Alternative Investment Analyst Review

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Chasing Performance Could be Dangerous to the Health of Your Portfolio

Selecting Top Decile Managers

Suppose we are considering a pool of 50 fund managers and want to select the best five managers to include in our asset allocation. Exhibit 1 displays the cumulative alphas of these 50 managers over a 60-month period. Also, assume that only one of these 50 managers has a true positive annual alpha of 2% with a tracking error of 6% per year. The other 49 managers have zero true alphas with the same tracking error of 6% per year.

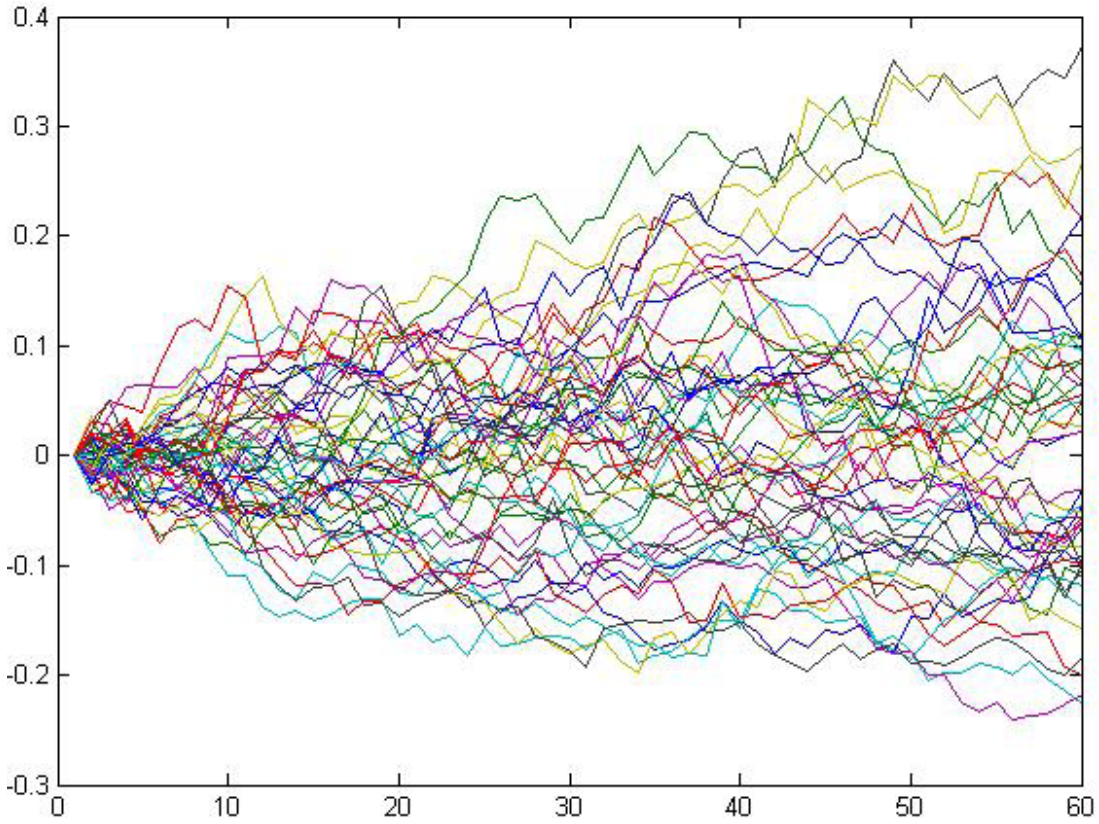

Exhibit 1: Hypothetical Cumulative Alphas of 50 Managers
Source: Author's Calculations

What are the chances that one of the top 5 managers is the manager with a true positive alpha? The answer is less than 2%! This will surprise most asset allocators. After all, 60 months is a long period, and with our star manager generating 2% alpha with 6% tracking error, we would expect the star manager to be near the top, if not the top manager.[1]

The problem is that while our manager's alpha is significant at 99% level, we are comparing the manager's performance to a highly biased sample – the managers who were lucky to produce positive alphas while their true alphas were zero. If we compare our star manager's performance to that of a randomly selected unskilled manager, there is about 99% chance that we identify our star manager (there will be about 1% chance that through pure luck a manager could match the performance of the star manager over a 60-month period). However, we are not comparing the star manager's performance to that of a randomly selected manager here.

How could the probability that the star manager is among the top 5 managers from a pool of 50 managers be so low? To understand this, let's look at the problem from a different perspective. Suppose all 50 managers have zero true alpha. What is the expected value of the cumulative alpha the top manager? The answer is 30%! That is, the luckiest manager is expected to produce about 6% alpha per year over a 5-year period. Of course, this manager is highly unlikely to repeat the same performance over the next five years, leading our asset allocator to regret his/her decision to hire the top manager. How about the average performance of the top 5 managers? The answer is about 3% alpha per year. That is, the average performance of the top 5 managers is higher than the average performance of our star manager, which is 2% per year. Again, the problem is that we are comparing our star manager to a highly biased sample of the managers. As discussed above, if we select a manager randomly and compare her performance to our star manager's performance, there is 99% chance that we will identify our star manager, but the sample of the top 5 managers is not random. Exhibit 2 displays the same data from Exhibit 1, but this time, the path of the star manager's alpha is highlighted.

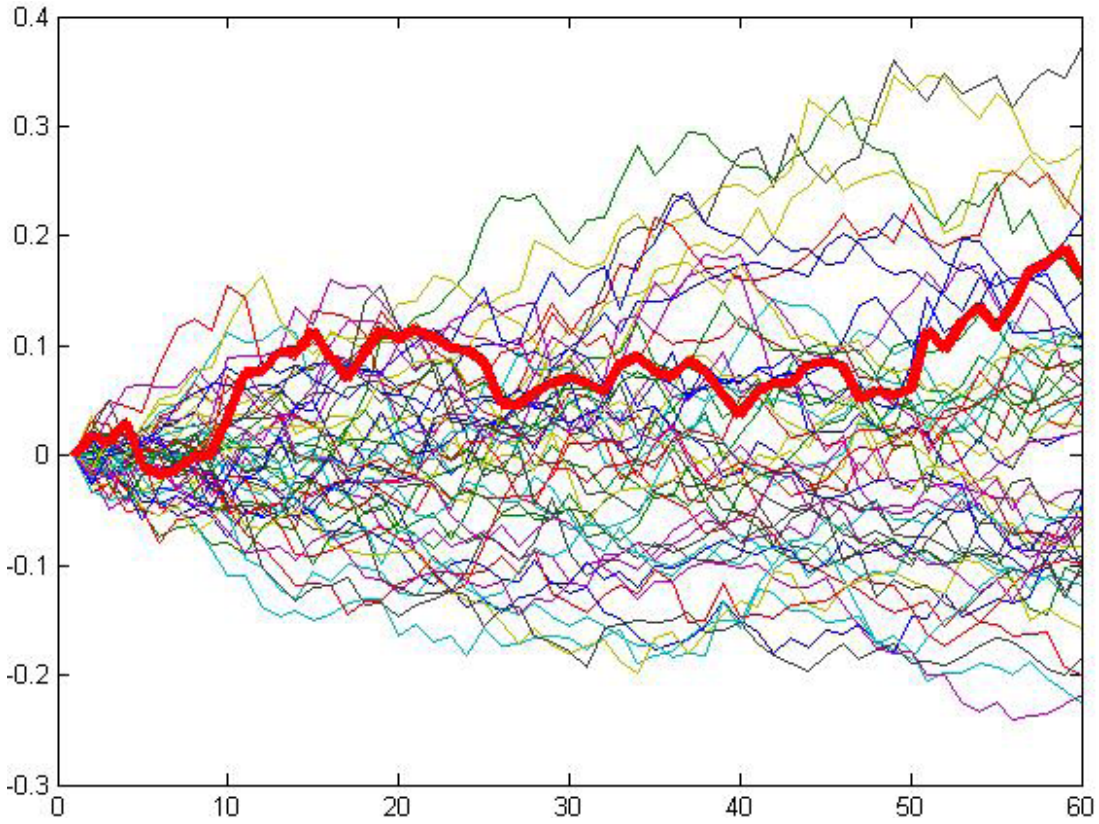

Exhibit 2: Hypothetical Cumulative Alphas of 50 Managers (Star Manager is Highlighted)
Source: Author's Calculations

How to Avoid the Dangers of Chasing Performance

The above analysis illustrates the dangers of chasing performance while not making adequate adjustments for the potential pitfalls of using highly biased samples. The above analysis applies to trading strategies, as well. In other words, we could evaluate the performances of 50 different trading strategies over a 60-month trial period. Even if every single strategy has zero true alpha, the top strategy is expected to have an alpha of 6% per year. By the way, the worse performing strategy is expected to show a negative alpha of 6% per year, even though all of them have zero true alphas.

What should an asset allocator do? One obvious answer is to use a longer track record. For example, we can use a pool of 50 managers with 20-year track records. There is a 90% chance that our star manager will be among the top 5 managers after 20 years. Of course, 20 years is a very long period, especially in the alternative investment industry. Also, note that the probability of selecting our star manager is still not 100%. To achieve that level of certainty, we need about 50 years of data.

There are four potential problems in finding a pool of managers with long track records. First, there will be significant survivorship bias in our sample because we are selecting managers that have been good, lucky, or both to survive 10 or 20 years. Second, in the hedge fund industry, a 5-year track record is actually rather long. So, finding a large pool of managers with track records exceeding five years is a difficult task. Third, most managers that have long attractive track records are likely to be closed to outside money. Finally, a fund manager with a long track record may not stick around for much longer, and, therefore, the investor faces the risk that the new manager may not be able to produce the same performance record.

Another potential solution to the problem is to focus on low volatility strategies. The primary reason that the probability of finding the star manager among the top 5 managers is so low is the volatility of the alphas. While 6% tracking error is typical for most active managers, the problem will become far less serious if we were to focus on strategies with low tracking errors. For example, continuing with our previous example, if the tracking error is 3% per year, then there is a 90% chance that our star manager will be among the top 5 performing managers. There is an important lesson here: since historical performances of the low volatility managers are more reliable, the investor can use quantitative approaches to due diligence in case of these managers. On the other hand, the investor should use qualitative approaches when evaluating managers in high volatility strategies as their track records are not highly reliable.

A final solution that I want to discuss is to focus on strategies where the relative number of skilled managers is expected to be large. This sounds rather obvious, but the implications of it may not be so obvious. The following example demonstrates the importance of focusing on the segment of the market where alpha is likely to be found, and in the process, we demonstrate an important application of Bayesian analysis.

In this example, we are examining a pool of managers, and after collecting their historical track records and calculating their alphas, we want to be confident that the selected manager has a true positive alpha. That is if the observed alpha is denoted by $\bar{\alpha}$ and the true alpha by α, we want to know the value of $P(\alpha > 0 \mid \bar{\alpha})$, the probability that the manager's true alpha is positive given the historical value of its alpha.

Suppose we believe that some percentage of equity long/short hedge fund managers have true positive alphas. This probability is denoted by $P(\alpha > 0)$. For example, if $P(\alpha > 0) = 0.05$, it means that there is a 5% chance that a randomly selected manager is skilled. Therefore, 95% of managers have zero true alpha. Next, we collect a sample of performance record of a manager, estimate the manager's historical alpha, and use an alpha detection method that has a very high degree of accuracy to tell us if the estimated alpha of the manager is consistent with a true positive alpha. This probability is given by $P(\bar{\alpha} \mid \alpha > 0)$. For instance, if $P(\bar{\alpha} \mid \alpha > 0) = 0.9$, then 90% of the times that a star manager's historical record is analyzed, we correctly identify that manager and only 10% of the times we make a mistake and identify an unskilled manager as a star manager ($P(\bar{\alpha} \mid \alpha \leq 0) = 0.10$). Given these figures, what is the probability of observing a historical positive alpha?

$$P(\bar{\alpha}) = P(\bar{\alpha} \mid \alpha > 0) \times P(\alpha > 0) + P(\bar{\alpha} \mid \alpha \leq 0) \times P(\alpha \leq 0)$$
$$= 0.9 \times 0.05 + 0.1 \times 0.95 = 0.14$$

This means that 14% of the times we will observe a positive historical alpha – sometimes because a skilled manager's track record is observed and sometimes because we are making a mistake and identify an unskilled manager as skilled. We are now ready to answer the most important question. Given a manager's historical alpha, what is the probability that the manager's true alpha is positive? That is, we want to calculate $P(\alpha > 0 \mid \bar{\alpha})$. Bayesian analysis can give us the answer:

$$P(\alpha > 0 \mid \bar{\alpha}) = \frac{P(\bar{\alpha} \mid \alpha > 0) \times P(\alpha > 0)}{P(\bar{\alpha})}$$
$$= \frac{0.9 \times 0.05}{0.14} = 0.32$$

This means that if the historical alpha of a manager is positive, then there is only a 32% chance that the manager's true alpha is positive, a rather disappointing result. Of course, this is much higher than a 5% chance that a randomly selected manager is truly skilled, but it is still too low.

Next, consider the same example, but this time, we are looking at a strategy that 10% of managers have true positive alphas. That is, $P(\alpha > 0) = 0.1$. We keep the other figures the same. The results are

$$P(\bar{\alpha}) = P(\bar{\alpha} \mid \alpha > 0) \times P(\alpha > 0) + P(\bar{\alpha} \mid \alpha \leq 0) \times P(\alpha \leq 0)$$
$$= 0.9 \times 0.1 + 0.1 \times 0.9 = 0.18$$

Therefore,

$$P(\alpha > 0 \mid \bar{\alpha}) = \frac{P(\bar{\alpha} \mid \alpha > 0) \times P(\alpha > 0)}{P(\bar{\alpha})}$$
$$= \frac{0.9 \times 0.1}{0.18} = 0.5$$

In this case, 50% of the times we will select the skilled manager. If we can improve our alpha detection methodology through the use of better models and more data, the results will improve drastically. For instance, if in the last example we improve the accuracy of our model to 95%, then $P(\alpha > \mid \bar{\alpha}) = 0.67$. This means that if we select a manager with positive historical alpha, there is a 67% chance that the manager's true alpha is positive.

There is one last improvement that we can make in our result: We can select a portfolio of managers. For instance, suppose ten managers report positive alphas, and we decide to select 5 of them after performing our qualitative due diligence. The probability of having at least one truly skilled manager among those five managers is 99.6%, and the probability of having at least three skilled managers among those five managers is about 90%. This is another, and less noticed benefit of diversification: the investor is far more likely to have at least a few star managers in a portfolio of managers.

Hossein Kazemi,

Editor

Endnotes

1. This probability is calculated using the distribution of the order statistics. For example, see David and Nagaraja, "Order Statistics," 3rd Edition, 2003, Wiley.

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Risk Parity

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Traditional asset allocation is grounded in the theory of Mean Variance Optimization (MVO). MVO is the most popular methodology used by institutional investors to build portfolios. This simple, yet powerful tool creates "efficient" portfolios that attempt to achieve objectives, such as maximum return or minimum risk portfolios, by selecting assets based on their expected return, expected risk (as defined by their standard deviation of returns) and correlations with each other.

Without delving too deep into the details of how MVO chooses portfolios, it is worth noting that at its core, the process tends to prefer assets that have relatively high risk-adjusted returns or a high level of return per unit of risk taken. Risk-adjusted returns are often measured by a statistical metric called the Sharpe Ratio. Based on the figures below and choosing only based on the Sharpe Ratio, Core Bonds (which have the highest Sharpe Ratio) would be preferred ahead of Global Equities and Inflation Linked Bonds, holding all else equal.

However, any investor that has used MVO to build a portfolio can attest that its results are not always as "clean" in practice as they are in theory. Detractors of MVO point to the fact that the process is extremely sensitive to changing inputs, and sometimes recommends unstable and "extreme" portfolios[3].

This is where risk parity comes in. Its proponents maintain that broad asset classes such as equities, bonds, and inflation-related assets[2] have similar long-term risk-adjusted returns, so using this methodology reduces dependence on input estimation, and focuses on building a portfolio that has a balanced exposure to the major asset classes by allocating risk equally to each.

Capital Allocation	Global Equities	Core Bonds	Inflation Linked Bonds
Expected Return (20-years)	7.5%	3.6%	3.3%
Standard Deviation	19%	4.0%	7.5%
Sharpe Ratio	0.29	0.41	0.18

Exhibit 1: Comparing Asset Classes Sharpe Ratios[3]

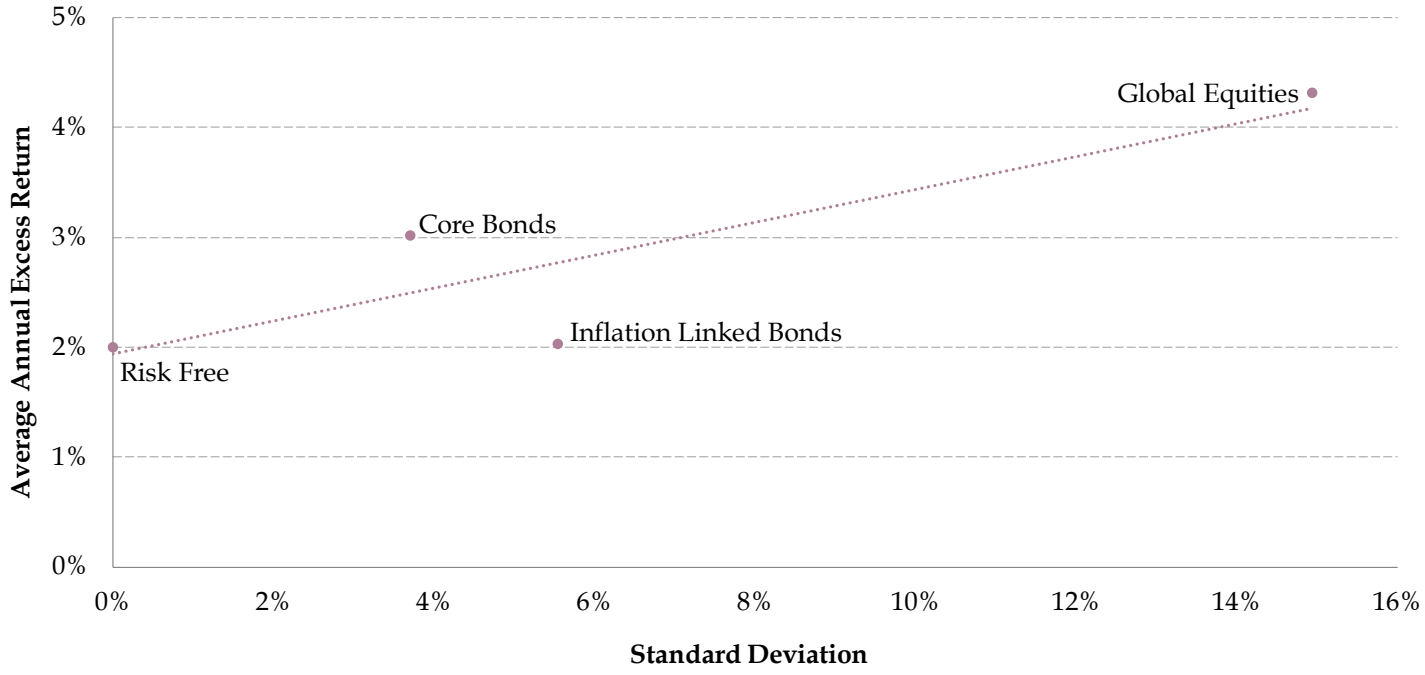


Exhibit 2: Excess Return to Standard Deviation Relationship[4] January 1988 - June 2018

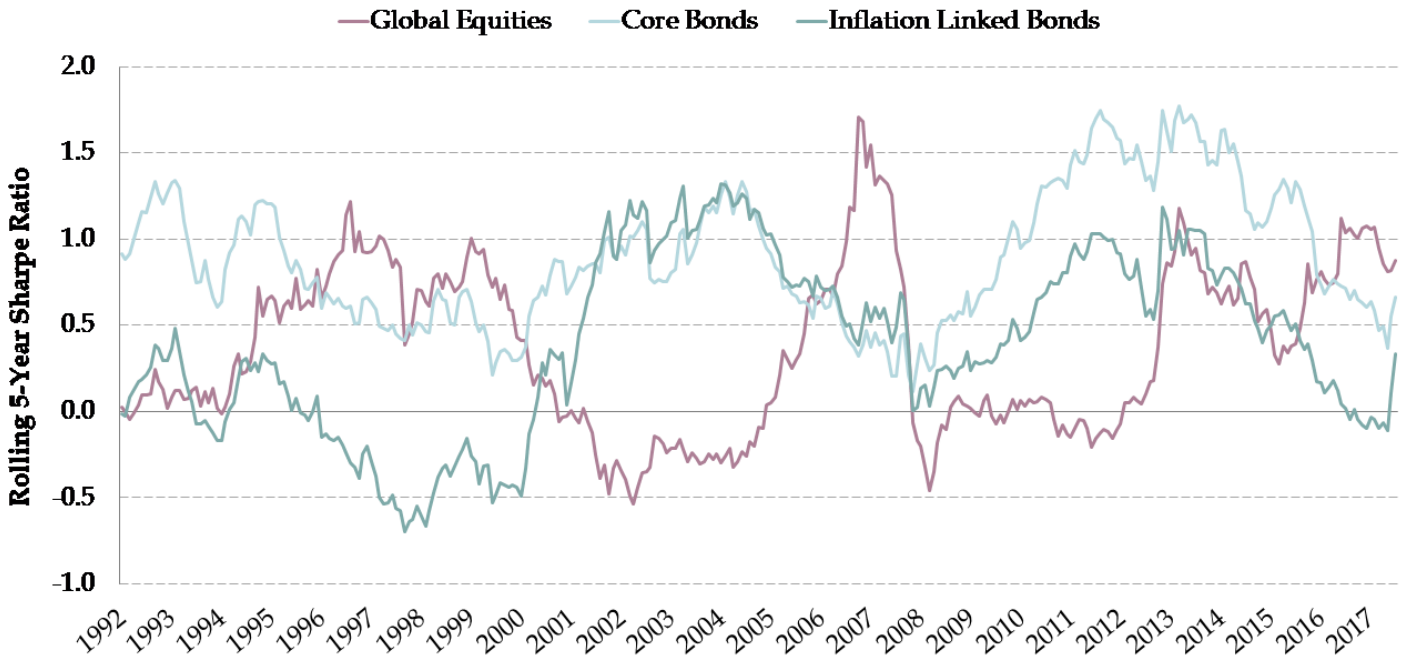


Exhibit 3: Rolling Asset Class Sharpe Ratios[8] January 1988 - June 2018

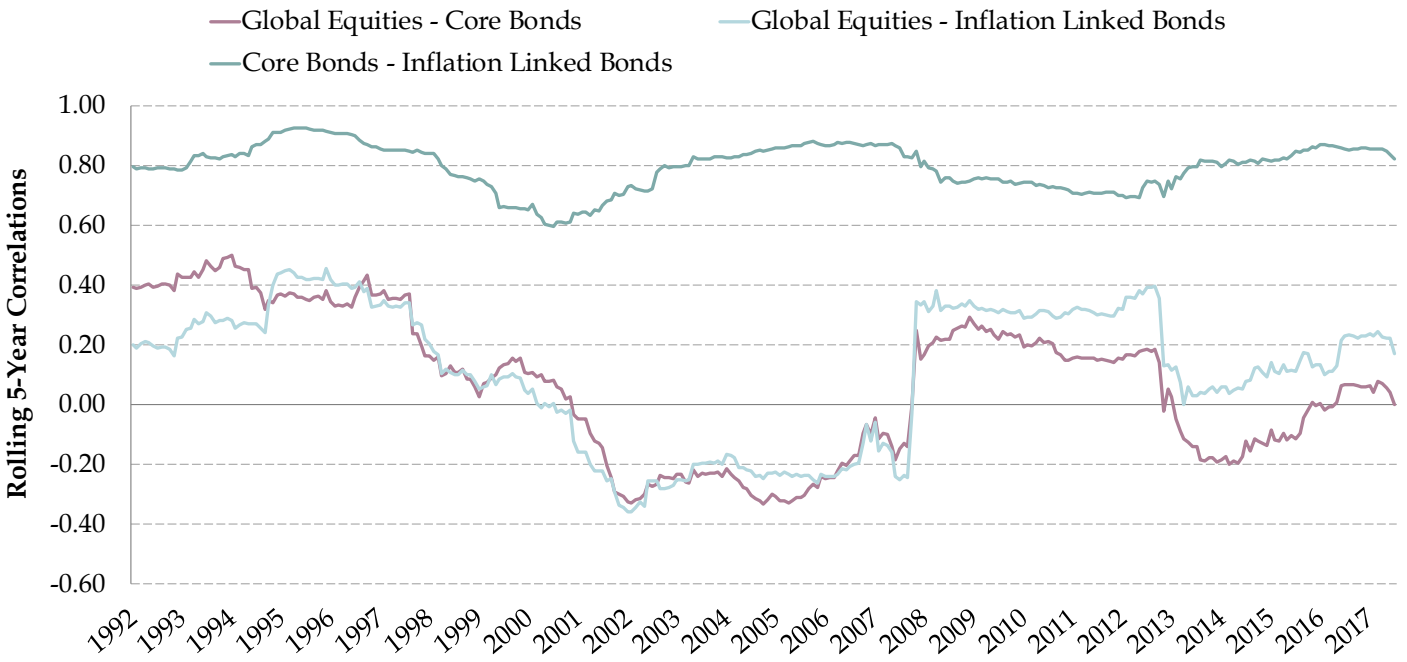


Exhibit 4: Rolling Asset Class Coreelations[6] January 1988 - June 2018

Furthermore, even though most inputs are relatively static, in reality, asset returns vary over time, going through cycles of relative under and out performance. Without the ability – or desire – to time these cycles, it follows that allocating risk equally should improve diversification.[7] However, for this to be true, the asset classes included in the risk parity portfolio should have little to no expected correlation with each other over the long term.[8]

Portfolio Construction

Risk Parity starts by creating a long-only portfolio that seeks to balance risks. The chart below shows how a risk parity allocation achieves a more balanced risk allocation than a traditional capital allocation, where the majority of risk taken is concentrated in equities. Furthermore, the resulting portfolio is superior from a risk-adjusted perspective (i.e., higher Sharpe Ratio). Unfortunately, not everything is positive, as the risk parity's portfolio expected return is considerably lower than the traditional allocation portfolio.

