2005 and May 2015. Chart is provided for illustrative purposes. Past performance is no guarantee of future results. See Appendix C for details of the “diversified high beta stock portfolio” construction. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Exhibits 7 and 8 together suggest that higher-volatility funds, *on average*, have a composition similar to a market portfolio, adjusted by a tilt towards higher-beta stocks.

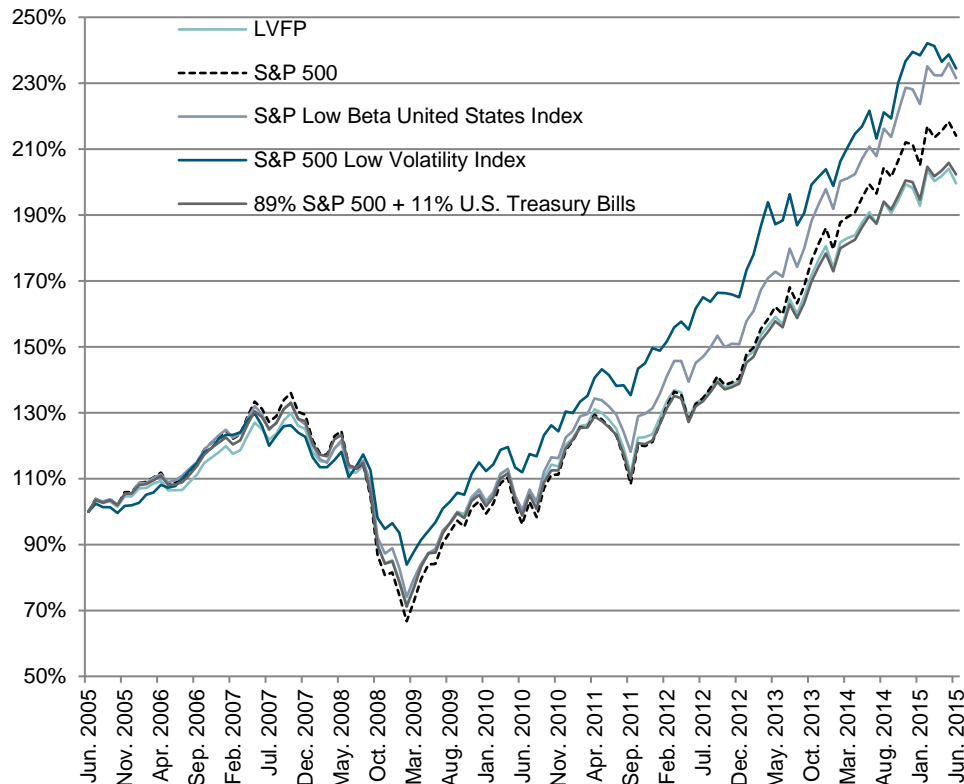
PROPERTIES OF LOWER-VOLATILITY FUNDS

Lower-volatility funds are a simpler case, since a significant cash allocation alone explains their average return.

Exhibit 9 compares the performance of the LVFP and the performance of a hypothetical “cash mix” portfolio that matches the overall full-period beta of 0.89 for the LVFP. The performance of the cash mix portfolio is constructed *pro forma* from an 11% allocation to the [S&P U.S. Treasury Bill Index](#) and an 89% allocation to the [S&P 500](#). For purposes of comparison, the performance of the S&P 500, the [S&P 500 Low Volatility Index](#) and the [S&P Low Beta United States Index](#) are also shown.