Capital Allocation	Traditional Allocation	Unlevered Risk Parity
Growth/Equities	60%	15%
Rate Sensitive	35%	56%
Inflation Linked	5%	29%
Expected Return (20 Years)	6.5%	4.4%
Standard Deviation	11.6%	5.3%
Sharpe Ratio	0.39	0.46

Exhibit 5: Traditional and Risk Parity Allocations[9]

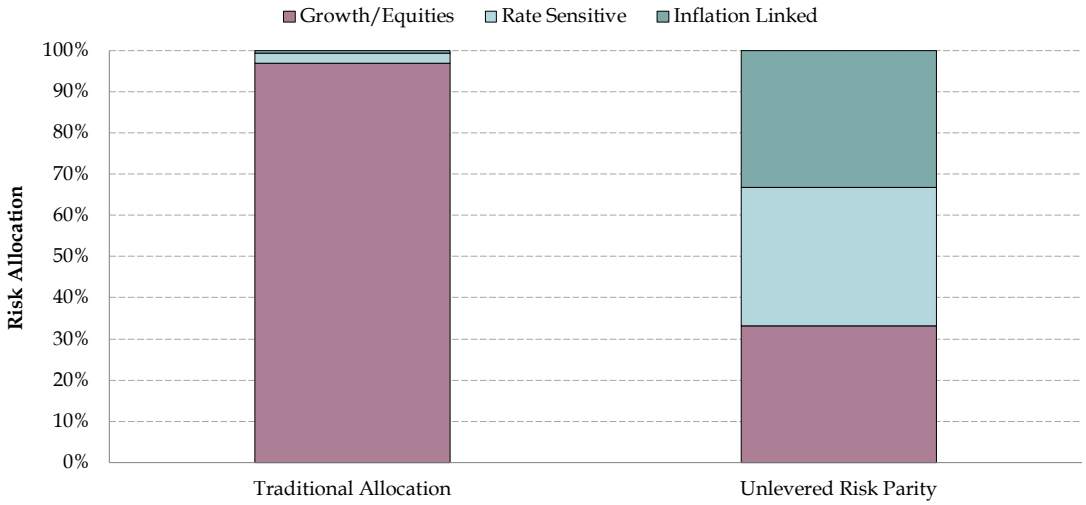


Exhibit 6: Risk Decomposition by Allocation

In order to bring the portfolio's risk up to a level where its expected return is commensurate with most investor's objectives, leverage needs to be introduced. This is usually done by levering up the entire unlevered risk parity portfolio.[10]

The levered risk parity portfolio in the example above involves levering up the unlevered version so that the portfolio's volatility matches that of the traditional allocation. As we can see, the resulting portfolio is still superior from a risk-adjusted perspective, but now it also has a higher expected return than the traditional allocation. Again, not all is positive, as the levered risk parity portfolio requires a leverage ratio of over two.

Capital Allocation	Traditional Allocation	Unlevered Risk Parity	Levered Risk Parity
Growth/Equities	60%	15%	34%
Rate Sensitive	35%	56%	124%
Inflation Linked	5%	29%	64%
Risk Free (Leverage)	0%	0%	-121%
Expected Return (20 Years)	6.5%	4.4%	7.0%
Standard Deviation	11.6%	5.3%	11.6%
Sharpe Ration	0.39	0.46	0.43
Gross Exposure	100%	100%	343%

Exhibit 7: Traditional and Risk Parity Allocations[11]

Implementation Issues

Investable Universe

Most risk parity strategies are constrained to investing only in bonds, equities, inflation linked securities and sometimes credit. However, institutional portfolios invest in a wide array of additional asset classes. Examples include credit-related securities (e.g., high yield and bank loans), private equity (e.g., buyouts and venture capital), real assets (e.g., real estate and infrastructure), and hedge funds.

Risk parity strategies need to invest in asset classes that are flexible enough to be easily levered. While using borrowing facilities[12] could, in theory, solve this issue, in practice, what occurs is that risk parity allocates capital through liquid derivatives such as futures, which offer cheap (almost free at times) and less risky leverage. Unfortunately, this means the strategy's universe is usually constrained to asset classes with liquid futures markets.[13]

Leverage[14]

Leverage is a key requirement for risk parity. While unlevered risk parity portfolios can offer attractive expected risk-adjusted returns, they will likely have expected return levels that fall short of most institutional investor's return objectives. In order to bring the allocation to an attractive expected return level, the portfolio needs to use leverage.

As expressed in the investable universe section, risk parity strategies usually access leverage through liquid derivatives such as futures. The dynamics of these contracts is such that by posting an initial margin of, for example, $1, an investor can achieve an economic exposure to the asset class of $10 or more.[15] Positions are then marked to market (valued) daily, so that any gains or losses increase or reduce this initial margin. In order to maintain the position, an investor

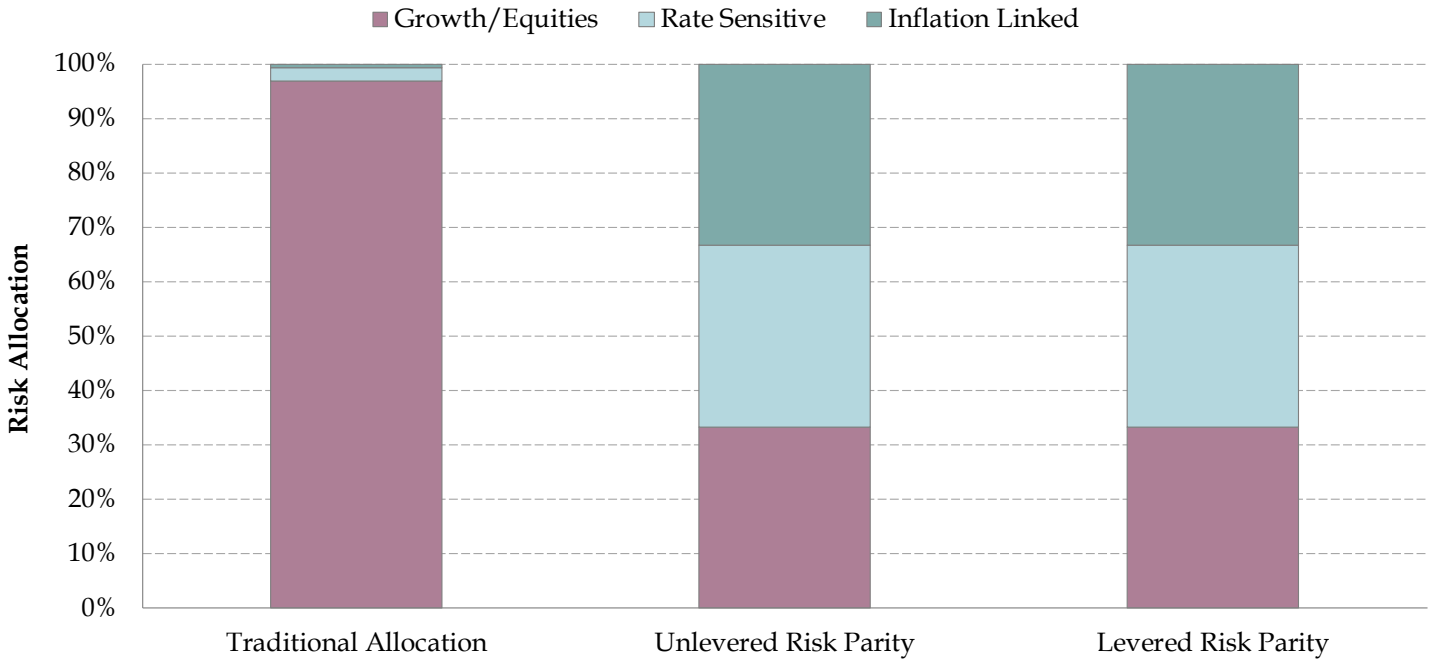


Exhibit 8: Risk Decomposition by Allocation, Includes Levered Risk Parity

needs to maintain what is called a "maintenance margin"[16] in her account at all times, or else be forced to exit the position.

Accessing leverage through exchange-traded futures is the preferred approach for creating risk parity portfolios, as futures markets for traditional asset classes are very liquid, offer virtually no counterparty risk, and have mechanisms in place that can limit the losses to an investor. This is a significant departure from models that access leverage through credit lines or borrowing facilities with banks or other lenders, as these are less liquid, are exposed to counterparty risk, and tend to meaningfully increase in cost during turbulent times.

Volatility Targeting

As we saw with the levered risk parity portfolio example, in order for a risk parity strategy to offer expected returns comparable to traditional capital allocations, the portfolio's expected risk (i.e., volatility) also needs to be increased (with leverage). Generally, risk parity implementations will select a target risk level,[17] say 10%, and construct a portfolio to match it.

Similar to how traditional capital allocation portfolios need to rebalance their weights periodically in order to avoid unwanted drift, risk parity portfolios also need to adjust both their asset class allocations and overall portfolio leverage in order to maintain a desired volatility level.

Asset class volatility is not constant – it moves up and down over time with returns. What this means for a risk parity allocation is that when the volatility of an asset is decreasing (increasing), it will appear less risky (riskier), so in order to maintain the target level of risk at the portfolio level, the strategy will increase (decrease) leverage and/or its risk exposure to the asset.[18] More simply, a volatility targeting strategy will increase leverage when expected volatility declines, and reduce it when volatility increases.

Volatility targeting creates a risk management challenge to implementation, given that increasing volatility tends to correlate with decreasing returns and vice versa. So while returns can be augmented by increasing leverage during benign periods, the opposite is also true. Losses may be amplified during periods of rising volatility, as it most likely involves increased selling at a loss. If not managed carefully, this de-levering could result in meaningful losses, especially during periods of volatility spikes.

Interest Rate and Equity Risk

The traditional risk parity portfolio generally has higher (and/or levered) allocations to low risk assets like bonds, and lower allocations to higher risk assets such as equities. This creates a portfolio profile with higher interest rate risk and lower equity risk relative to traditional allocations.

The table below shows how this dynamic translates to performance during stress events based on four markets factors: rising rates, widening spreads, a strengthening dollar, and equity bear markets. It shows that risk parity portfolios are expected to suffer far worse returns relative to traditional allocations during interest rate spike scenarios. The trade-off, however, is that they would outperform traditional allocations during negative scenarios for equities.

A higher bond allocation has helped historical performance, as we have lived through a secular decline in interest rates since the early 1980s. While forecasting the future path of interest rates has been an exacerbating exercise since the Global Financial Crisis, it is clear that the current starting point for interest rates should not lead to similar tailwinds as the historical periods.

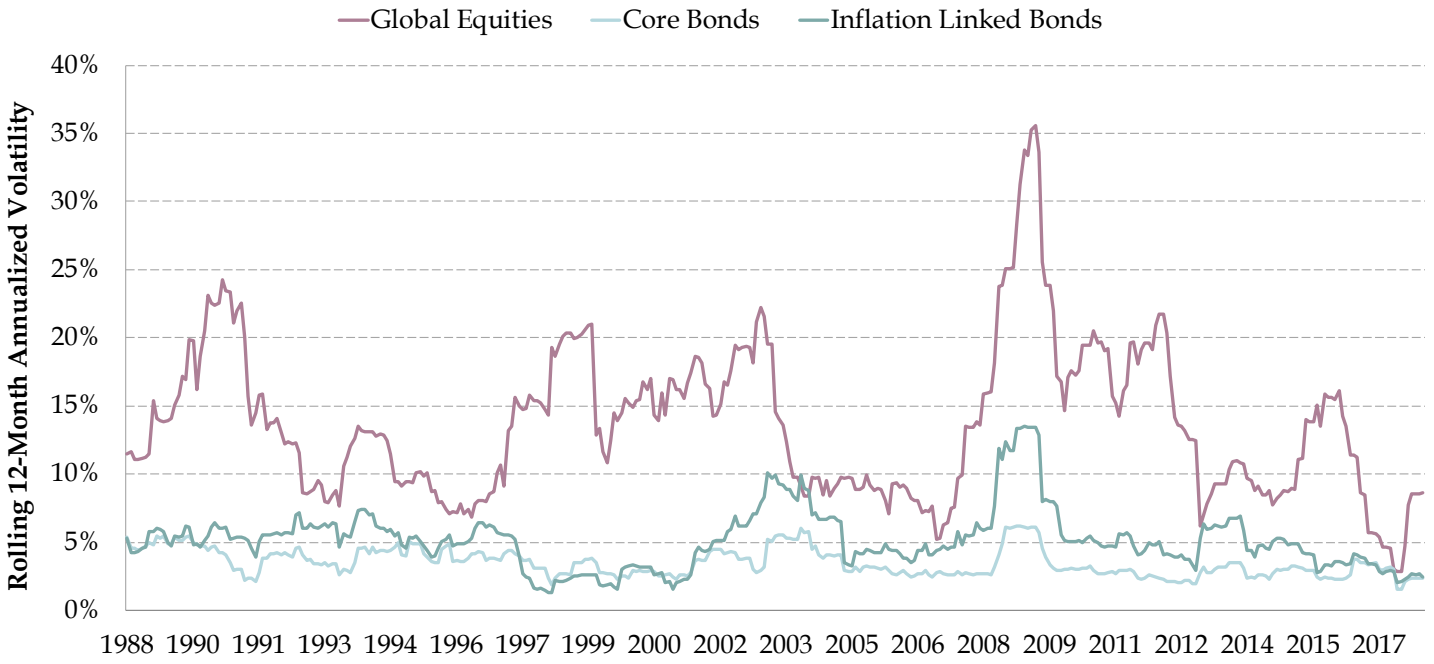


Exhibit 9: Asset Class Volatility[19]

Scenarios	Traditional Allocation	Unlevered Risk Parity	Levered Risk Parity
10-year Treasury Bond rates rise 100 bps	3.7%	-1.3%	-3.4%
10-year Treasury Bond rates rise 200 bps	1.3%	-6.1%	-13.7%
10-year Treasury Bond rates rise 300 bps	-1.7%	-11.0	-24.2%
Baa Spreads widen by 50 bps, High Yield by 200 bps	-1.3%	2.0%	2.3%
Baa Spreads widen by 300 bps, High Yield by 1000 bps	-19.7%	-4.9%	-11.9%
Trade Weighted Dollar gains 10%	0.2%	3.9%	3.2%
Trade Weighted Dollar gains 20%	-3.0%	-0.2%	-0.7%
U.S. Equities decline 10%	-5.2%	0.2%	-1.3%
U.S. Equities decline 25%	-14.7%	-2.8%	-7.7%
U.S. Equities decline 40%	-26.0%	-8.5%	-18.9%

Exhibit10: Stress Scenarios[20]

Active Risk (Maverick Risk)

While a risk parity allocation for an institutional portfolio is a valid strategy, it is also not widely implemented among the investment industry. Capital-based allocations based on MVO concepts (or extensions) continue to be commonplace in the space. This means that institutional investors that wish to implement risk parity for their portfolios will take on meaningful tracking error (i.e., active risk or "maverick" risk) relative to peers. Understanding and quantifying this risk is key to determining if they will be comfortable being significantly "different" from peers at any point in time.

Derivatives Infrastructure and Knowledge

The implementation of levered risk parity allocations requires that institutional investors have sufficient infrastructure to trade and manage derivatives contracts. Investors without sufficient staff and infrastructure may access risk parity strategies through investment managers who offer a range of risk parity solutions, varying from simple asset-based risk parity portfolios to more complicated risk factor parity portfolios. Management fees start at 0.5% and can go much higher.

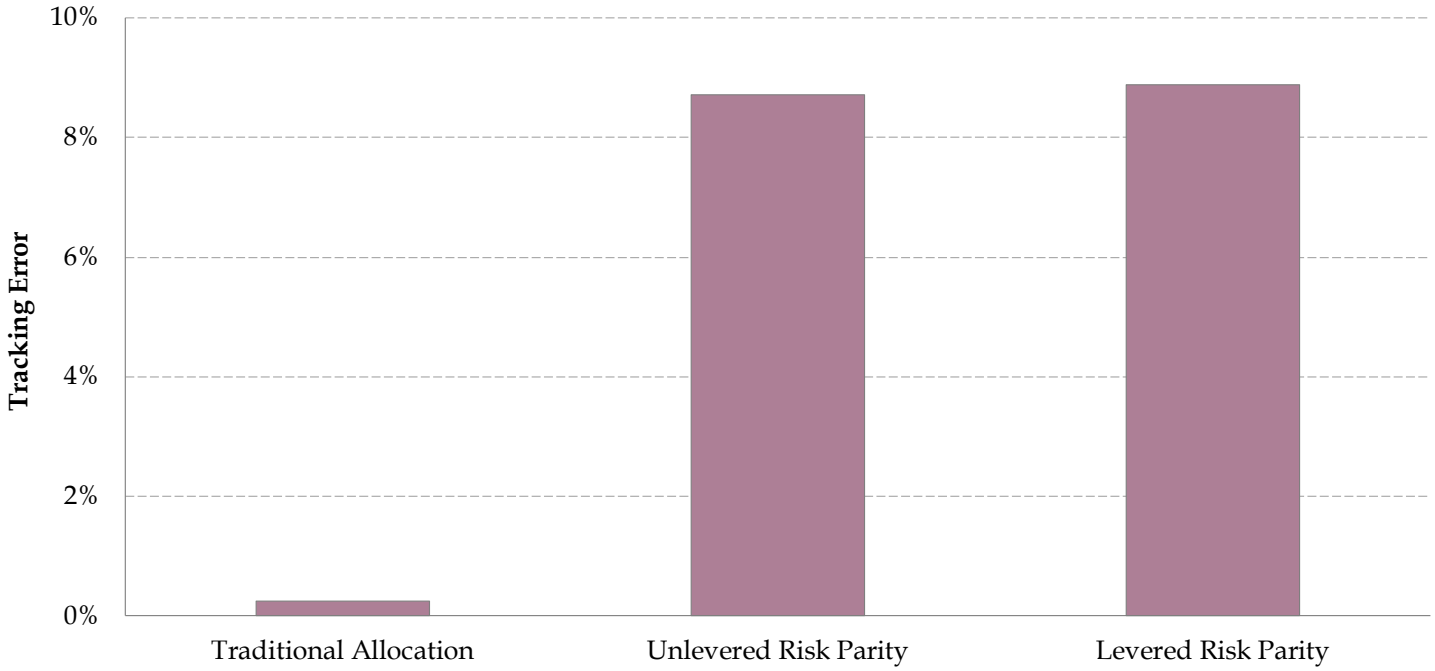


Exhibit 11: Expected Tracking Error Relative to Peers[21]

Historical Performance

The table below shows how risk parity portfolios as constructed in previous sections would have fared during several notable historical scenarios (both positive and negative). Consistent with the stress scenarios results, here we can observe that risk parity allocations tend to perform better than traditional allocations during turbulent times for equities (due to their inherent equity underweight) but underperform during periods of rapidly rising rates, given their levered bond exposures.

A rolling return analysis shows similar results. With the caveat that Risk Parity strategies have had a clear tailwind of declining interest rates during the sample period, one can observe how they tend to defend better than traditional allocations during turbulent times.

Scenarios	Traditional Allocation	Unlevered Risk Parity	Levered Risk parity
Negative			
Taper Tantrum (May-Aug 2013)	-2.1%	-4.6%	-10.2%
Global Financial Crisis (Oct 2007 - Mar 2009)	-24.2%	1.0%	-1.6%
Popping of the TMT Bubble (Apr 2000 - Sep 2002)	-16.2%	19.7%	31.7%
Asian Financial Crisis (Aug 1997 - Jan 1998)	-0.1%	2.9%	3.4%
Rate spike (1994 Calendar Year)	1.6%	-3.1%	-11.5%
Crash of 1987 (Sept - Nov 1987)	-12.0%	-1.2%	-4.4%
Strong dollar (Jan 1981 - Sep 1982)	4.5%	19.6%	13.7%
Volcker Recession (Jan - Mar 1980)	-6.8%	-8.0%	-21.3%
Stagflation (Jan 1973 - Sep 1974)	-20.6%	-0.3%	-17.0%
Positive			
Global Financial Crisis Recovery (Mar 2009 - Nov 2009)	39.8%	18.2%	40.2%
Best of Great Moderation (Apr 2003 - Feb 2004)	29.8%	12.2%	25.9%
Peak of the TMT Bubble (Oct 1998 - Mar 2000)	33.8%	11.1%	16.4%
Plumeting Dollar (Jan 1986 - Aug 1987)	70.6%	27.4%	48.5%
Volcker Recovery (Aug 1982 - Apr 1983)	35.6%	24.6%	47.2%
Bretton Wood Recovery (Oct 1974 - Jun 1975)	30.2%	13.1%	23.4%

Exhibit 12: Historical Scenarios [22]

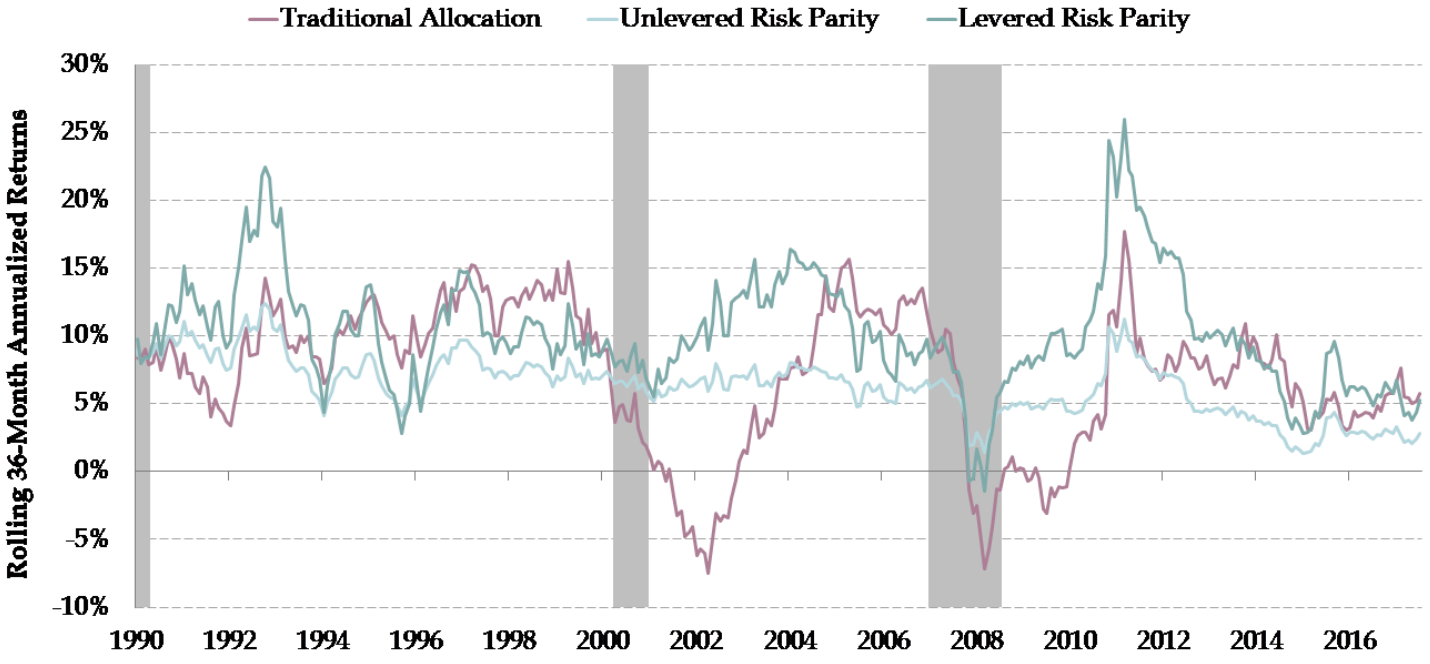


Exhibit 13: Rolling 36-Month Annualized Returns[23]

Conclusion

Risk parity is a strategy that allocates risk (as opposed to capital) in a balanced manner. Given that its expected return and volatility without leverage tends to be much lower than for traditional allocations, risk parity utilizes leverage to increase the expected return, and consequently expected risk of the portfolio.

Portfolios that allocate through risk parity will usually have higher (and usually levered) exposure to bonds and lower exposure to equities than traditional allocations. This means the strategy tends to do better during times of equity declines but underperform during periods of rising rates.

There are several important issues to take into account when considering risk parity strategies. The first one is leverage: leverage is a flexible tool that amplifies both gains and losses for a portfolio, but may also expose it to additional risks such as liquidity and counterparty risk. In order to mitigate these risks, risk parity is usually implemented with the almost exclusive use of liquid exchange-traded derivatives, such as futures. These derivatives vastly reduce liquidity and counterparty risk, as well as borrowing costs, but they also considerably reduce the investable universe for investors.

Finally, in order to implement a successful Risk Parity strategy, investors need to be comfortable with an allocation that is very different (in terms of expected tracking error) from peers, which will inevitably lead to periods of underperformance, most likely during times of strong equity rallies.

Endnotes

1. Concentrated portfolios that only allocate to one or two assets (instead of making full use of the available universe).
2. Commodities and/or Inflation Linked Bonds.
3. Based on Meketa Investment Group's 2018 Asset Study. The Risk Free rate is assumed as 1.98%, consistent with current 90-day Treasury Bill yields at the time of writing.
4. Source: AQR and MIG. Global Equities, Core Bonds and Inflation Linked Bonds proxied by MSCI ACWI, Bloomberg Barclays U.S. Aggregate and Bloomberg Barclays US TIPS indices respectively. TIPS returns prior to March 1997 backfilled with MIG proprietary estimates. Risk Free plotted for reference.
5. Source: AQR and MIG. Global Equities, Core Bonds, and Inflation Linked Bonds proxied by MSCI ACWI, Bloomberg Barclays U.S. Aggregate and Bloomberg Barclays US TIPS indices respectively. TIPS returns prior to March 1997 backfilled with MIG proprietary estimates.
6. Global Equities, Core Bonds, and Inflation Linked Assets proxied by MSCI ACWI, Bloomberg Barclays U.S. Aggregate and Bloomberg Barclays US TIPS indices respectively. TIPS returns prior to March 1997 backfilled with MIG proprietary estimates.
7. This would mean avoiding being concentrated (in terms of allocated risk) in the current worst performing asset. The opposite is also true unfortunately, as a broad risk parity allocation will avoid overweighting the best performing assets.
8. The correlation profile of assets is a very important assumption when evaluating the investable universe of Risk Parity strategies. In general, these strategies tend to allocate to Equities, Core Bonds, and Inflation Linked Assets, given the underlying assumption that these assets should be lowly correlated over the long term because their returns are driven by different economic factors, such as growth, interest rates, and inflation, respectively. Some risk parity portfolios create a fourth "bucket" for credit, but this asset class is not necessarily orthogonal to the other buckets (i.e., it has at least a fair amount of positive correlation to equity).
9. Expected Return, Volatility, and Correlation figures based on Meketa Investment Group 2018 Asset Study.
10. This process is consistent with Finance Theory that argues that in order to increase the expected return of an efficient portfolio, leverage should be used, as opposed to overweighting higher return asset classes. However, this also assumes that leverage is always available at the risk free rate (with no volatility or correlations to the rest of the assets in the portfolio).
11. Expected Return, Volatility, and Correlation figures based on Meketa Investment Group 2018 Asset Study.
12. Any type of short-term credit provided by a bank or non-traditional lender.
13. There are risk parity products/strategies that implement portions of their allocations that do not have developed futures markets (e.g., TIPS) through physical assets (i.e., direct ownership). However, directly owning the assets further constrains the strategy's total exposure limits and its ability to access leverage. Additionally, these exposures are passively implemented. Thus, risk parity crowds out active management, and any manager alpha that might be available in less-efficient asset classes must be foregone.
14. Leverage is the use of borrowed funds to purchase an asset or make an investment. Doing so creates economic exposures that exceed the value of the capital put up for the investment.
15. Hypothetical example only, does not reflect current leverage ratios available for derivatives contracts.
16. Maintenance margins are lower than initial margins and vary by asset class, depending on factors such as the asset's volatility.

17. Target Risk levels vary, usually between 5% and 20%. Levels are chosen with objectives such as matching equity market volatility, or bond market volatility, among others.

18. This explanation assumes risk is standard deviation of returns only. Sophisticated implementations of risk parity will include other measures of risk as well as the correlations between assets. The same logic applies: the less risky (riskier) an asset becomes and the less (more) correlated it becomes relative to the other assets in the portfolio, the higher (lower) its risk parity allocation should be, translating directly to higher (lower) leverage.

19. Global Equities, Core Bonds, and Inflation Linked Bonds proxied by MSCI ACWI, Bloomberg Barclays U.S. Aggregate and Bloomberg Barclays U.S. TIPS indices respectively.

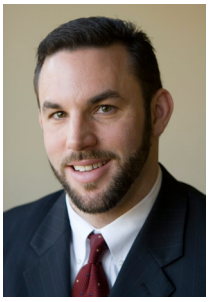
20. Based on Meketa Investment Group 2018 Asset Study.

21. Peer portfolio defined as 60% Growth/Equities and 40% Rate Sensitive.

22. Based on Meketa Investment Group 2018 Asset Study. Simplified example for illustration purposes only. Does not include potential allocation changes (e.g., changes in leverage or target volatility) to portfolios during the periods studied.

23. Based on Meketa Investment Group 2018 Asset Study. Simplified example for illustration purposes only. Does not include potential allocation changes (e.g., changes in leverage or target volatility) to portfolios during the periods studied.

Author Bio



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Meketa Group

Mr. Benham joined Meketa Investment Group in 1999. As Director of Research, Mr. Benham oversees all research projects, including white papers and the firm's annual asset study. Mr. Benham leads the design of the firm's portfolio construction initiatives and he is key in constructing customized investment programs. Mr. Benham is the chair of the firm's Investment Policy Committee and a member of the Private Markets Investment Committee.

Mr. Benham received an undergraduate degree in Finance from Bentley College. He holds the Chartered Financial Analyst designation, and he is a member of the CFA Institute and the CFA Society Boston. Mr. Benham also holds the Chartered Alternative Investment Analyst (CAIA) designation and is a member of the CAIA Association®. Prior to joining Meketa Investment Group, Mr. Benham was employed at State Street Bank, performing operations analysis and developing process improvements.

Mr. Benham has served as a frequent speaker at industry events, including: the International Foundation of Employee Benefit Plans Annual Conference, the NCPERS Annual Conference, the Investment Forum for Endowments, Foundations and Pension Funds, the Endowment and Foundation Forum, the Made in America Conference, the Institutional Investor Public Funds Roundtable, the CFA Society Boston Asset Allocation Seminar, the Institutional Investor Global Real Assets Forum, the Institutional Investor Infrastructure Investment Forum, the SuperReturn Latin America conference, the Institutional Real Estate VIP conference, and the Investing in Infrastructure Assets Europe and Americas conferences.

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Mr. Obregon joined Meketa Investment Group in 2014. A Research Analyst for the firm, his responsibilities include asset allocation, risk management, and macro-economic research, and investment manager research. Mr. Obregon works directly with the public markets manager research team and the Director of Research to develop and communicate research and guidance to our Consultants and clients.

Prior to joining Meketa Investment Group, Mr. Obregon was employed by Agrega Partners in Caracas, Venezuela, a financial and strategic consulting firm. In addition, he served as an Analyst for Core Global Management, an actuarial consulting firm in Caracas.

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Meketa Group

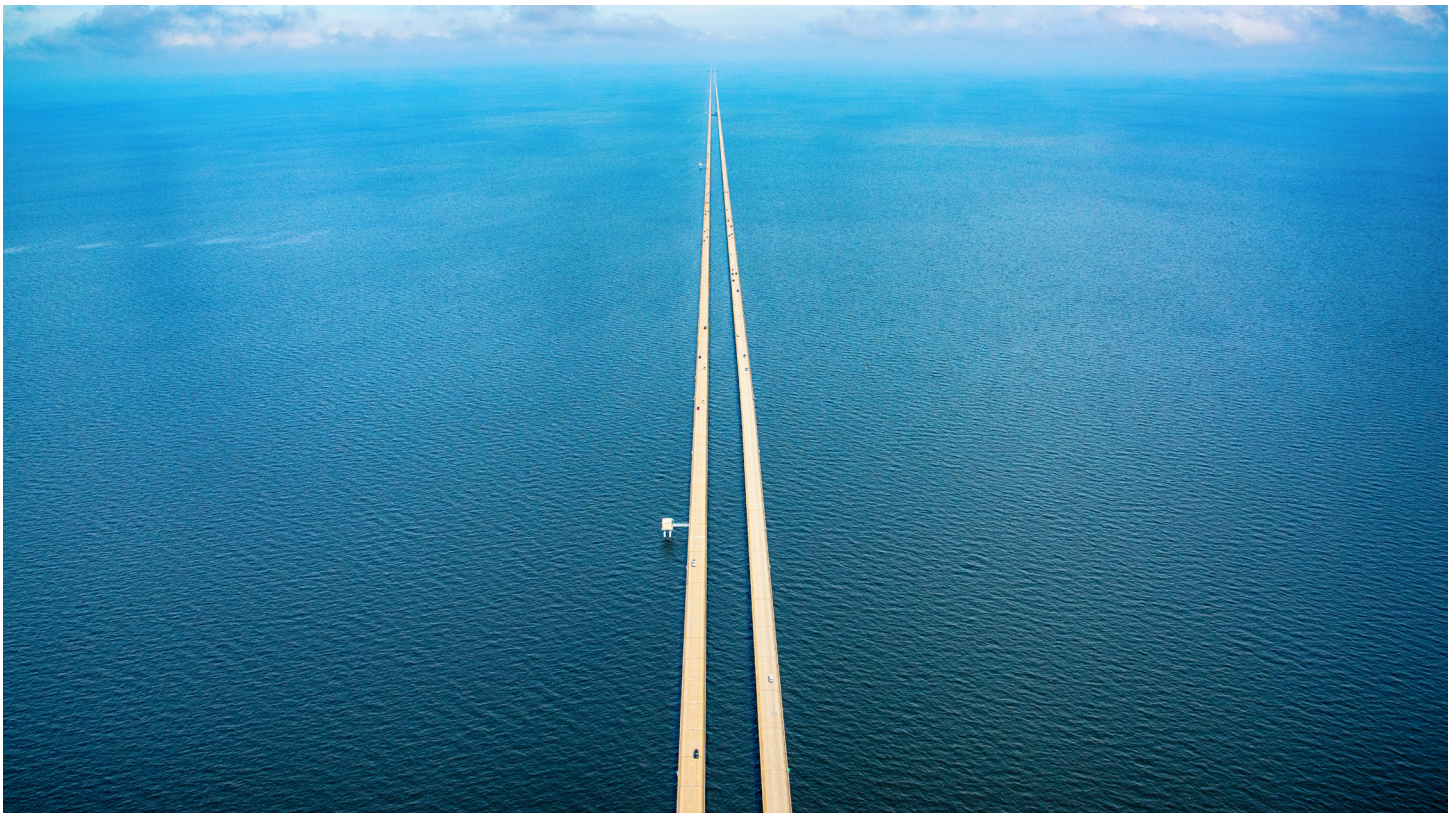
Dr. Yontar joined Meketa Investment Group in 2015 and has been in the financial services industry since 2007. A Senior Vice President of the firm, Dr. Yontar serves as a consultant for a variety of clients on their endowments, foundations, and pension plans. His areas of expertise include investment policy design, modeling of asset and risk allocations, derivativesbased strategies, and analysis of manager and fund performance.

A member of Meketa Investment Group's research team, Dr. Yontar chairs the firm's NonProfit Committee and serves on the Strategic Asset Allocation and Global Macroeconomic/Tactical Asset Allocation, Compliance, and Marketing Committees.

Prior to joining the firm, Dr. Yontar was Managing Director, Investments and Derivatives, at Cambridge Associates. While there, he advised endowment, foundation, and high-net-worth private clients on asset allocation and manager selection, while also serving as a research specialist on portfolio construction, risk management, and derivatives.

Prior to this, he led the analytic services department at Upromise where he was responsible for marketing strategy analysis, reporting, and research. Previously, he was a management consultant, serving as a project and team leader at Monitor Group and as an analyst at Dean & Company.

Dr. Yontar graduated from Harvard University with a PhD and MA in Political Science, and a BA, magna cum laude, in Government. He serves as the Treasurer for the Harvard Band Foundation, where he is responsible for supervising endowment investments and capital gran



Long Alpha and Shareholder Activism Strategies

Sam Kavehrad, *CAIA*
RVK

As investment boards continue mulling over the "active vs. passive" management debate, additional options that sit just outside the traditional equities space are resonating with some institutions. For those wary of surrendering higher fees for strategies constrained by tracking error and index weights, long alpha and shareholder activism hedge funds offer a bolder, purer flavor of active management that aims to outperform global equity markets over a multi-year investment horizon.

The following thoughts offer an initial assessment of the strategic nature, terms, and implementation considerations for long alpha and shareholder activism hedge fund strategies.

Long Alpha Strategies

The protracted impact of low interest rates and quantitative easing has led to sustained gains across most long-only indices and ETFs. Increasingly steering global asset flows into these products, many investors have developed muted expectations for hedge fund managers that deploy short selling as a tool for return generation. One response that has emerged from many blue chip long/short equity and multi-strategy hedge funds is to offer investors the long equities sleeve of their flagship strategies as a standalone product, blurring the lines between hedge funds and traditional active equity managers.

Recognized for their ability to attract and retain the world's top talent, hedge funds offer investors a research edge channeled towards generating long alpha within truly active, unconstrained portfolios. Deploying value, growth, or hybrid approaches across multiple sectors of expertise, investment teams build positions across a more concentrated group of companies while avoiding unattractive industries altogether.

Long alpha strategies offer a departure from the standard "2&20" fee paradigm, which is a hot button topic for many institutions. In contrast, the typical terms for long alpha strategies attempt to align manager incentives more strongly with alpha generation, while additionally offering flat management fee options. The following represents typical terms for these offerings based on RVK's extensive dialogue with managers, primer brokers, and institutional allocators.

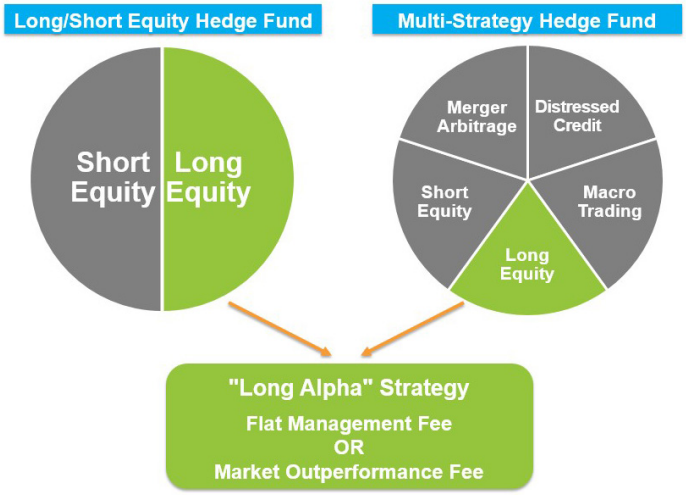


Exhibit 1: Long Alpha Products

Typical Long Alpha Strategy Terms

Shareholder Activism Strategies

Introduced by economist and philosopher Adam Smith, the "Agent vs. Principal Problem" elegantly highlights the cardinal tenet behind shareholder activism:

"The directors of joint stock companies, however, being the managers rather of other people's money than their own, it cannot well be expected that they should watch over it with the same anxious vigilance as owners. Negligence and profusion, therefore, must always prevail, more or less, in the management of the affairs of such a company." Wealth of Nations, 1776

Activists serve as a primary catalyst for unlocking value within identified public companies through engagement with those companies' management teams and boards of directors. They are, in a sense, bringing the owner's voice closer to the decision-making process. After an ideal candidate for shareholder activism is identified, the investment team proposes a course of action to company management.

Levers for Value Creation

- Operations - Cost reduction programs, revenue growth initiatives, productivity measurement, improved investor relations.
- Strategic Transactions – Merger, acquisitions, divestitures, joint ventures, private company sales (LBOs), public company sales.
- Capital Structure - Share buybacks, alternative security structures, debt refinancing, dividend policy, equity infusion (PIPES).
- Management/Board - Recruitment of C-Suite talent, strengthening incentives systems, direct board participation, governance or policy changes.

	Management Fee	Performance Fee	Liquidity	Notice Period
Flat Fee Model	1% to 2%	0%	Monthly or quarterly	30 days to 90 days
"Outperformance" Model	0%	20% to 30% Only assessed on outperformance above benchmark	Monthly or quarterly	30 days to 90 days
Hybrid	0.5% to 1%	10% to 20% Only assessed on outperformance above benchmark	Monthly or quarterly	30 days to 90 days

Exhibit 2: Typical Terms for Long Alpha Strategies

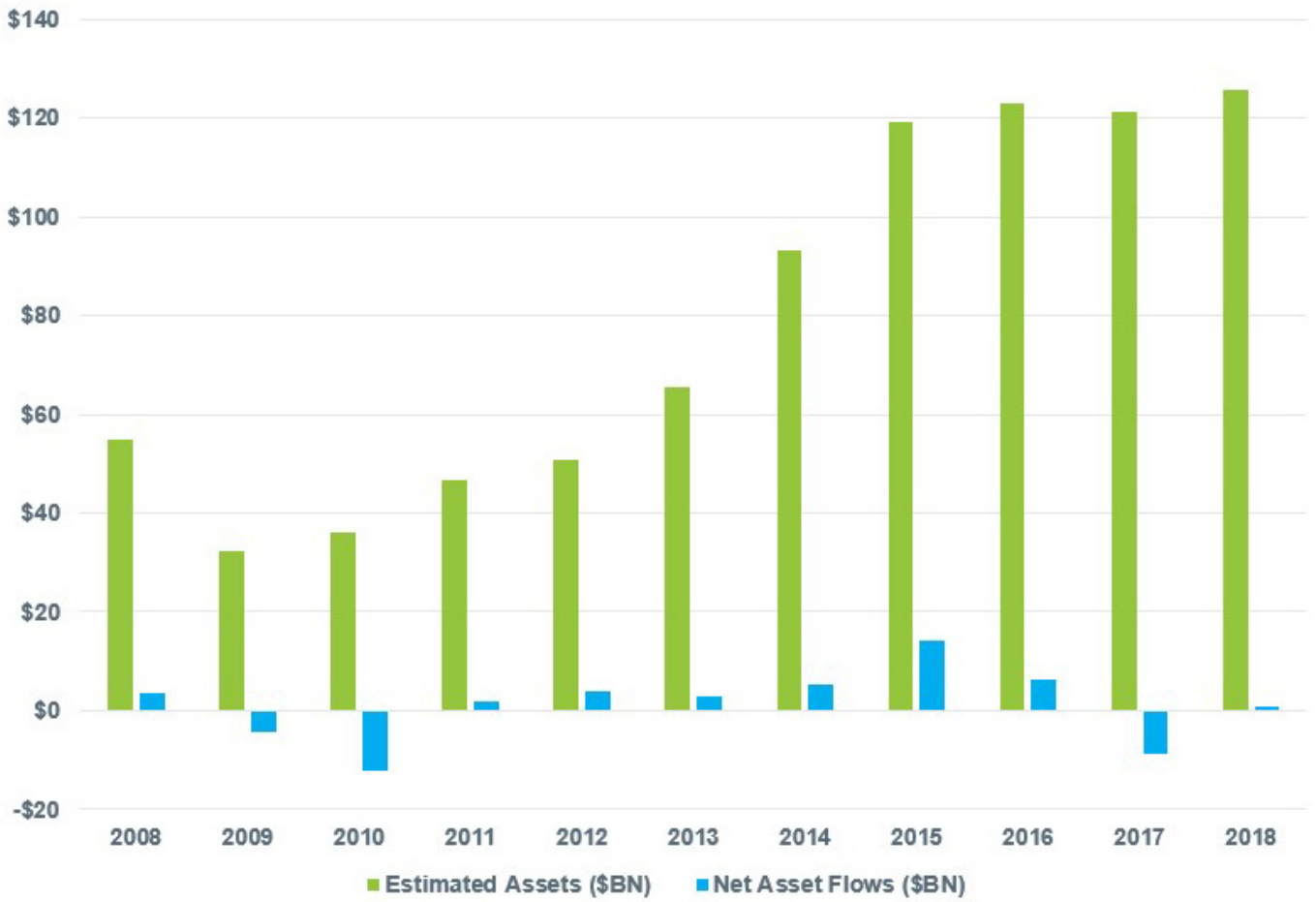


Exhibit 3: Asset Flows for Shareholder Activism Strategies
Source: Hedge Fund Research (HFR)

While a small handful of headline-grabbing activists rely on a more adversarial approach that can include public letters criticizing management or proxy contests, many managers prefer constructive collaboration and a behind-the-scenes campaign for unlocking shareholder value that has proven to be highly effective.