Exhibit 9: LVFP Return Comparisons

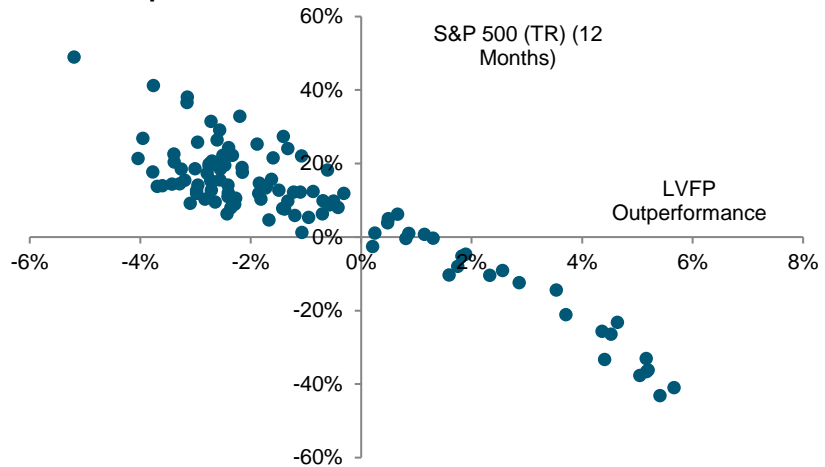
The average performance of a lower-volatility fund is almost indistinguishable from that of a hypothetical fund based on the S&P 500 with 11% allocated to cash.



Sources: CRSP, S&P Dow Jones Indices LLC. Data from June 2005 through June 2015.. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

The average performance of a lower-volatility fund is almost indistinguishable from that of a hypothetical fund based on the S&P 500 with 11% allocated to cash. Moreover, the performance *is* distinguishable from the performance of lower-beta stocks. As confirmation, Exhibit 10 shows a scatter plot of the monthly returns of the S&P 500 in comparison to the monthly outperformance of the LVFP.

Exhibit 10: LVFP Outperformance Versus S&P 500



Sources: CRSP, S&P Dow Jones Indices LLC. Data from June 2005 through June 2015. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

The key observation of Exhibit 10 is the extremely high correlation (0.92) between the [S&P 500's](#) 12-month return and the degree to which the LVFP out- or underperforms. For comparison, the equivalent correlation is a much-lower 0.73 for the [S&P Low Beta United States Index](#), or 0.77 for the [S&P 500 Low Volatility Index](#). This suggests that **the LVFP is more likely to have achieved its lower volatility by carrying a high cash allocation, rather than by owning lower-risk stocks.**⁹

Within any given fund category, fund volatility is effectively independent of fund return.

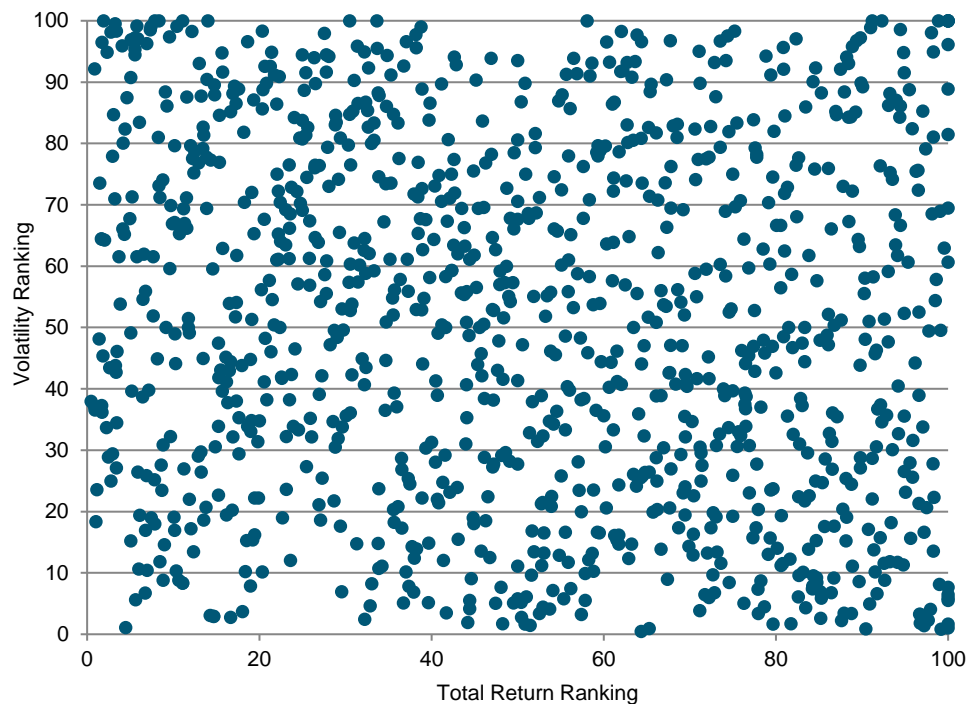
ON THE RELATIONSHIP BETWEEN FUND RISK AND FUND RETURNS

If the more volatile funds were generally more concentrated, or included stocks with higher beta, we should expect no increase in return from increased fund volatility.¹⁰ On the other hand, if lower-volatility funds are those with persistently higher cash allocations, we *should* expect a reduction in returns over the period 2005-2015, during which U.S. equities rose around 8% annually.