Staying power to successfully navigate multi-year activism campaigns requires a stable investor base committed within longer lockup share classes. Additionally, investors who acquire over 5% of a company's common stock or participate on investment boards are subject to strict SEC trading restrictions. While portfolios are comprised of public equities, the activist's approach to unlocking company value and long field of vision more closely resembles private equity strategies. Mainly represented by institutional investors, shareholder activism strategies have experienced tremendous asset growth over past decade.

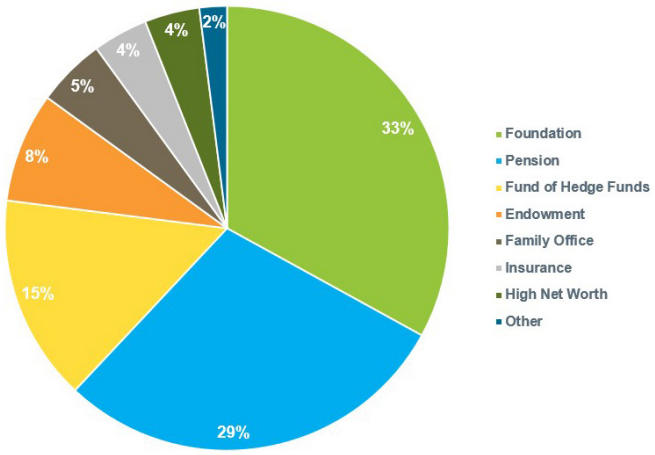


Exhibit 4: Shareholder Activism Investors by Type
Source: Prequin

	Management Fee	Performance Fee	Liquidity	Notice Period	Optional Co-Investments
Classic Hedge Fund Structure	2%	20% Crystallizes quarterly	Quarterly	45 days to 90 days	No
Rolling 3-5yr Evergreen Structure	1% to 2%	20% (Pending 6-8% hurdle) Crystalizes at end of term	Multi-year term Option to re-subscribe	45 days to 90 days	Yes Mgmt. fee waived
Fixed Term Drawdown Structure	1% to 2%	20% (Pending 6-8% hurdle) Crystalizes at end of term	Finite term length Callable commitments	N/A	Yes Mgmt. fee waived

Exhibit 5: Typical Terms for Shareholder Activism Strategies

Typical Activist Strategy Terms

Portfolio Implementation

A growing trend with institutional investors that adds depth beyond the classic "style box" approach to equity portfolio construction is the inclusion of a core/satellite framework striking an allocation balance between passive indexation and truly unconstrained active managers

Essentially, the investor's risk budget for tracking error and volatility shifts to a satellite group of "high octane" active managers, while the core constituents are represented by passive indexation strategies serving as the main source of "cheap beta" equity market exposure.

Although long alpha and shareholder activism funds are housed within limited partnership structures, the nature of both strategies alleviates the bucketing debates that are more prevalent with their hedged counterparts, such as long/short strategies.

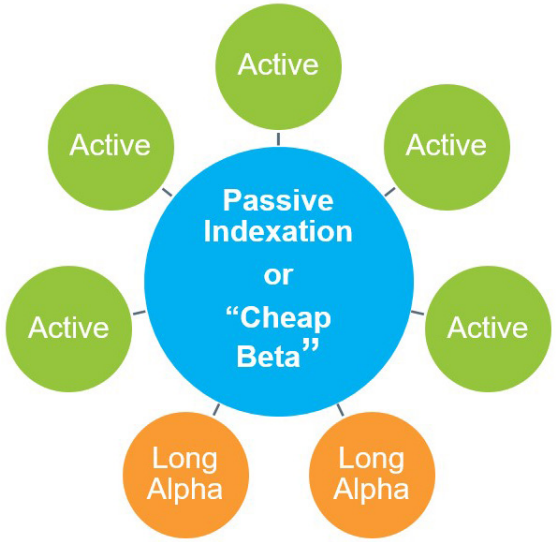


Exhibit 6: Implementation Framework

Exhibit 7: Key Considerations & Trade-Offs

In most cases, both strategy types are comprised of unlevered long equities that seek to generate excess returns beyond a respective equity benchmark. While some institutional allocators have historically designated these strategies as part of an equities allocation, others have housed them within an alternatives bucket alongside other hedge fund investments. Sharing characteristics of active equity management and less-liquid private strategies, both bucketing approaches can be reasonable, provided there is a solid understanding of the risk and return objectives highlighted above.

While the overall objective of equity market outperformance is initially attractive, institutional investors need to judiciously evaluate the risk/reward tradeoffs involved. While long alpha and activist hedge funds may be a viable solution for some, reduced liquidity, high tracking error, and increased fees can make them unsuitable for others. Additionally, participation in limited partnership structures is always accompanied by a higher administrative burden.

Conclusion

Both long alpha and shareholder activism can represent an effective solution for investors seeking truly unconstrained active equity management. Employing highly differentiated investment approaches, these strategies aim to achieve significant equity market outperformance over multi-year investment horizons. While not appropriate for all, these strategies are worth exploring as a potential source of robust, long term alpha generation within the institutional investor's portfolio.

Author Bio

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Located in our Portland office, Sam joined RVK in 2014 as a Senior Manager Research Analyst. He was promoted to Manager Research Consultant in 2017. He is a senior member of the Investment Manager Research group, working closely with institutional clients on hedge fund manager selection, portfolio construction, risk management practices, and structuring limited partnership terms.

Previously, Sam served as a Research Analyst for a large asset management firm, where he focused on the sourcing, due diligence, and analysis of hedge fund strategies.

Sam graduated with a Bachelor of Science degree in Finance from Portland State University and is a CAIA Charterholder. He also serves on the Board of Directors for the Portland Alternative Investment Association.

Operational Plus Commercial Due Diligence: Strengthen the Shield Against Fraud

Jinzhu Chen, *CAIA*
Anbang International

When Professor Eugene Fama developed the Efficient Market Hypothesis ("EMH") in 1970 (Fama 1970), the investment community was largely organized around public markets, which also demarcated the frontiers of empirical application of classical pricing models such as CAPM and factor models despite their extensive theoretical coverage. The past half century has witnessed, on the one hand, the EMH pushing to the limits of its semi-strong form in public markets evidenced by the growing market share of passive management, and on the other hand, expansion of the institutionalized investment universe into a variety of alternative investments.

A causal relationship may be established between these two observations. By definition, as a market improves in efficiency, the cost of "mining" information not yet captured by price becomes exorbitant, which drives investors seeking abnormal profits to other markets. The private and asymmetric nature of information in alternative investment markets implies access to alpha for diligent market players, which partially explains their increasing popularity with the investment community.

Due diligence ("DD") is in essence the search for information that has yet to be reflected in price, which in turn represents an opportunity to materialize into excess returns. The umbrella term due diligence encompasses all such efforts in any segment of the capital market. Indeed, it first came into common use by broker-dealers in the 1930s to refer to their investigations of public stock offerings, and it was only over time that its original meaning was assigned to research analysis, presumably to signify the tilt from the diligence exercised on information gathering to analysis of available information. The term due diligence itself now largely denotes investigations on investments with a private element, be it mergers and acquisitions ("M&A") or subscription to a hedge fund.

Is it the end of the story and will the prevailing nomenclature persist? Very unlikely. While difficult to deduce precisely how it will evolve, as long as the pursuit of higher investment returns persists, which it will, novel DD approaches with recognizable value-add would quickly diffuse in the investment community, making them routine and common. Interestingly but unfortunately, DD practices as an intangible good demonstrate the properties of both unpatented intellectual property and negative externality, which means that once "invented", they would soon be "copied" at minimal marginal cost with new findings factored into equilibrium price (i.e. the market becomes more efficient), congesting out any excess returns that could have been earned on informational edge.

What happened in public markets is repeating itself with alternative investments, however slowly, and the chase after abnormal profits eventually eliminates them. Nevertheless, our job as professionals is to iteratively aim at a moving target called superior returns by relentlessly recalibrating the DD weapon, until the mission becomes so formidable that new fronts must be opened. Doomed as it may sound, huge gaps remain to be filled and profits to be gleaned along the trudge toward a fully efficient market, mirroring John Maynard Keynes' famous "in the long run we are all dead" quote from a bright angle.

Use Operational Due Diligence to Detect Lurking Hazards

A comprehensive review of prevailing DD practices across alternative investment sectors is beyond the scope of this article. Rather, it will try to shed some light on the theme of continuously upgrading the DD toolkit to keep effectiveness, by focusing on the relatively mature and organized domain of buyout private equity ("PE") deals.

For such transactions, the DD process is to a great extent normalized around three pillars – financial, legal, and commercial. Amongst the three, financial and legal due diligence largely examines standardized documents provided by the seller or the target, aiming material issues with the health of the business. On the other hand, commercial due diligence ("CDD") is conducted on a broader collection of non-standard information from various sources, trying to gauge a target's commercial attractiveness against the full context of internal and external settings.

This systemic approach is by now well embraced by the PE investment community and has become basic know-how for the buy-side and the sell-side alike. However, as we have taken great pains to explain, its success also preludes diminishing effectiveness. What used to be an unnoticeable gap between the three pillars now stands out as prominent, namely finding issues with the target's health with non-standard information.

To borrow a concept from the CAIA curriculum book on fund operational due diligence, all such risks can be categorized under meta risk, which is used as a "miscellaneous, intangible catchall" for qualitative risks not captured by specific, measurable risks (Kaplan Schweser 2018). In fact, they are more precisely termed as uncertainties rather than risks because neither their probabilities of occurrence nor the magnitude of associated losses can be scientifically measured in advance. They are extremely difficult, if not impossible, to be discerned by conventional DD methods (and what is conventional now only became common practice in the last thirty to forty years), but they can be latent for a prolonged period with substantial tail losses, aggravated by the information asymmetry and low liquidity of PE investments.

One way to tackle this is to introduce an element of operational due diligence ("ODD") into CDD, usually conducted by the investor itself and sometimes assisted by investment banks. This is because operational risks are in general qualitative in nature, diverse across industries, and incompatible in documentation format. They are not enclosed in the specialty areas of external advisors, hence have to be picked up by the investor itself who is ultimately accountable for investment outcomes. This of course comes with a cost, explicit or implicit, but it may also come with higher marginal benefits than the same amount spent on financial due diligence ("FDD") and legal due diligence ("LDD"), which already command millions of dollars. It also infuses new value into CDD, which often reduces to looking for evidence to corroborate a business case established long before the DD stage.

Besides cost, another constraint is the tight timeline imposed by the seller. To find deficiencies that the seller fails to find or pretends not to have found within a short time window, the buyer's DD has to go with the deal flow and make the best use of each step:

- Deal screening: include a reference list on potential points of concern with the target's operations in preliminary business analysis. Since very few deals proceed to the DD stage, it may be worthwhile to methodically develop and continuously enrich a list for the investor's specialized sectors in the course of investment activities.
- Before bidding: consult sector experts, internal or external, on industry-specific pitfalls to beware. This complements the generalized advice from investment banks, law firms, and accounting firms, and is particularly vital for cross-border investments.
- Bidding to signing: kick off ODD as soon as practicable. Leverage on initial findings from FDD and LDD and probe deeper. Raise DD requests on questionable practices, go ahead to learn more about the business if met with cooperation, otherwise make it a case for protective SPA clauses against future mishaps.
- Signing to closing: take full advantage of the conveniences at this transitional phase to thoroughly inspect the business. This will be discussed in detail later.

To convert operational uncertainty to operational risk, an ODD takes profound insights to see right through abnormal practices when the buyer is still an outsider to the business. This may sound like using a microscope with frosted lens to find the one marked cell on a whole sample, but isn't it what investment is all about?

Tong Yang Life Insurance Meat Loan Fraud[1]

As the old Chinese saying goes, "A fall into the pit, a gain in your wit," the idea of this article originated from a tragedy.

In 2015, Anbang Insurance Group acquired a controlling stake of 63.01 percent in Tong Yang Life Insurance Co. Ltd. ("TYL"), the then 8th largest life insurer in Korea, from Seoul-based private equity fund Vogo Investment Group ("VIG") and other minority shareholders for a combined consideration of KRW1.13 trillion (about US$1 billion). The deal was first announced in February and closed in September 2015, which marked the first Chinese investment in Korea's financial industry and also the biggest investment ever from China.

About one year after the acquisition, a colossal credit fraud on meat loans burst in the Korean insurance industry. As background information, meat loans are loans extended to distributors secured by imported frozen meat. Borrowers and creditors are connected by specialized agents who may also provide valuation and pooling services. Despite higher risks due to the lack of a centralized collateral registry and valuation system, this type of loans gained traction in a low-interest environment with Korean financial institutions, notably insurance companies, savings banks, and investment funds.

Police investigation and independent audit on cold storage warehouses found serious "double dipping" by Korean meat distributors in taking out multiple loans against the same collateral, and only less than 20 percent of the documented meat consignments turned out to exist. Around twenty creditors were involved with an estimated sum at stake of over KRW600 billion (about US$550 million), among which TYL alone accounted for KRW380 billion (all booked as non-performing loans later), or 21.3 percent of its net equity as of December 31, 2016. Concurrent rights to the same collateral also invoked conflicts among creditors.

By January 2017, TYL claimed that meat distributors had failed to pay back KRW283.7 billion in loans. TYL reserved KRW266.2 billion for non-performing meat loans by the end of 2016, which directly contributed to the 78.2 percent YoY drop in its net profit to KRW3.44 billion, despite a 58.1 percent YoY growth in revenue to KRW7.43 trillion.

In June 2017, Anbang filed a KRW698 billion (about US$612 million) compensation claim with the International Chamber of Commerce's arbitration court in Hong Kong ("ICC") against former TYL shareholders for failing to disclose risks of meat loans during due diligence for the acquisition.

This is a classic case of major tail risk materializing from a merger and acquisition deal, causing the investor humongous losses in several aspects:

- **Direct financial loss:** according to an industry veteran with over 20 years of experience, the TYL meat loan fraud was the most catastrophic financial incident he had ever observed. Statistics provided by Financial Supervisory Service ("FSS") also suggest it to be the largest financial incident in terms of total worth of damages over the five-year period of 2012-2016, with loss suffered by TYL only second to the cumulative damages of KRW453.1 billion to KB Kookmin Bank over 40 plus incidents.
- **Regulatory enforcement:** the Korean Financial Services Commission ("FSC") conducted a special audit on the TYL meat loan case from December 2016 to January 2017 and February to March 2017. The Prior Notice of Contemplated Measures issued in April 2018 indicated partial suspension of TYL's business or operation and sanction measures on certain managerial staff for improper loan management practices. The FSC however resolved in May 2018 on milder measures as institutional warning to TYL and caution to staff with supervisory responsibilities. In addition, several former employees in various managerial roles were prosecuted and convicted of fraud and malfeasance offences.
- **Business disruption:** although difficult to measure, it has the most extensive and long-term impact. In an industry founded on trust, even if business suspension ended up not being imposed, clients with no lack of choices in the saturated Korean insurance market still walk away, not to mention repercussions such as uncertainties around operations, damage on staff morale, shackles on business decision making, lost development opportunities in shortage of solvency buffer, and resources dedicated to compliance and risk management to meet increased regulatory scrutiny.
- **Loss in market value:** an integrated indicator of all impacts above. TYL's stock price dropped by 12.2 percent in the week following its announcement on the potential meat loan loss, which magnified to 30 percent in two months, along with downgrade and reduction in target price by all security houses covering TYL. Although TYL was also experiencing other major difficulties, notably turmoil around the controlling shareholder, the meat loan fraud apparently accounts for a large portion of the plummeting stock price immediately following the breaking news.

Overall, business losses are front-loaded with unlimited downside, whereas recoupment of any indemnity has to follow years of legal proceedings and is capped by the lower of the claim filed and financial strength of the counterparty. In the TYL case, Anbang even had to provide KRW528.3 billion of emergency capital injection to stave off regulatory insolvency (Shim 2017). It is not inconceivable for the insurer to go on a fire sale or even cease operations long before an arbitration award, had the parent company been less deep-pocketed.

Practical Lessons from the Fraud Case

The TYL meat loan case provides a very interesting subject to enlighten on fraud avoidance in mergers and acquisitions. TYL is a publicly listed company, which subjects it to dual supervision by both insurance and securities regulators and extensive disclosure requirements. The scrutiny it is under in the normal course of business may not fall short of a standard DD, yet failed to prevent an ostentatious fraud for years. This points to the need of more probing measures for a DD to be effective.

From hindsight, bursting of the Ponzi scheme seems inevitable, and the primary point of dispute between Anbang and VIG is whether the latter willfully concealed the risks. While resolution on this is pending adjudication by the arbitration tribunal, it is time to extract preliminary lessons that may help future acquirers avoid similar pitfalls, or at least gain a better position should disputes arise.

To do this, we will conduct a series of what if exercises and try to generalize insights obtained to broader settings. For each exercise, follow-up actions are grouped into prevention – to cure or quit before closing, and insurance measures against future controversies or even litigations. As conventional wisdom suggests, prevention is the better cure. This is especially true in the TYL case, as the acquirer was under pressure to improve performance by adopting an aggressive business model, which makes it harder to distinguish between calculated and blind risk taking.

What if Comparitive Study was Made on Average Asset Allocation of the Korean Insurance Industry vs. TYL?

TYL had around KRW2 trillion other loans on its books at closing, which accounted for 20 percent of other loans of all Korean life insurance companies and exceeded the total sum of the three largest players. While insurance companies may diverge in definition of asset classes, the fact that meat loans as one subclass of other loans took up around 10 percent of all TYL loans would have been significant enough to sound the alarm.

Why can't we count on FDD by accounting firms to detect such anomalies? Because FDD, like financial audits, is to a large extent standardized across economic sectors. For example, loans are typically classed by term, size and whether secured or not, with samples mostly drawn from unsecured sizeable loans. Only in-depth industry knowledge may direct DD performers to where business-specific risk lies, in this case tens of thousands of meat-secured loans with each insignificant in amount. Moreover, even if samples from this loan class were drawn by FDD, investigation of paper documents from a financial rather than operational perspective would have difficulty finding anything.

Follow-up Actions:

Prevention: the next *what if* exercise.

Insurance: the sales and purchase agreement ("SPA") typically requires prior consent from the buyer for any material decisions made on or by the target before closing. In view of risk concentration around meat loans, it would have been worthwhile to negotiate for a broader set of scenarios and looser thresholds for such consent to be sought, including renewal of or increase in aggregate credit line to a group of concerted parties, uplifting a loan class's pro rata proportion to total invested asset portfolio, etc. Purpose of such measures is twofold: detect anomalies if consent is sought too often, and establish breach of contract if consent is not adequately sought or obtained.

Lesson learned: success of an insurance business not only rests with the liability side, which often draws most of the fire of a CDD, but also stands on the other leg as asset allocation. It is advisable for potential acquirers to closely examine the soundness of investments made against premium income, otherwise any projected business growth would be a skyscraper built on shaky ground.

Extension of the lesson to other sectors may include management of the FF&E reserve of the hospitality industry, timber stock of the furniture industry, crude oil inventory of refineries, etc.

It is probable that such investigation does not detect any material risk. In the TYL case, the other loans class comprised over KRW1 trillion asset-backed loans, which also included fish-secured loans, project financing, and loans secured by other assets in addition to meat loans. Examination on these high-risk high-return loans would have served as an insurance against risk that does not materialize, not unlike most other DD efforts.

What if Due Diligence was Conducted on how TYL Handled Meat Loans?

A review of media reports on the incident suggests at least the following deficiencies in TYL's meat loan management:

- Delegation of collateral evaluation to agent: TYL had Profit International, its exclusive meat loan solicitor since 2007 and nominal borrower for a number of meat distributors, prepare the 'Valuation of the Meat', posing apparent conflict of interest.
- Absence of on-site collateral inspection: TYL is believed to have extended loans solely based on 'Valuation of the Meat' prepared by Profit International without on-site checking of collateral, nor did it require Profit International to conduct physical inspection.
- Failure to identify affiliation between borrowers: as of 31 December 2015, TYL had extended a total credit of KRW114.3 billion to 11 borrowers, which all turned out to be affiliated with Warner Company through cross-shareholding and executive double hatting. All these loans became non-performing loans. The actual amount could be even higher as these companies gained access to additional credit through Profit International as nominal borrower, which well exceeds the credit limit for a group of affiliates.

Had ODD been conducted on TYL's meat loan management, those deficiencies would have had a good chance of being detected. This may seem like a needle in a haystack, but totally feasible if the first what if exercise was performed.

Ideally, any fault with the business can be detected before signing the SPA, yet we do recognize the pressing timeline and confidentiality concerns of sellers in practice. A good time to conduct an investigative ODD is the period from SPA signing to deal closing, in TYL's case February to September 2015. A designated transaction team of the buyer is generally stationed at the target's premises during this period, furnished with full and timely access to its business and documents. An affluence of information and knowledge about the business can be

gained if such access is effectively utilized, not only for hazard screening, but also conducive to post-investment integration and development.

Follow-up Actions:

Prevention: provided that the representations and warranties and covenant clauses in the SPA are tactically negotiated, material faults detected before closing should be corrected and the purchase price adjusted accordingly. In the most extreme case, the buyer may walk away cost-free.

Insurance: this is the second line of defense if preventive measures prove impracticable or inadequate. Depending on relative bargaining power of the two sides of transaction, the buyer may ask the seller to provide insurance, implicit or explicit, against future losses thereon for a certain period, or purchase insurance, in its literal sense, from third parties at own cost.

Lesson learned: although not totally clear from public information, it is implausible that the 8th largest Korean insurer did not have a full set of operational guidelines on loan management, rather failed to be observed in practice.

This case is special in that the fraud developed around the time of transfer of a controlling stake, but it is by no means unique in its cause. Operational failure looms large over most of the recent financial frauds, in the same vein as reckless driving being the most common cause of road accidents. In fact, similar meat loan fraud emerged in Korea as recently as 2013, where distributors also "received loans from different non-banking institutions against the same meat in warehouse" (Condon 2017).

Some may argue that it is already mission improbable to discover frauds in the normal course of business (echoed by VIG in its defense), how could we expect an investor-to-be to succeed from outside? To this, our answer is that a robust CDD, like an internal audit but free from preconception and intra-organizational affiliations, is in a better position to overhaul the target's business because it is not accustomed to the long-standing operational anomalies. For example, the special relationships between TYL borrowers could have been uncovered simply by reviewing their publicly accessible company registries.

What if a Request was made to the Seller for Onsite Audit of Collateral?

Up to this point, only hypotheses can be derived from the series of desktop research, but conclusions can only be drawn from an onsite audit. Indeed, TYL is said to have discovered the fraud while examining imported meat held as collateral in cold storage (Condon 2017).

Whether or not risks identified by CDD warrants an onsite audit and on how large a sample is a judgment call, nevertheless simply raising the request may benefit the buyer by testing out the seller's willingness to cooperate.

Follow-up Actions:

Prevention: if the seller is cooperative, the buyer may well proceed with the audit and decide on the scale by analyzing the cost of engaging professional parties on this job against potential benefits. Preventive measures would ensue on findings from the inspection.

Insurance: if, however, the seller rejects, extra caution must be taken, and the seller's story scrutinized. The buyer will then decide whether to insist, to demand firmer guarantee from the seller on the loan portfolio, or to carefully document correspondence with the seller in case fraud is identified after closing and disputes over whether seller had prior knowledge arise. The second and third moves are not mutually exclusive, and both serve as insurance against risks.

Lesson learned: while existence of fraud is a fait accompli, assignment of responsibility is more critical to parties of the transaction. If the first best outcome of nipping risks in the bud cannot be achieved, then the next best is to prepare in advance for a rainy day. With DD findings pointing to tangible and specific threats to the business, it could be a sure-fire to request for taking the investigation one step further. Even a flat denial by the seller may, to say the least, save millions of dollars in litigation later.

What if an ODD was Conducted on VIG as the Lead Seller?

For institutional investors screening PE funds for investment, ODD has become the norm, which helps investors gain "an understanding of how a private equity fund operates from a process and procedures perspective" and of "how the fund works across the risk areas" (Kaplan Schweser 2018). In contrary, M&A DD focuses on the portfolio company as the target rather than the fund per se as the seller.

This makes good sense as the buyer and the seller ideally have fulfilled all contractual obligations upon ownership transfer of the target, especially as PE funds, unlike an ordinary parent company, have few business relationships with portfolio companies that may carry over. This apparently holds if nothing happens thereafter. However, representations and warranties clauses that exhaust the alphabet in a typical SPA indicate that closing only marks the beginning of certain obligations, which makes a case for the buyer to know the seller better.

The TYL arbitration case centers on whether VIG was aware of risks of the meat loans but chose to conceal them from Anbang. An executive of VIG claimed that "Even TYL employees became aware of the meat loan issue late. There was no way for the shareholder at the time to be aware of the issue in advance" (Shim 2017).

An ODD on VIG, which by no means needs to be full-scale, could have done the buyer some good. On the one hand, it can locate weak links in the fund's post-investment operational processes and make them focus areas for DD on the target as well as shed light on key terms of transaction documents. On the other hand,

documentation of the fund's participation in target's operations may lend more support to the buyer's claim than indirectly relying on expert witness's testimony about common industry practices.

> **Lesson learned:** as little public information is available on the ongoing arbitration, we will refrain from making specific suggestions on actions that could have been taken, but rather leave it as an invitation to the investment community to start thinking about whether and how fund ODD techniques can be applied to acquisition deals with the seller being a PE fund. While we do recognize the complexities and particularities of fund ODD that consume extra time and cost, extra care is also needed when dealing with funds. Just to name a few reasons:
>
> - They are in general well-versed in deal processes, negotiation tactics, and contract laws.
> - They are less likely to be actively involved in portfolio companies' daily operations, which lends weight to their claim of innocence.
> - Their buy-and-sell model dictates a rather short holding period, over which representations and warranties are in general applied.
> - They have a limited window to distribute sale proceeds to investors and/or pay down leverage, hampering their ability to indemnify future contingencies.
> - They are oftentimes incorporated offshore, posing difficulty for efficient enforcement of judgment cost- and time-wise.

Conclusion

This article discusses operational risk investigation on acquisition targets by adding elements of ODD into CDD, and makes practical recommendations by examining the recent TYL meat loan fraud case. Like a physical examination, even the most sophisticated DD measures cannot be exhaustive, but the improvement in chances of early detection could be worth all one's life – had the owner of TYL still been VIG at the time the fraud was exposed, it would likely have gone bankrupt as no Korean PE fund management company has an equity in the hundreds of billions of won, according to market observers.

Also similar to physical examination, in the wake of technology advancement and digitization of information, standardized and quantitative analysis has become much more convenient, with the help of state-of-the-art medical device or well-trained professional advisors. Powerful as such instruments may be, if due diligence is all about reading paper documents furnished by the seller and reports prepared by external advisors, then we investment professionals set ourselves too simple a task. The ultimate due diligence liability that rests with the investor should command more profound scrutiny, which in turn calls for non-standard measures derived from hard-earned insight and expertise.

Some may argue that the cost of what is ideal may not be justified by its expected gains. While cost is always a crucial factor, classic principal-agent theory suggests that the cost-benefit analysis of investment professionals as the executor and that of the investing entity as the shareholder may not agree, and the former often prevails. Benefit to the investment team is typically twofold – a hefty bonus immediately upon completion of a deal, and the more intangible but lasting returns from an impressive deal list on resume. The personal cost is however rather limited and contingent, with accountability difficult to assign internally ex post. On the other hand, a meticulous DD consumes efforts and resources, returning either minor findings that take further efforts to correct before the deal can move ahead, or major defects that can bring down the whole deal, but its savings on potential losses that never realize seldom get recognized by the company or the wider investment community.

Operational risk is a risk without reward, which makes efforts that forestall such risks all the more worthy of a reward. While investment companies can achieve this with better aligned incentive mechanisms, high turnover of this profession demands that the whole investment community be mobilized to promote a risk-aware culture and do its members justice for deals dropped for a reason, rather than simply attributing credits by the counts of done's.

This echoes the dilemma depicted at the beginning of this article. Innovative DD techniques are rapidly picked up by peers and sellers alike, reversing their own effectiveness. This appears to be a zero-sum game, or worse, since total worth to all parties is fixed at the target's intrinsic value, whereas extra resources are consumed on additional DD activities. However, if we cast our eyes beyond individual deals to the general investment environment, this is in a large part offset by positive spillover effects, manifest as greater information efficiency in both the investment market and the talent market.

Endnotes

1. All narrative and analysis on Tong Yang Life Insurance Co. Ltd. and the meat loan fraud case are based on public information, including media reports. As information on the ongoing meat loan arbitration case is classified, some representations in this article may not have been verified by an official source.

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Positioning for Late Cycle with Defensive Equity

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Equities have been on quite the run. In the 10-year period ending October 31, 2018, the MSCI World Index delivered an annualized return of 10.02%, while the annualized return on cash was a mere 34 basis points. This equates to a 9.68% annualized equity risk premium over the past 10 years. Few, if any, investors expect nearly as high an equity risk premium over the next 10 years. In fact, we frequently hear investors categorize the current market environment as "late cycle." The market events of 2018 have done nothing to assuage the fear that the end of the equity bull cycle is near. We have experienced volatility spikes, increasing trade war rhetoric, and extreme oil price movements, to name just a few concerning episodes. Yet for all of this relative turmoil in 2018, we have also seen signs of economic strength, with the US unemployment rate at its lowest level in almost 50 years, consumer and business confidence at multi-year highs, and impressive corporate earnings growth. The contradictory signals reflect the conundrum investors face when positioning for late cycle. If an investor knew with certainty that we are at the top of an equity bubble, they would position their portfolio as defensively as possible. Conversely, if the same investor knew with certainty that the equity bull market would continue to accelerate into a bubble, they would position their portfolio to be as growth-oriented as possible. This is all easy enough provided an investor can time market cycles with certainty. In reality, precisely timing market cycles is guesswork at best, with wrong guesses negatively impacting an investor's goal of long-term wealth creation.

We use the dot-com era (1995-2003) as a case study to show the impact of making asset allocation decisions during different phases of a cycle. We compare back-tested results for allocating between a cap-weighted MSCI World Index (MSCIWI) portfolio (risk-on), a simulated, lightly

constrained[1] minimum variance (MV) portfolio (risk-off), and a simulated defensive equity multi-factor (DEMF) portfolio. For purposes of this paper, we define a DEMF portfolio as a portfolio built through a two-step systematic process. The first step systematically selects securities with attractive quality, value, momentum and diversification scores from the MSCI World index. The second step systematically weights these securities using a risk budgeting procedure to form a portfolio that targets balanced risk contribution across sector, countries, and securities. We focus our case study on the dot-com era, as it represents the most recent period with a complete equity market cycle from bull to bubble to burst. We find many similarities, and some differences, between the current environment and the dot-com period. We draw three conclusions from our analysis. First, each of the three portfolios has a particular segment in the cycle where it outperforms. Second, there is great ambiguity in determining where we are in the equity market cycle (bull, bubble, burst). Third, given the difficulty in timing the market cycle, we believe that it is prudent for investors to seek portfolios that potentially offer the most robust results across the entire continuum of the cycle.

Narrow Markets

One of the most distinguishing features of the dot-com bubble was the narrowness of the rally. First, most of the stocks that carried the dot-com bubble came from a single sector (technology). Second, because a large percentage of the dot-com stocks were US companies, the rally was also very narrow from a country perspective. Finally, there were periods in the dot-com era where the largest stocks dominated the indices in which they were included.[2]

The current bull market is also driven in large part by technology companies (i.e., FAANG: Facebook, Apple, Amazon, Netflix, and Google). For example, over the 18-month period ending in June 2018, the FAANG+ index returned 104%, whereas the broader market (S&P 500) returned only 25%. To gain some perspective on how similarly today's technology sector is behaving relative to the dot-com period, we plot the ratio of index levels for the MSCIWI's Information Technology sector versus the MSCIWI's Utility sector (see Exhibit 1). Since 1995, the current level of outperformance of the Information Technology sector has only been rivaled during the dot-com era.

Exhibit 1: Ratio of the MSCIWI Information Technology Sector Price Index vs. The MSCIWI Utility Sector Price Index
Source: Bloomberg

Today's environment is also similar to the dot-com period in terms of relative country performance. Exhibit 2 shows the rank of the 36-month return for the US relative to the other countries in the MSCIWI, where rank 1 is the highest as evaluated by each country's trailing 36-month return. While the US currently ranks as one of the best performing countries, we note that the average rank of the US is 9 over the period from 1995 to 2018.

Exhibit 2: Rank of 36-Month Country Return for the US
Source: MSCI

As a final measure of narrowness, Exhibit 3 shows the rolling 12-month excess return (excess relative to the MSCIWI index return) of the top 10 largest stocks in the MSCIWI. This chart shows that the 10 largest stocks have been the primary drivers of the index's positive performance. This magnitude in return dispersion between the largest stocks and the rest of the index has only been matched in three other periods since 1995. Two of these periods occurred before the dot-com bubble burst in 2000, and the other period occurred after the Global Financial Crisis in 2008.

Exhibit 3: Rolling Cumulative Return of a Value-Weighted Portfolio of the 10 Largest Stocks in Excess of the MSCIWI
Source: MSCI

The large performance dispersion across sectors, countries, and names points to a lack of breadth in the current bull market and is alarmingly similar to what we saw as the dot-com bubble was forming. How similar are today's valuations to those during the dot-com bubble? Valuation ratios in the dot-com era were stretched very thinly by the explosive price appreciation of nascent companies, many of whom had very low or even negative earnings, resulting in staggeringly high price-earnings (PE) and price-to-book (PB) ratios.

Valuations

From the standpoint of the overall market, the current market PE and PB ratios seem to have climbed recently, but still have not risen to match those at the peak of the dot-com bubble. Exhibits 4 and 5 show the US PE and PB ratios over time. The current level of both of these variables appears more in line with the beginning of the dot-com bubble rather than the end of the dot-com bubble

Exhibit 4: PE Ratio for the MSCI US Index
Source: MSCI

Exhibit 5: PB Ratio for the MSCI US Index
Source: MSCI

Index level valuations represent the weighted average valuation for all of the stocks in the index. For the purpose of this analysis, we want to compare the valuations of the largest stocks, which happen to be responsible for driving the market higher in both the dot-com bubble as well as today's current bull market. Exhibit 6 shows the PE and PB ratios of the 10 largest stocks in the MSCIWI through time.

Based on the results shown in Exhibit 6, it does not appear that the valuation ratios of the largest firms in the index are stretched. While they are slightly higher than they were during the credit expansion, they are substantially lower than those seen at the top of the dot-com bubble. This suggests an important distinction between the dot-com era and today. The technology companies driving the market higher during the dot-com era were largely start-up companies on the forefront of a technological revolution. Cash burn was high and their revenue models were largely untested. Even amidst the height of the dot-com euphoria, it wasn't unreasonable to think that some of the Internet start-ups would fail. The stocks at the forefront of today's equity market rally are mature companies with proven revenue models producing healthy cash flow. Despite their strong price appreciation, their fundamental factor characteristics, such as quality and value, remain strong. While the price of Apple's stock may decline at some point in the future, it is hard to imagine the company will fail within the next 10 years.

Extreme performance in growth stocks (technology) and high measures of market narrowness do suggest that the current environment is similar to the dot-com era. However, the current valuations, while increasing, are still not in the range where the dot-com bubble began to burst. These similarities and differences result in great ambiguity as to where we are regarding the current phase of the market cycle. The lack of breadth suggests the equity bull market may be on its last legs, while reasonable factor characteristics like quality and value potentially point to greater upside. Given the uncertainty, many investors are scrambling to build a portfolio that can still participate if the bull market continues, but is defensively positioned in case it does not. In the next section we compare the back-tested results of a simulated DEMF strategy with that of the capitalization-weighted index

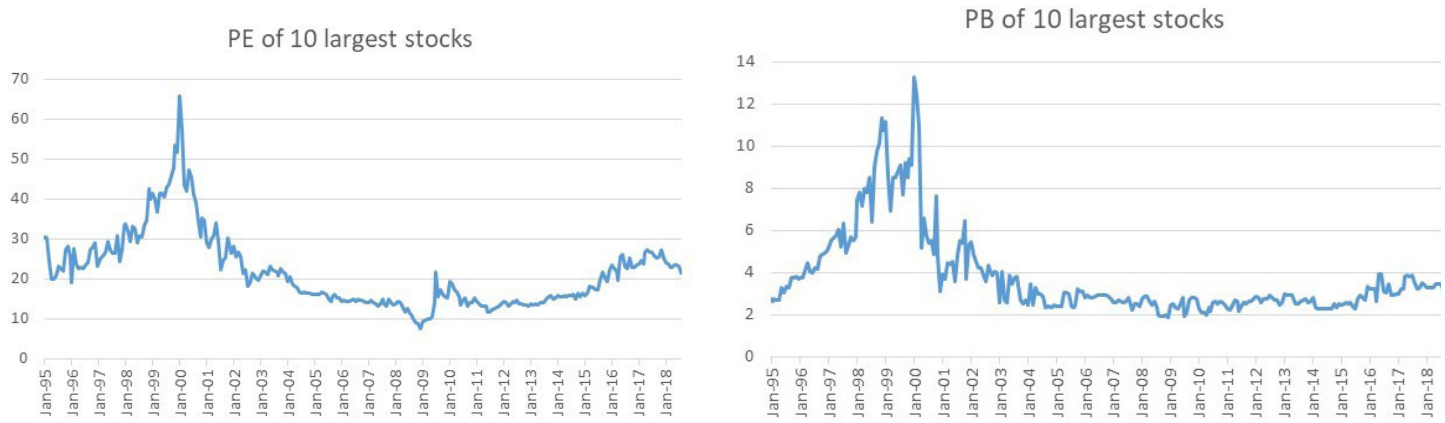


Exhibit 6: PE and PB Ratios for the Top 10 Largest Stocks in the MSCIWI
Source: MSCI

(risk-on) and a simulated minimum variance portfolio (risk-off) during different subperiods of the dot-com era. Given the inherent ambiguity attempting to determine where we currently are in the cycle, we demonstrate that neither cap-weighted nor minimum variance approaches have historically been robust enough to both participate in the upside and protect on the downside throughout the course of an entire market cycle.

Case Study: Dot-com bubble[3]

Timing the market precisely can be very tricky (perhaps impossible), but recognizing dislocations in the market and structuring your portfolio to avoid unnecessary risk taking is prudent. Our research indicates that investing in risk-on portfolios such as a cap-weighted index is lucrative during rising markets, while investing in risk-off portfolios such as a minimum variance portfolio is valuable during falling markets. However, the reverse is not true. In Exhibit 7 we show the difference between the MSCI World Index and a lightly constrained minimum variance portfolio optimized using a risk model and the constituents of the MSCIWI.[4]

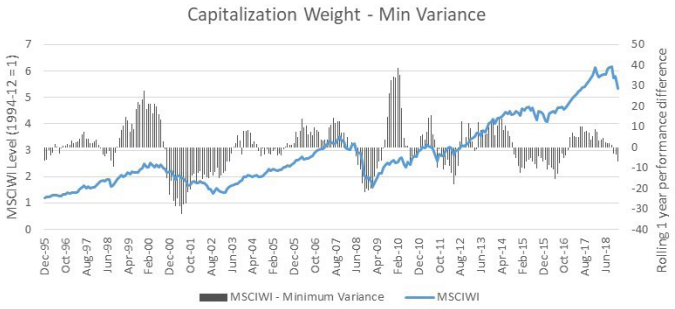


Exhibit 7: Rolling 1-Year Hypothetical Performance Difference Between the MSCI World Index and the Simulated Minimum Variance Portfolio
Source: MSCI and PanAgora

While the pattern of the cap-weighted index's performance and the back-tested results of the simulated minimum variance portfolio appear to be polar opposites, they appear to be similar in at least one significant respect. Both portfolio weighting techniques can lead to unnecessarily high risk concentrations across individual stocks. High risk concentrations can lead to extreme performance patterns. The cap-weighted index has unnecessary risk concentrations in its largest stocks, while the simulated minimum variance portfolio appears to include unnecessary risk concentrations in stocks with the lowest ex-ante volatility (Qian, Alonso, and Barnes 2015). These risk concentrations can lead to instability in return capture across different segments in the market cycle.

The back-tested results generated by a DEMF strategy appear to be less sensitive to market cycles than both cap-weighted and low volatility approaches as a DEMF strategy is designed to offer both upside participation during periods of market strength and downside protection in periods of market weakness. In our opinion, a DEMF portfolio benefits from a two-step systemic build process (asset selection and portfolio construction), with each step designed to offer a differentiated solution. First, in asset selection, a subset of stocks is selected from the universe that has high exposure to compensated risk factors like Quality, Value, and Momentum. In this step, a diversification score is assigned to each stock with the intent to select a diverse set of stocks with high factor scores without having to rely on arbitrary optimization constraints. Second, in portfolio construction, Risk Parity principles can be applied to balance risk across sectors, countries, and stocks. The resulting portfolio is designed to be a combination of return-enhancing stocks (via targeted factor exposures) assembled in a way that seeks to provide high downside protection (via risk-based portfolio construction).

Exhibit 8 demonstrates the hypothetical performance of a back-tested portfolio utilizing a DEMF strategy in different types of bubble/burst environments. As indicated in Exhibit 8, we have broken up the dot-com era into different time periods.

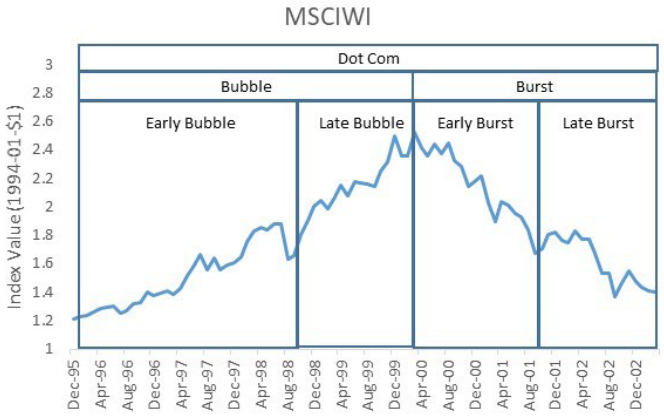


Exhibit 8: Back Tested Results Breaking Up the Dot-Com Era into Subperiods
Source: MSCI and PanAgora

These subperiods represent different phases of a full market cycle, all with different market characteristics. The Late Bubble and Early Burst periods are meant to identify two of the more extreme markets, while the Early Bubble and Late Burst periods are meant to represent less extreme markets. Distilling the entire cycle into subperiods can help identify how each approach performs across different environments. Exhibit 9 compares the subperiod performance for the cap-weighted index against the back-tested results of the simulated minimum variance portfolio and a simulated DEMF portfolio, in all such cases for the period commencing January 1995 through March 2003. Across the four phases of the cycle, the DEMF strategy appears to generate the best results during less extreme or concentrated periods, which happen to be at the very beginning and very end of the cycle. During these periods, diversified portfolios appear to perform better by capturing greater upside in broad rallies and/or offering lower downside capture in broad-based sell-offs. In the Early Bubble phase, the gains in the return data were broader-based across sectors, countries, and names, generally resulting in upside capture across the entire universe of developed market stocks. In the Late Burst phase of the cycle, the losses in the return data were also broadly distributed, with diversification limiting downside capture.

Per our back-tested research, during both the Early Bubble and Late Burst phases, the results generated in respect of DEMF portfolios outperformed the cap-weighted and simulated minimum variance portfolios.[6] In the Late Bubble phase, the cap-weighted portfolio demonstrated superior performance to the results generated by both the DEMF and simulated minimum variance portfolios, as the market strength was narrowly

	Period Dates	MSCIWI	MV Back test	DEMF Back test	Performance Dispersion
Early Bubble	Jan-95 to Aug-98	14.23	16.58	18.55	2.16
Late Bubble	Sep-98 to Mar-00	31.96	4.62	15.90	13.74
Early Burst	Apr-00 to Sep-01	-23.99	1.70	-5.63	13.23
Late Burst	Oct-01 to Mar-03	-11.17	-2.34	4.13	7.68
Bubble	Jan-95 to Mar-00	19.31	12.84	17.75	3.38
Burst	Apr-00 to Mar-03	-17.83	-0.34	-0.87	9.95
Dot-com	Jan-95 to Mar-03	4.18	7.85	10.60	3.22
Late Bubble Early Burst	Sep-98 to Sep-01	0.90	3.19	4.88	1.99
Full Back test[1]	Jan-95 to Dec-18	7.23	8.18	10.41	1.63

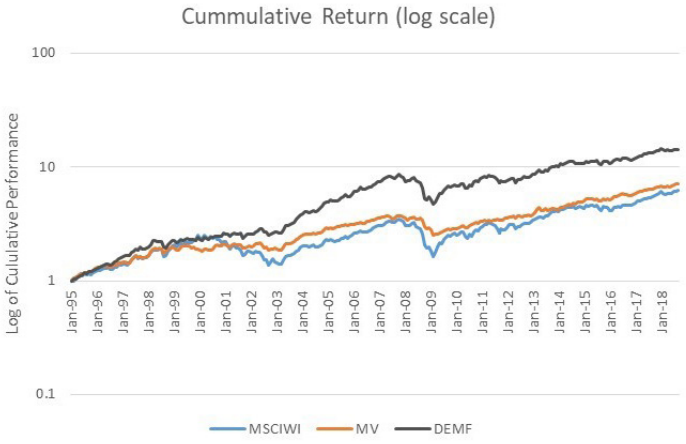
Exhibit 9: Performance/Back Tested Results (as applicable) in Dot-Com Era Subperiods. The Dispersion Column Shows the Cross-Sectional Standard Deviation of Return across Each Portfolio
Source: MSCI and PanAgora

concentrated in the largest stocks. Cap-weighted portfolios have an inherent momentum exposure which is strongly compensated towards the end of the Bubble period. During the dot-com cycle, this momentum was in the largest-weighted stocks in the technology sector. The price appreciation in stocks accelerated through the Late Bubble period, as the annualized return of the cap-weighted portfolio was more than double the annualized returns in the Early Bubble period. In contrast, the results in the Late Bubble period were lower than the Early Bubble period for both the minimum variance and the DEMF simulated portfolios. This further points to the lack of breadth in the rally. During the initial wave of bubble bursting, the results generated by the simulated minimum variance portfolio appears to be superior to both the cap-weighted and DEMF portfolios by delivering a hypothetical annualized return of 1.7%. The initial retracement in the equity market resulted in a sharp momentum crash with the largest stocks experiencing the largest drawdowns.