In fact, the data would appear to support a conjecture that, within any given fund category, fund volatility is effectively independent of fund return. Exhibit 10 shows a scatter plot of the volatility and return ranking of the U.S. funds that continued to report monthly returns and stayed within the same category over the full study period; each point in Exhibit 10 represents the return and volatility ranking for one of the 1,067 funds in the sample.

⁹ This provides at least some putative advice for active managers with a low-volatility bias: they should hold low-volatility stocks and less cash, rather than the S&P 500 with a larger cash position. See Chan, Fei Mei and Craig J. Lazzara, "[Is the Low Volatility Anomaly Universal?](#)" April 2015.

¹⁰ Absent skill, concentration does nothing to improve returns. Although the lack of outperformance from higher-beta stocks is not a theoretical necessity, it is nonetheless a historical fact.

Exhibit 11: Return Ranking Versus Risk Ranking in U.S. Funds

Sources: CRSP, S&P Dow Jones Indices LLC. Data from June 2005 through June 2015. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

The correlation of the two series in Exhibit 11 is -0.13 , which would actually suggest a *negative* relationship between fund risk and fund return. However, the chart itself suggests that such correlation is spurious; it appears to the eye as a textbook illustration in statistical independence. At least, the performance of different funds in the same category did not noticeably rise commensurately with their relative risk profile in the sample.

Funds have not typically provided a risk reduction, and those that did appeared to do so through cash allocations.

CONCLUSIONS

Our examination of fund risk provides insights into trends within the active fund industry, including the level of cash allocations, along with the presence and degree of more systematic factor biases—such as the use of high-beta stocks. Fund risk is also important in the context of broader discussions around the value of active management. As we have seen, funds have not typically provided a risk reduction, and those that did appeared to do so through cash allocations.

Our analysis of fund volatilities suggests meaningful and actionable conclusions that may be used by investors in active funds. Since prior relative risk levels in single funds have provided a meaningful prediction of future relative risk levels, active fund risk might be sensibly managed with reference to historical track records. Further, moving from a less to a more risky fund does not appear to have increased returns. Market participants may not want to assume that higher aggressiveness must prove rewarding.

APPENDIX A: THE POSSIBILITY OF “DIWORSIFICATION”

“Diworsification” is the unintuitive possibility that the volatility of a portfolio can be higher than the volatility of the assets it contains. Mathematically, it is easy to evaluate. One can even create portfolio volatility from assets that have none. Formally, a collection of assets that have a fixed, constant return (that is, zero return volatility) will, unless their rates of return are identical, form a portfolio with a variable return. The portfolio return will change over time, trending toward the return on the highest-yielding asset.

Diworsification is yet to be reported in wide samples of active funds or portfolios. However, it might be found in a market where there is a significant advantage in being quick to react to events, but a ruthless competition to keep ahead of the pack.

Scenario: The Skilled and the Hapless

Suppose stocks only went up or down following good news or bad news; either rising or falling by 50% each time. Investors are split into the skilled and the hapless. When stocks are about to rise, the skilled buy them in advance. Before stocks fall, they have already been unloaded onto the hapless. All the skilled investors share an identical return profile.

Exhibit A1 follows the two-period evolution of the market portfolio composed of both skilled and hapless investors, assuming their shared total assets were USD 100 and both started with USD 50.

Exhibit A1: Hapless and Skillful Investors			
TOTAL ASSETS	DATE 1	DATE 2 (BAD NEWS)	DATE 3 (GOOD NEWS)
Hapless	USD 50	USD 25	USD 25
Skilled	USD 50	USD 50	USD 75
Composite (Asset Weighted)	USD 100	USD 75	USD 100
PERIOD RETURNS			
Hapless	-	-50%	0%
Skilled	-	0%	+50%
Composite (Asset Weighted)	-	-25%	+33%
STANDARD DEVIATION OF RETURN (OVER TWO PERIODS)			
Hapless	-	-	25%
Skilled	-	-	25%
Composite (Asset Weighted)	-	-	29%

Source: S&P Dow Jones Indices LLC. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

The asset-weighted composite reflects news both good and bad, while each type of investor reports only one type of news; the composite has a 58% spread in returns for different periods (-25% to 33%) compared to a 50% spread for each investor.