Per our test, the minimum variance portfolio delivered a hypothetical positive return over this period, as it was concentrated in the lowest volatility and more defensive stocks, which generally avoided sharp drawdowns. In contrast, the cap-weighted portfolio was concentrated to the highest momentum stocks, resulting in an annualized drawdown of 24% over the Early Burst phase of the cycle. Finally, the dispersion column demonstrates how much variation in return there was across the three different portfolio approaches in our testing. This is particularly true in respect of the inflection points of the cycle as the market transitioned from the peak of the bubble to the beginning of the crash. Although not our primary focus in this paper, Exhibit 9 also shows the performance (or back-tested results in the case of the simulated minimum variance portfolio and the DEMF portfolio) of all three portfolios over the full back test period from January of 1995 through December of 2018. As indicated in our research, the simulated DEMF portfolio outperformed both the cap-weighted and the simulated minimum variance portfolios over the back test period suggesting the robustness of the DEMF strategy even outside of the dot-com period.

Maximizing Upside and Limiting Downside Capture

Despite the fact that all of the portfolios described in this paper started with the same investment universe, the subperiod performance (or back-tested results in the case of the minimum variance and the DEMF simulated portfolios) across portfolios exhibits a remarkable amount of dispersion. Cap-weighted portfolios appear best suited to maximize upside capture, while minimum variance portfolios appear best suited to limit downside capture. In periods where risk-adjusted returns are similar across the universe, the diversification benefit of the simulated DEMF portfolio appears to have added significant value. While these differences are dramatic over the course of the eight-year dot-com cycle, they are largely representative of the natural cycle for equity investors. We believe the most efficient equity portfolios are the ones that can demonstrate a long-term, positive asymmetry between upside and downside capture. Exhibit 10 shows the cumulative performance for the MSCWI and the back tested MV and DEMF strategies from 1995-2018. As expected, the cap-weighted portfolio (MSCIWI) captured the best upside participation, but also captured much of the downside. The back-tested results of the simulated minimum variance portfolio appear to provide the best downside protection, but also captured little of the upside during rising equity markets. It is worthwhile to note that the back-tested results of the simulated minimum variance



	MSCIWI	MV Back Test	DEMF Back Test
Return	7.23	8.18	10.41
Risk	14.58	9.41	12.23
Return/Risk	0.50	0.87	0.85
Upside Participation	1.00	0.59	0.91
Downside Participation	1.00	0.36	0.59
Participation Ratio	1.00	1.63	1.53
Participation Difference	0.00	0.23	0.31
Participation Average	1.00	0.48	0.75

Exhibit 10 Simulated Cumulative Return in Log Scale for MSWI, MV Back Test and DEMF Back Test
Source: MSCI and PanAgora

portfolio appear to exhibit some positive asymmetry between upside and downside capture, providing empirical support for the low beta anomaly. The back-tested results of the simulated DEMF portfolio appear to achieve the greatest long-term asymmetry between upside and downside capture. As demonstrated in Exhibit 10 below, the simulated DEMF portfolio neither achieves the highest upside capture nor minimizes the lowest downside capture. Rather, such strategy appears to strike a balance between the two objectives. Based on our findings, this balance potentially facilitates more efficient harvesting of equity risk premium when navigating transitions from bubble formation to bubble burst periods, or more generally the natural ebbs and flows of equity market cycles.

Conclusion

The recent equity market turbulence in conjunction with the unprecedented length of the current bull market is tempting investors to predict where we are in the cycle and position their portfolios accordingly. These predictions are difficult to make with precision on an a priori basis. Furthermore, the consequence of inaccurate predictions can be wealth destruction. A cap-weighted investor who mistakenly moves into a minimum variance portfolio in the early stages of a bubble formation may significantly limit their upside capture. A cap-weighted investor who mistakenly rides the wave into the bursting bubble phase can wipe out a significant portion of the wealth they created in the bull market. In this paper, we have presented our findings which we believe demonstrate that a well-designed DEMF strategy has the potential to achieve greater positive asymmetry between upside and downside capture and thus, in our opinion represents a robust and prudent solution over a full market cycle. While we expect a portfolio implementing a DEMF strategy to lag a cap-weighted portfolio in the late stages of a bubble, we expect its targeted exposure to compensated risk factors will help capture a material amount of the equity market's upside. We also expect a portfolio implementing a DEMF strategy to lag a minimum variance portfolio during a sharp decline in the equity market, but we expect a DEMF strategy's risk-based diversification to limit a significant amount of downside capture. A portfolio that can achieve balanced performance across up and down markets via implementation of a DEMF strategy will be less sensitive to equity market transitions between different phases in market cycle. In our view, this consistency makes a well-designed DEMF strategy a potentially attractive solution for investors who are concerned, yet not convinced, that we are approaching the end of a great bull market run.

Endnotes

1. No constraints other than a non-negativity (long-only) and maximum stock weight of 10%.
2. We have selected the dot-com cycle for our back-testing period in these materials because it represents a recent complete market cycle and because of what we believe to be certain similarities to the current equity cycle. However, our research indicates that the strategies described herein generate similar back-tested results in other market conditions. We would be happy to share our back-tested results for these other cycles upon request. There can be no assurance that the current equity cycle will behave in a manner similar to the dot-com cycle or that any strategy described herein will behave in a manner consistent with the back-tested performance results set forth herein.
3. This case study relies substantially on back-tested results of simulated strategies. Back-tested results are subject to material limitations. For more information, please see the disclaimers at the end of the case study.
4. The simulated minimum variance portfolio is calculated based on the MSCI World Universe. For purposes of this paper, we have applied a non-linear optimization procedure with the objective function of minimizing the portfolio's total variance. We imposed three constraints: 1) the weights must be positive (long-only), 2) the weights must sum to 1 (fully invested), and 3) no single stock weight above 10% (breadth). The back-tested results for the simulated minimum variance portfolio are shown gross of any fees and trading costs, each of which would materially reduce such results.
5. Back-tests are run using all internally available data. Data prior to 1995 is not available due to limitations in our internal database system regarding the storage of stock level information. For a portion of the full back-test period described in this paper (more specifically June 1, 2015 through December 31, 2018), PanAgora managed an account funded with proprietary capital that implemented a variation of the DEMF investment strategy described in this paper. The investment strategy implemented by

such account has evolved since the account's inception as PanAgora's experience and techniques implementing such strategy have been refined over time. The assumptions used to generate the back-tested results set forth in this paper were based on PanAgora's views (as of the date of this paper) on managing a defensive equity multi-factor portfolio. For the period commencing at inception of the proprietary account through August 31, 2017, the actual performance results achieved in such proprietary account underperformed the back-tested results of the simulated DEMF portfolio described in this paper. For the period commencing September 1, 2017 through December 31, 2018, the actual performance results achieved in such proprietary account outperformed the back-tested results for the same period with a convergence of performance results towards the end of such period. Please contact PanAgora for additional information regarding the actual performance results for such proprietary account.

6. Significant care is taken when building a back-test of a systematic strategy. All back-tests are conducted out of sample, gross of fee. None of the back-tests employ any leverage and all back-tests are run using the constituents of the MSCI World Index. There are no changes in the back-test methodology for any of the back-tests presented in this paper over the period for which data covers (1/1995-12/2018). For the MV back-test we use a proprietary optimization procedure to construct a simulated minimum variance portfolio from the constituents of the MSCI World Index. In the MV back-test optimization we include a long only constraint, a fully invested constraint, and a maximum weight constraint for any individual stock of 10%. For the MV back-test we do not account for trading or transaction costs. For the DEMF back-test we select securities from the MSCI World Index that are highly diversifying and have overall high exposures to Value, Quality, and Momentum factors. Once the stocks are selected we calculate weights to each stock such that we balance risk across the portfolio's sectors, countries, and stocks. For this DEMF strategy, we assumed a 150 basis point annual trading cost as a result of market impact, bid/offer spread, and commissions.

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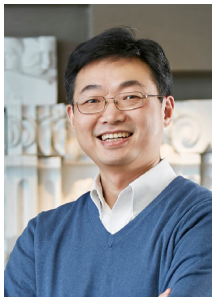

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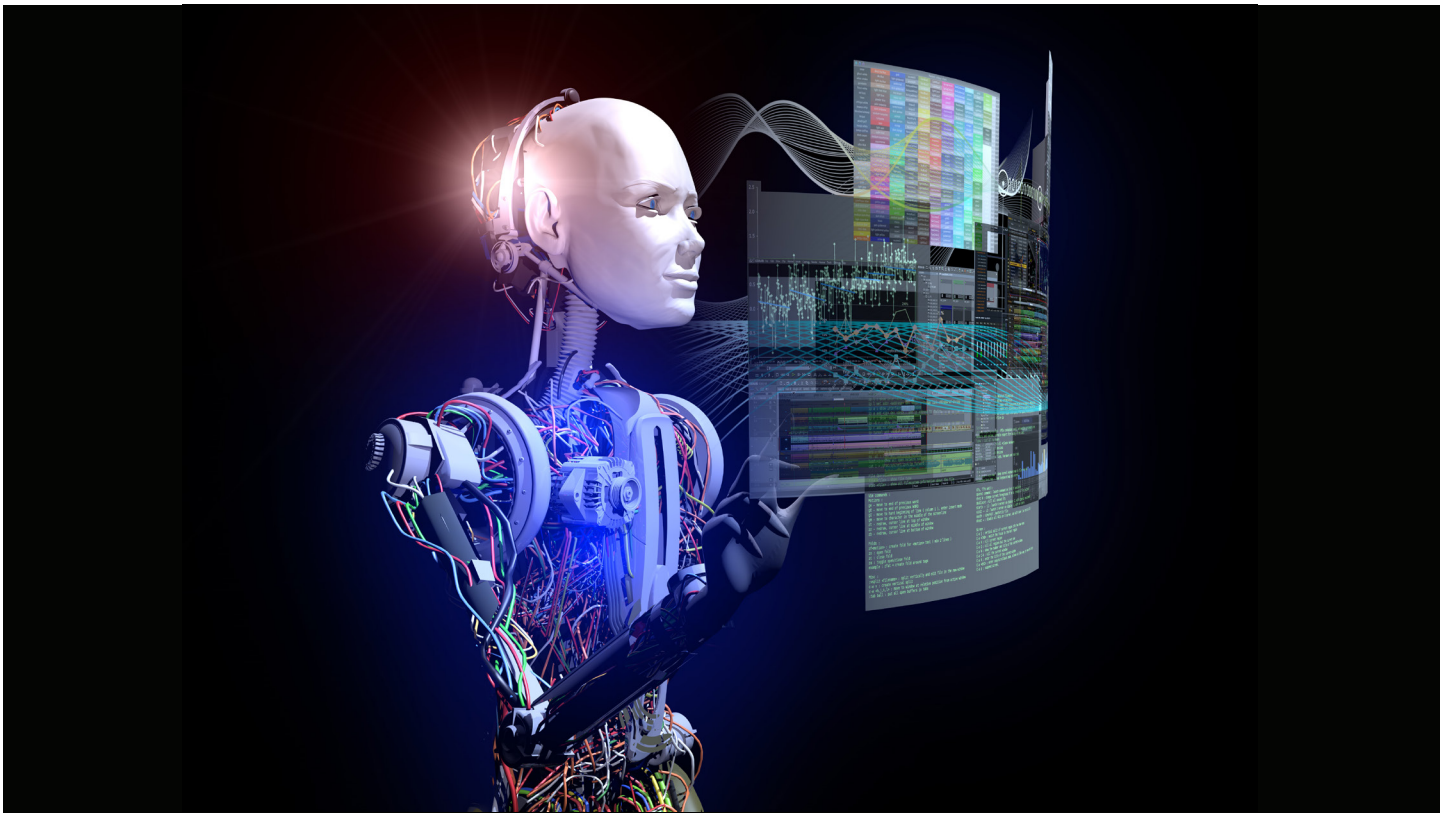

Machine Learning for Visual Risk Analysis and Hedge Fund Selection

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One of the main principles to build portfolios of financial assets is to achieve stable long-term performance and avoid large drawdowns. This article describes how a method of Machine Learning, Kohonen's Self-Organizing Maps, can be applied to visualize risk and to build robust portfolios of hedge fund managers. Essentially, it documents a feasibility study that was conducted to gauge whether Machine Learning can add any value to the investment process of an investor in hedge funds.

Robust portfolios can be created by avoiding concentrations and by diversifying across hedge fund managers and hedge fund styles: a portfolio comprising only, for example, long/short equity managers will suffer larger drawdowns when equity markets fall than a portfolio that invests partly also, for example, in credit or macro strategies. How can we avoid concentrations in the portfolio? A statistical tool for identifying similarities in data are the Self-Organizing Maps (SOM). SOM were developed in the 1980s by Teuvo Kohonen (Kohonen, 1982). They project objects onto a 2-dimensional map with similar objects being placed closely together. SOM can be used to identify similarities in risk behavior of hedge funds: managers with similar risk behavior and hence similar investment strategies appear on near-by units, i.e., near-by areas on the map. A potentially important feature of SOM is that they are able to exploit non-linearity in the data, as hedge funds deploy trading strategies and instruments that lead to non-linear return profiles. SOM can be interpreted by visual inspection and can process incomplete and noisy data. The tools required for Machine Learning have become commoditized, as several toolboxes are available free on the internet. All network training and calculations discussed here were conducted with the R package "kohonen". Exhibit 1 shows a SOM with 5 x 5 = 25 units which was created with hedge fund return

data from Oct 2009 to Sep 2013 (48 months). We call this 4-year period vintage year 2014. Vintage year 2008 would comprise the 48 monthly returns from Oct 2003 to Sep 2007, etc.

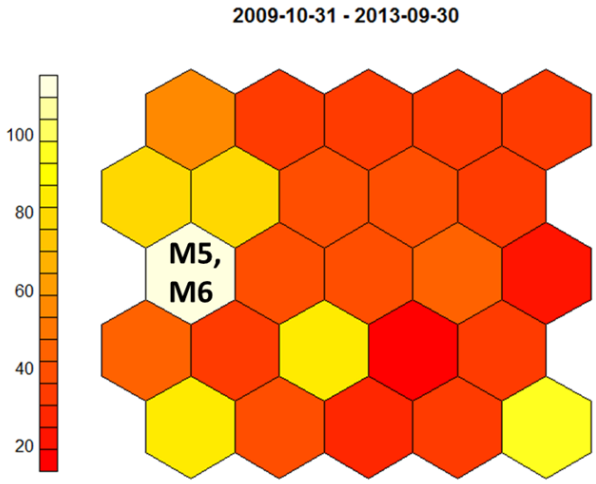

Exhibit 1: A 5 x 5 Self-Organizing Map

The 2 managers M5 and M6 exhibit similar return profiles and hence appear on the same unit, here unit 11. The counting of the units starts with unit 1 at the bottom left, unit 5 at the bottom right, the unit in the middle of the map has number 13, unit 21 is in the top left corner and unit 25 in the top right corner. The colors in Exhibit 1, explained by the scale on the left, represent the number of hedge funds that were mapped onto the 25 units. For example, unit 21's color orange tells us that about 60 managers were mapped onto this unit. Unit 11 is the busiest unit with 110 managers mapped onto it. Most managers occupy the left part of the SOM, while fewer managers are in the upper right part of the SOM. If a portfolio would only comprise managers from the left part of the SOM, risk would be concentrated in similar hedge fund strategies and little diversification could be expected in times of drawdowns. In addition to hedge funds, any other instruments, like equity, bond or commodity indices, can be integrated into the SOM. If the S&P500, for example, also shows up on the busy unit 11 it is clear that many managers follow trading strategies that produce a similar return / risk profile as equity markets. Investors seeking diversification away from equities would therefore look at managers mapped remote from unit 11.

Portfolio Selection with SOM

Applying the SOM for risk analysis seems sensible, but how can it be used for manager selection? We suggest one method, which we call SOM_REMOTE (other methods are available, but are beyond the scope of this article, see Huber (2018)). Twelve managers are selected according to the following scheme:

A SOM with 25 units (5 x 5) is created. Managers are selected from the most remote units of the SOM, i.e., from the 4 corner units in the bottom left (unit 1), bottom right (unit 5), upper left (unit 21) and upper right corners (unit 25), together 12 managers. The idea is to pick managers with high diversification potential.

To gauge whether SOM_REMOTE helps to enhance risk management, a comparison with simple benchmarks is useful. To this end, we simulate 2 ways to construct benchmarks which are both independent from the creation of SOMs:

1 Method Free: Randomly pick 12 managers from the universe of the corresponding vintage year. In theory, all managers could come from the same style (e.g., long/short equity). Method Free allows for unconstrained selection of managers.

2 Method Style: Each of the 12 randomly picked managers needs to come from a different self-declared style. This ensures minimum diversification based on the self-declared styles of the managers. The styles, like long/short equity, event driven, or short-term trading, are taken from Barclay Hedge. There are 80 styles in the database. All managers are categorized according to one of those self-declared styles.

Basis for the simulation experiment is the Barclay Hedge database comprising monthly returns from 2003 to 2014. Our focus is on single hedge funds, hence funds of funds were excluded. After applying several filters, for example, minimum assets under management USD 50 million and a minimum of 48 months of data, each vintage year ca. 1,000 managers fulfill the filter criteria and form the universe for training the SOM.

The simulation experiment involves training a SOM for one year, randomly drawing 12 managers based on the 3 methods and measuring out-of-sample performance for the following year. All managers were equal-weighted. For each of the 7 years from 2008 to 2014 and each method, 10,000 portfolios were randomly drawn. In total, 3 * 7 * 10,000 = 210,000 portfolios were simulated.

Empirical Results

Exhibit 2 displays the equity lines for annual out-of-sample performance. Each annual point on the equity lines for the 3 methods is the average over all 10,000 simulations for one vintage year. Exhibit 2 also includes the 2 additional benchmarks Barclay Hedge Fund Index, an equal-weighted average of the Barclay Hedge Fund universe, and S&P500 Total Return Index (=SPXTR).

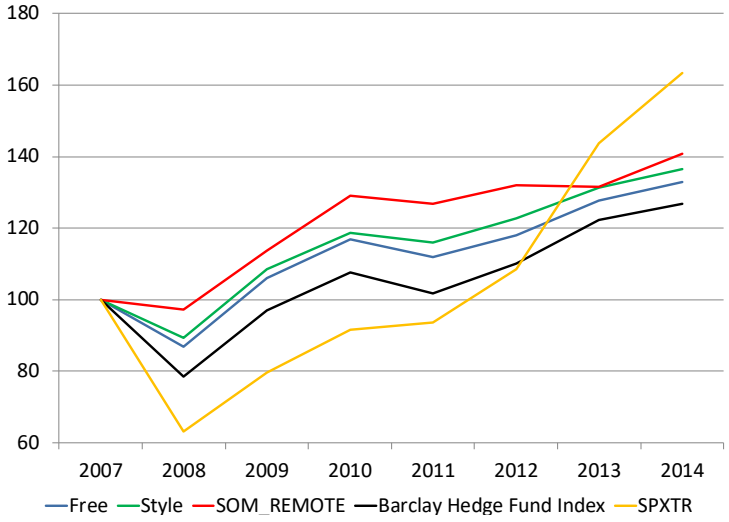

Exhibit 2: Out-Of-Sample Equity Lines for Rolling Simulations

	Free	Style	SOM_REMOTE	Barclay Hedge Fund Index	SPXTR
[Mean] Return	4.1%	4.6%	5.0%	3.4%	7.3%
[Mean] Vol	7.1%	6.5%	6.2%	7.6%	16.8%
Return/Vol	0.58	0.70	0.81	0.45	0.43
[Mean] MDD	-16.7%	-15.0%	-10.9%	-22.9%	-48.5%

Exhibit 3: Performance and Risk Measures for the 3 Models and 2 Benchmarks over the 7 Years of Out-Of-Sample Performance

Best performer based on the equity line only is SPXTR with an index level of 163 in Dec 2014, followed by SOM_REMOTE (141) and Style (137). SPXTR experienced the largest drawdown in 2008 of -37%, followed by the Barclay Hedge Fund Index (-22%). The simulated hedge fund portfolios show less severe drawdowns in 2008: the worst is from Free (-13%), followed by Style (-11%) and SOM_REMOTE (-3%). SOM_REMOTE mitigates the negative performance in 2008 massively and is the most stable performer: it generates low drawdowns but lags in years of equity market recovery (2012, 2013). Exhibit 3 provides an overview of different risk and performance metrics.

Mean returns increase from Free over Style to SOM_REMOTE. Volatilities decline in that order. The ratio Return / Vol climbs from Free (0.58) to SOM_REMOTE (0.81). This is equivalent to an increase of 40%. In terms of Return / Vol ratio, the 2 benchmarks SPXTR and Barclay Hedge Fund Index are behind at the back: SPXTR generates by far the highest return at +7.3%, but at the cost of much higher volatility (16.8%) than the others. This results in the least favorable Return / Vol ratio of 0.43. The Barclay Hedge Fund Index achieves the second-lowest return at 3.4%, but at the second-highest volatility of 7.6%. Its Return / Vol ratio at 0.45 is only slightly higher than SPXTR's.

The row "[Mean] MDD" in Exhibit 3 gives the mean Maximum Drawdowns over the 10,000 simulations. The general pattern is that Free has the highest MDD at -16.7%, which declines from Style to SOM_REMOTE at only -10.9%. The MDDs of the 2 benchmarks SPX at -48.5% and Barclay Hedge Fund Index at -22.9% are far behind. The Barclay Hedge Fund Index experiences a higher MDD than Free.

Summary and Outlook

Machine Learning and Self-Organizing Maps can be deployed to visual risk analysis and selection of hedge fund managers by identifying similarities in the return structures of hedge funds. For example, it can be expected that 2 managers following a long/short equity strategy generate similar returns. Based on their historical returns, hedge funds with similar return profiles are mapped onto the same or near-by units of the SOM. By analogy, managers that are based on remote parts of the SOM exhibit dissimilar return structures and hence can be regarded to diversify each other.