A competitive environment allows the two-period example of Exhibit A1 to continue indefinitely. Suppose after the events of Exhibit A1 occurred, one-third of the skillful (USD 25 out of USD 75) became hapless. Then, the scenario again matches the initial conditions of Exhibit A1—both skilled

and hapless have USD 50. In every other period, there will be funds comprising over 75% of the market with records that attest *only* to good news.¹¹

The point of thought experiments such as this is to emphasize not only that aggregate fund risk reduction is possible, but also that **persistence in outperformance and a ruthless competition to remain skillful is one scenario in which it may occur.**

APPENDIX B: AVERAGE FUND VOLATILITIES

Exhibit B1 provides summary statistics of observed fund volatilities in several major fund categories over the 10-year period from June 2005 to June 2015. In order to control for survivorship bias, volatility statistics are shown for five distinct two-year periods.

Exhibit B1: Observed Average Volatilities of Europe and U.S. Funds.					
U.S. FUNDS & BENCHMARKS	JUNE 2005 TO JUNE 2007 (%)	JUNE 2007 TO JUNE 2009 (%)	JUNE 2009 TO JUNE 2011 (%)	JUNE 2011 TO JUNE 2013 (%)	JUNE 2013 TO JUNE 2015 (%)
DOMESTIC FUND CATEGORIES					
All-Cap Broad	7.15	22.82	15.09	14.12	9.29
S&P Composite 1500	9.43	21.96	15.04	13.62	9.31
All-Cap Growth	8.88	22.97	15.70	15.33	10.28
S&P Composite 1500 Growth	7.22	20.89	14.86	12.82	9.40
All-Cap Value	6.39	22.34	14.55	15.64	9.33
S&P Composite 1500 Value	6.90	24.08	15.78	14.76	9.64
Large-Cap Broad	6.76	21.74	14.67	13.36	9.09
S&P 500	6.72	21.52	14.87	13.24	9.24
Large-Cap Growth	8.14	23.12	15.30	14.95	9.88
S&P 500 Growth	7.08	20.34	14.76	12.44	9.41
Large-Cap Value	5.97	21.61	14.87	13.22	9.08
S&P 500 Value	6.70	23.90	15.60	14.44	9.53
Mid-Cap Broad	8.50	24.66	16.14	16.70	10.21
S&P MidCap 400	9.40	26.01	16.88	16.83	10.87
Mid-Cap Growth	10.25	25.65	16.54	16.63	10.91
S&P MidCap 400 Growth	9.79	26.27	16.63	16.57	10.97
Mid-Cap Value	8.08	25.61	15.74	16.03	10.25
S&P MidCap 400 Value	9.32	26.18	17.46	17.31	11.33

Sources: Morningstar, CRSP, S&P Dow Jones Indices LLC. Data is from June 2005 through June 2015. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

¹¹ Technically speaking, every other period N there will be 75% of assets owned by always-skilled investors, and a remaining 25% of assets owned by hapless investors, some of whom used to be skilled. The composite's volatility will always be 0.29, which is greater than the asset-weighted average of the skilled—who have a weight of 75% and a volatility of 0.25—and the 25% hapless, whose volatility ranges from 0.25 (the always hapless) to a maximum of 0.38 for those who lost their edge near the period N/2.

Exhibit B1: Observed Average Volatilities of Europe and U.S. Funds. (cont.)					
U.S. FUNDS & BENCHMARKS	JUNE 2005 TO JUNE 2007 (%)	JUNE 2007 TO JUNE 2009 (%)	JUNE 2009 TO JUNE 2011 (%)	JUNE 2011 TO JUNE 2013 (%)	JUNE 2013 TO JUNE 2015 (%)
DOMESTIC FUND CATEGORIES					
Small-Cap Broad	10.38	26.26	17.75	17.43	12.49
S&P SmallCap 600	10.84	27.28	18.70	17.25	13.18
Small-Cap Growth	11.38	26.05	17.88	18.11	12.86
S&P SmallCap 600 Growth	10.76	27.00	17.86	16.64	13.30
Small-Cap Value	9.61	27.34	19.48	18.17	12.65
S&P SmallCap 600 Value	11.10	27.92	19.85	17.99	13.39
U.S. FUNDS & BENCHMARKS	JUNE 2005 TO JUNE 2007 (%)	JUNE 2007 TO JUNE 2009 (%)	JUNE 2009 TO JUNE 2011 (%)	JUNE 2011 TO JUNE 2013 (%)	JUNE 2013 TO JUNE 2015 (%)
INTERNATIONAL FUND CATEGORIES					
International Large-Cap Equity	2.55	7.93	5.10	5.09	3.06
S&P Developed Ex-U.S. LargeMidCap	1.74	7.96	5.07	5.11	3.07
International Small-Cap Equity	2.85	7.96	5.09	5.03	3.16
S&P Developed Ex-U.S. LargeMidCap	1.74	7.96	5.07	5.11	3.07
Global Equity	2.11	6.49	4.56	4.31	2.63
S&P Global 1200	1.98	7.05	4.68	4.36	2.70
EUROPEAN FUNDS & BENCHMARKS	JUNE 2005 TO JUNE 2007 (%)	JUNE 2007 TO JUNE 2009 (%)	JUNE 2009 TO JUNE 2011 (%)	JUNE 2011 TO JUNE 2013 (%)	JUNE 2013 TO JUNE 2015 (%)
European Equity (EUR)	2.48	6.12	3.40	3.94	2.79
S&P Europe 350 (EUR)	2.19	6.08	3.65	3.88	2.90
UK Equity (GBP)	2.37	5.98	4.04	3.98	2.69
S&P United Kingdom BMI (GBP)	2.12	5.59	4.11	3.64	2.98
Global Equities (EUR)	2.48	5.55	2.96	3.22	2.20
S&P Global 1200 (EUR)	2.41	5.47	3.06	2.91	2.26

Sources: Morningstar, CRSP, S&P Dow Jones Indices LLC. Data is from June 2005 through June 2015. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Exhibit B1 demonstrates that the average fund volatility is—to the first degree of approximation—usually close to benchmark volatility, and (on balance) fund volatilities are typically slightly higher than their benchmarks. There are of course several exceptional periods and fund categories; notably, U.S. value funds appear to be persistently less risky than their benchmarks during most periods.

APPENDIX C: THE HIGH BETA STOCK PORTFOLIO

The HBSP was constructed as follows.

- First, we defined a return series for a hypothetical high-beta-stock-concentrated portfolio as the capitalization-weighted return of the 30% of stocks with the highest beta by capitalization in the [S&P United States BMI](#). This may be derived from the performance of the [S&P Low Beta United States Index](#), which represents the 70% of stocks by capitalization with the lowest beta.
- The beta to the [S&P 500](#) of this high-beta-stock-concentrated portfolio from June 2005 to June 2015 was measured at 1.43, while the HVFP beta for the same period was equal to 1.15.
- The performance of the HBSP was constructed through a constant-weight monthly rebalanced combination of the concentrated portfolio return and the S&P 500, with the weight set so that the full-period beta matched 1.15.

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PERFORMANCE DISCLOSURE

The S&P Composite 1500 Growth was launched Dec. 16, 2005. The S&P Composite 1500 Value was launched Dec. 19, 2005. The S&P 500 Low Volatility Index was launched on April 4, 2011. The S&P Low Beta United States was launched on March 19, 2012. All information presented prior to an index's Launch Date is hypothetical (back-tested), not actual performance. The back-test calculations are based on the same methodology that was in effect on the index Launch Date. Complete index methodology details are available at www.spdji.com.

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Another limitation of using back-tested information is that the back-tested calculation is generally prepared with the benefit of hindsight. Back-tested information reflects the application of the index methodology and selection of index constituents in hindsight. No hypothetical record can completely account for the impact of financial risk in actual trading. For example, there are numerous factors related to the equities, fixed income, or commodities markets in general which cannot be, and have not been accounted for in the preparation of the index information set forth, all of which can affect actual performance.

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