We suggest a simple method to exploit the SOM feature of identifying similarities in high-dimensional data: managers are selected from the 4 most remote parts of the SOM, i.e., the units in the lower left, lower right, upper left and upper right corners (called method "SOM_REMOTE" in the article). In discussions with clients it has turned out that the way SOMs work as well as the method to pick managers from remote areas of the SOM can be intuitively explained and understood, which increases acceptance by practitioners.

The SOM-based selection method is compared to 2 simple benchmarks: 1) in method "Free", managers are picked randomly from the whole universe without any restrictions. In theory, all managers in a portfolio could come from the same style. This constitutes the most basic way to select hedge funds. 2) Method "Style": each manager selected must follow a different self-declared style based on the Barclay Hedge style categories. This selection procedure is meant to establish a minimum diversification across hedge fund styles. A simulation experiment, where random portfolios were constructed from randomly picking managers according to the SOM-based method and the 2 benchmark selection approaches shows that risk/return metrics indeed improve from methods "Free" over "Style" to "SOM_REMOTE". SOM_REMOTE reduces drawdowns noticeably, which leads to strongly enhanced risk/return measures.

The simulation experiment described in this article is meant to show that SOM in general can add value to the investment process for hedge fund selection. In our simulation experiment, managers were picked randomly from a SOM and then equal-weighted in a portfolio. For sure more intelligence can be applied here, for example, by focusing on managers with the capability to generate alpha over a set of risk factors. Alternatively, a benchmark to measure alpha against could comprise all managers mapped onto one unit. An example for a practical investment process could be to run SOM as an initial step to identify managers with unique strategies. Those can, for example, be purchased in a stand-alone portfolio that is meant to perform stable. Or they can be added as a sub-portfolio to an existing portfolio. Rather than equal-weighting managers in a portfolio, as in our simulation experiment, more sophisticated portfolio construction mechanisms could be deployed. One example in this regard is to use optimization algorithms that take the specifics of hedge funds, like non-linear return profiles, into account.

Apart from portfolio selection SOM can also be applied for risk analysis. As shown in Exhibit 1, many managers produce similar return profiles. If the managers of an existing portfolio come all from the same part of the SOM, there is little diversification to expect in times of crisis. A SOM can help to make the return profiles of hedge funds more transparent and to find diversifiers to an existing portfolio – those could come from a remote part of the SOM. SOM can also be deployed to check whether the self-declared style of one manager actually matches this style's expected return structure. If, for example, a convertible arbitrage manager would be assigned to a unit close to trend-followers,

this would give a good reason to ask a few questions. Managers that declare to belong to a certain strategy should exhibit return structures similar to other managers following that style – or they should be able to explain why they deviate. Closely related to that sort of style analysis is benchmarking, where all managers on one unit or near-by units could be defined as benchmark constituents. Apart from a clear visual interpretation such a benchmark would also incorporate non-linear risk, definitely an advantage when dealing with investments involving derivatives and hedge fund strategies.

Another application of SOMs is the detection of style drift. To this end, 2 SOMs need to be trained on 2 non-overlapping different periods, for example, a) 2015 to 2016 and b) 2017 to 2018. If our convertible arbitrage manager can be found on SOM a) close to other convertible arbitrage managers and on SOM b) closer to equity strategies, this might be a hint that this manager has taken more equity risk than his peers.

The SOM can also be helpful for risk analysis of an existing portfolio with investments where no valuation model is available (black box investments). This could involve derivatives, for which prices, but no valuation model is available, or hedge funds for which no position transparency exists. Inputs would be historical returns of the portfolio's instruments, together with a few benchmarks, like the S&P500, bond or commodity indices. The trained SOM could visualize which instruments, like derivatives or hedge funds, behave similar to the benchmarks. If many instruments are mapped onto the same units, as seen in Exhibit 1, there might be risk concentrations in the portfolios. The SOM is particularly useful in this case as it can process non-linearity in returns (derivatives, hedge funds) and can visualize the risk of black box investments and help to integrate it into a risk framework.

Other instances for applications in finance are bankruptcy prediction, where inputs are balance sheet ratios. The SOM will place corporates with similar balance sheet structures on the same units, for example, A-rated entities would be close together on near-by units in the upper left corner, while C-rated ones would be assigned to units in the bottom right. Fraud detection could work in a similar fashion, for example, to uncover credit card fraud. Inputs could be data that describe regular customer behavior, and the SOM can help to detect outliers. Typically, there will be one area of the SOM, for example in the bottom right corner, where customer behavior differs from the rest of the SOM. If customer vectors are mapped onto this area they exhibit divergent or fraudulent behavior.

In summary, some of the specific features of SOM, like their visualization capabilities and their possibilities for interpretation, their ability of dealing with non-linear and noisy data can help to enhance investment processes.

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A Panel Discussion on Commodities

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Moderator: Commodities can be puzzling. Despite their status as one of the decade's worst-performing asset classes, commodities markets have continued to grow. In fact, open interest — the number of commodities contracts outstanding — has been booming on futures exchanges in recent years. What can explain this puzzle? Is this a good time for investors to increase their portfolio allocation to commodities?

Welcome to our panel discussion on commodities. Its purpose is to provide an objective look into the complex and rapidly changing world of commodities with an emphasis on commodity investing. Today's panel consists on the co-editors and several contributing authors of *Commodities – Markets, Performance, and Strategies* published by Oxford University Press. Let's welcome our panelists: Tom Barkley, Hunter Holzhauer, Dianna Preece, and Andrew Spieler.

This panel discussion examines some important topics about commodities using a question and answer format. It starts by offering a brief historical background on commodities and then turns to commodity investing. Next, the discussion turns to commodity returns and performance followed by commodity trading with special emphasis on energy markets. Financialization and the role of technology are then examined followed by views about current and future trends in commodities.

Historical Background on Commodities

Moderator: Let's begin with a background question: How did commodity markets develop?

Barkley: Commodity markets have been around for centuries. These markets existed in a crude form as far back as the Sumerians between 4500 and 4000 BC, when clay tokens were made and sealed in clay vessels, representing a number of sheep or goats to be delivered at a time in the future. Derivative contracts on sesame seeds existed in Mesopotamia as early as 1809 BC. The Amsterdam Stock Exchange, often considered the first stock exchange, originated as a commodities market in 1530. Formal futures markets originated in the Dutch Republic during this time, and early futures contracts were traded on tulips at the peak of the Dutch Tulipmania in 1636. Despite these instances, some historians reckon that the first recognized futures trading exchange was established by Japan in 1710 for the trading of rice futures. Finally, many view the listing of the first-ever standardized "exchange-traded" forward contracts in 1864, by the Chicago Board of Trade (CBOT), as the beginning of modern-day commodity futures markets.

Harris: As Tom said, the U.S. markets developed as risk management tools for farmers during the mid-19th century. The CBOT offered farmers a place to reduce their price risk—farmers could fix the price they expected to receive for crops grown in the future, which greatly helped in reducing the risks of farming. Once a forward contract price was determined, the farmer could then concentrate on managing costs to come in below the revenue targets.

Of course, the agricultural markets have this long and storied history, but the massive growth in commodity trading has occurred during the past 40 plus years when financial commodities began to trade. The current commodity markets have come to be dominated by financial commodities like equity index products, individual equities, interest rates, and currencies. These financial commodities have comprised somewhere between 80% to 90% of volume and open interest around the world during this past decade. The risk management function that commodity derivatives serve are not only valuable for farmers and miners, but also help in managing risk in financial markets.

Commodity Investing

Moderator: As previously discussed, commodities have a long and fascinating history. Let's now turn to several questions involving commodity investing. Do investors actually hold physical commodities or use derivatives to access commodity exposure?

Spieler: The majority of commodity investments are indirect either through derivatives or mutual fund and exchange-trade fund (ETF) structures. Larger institutional investors such as investment firms and large end users such as airlines may invest directly. One example is Delta, which acquired refining assets in 2012 and now buys crude oil, refines the crude, and sells the excess in the open market. Another example is when the market for crude oil is in contango, which occurs when a commodity's futures price is above the expected spot price. Under this condition, investors buy crude oil and absorb the storage cost to leave on tankers. A search of Google "Oil Tanker Armada Singapore" results in a satellite image of such oil tankers sitting between Malaysia and Singapore.

Barkley: Whether investors actually hold physical commodities or use derivatives to access commodity exposure may depend on the size of the investment. Institutional investors may have divisions dedicated to the purchase, storage, trading, and sale of various physical commodities, which is often the case for large agricultural companies or wholesale energy marketers. These investors may also use various derivative contracts such as forwards, futures, commodity swaps, and options to gain exposure to or hedge the price of the underlying commodity. Retail investors, conversely, are likely to use derivatives particularly futures, investments in ETFs, and investments in shares of companies that produce the relevant commodity to gain this same exposure. Institutional investors and more sophisticated retail investors might also use a Commodity Trading Advisor (CTA) for recommendations about commodity futures.

Preece: I agree that situational factors affect whether investors hold physical commodities or use derivatives to access commodity exposure. Some investors, especially institutions, invest in the physical commodity but most use derivatives as a means to gain exposure. The problem with owning physical commodities is the cost of carry. If investors buy the physical commodity, they must transport and store it. In the case of agricultural commodities like corn or soybeans, the risk of spoilage is possible. Sometimes insuring physical commodities is needed, which is also part of the cost of carry. These costs erode potential commodity returns. Investors can avoid these costs by using derivatives to gain access to the asset class.

Harris: In my view, some level of distrust has existed in commodity markets. For example, farmers have long been skeptical of counterparties who do not hold or use physical commodities. In fact, the Commodity Futures Trading Commission's (CFTC) Large Trader Reports parse out non-commercial trader positions from commercial trader positions to shed light on what financial investors might be doing in commodity markets. And certainly, investors who do not hold or use physical commodities have been under scrutiny by regulators whenever prices seem to move in unexpected directions.

Moderator: Conventional wisdom suggests that investors should commit a relatively small percentage of their portfolios to commodities, but some investment professionals disagree. What are your views on the following question: Why are commodities desirable in a well-diversified portfolio? That is, what are the benefits of commodity investing?

Barkley: Commodity investing offers six major benefits: diversification, inflation protection, hedge against event risk, liquidity, trading on lower margin, and high potential returns.

Spieler: I agree. All these are potential benefits of having commodities in a portfolio. Besides diversification, perhaps the most important benefit is likely the positive correlation with inflation.

Moderator: In recent years, the United States has experienced a rise in interest rates after years of artificially low rates. Are commodities still an inflation hedge?

Spieler: The effect of increasing interest rates, primarily due to inflation, on commodities is unclear. Rising inflation increases the cost of carry and the desire to carry inventories of commodities at higher interest rates decreases. Higher interest rates can lead to higher supplies of commodities. For example, miners may want to mine now rather than the future.

Moderator: An important consideration when investing in any security or asset is risk. What are the major risks associated with commodity investing?

Barkley: Two of the more important risks associated with investing in commodities are the volatility of commodity prices and tendency for mean-reverting prices. More specifically, commodity prices can fluctuate substantially based on supply and demand in the market for a particular commodity. For instance, decisions made by the Organization of Petroleum Exporting Countries (OPEC) regarding production affect crude oil prices. Over time, prices in commodity markets tend to revert toward a mean. Thus, unlike stocks that might grow in value over time, when prices rise, new technologies emerge that allow greater production of the underlying commodity.

Spieler: Aside from the traditional risks, shifts in consumer demand can dramatically affect input commodities such as copper and the increasingly popular lithium used for batteries. Another risk is the increasing number of international mergers and possibility of poor integration and even accounting fraud. Examples include Caterpillar and SQM, a Chilean copper mining company.

Harris: For long-term investors, one risk in using derivatives for commodity exposure is in the uncertain roll yield, where expiring contracts have to be renewed. For some products like commodity ETFs, the cost of rolling out of expiring contracts and into more distant contracts can substantially erode returns and the risk of executing long-term strategies with shorter-term contracts presents new and unique risks to commodity investors seeking exposure through these vehicles.

Moderator: Having discussed risks associated with investing in commodities, let's now turn to another question. What ways are available to invest in commodities?

Barkley: Four major ways are available to invest in commodities. One method is direct investment, which involves buying, holding, and selling the physical product. The second method is to own stock of natural resource companies by buying, or short-selling, shares in a firm that directly produces the commodity. A third way is to invest in commodity mutual funds and ETFs. However, ETFs often have lower fees than mutual funds. The fourth method is through commodity futures where investors seek a return from trading through an exchange, often speculating on the direction that prices will take.

Commodity Returns and Performance

Moderator: Next, let's turn to commodity performance. When the financial media presents commodity returns, what is being reported? In particular, for commodity futures, can you explain how commodity futures returns include collateral returns, spot returns, and roll returns?

Preece: Several sources of return are available to commodity futures investors. First, many futures investors invest the full notional amount of the contracts as collateral, which is called a collateralized futures position. Because commodity futures are leveraged, investors can have considerable cash tied up in collateral, which gets invested in other assets, usually risk-free assets such as Treasury bills. The return that is generated from the collateral investment is called the collateral return. The collateral return is also called the Treasury-bill return, the cash return, or the collateral yield.

The spot price of a commodity is the current price. The spot return reflects changes in the underlying commodity price. The roll yield results when a commodities investor wants to hold a long position in futures over a long period. The investor must sell or "close out" positions in futures contracts that are expiring and reinvest in longer-term contracts. The roll return is the gain or loss associated with rolling a futures contract forward. When the market is in contango, the roll yield is usually negative because longer-date contracts are more expensive than shorter-date contracts. When the market is in backwardation, the roll yield is usually positive because longer-date contracts are less expensive than shorter-term contracts. Backwardation is the market condition wherein the price of a commodities' forward or futures contract is trading below the expected spot price at contract maturity.

Moderator: How have commodities performed during periods of stress – and has this changed in the post-financial crisis of 2007-2008 period?

Preece: Before the financial crisis of 2007–2008, also called the global financial crisis (GFC), a passive investment strategy in commodities generally meant equity-like average returns. It also meant a hedge or at least a partial hedge against inflation and negative return correlations with stock and bond returns. But during the crisis, commodities did not perform well. Returns were more positively correlated with traditional asset classes than expected. Commodity prices fell from peak levels after the financial crisis to a bottom in 2011. Since the financial crisis, commodity performance has been generally weak. In late 2015, investors started paying attention to commodities again, expecting a turn around. Investors are finally believing we have hit a post-crisis bottom. But by early 2018, some commodities had not lived up to the bullish expectations while others, such as metals, performed well. When it comes to commodities, there really is no "commodities." You have to consider the individual commodity because agricultural commodities may be performing poorly while oil or metals are performing well.

Spieler: Picking up on the individual nature of commodities, the wide variety of commodities and instruments makes generalizing difficult. For example, gold and oil spiked around the GFC. Crude oil peaked around $147 and subsequently plunged to under $30. Copper experienced large gains tied to strong Chinese growth but these gains have retreated. Perhaps the more interesting part of commodities markets is the emergence of lithium and liquified natural gas (LNG). As battery and solar power becomes more commonplace and affordable, the demand for lithium should rise.

Commodity Trading and Energy Markets

Moderator: Our next set of questions focuses on commodity trading and energy markets. Who are the biggest commodity traders in terms of companies and countries?

Holzhauer: The firms that trade the most commodities are still investment banks such as Goldman Sachs, JP Morgan, and Citibank. That said, the biggest commodity traders are often countries. For example, China remains a large oil importer. Yet, since the financial crisis of 2007-2008, the United States has gone from importing to exporting millions of barrels of refined oil per day. As for growth, commodity trading among developing nations, such as China, is obviously growing at a faster pace than in the United States or the European Union. Between 2005 and 2015, commodity trading in China grew by 55% compared to just 28% for the Americas and 16%

for Europe, Middle East, and Africa (EMEA). In fact, trading commodities, especially via derivatives, has never been easier or more popular. In 2015, derivative volume increased by 20% and trading volume increased by 26%. With over 4 billion contracts traded, commodities passed single stock options as the most traded class of derivative contracts.

Spieler: Many large investment houses are shedding their direct ownership of commodities and related assets partly due to the Volcker rule, which prohibits banks from using their own accounts for short-term proprietary trading of commodity futures, as well as options on any of these instruments. The rule was enacted because these speculative trading activities are not in the best interest of bank customers. As for countries, the largest suppliers of key commodities are Saudi Arabia and the United States. Natural gas is most abundant in Russia and Qatar and, due to fracking, in the United States. The Chinese government has been aggressive in acquiring oil assets in Nigeria. Canada, New Zealand, and Australia's economies are also heavily tied to natural resources.

Moderator: Speaking of the Volcker rule, how have regulation and deregulation affected commodity traders?

Spieler: As mentioned previously, the Volcker rule as a part of the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 (Dodd-Frank) have spurred the sale of commodity assets from the bulge bracket banks, which are massive, multinational corporations. This change has opened up potential opportunities for hedge funds and managed futures (commodity trading advisors) to provide investment advice and execution. In the United States, the lack of regulation on fracking has dramatically increased capital investment and output. A need exists for pipelines for transmission. Many jobs have been created, particularly in North Dakota.

Holzhauer: In the wake of the financial crisis of 2007-2008, financial markets around the world increased regulation. Legislation such as the Dodd Frank Act in the United States and the Basel III/CRD IV in the European Union has affect commodities. These regulations created a mass exodus of banks for the commodity trading business as regulations squeezed margins tighter and tighter. Banks have increasing difficulty making a profit in trading commodities if they have to physically hold them. Moreover, regulation has become a double-edged sword for banks in the commodity trading business. Regulation is not only cutting their bottom line, which means they are losing clients, but also taking away their best employees as top talent leaves banks to join trading houses or start their own firms. As for deregulation, although President Trump may have rolled back more federal rules and regulations than any modern president, years are likely to pass to see if his policies have had any material impact on the commodities industry.

Moderator: Now let's turn to energy markets. How do energy markets compare to other commodity markets?

Barkley: According to the most recent CME Group Leading Products report, crude oil (WTI) and natural gas futures and options rank first and third respectively in terms of average daily volume traded and open interest, excluding financial products. Exhibit 1 shows these values at the end of 2018.

As shown in charts on the Trading Economics website, WTI Crude Oil (USOIL) and the S&P GSCI Index (SPGSCI) are highly correlated over time, demonstrating the relative importance of crude oil in the measurement of the commodity index. Exhibit 2 shows a chart comparing the two lines between 2014 and 2018.

Although these trades can be conducted using physical commodities that can be stored/warehoused, this is not possible with electricity, which must be used as it is generated. Hence, a need exists for regulated electricity grids throughout the country to make sure that demand is always balanced with supply.

Energy Contracts	Future		Options	
	ADV Notional ($millions)	Open Interest	ADV Notional ($millions)	Open Interest
Crude oil (WTI)	$69,452	2,255,749	$10,297	3,988,348
Natural gas	$11,584	1,623,201	$2,376	2,112,429

Exhibit 1: Average Daily Trading Volume and Open Interest

Spieler: The need for transporting LNG is increasingly important. Derivatives on LNG are quite small and are likely to increase dramatically.

Moderator: What salient features appear in investments in energy markets?

Barkley: Many energy commodities are derived from crude oil, so prices of gasoline, heating oil, and natural gas move in tandem with those of crude oil. The prices of these distillates, which are outputs of refineries, are highly correlated with the input's prices, namely crude oil. Consequently, returns derived from investments in the by-products largely depend on the returns in the underlying raw input.

Exhibit 2: WTI Crude Oil versus the S & P GSCI Index

As discussed previously, to the extent that the supply of oil globally is largely determined by the OPEC cartel, prices and returns are tied to decisions made by leaders of these countries. As described by the U.S. Energy Information Administration (EIA), the U.S. has been able to increase production of oil through more cost-effective drilling technology, leading to an increase in the global supply.

Spieler: Markets for weather derivatives also exist based on temperature, rainfall, and snowfall.

Moderator: What methods do firms use to manage energy risk?

Barkley: Energy companies use various approaches to manage and mitigate risk. Here are some methods used to manage market risk, credit risk, and operational risk.

- Market risk. Energy companies often use financial instruments for hedging market risk: exchange-traded futures contracts, OTC forward contracts, commodity swaps, call and put options on various spreads, and exotic options. In particular, when refineries are concerned about the spread between crude oil input prices and gasoline output prices, known as the crack spread, they use option contracts or swaps that relate specifically to this spread to hedge. Similarly, power plant managers care about the spread between fuel input prices and wholesale electricity output prices, known as the spark spread, when the input fuel is natural gas, the dark spread when it is coal, and the quark spread when it is uranium. Again, commodity swaps and options are available on these spreads.
- Credit risk. Energy companies can use specific contract arrangements for mitigating credit risk. These arrangements include margining agreements, collateral, credit limits, guarantees from parent companies, and netting agreements. Netting arrangements allow for multiple contracts between two entities to be settled with one net unilateral payment. In each case, the objective is to reduce the exposure to a default by the counterparty to the contract – whether the counterparty is taking or delivering energy.
- Operational risk: Finally, energy companies often use additional facilities to manage operational risk, particularly peaker plants, which are power plants that generally run only when the demand for electricity is highly. These plants allow power generators to increase the production of electricity quickly when the demand increases, and to ramp down when it subsides. Generally, these are turbine plants fueled by natural gas in which the ramp-up time might be only three to four hours.

Financialization

Moderator: How has financialization affected commodity markets?

Harris: Commodity markets have extensive histories with financial firms taking on some of the risks. As noted earlier, farmers have long viewed financial players with suspicion – perhaps rightly so. Probably as a result, the CFTC produces reports on the positions of "non-commercial" traders in the U.S. markets. More recently, financialization has been used to describe long-only commodity index funds that increased commodity futures positions substantially between 2002 and 2008. Some commentators claim that this recent financialization represents excessive speculation that destabilizes prices and unwarranted volatility in commodity markets. Although a few research papers model how this might happen, the bulk of the evidence suggests the opposite. In agriculture markets, for instance, long-only index funds provide a solid set of counterparties that stand ready and willing to buy commodity futures from producers or

farmers. Other studies show that the increase in index fund participation has little or no effect on prices or volatility. Still other studies show that hedge fund participation has led to more stable commodity markets with lower volatility.

Overall, I think regulators are right to scrutinize new market developments such as financialization to ensure commodity markets are fair for all traders. These markets are important sources of price discovery for many commodities used every day. When the view of financialization shifted from concerns about traditional speculators like managed futures funds or hedge funds to long-only commodity index funds, the CFTC began collecting data and producing reports on index investing. This type of transparency has provided researchers with data to directly examine whether and how financialization has changed commodity markets. So far, this recent round of financialization apparently has not proven to be problematic.

Role of Technology

Moderator: How are changes in technology such as fracking and algorithmic trading affecting the commodity industry?

Holzhauer: Fracking is interesting because many view it as a negative for the environment, but a positive for the commodity trading industry. One huge concern with fracking is whether it, especially the wastewater from fracking, can contaminate fresh drinking water. Finding safer and more environmentally-friendly methods for extracting natural gas will likely become imperative, especially if fracking becomes more heavily regulated. Regulations may also force us to rely even more on alternative and renewable sources of energy, develop better batteries for storing energy, and create more efficient desalination water systems. Seeing what solutions can be created as technology becomes more advanced should be fascinating.

Spieler: Because fracking has increased the supply of crude oil and natural gas, it has affected OPEC's monopoly pricing. There are some other subtle effects of fracking and its concomitant supply effects. Consider the impact on commodity indices used for ETFs and benchmarking. As the supply changes, so does the weighting in the index. Algorithmic trading will lead to developing further advanced quantitative strategies. Additionally, the use of high frequency and non-structured data can be incorporated into trading strategies.

Holzhauer: Technology has produced a continuous supply of fundamental and technical analysis. As trading becomes more data driven, technology such as algorithms will make all financial markets, including the commodities market, more efficient. However, what is seen as a good change for the commodities market, may not be a good change for all commodity traders. Some commodity traders are doing better than ever and taking full advantage of the changing technology. Yet, the landscape for commodity traders is becoming both more competitive and specialized, especially for commodity traders preferring to trade without algorithms. In fact, many commodity traders are being pushed to either work at large multinational firms that can afford top commodity traders that essentially manage algorithms or at smaller, specialized firms on complex deals in niche areas where algorithms are scarce.

Current and Future Trends in Commodities

Moderator: Is the U.S. commodity industry likely to continue to grow in the near future? Why or why not?

Holzhauer: In general, yes, the U.S. commodity industry is likely to grow in the near future. In fact, in a recent survey, commodity traders stated that North America has the highest growth potential. However, the specific commodities that experience the most growth are likely to depend on prices, which are based almost entirely on supply and demand. For example, predicting the growth of the crude oil market can be difficult due to the volatility of crude oil prices. Since the 2008 recession, the United States has increased its oil production due to the shale boom. Thanks to areas such as the Permian Basin, the United States. is now the world's leading producer of oil. Moreover, the Energy Information Administration predicts that the United States may be a net exporter of "all" energy products (not just oil) sometime between 2020 and 2040. Once again, the wide range is based on the natural volatility of energy prices. One huge positive for the U.S. commodity market has been the employment growth across several industries including not only energy but also metals, recyclables, agriculture, livestock, and even the financial markets for commodity traders.

Spieler: Fracking will increase the supply of crude oil and natural gas as well as the use of derivatives for LNG. A growing need also exists for lithium in rechargeable batteries. However, the supply of lithium is largely in politically unstable countries, so commodity derivatives will be useful in managing risk in these industries.

Moderator: How are demographic trends such as climate change and population growth affecting commodities?

Barkley: As global populations increase, the demand for commodities is likely to increase proportionately. Countries such as China and India are using vast amounts of raw materials in their production processes, with consumption demand from their citizens fueling this – and that does not account for exports for many manufactured goods. At the same time, the evidence of global warming and environmental degradation has caused many governments to limit carbon emissions as they are deemed to be destructive to the ozone layer. New markets have opened up for the trading of carbon credits, which is a permit or certificate allowing the holder to emit carbon dioxide or other greenhouse gases. The trading of these carbon credits imposes a cost on companies that are greater pollutants of the atmosphere, as they are required to buy more credits to match their production levels when these exceed certain caps. Similarly, firms that pollute less benefit from the sale of their excess (unused) carbon credits.

Holzhauer: Many areas of the globe, especially highly populated and growing areas such as Asia and Africa, are depleting their supplies of freshwater while their demand is growing. Part of the problem is that roughly 75% of all freshwater is in glaciers and snowfields, which required improving desalination technology. Climate change is likely to lead to new regulations on commodity markets – even if the market is undergoing a temporary reprieve from regulations while President Trump remains in office.

Although regulations are disrupting the supply of certain commodities, a growing population disrupts the demand for certain commodities. Most global population forecasts have the global population rising from 7.5 billion people to a range of 9 to 13 billion people by the end of the 21st century. Advances in fertility practices and healthcare in general are also increasing both birth rates and life expectancy rates. As countries become more developed, their population growth may decrease, but their demand for commodities may actually increase. In fact, the United States and Europe still lead the way in terms of global consumption. Thus, current emerging markets such as those in Asia and Africa may take over the market share of demand for commodities in the future. Commodities that will likely be in high demand include base metals and raw metals to build infrastructure, energy resources for electricity and transportation needs, and agricultural and livestock for food.

Moderator: Which global regions have the most growth potential for commodity trading?

Holzhauer: Each area of the globe has its own growth story. That said, most commodity traders seem to favor North America in terms of growth potential for commodities, but that is mainly on the supply side – especially with energy. However, there are different areas of growth for different commodities. For example, in terms of livestock and agriculture, the United States, China, and India are still the top food producing countries and this is unlikely to change anytime soon. China leads in the production of rice and pork whereas the United States leads in producing milk, chicken, and beef. India is right behind these countries in several categories. Brazil is probably a good fourth country to mention because it produces sugarcane, coffee, and fruit due to its warmer climate.

As for demand, the United States and Europe still lead the way in consumption and the U.S. is often – sadly - cited as the country that throws away the largest amount of food. However, countries with fast growing populations and economies – especially Asian countries such as India and African countries such as Ethiopia – will drive up the future demand for commodities.

Finally, diversification may spur its own growth potential. For years, the statistics show that developed countries tend to be more diversified in their exports than developing countries. Seeing more diversification and less concentration of specific commodity markets would be nice as many emerging markets become more developed. This diversification would allow these countries to develop more stable economies and probably create a more stable commodities market in general.

Moderator: What trends are likely to evolve regarding commodities?

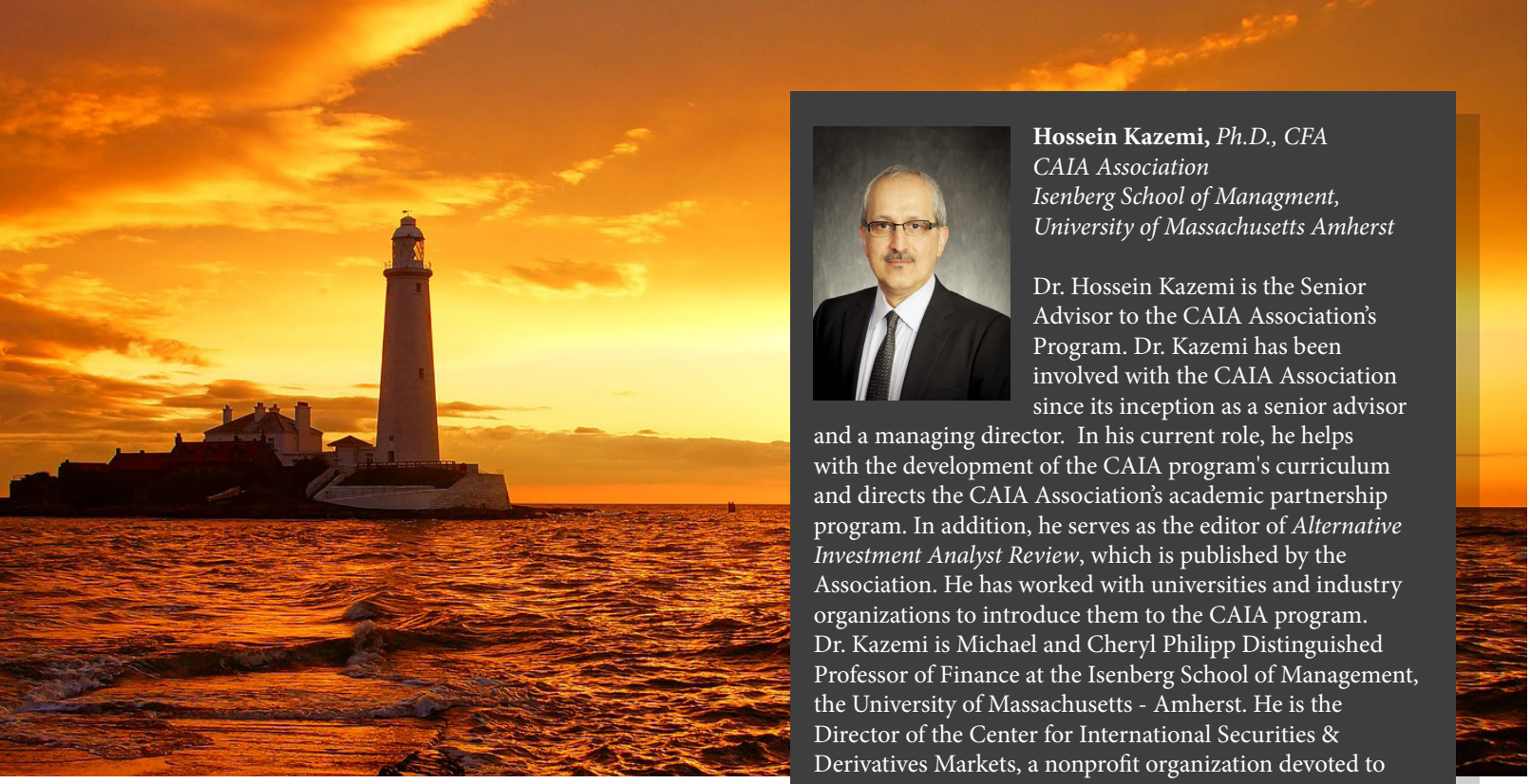
Holzhauer: Several trends in commodities are worth mentioning. The most publicized issue is probably the ongoing tariff situation with China. This issue actually relates to another relevant trend, which is China's general shift to a more consumer-led economy instead of a manufacturing economy. China represents roughly 40% of the global demand for metal commodities, but it is lowering demand for foreign steel by increasing its production of cheap steel. In fact, China has shut down more than 40 million tonnes of global steel-making capacity. Many have scolded China for its debt practices with poorer African countries. China is basically giving some African countries billions of dollars in shady loans that they know these countries cannot repay, which allows China to later exploit the countries for their natural resources.

Like the rise in tariffs and other issues with China, more government interventions appear on the horizon. These interventions will be across the board and likely range from mandated trade measures to renewable energy credits to constraints on foreign investments to even specific operating policies for government agencies. The most obvious example might be OPEC, which continues to try to influence the supply and demand of crude oil. Another good example involves the steel industry where governments continue to issue subsidies for inefficient steel facilities and some countries even continue to build new steel facilities. Agriculture is another commodity industry heavily influenced by government regulations and tariffs.

Finally, government interventions in the financial sector can also affect commodities. The most relevant example may be that our business and economic cycles are lengthening largely due to Federal Reserve policies including quantitative easing and changing interest rates. The United states has undergone one of the longest bull equity markets in its history. Has this bull run its course or is it a sign of things to come? Either way, the economic progress in the wake of the 2008 recession has increased demand within the commodity markets and is likely to disrupt commodity markets if and when the good times come to an end.

Spieler: I would say trends include incorporating high frequency, unstructured data, non-traditional data sources. An increase in the use of lithium and LNG derivatives is likely to occur. Global warming will also have an impact. Increasing human population increases the need for agriculture and livestock, which are active commodities, and reduces freshwater, which is a rapidly dwindling natural resource.

Moderator: Let's conclude our session by thanking the panelists for their insights about commodities, which have helped to make them less puzzling.



The CAIA Endowment Investable Index

Hossein Kazemi

Kathryn Wilkens, *CAIA*
Pearl Quest

We present the historical weights, allocation as of month-end December 2018, and historical performance to the replication portfolio that was introduced in our AIAR publication Volume 6 Issue 1.

The graph on the following page shows the exposures of the Multi-Asset ETF portfolio through time. It is important to note that the volatility displayed by these exposures does not imply that endowments alter their asset allocations as frequently as the Multi-Asset ETF portfolio. While an endowment may hold a fixed allocation to various asset classes, the underlying assets/manager may display time-varying exposures to different sources of risk. For instance, a hedge fund manager may decide to increase her fund's exposure to energy stocks while reducing the fund's exposure to healthcare stocks. Though the endowment's allocation to that manager has remained unchanged, its exposures to energy and healthcare sectors have changed. Also, if returns on two asset classes are highly correlated, then the algorithm will pick the one that is less volatile. For instance, if returns on venture capital and small cap stocks are highly correlated, then the program will pick the small cap index if it turns out to be less volatile.

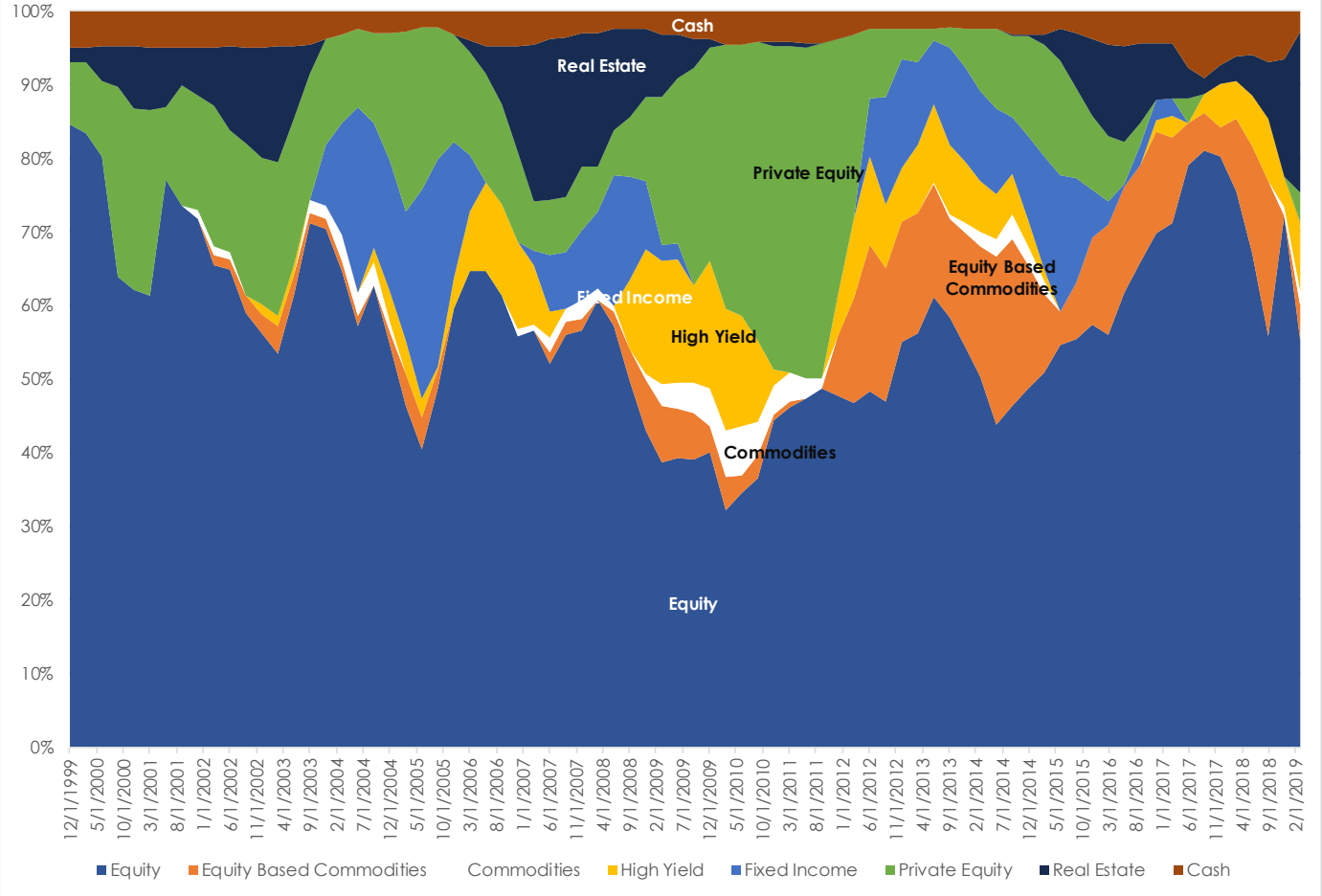
Hossein Kazemi, *Ph.D., CFA*
CAIA Association
Isenberg School of Managment, University of Massachusetts Amherst

Dr. Hossein Kazemi is the Senior Advisor to the CAIA Association's Program. Dr. Kazemi has been involved with the CAIA Association since its inception as a senior advisor and a managing director. In his current role, he helps with the development of the CAIA program's curriculum and directs the CAIA Association's academic partnership program. In addition, he serves as the editor of *Alternative Investment Analyst Review*, which is published by the Association. He has worked with universities and industry organizations to introduce them to the CAIA program. Dr. Kazemi is Michael and Cheryl Philipp Distinguished Professor of Finance at the Isenberg School of Management, the University of Massachusetts - Amherst. He is the Director of the Center for International Securities & Derivatives Markets, a nonprofit organization devoted to research in the area of alternative investments, a co-founder of the CAIA Association, and home to CISDM Hedge Fund/CTA Database and the *Journal of Alternative Investments*, the official research publication of the CAIA Association. He has over 25 years of experience in the financial industry and has served as consultant to major financial institutions. His research has been in the areas of valuations of equity and fixed income securities, asset allocation for traditional and alternative asset classes, and evaluation and replication of active management investment products. He has a Ph.D. in finance from the University of Michigan.

Kathryn Wilkens, *Ph.D., CAIA*
Pearl Quest LLC

Kathryn Wilkens, Ph.D., CAIA is a curriculum and exam advisor to the Financial Data Professional Institute and the founder of Pearl Quest LLC, a consulting firm. She is also a copy editor for the Journal of Alternative Investments and subject matter expert for the Chartered Alternative Investment Analyst exams on Wiley's Efficient Learning Platform. Kathryn has published several journal articles and book chapters on investments and edited the first edition of the CAIA textbooks. Pearl Quest was founded in 2011 and creates data science applications for investments.

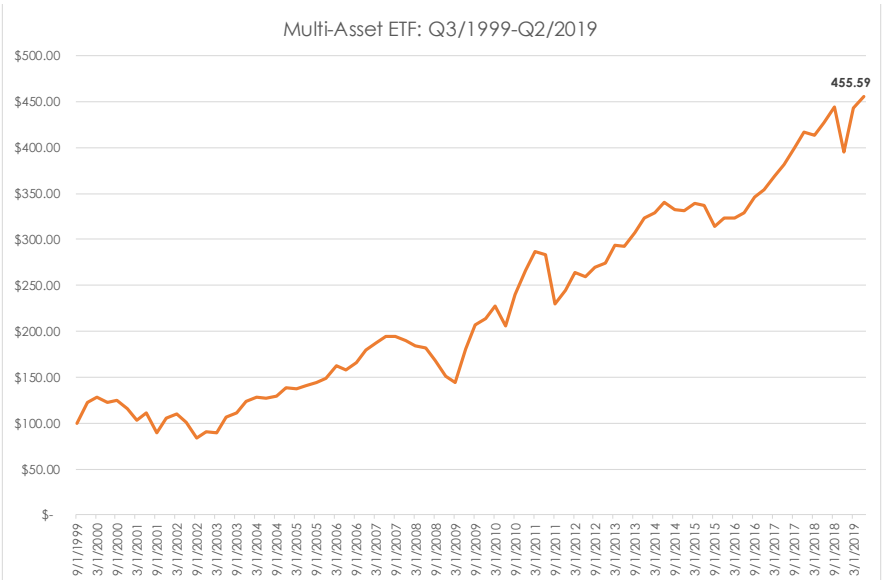
Endowment Index Weights



Allocation Suggested by Algorithm

iShares Russell 2000 ETF	Invesco QQQ ETF	MSCI World Free NR USD	Vanguard FTSE Emerging Markets ETF	Industrial Select Sector SPDR® ETF	Utilities Select Sector SPDR® ETF	Invesco DB Commodity Tracking ETF	iShares iBoxx $ High Yield Corp Bd ETF	Invesco Global Listed Private Equity ETF	SPDR® Dow Jones Global Real Estate ETF	Cash
14.3%	19.0%	14.3%	5.7%	4.8%	1.9%	1.9%	9.5%	3.8%	21.9%	2.9%

Historical Performance



The List: Alternative Indices

The performance table, on the following page, is a collection of both traditional and alternative indices for the 1, 5, and 10-year period annualized through December 2018. Both the annualized volatility and draw-down figures are calculated using a 10 year quarterly return series.

Alternative investments have been growing markedly over the past few years, creating a multitude of opportunities for owners and allocators alike. As the number and type of alternative asset classes continue to proliferate, we believe they are playing a more unique role in assisting investors achieve their desired investment outcomes. As we expect this trend to continue, we found it necessary to structure a pure alternative assets portfolio to have visibility in this exciting marketplace.

We set out to strike a balance between available assets in proportion to their market value, and to reflect the average "alternative investor". We defined the investment opportunity to simply be the following three assets classes: Real Asset, Private Equity/Venture Capital, and Hedge Funds. Real assets are comprised of real estate, commodities, timberland, farmland, infrastructure, bank loans, and cat bonds; within real asset the weights were structured to reflect the market portfolio[1] within that universe. To arrive at our weight's, we researched various endowments and foundations, as well as surveys conducted by Willis Towers Watson and Russell Investments. Based on our research, alternative historical allocations have not had material deviation and therefore we decided to implement a market weight of 1/3 across each of those asset classes. A few of the constituents are not investable, and some may be reported gross or net of fee.

Ending June 2019

	1 Yr	5 Yr	10 Yr	Ann. Vol	10 Yr Max Drawdown
MSCI World Free	6.36%	7.77%	13.51%	14.95%	-16.52%
Barclays Global Agg	-0.31%	1.18%	3.16%	5.48%	-7.17%
MSCI Emerging Markets	-6.60%	4.68%	10.57%	20.11%	-23.90%
Barclays Global High Yeild	2.65%	4.11%	11.20%	10.67%	-8.27%
HFRI Fund Weighted Composite	0.84%	3.07%	5.52%	6.22%	-7.63%
CISDM EW Hedge Fund	1.56%	4.00%	6.62%	6.98%	-7.84%
CISDM CTA EW	5.06%	5.72%	4.00%	6.74%	-7.94%
CISDM Distressed Securities	0.41%	2.56%	7.28%	5.94%	-7.08%
CISDM Equity Long/Short	0.81%	3.75%	6.36%	7.07%	-8.79%
CA US Private Equity***	17.29%	13.06%	11.94%	8.08%	-4.19%
CA US Venture Capital***	18.24%	14.54%	10.99%	8.09%	-3.41%
LPX Mezzanine Listed Private Equity	19.57%	8.64%	19.75%	24.70%	-37.79%
FTSE NAREIT All Equity REITs	20.48%	10.43%	19.08%	18.16%	-31.87%
NCREIF Property	6.55%	9.02%	7.40%	4.73%	-23.75%
S&P Global Property	-8.93%	1.21%	10.44%	17.50%	-20.92%
S&P Global Infrastructure	5.76%	1.98%	7.24%	14.07%	-18.18%
Bloomberg Commodities	-4.71%	-8.27%	-1.49%	14.96%	-53.55%
NCREIF Timberland	3.39%	4.92%	3.83%	3.56%	-5.69%
NCREIF Farmland	6.59%	8.34%	10.83%	4.62%	0.00%
Alternative Assets Portfolio * **	**4.38%**	**6.06%**	**7.14%**	**3.18%**	**-2.40%**
Global 60/40	**3.69%**	**5.14%**	**9.37%**	**9.87%**	**-9.52%**
60% Alternative / 40% Global 60/40	**4.11%**	**5.69%**	**8.03%**	**5.86%**	**-4.18%**

NOTE: All returns are calculated using arithmetic mean

Source: CAIA, CISDM, HFRI, Cambridge Associates and Bloomberg

1. Global Investment Capital Market by Hewitt EnnisKnupp, an Aon Company

Submission Guidelines

Article Submission: To submit your article for consideration to be published, please send the file to **AIAR@caia.org**.

File Format: Word Documents are preferred, with any images embedded as objects into the document prior to submission.

Abstract: On the page following the title page, please provide a brief summary or abstract of the article.

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