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GLOBAL MACRO

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ABSTRACT

Meketa Investment Group considers Global Macro to be a stand-alone hedge fund category. We believe that it has the potential to offer low correlation, lower volatility, and lower drawdowns relative to equity, which can make Global Macro a valuable asset class for an institutional portfolio.

BACKGROUND

What is Global Macro?

Global Macro hedge funds employ a top-down approach to investing, which starts by evaluating the overall global economic landscape, and then breaks it down by different countries, regions, and asset classes in order to develop investment ideas.[1] This broad investment spectrum translates into a very large investable universe that, aside from liquidity restrictions, can include almost any tradable asset in the world. However, Global Macro managers have tended to gravitate toward equity indices, currencies, government bonds, interest rates, and commodities.

Types of Global Macro Managers

Global Macro managers can generally be divided into two main groups according to their investment processes: discretionary and systematic.[2] Discretionary funds are run by a single portfolio manager or team of portfolio managers who control and implement all investment decisions within a fundamental investment framework, where individuals, not computers, are responsible for the implementation of all investment ideas, in addition to the evaluation of economic and financial information required to generate them in the first place.

Systematic managers, also known as CTAs (Commodity Trading Advisors[3]), run quantitative investment strategies, in which computer models implement trades and investment decisions. Traditionally, systematic macro managers were characterized as "trend-followers[4]." In recent years, however, with advancements in technology and quantitative finance, quantitative funds that implement the entire spectrum of Global Macro strategies (e.g., carry, relative value, etc.), and evaluate non-price data[5] in addition to price data, have become more common.

Finally, it is worth mentioning a sub-division of Global Macro funds that can be systematic and/or discretionary: tail-risk hedging funds. As their names suggest, these funds are a more

[1] This is the opposite of a bottom-up investment approach, which starts by evaluating factors affecting individual assets or securities to develop investment ideas, giving less importance to the influence of broad economic factors.

[2] There are also funds that will implement a hybrid approach, combining systematic and discretionary strategies, though this is less common.

[3] The term Commodity in CTAs comes from the 1970's when the Commodity Futures Trading Commission (CFTC) was founded in the U.S. It is understood to cover all types of futures contracts.

[4] Trend following refers to an investment strategy based on capturing the "Momentum" factor (as identified by Carhart in 1997), and only takes into account price data of assets, as opposed to evaluating a range of economic and financial data. Momentum is explained in more detail in the following section.

[5] Examples of non-price data include: valuation and dividend yields for equity indices, interest rate levels, and current account differentials for currencies, and term structure slopes for interest rates and commodities, among many others. This in addition to broad economic metrics such as GDP and inflation.

specialized brand of Global Macro that seeks to provide protection in the form of high positive returns in periods of severe equity drawdowns, or put another way, provide hedging for left tail equity events. Unlike traditional insurance strategies, however, these funds should not be expected to lose money in all other market environments.

Investable Universe

Global Macro investment managers have one of the most, if not the most, unrestricted investable universes among investment managers. Their only restriction is liquidity.[6] Thus, any asset that offers daily liquidity is potentially part of the opportunity set. It is beneficial for managers to have such a wide array of tools at their disposal, as it gives them the liberty to express top-down global economic views using almost any liquid instrument imaginable. These instruments include direct ownership of equity and fixed income, and indirect ownership of most asset classes through derivative instruments such as futures, forwards, and options.

SOURCES OF RETURN

In this section, we describe some of the most popular types of trades implemented by Global Macro managers, to provide a better understanding of their sources of return and risks.

- **Relative Value/Perceived Arbitrage[7]:** These trades are usually the most common type found in Global Macro portfolios. Relative value implies simultaneously buying and selling a pair of assets (i.e., "pair trading") that are somewhat related, with the expectation that their valuation spread will either contract (convergence trade) or expand (dispersion trade).

  Relative value trades can take several forms and target many different objectives. For example: in equity, going long (i.e., buying) an industry sector and short the market with the expectation that the given sector will outperform the market. In fixed income, intra-curve relative value trades could involve being long a two-year bond and short a ten-year bond issued by the same government, to profit from an anticipated steepening of the yield curve.

  While the essence of relative value trades is the same across different types of strategies and managers, the key distinction with regard to other strategies like relative value hedge funds, is whether such trades are implemented from the top down or bottom-up. Global Macro hedge funds will develop relative value trades at a "top-down" level, (e.g., equity index of a country relative to another, currency of a country relative to another, etc.) whereas relative value hedge funds tend to be more "bottom-up" focused (e.g., relative value of one U.S. Treasury security versus

[6] Liquidity is important for Global Macro managers because it gives them the flexibility to quickly react to changes in macroeconomic conditions, in line with their generally top-down way of investing. This allows them to be well prepared to increase or decrease risk during both calm and volatile markets.

[7] Although the term arbitrage is sometimes used loosely in the investment industry to describe relative value/convergence trades, the true meaning of the term arbitrage refers to the instantaneous riskless profit obtained by buying and selling two assets that should trade at a similar value but currently do not. Most real-world *arbitrage* opportunities dissipate quickly and involve taking some sort of risk: liquidity, counterparty, valuation, etc.

another of varying maturity or relative value of corporate bond of the same issuer but with different seniority levels, among many others).

- **Directional/Mean Reversion:** Refers to an outright long (short) position in an asset given the expectation that it will increase (decrease) in value over a given period of time. While it can be argued that relative value convergence trades also pursue mean reversion at some level, they differ from directional trades because convergence trades are generally based on pairs (i.e., on the value of an asset relative to another), as opposed to the expected value of one specific asset.

  Directional trades may be less predominant in Global Macro portfolios during normal times, but they can have the highest allocations during times of market turbulence or crises. It is a widely held belief that market crises and crashes cause departures from equilibrium in the value of assets, so when a Global Macro manager has a thesis about a disruption in the market, she can establish outright long or short trades (i.e., directional) to capture the return to historical average of the asset's price or its perceived valuation equilibrium. In summary, relative value trades tend to be market neutral, while directional trades accept market risk.

  Many prominent Global Macro managers earned their fame by successfully implementing directional trades that produced significant gains for their funds. George Soros earned notoriety by shorting the British Pound in 1992, forcing the U.K to withdraw from the European Exchange Rate Mechanism.[8] Paul Tudor Jones correctly predicted 1987's Black Monday by shorting the U.S. stock market through one of its largest single-day declines.

- **Currency Carry**: One of the most popular macro trades, the carry trade, is a type of relative value or pair trade that involves shorting a currency whose country has a low interest rate (e.g., the U.S. dollar or euro) and using the proceeds to go long a currency with a higher interest rate (e.g., the Australian dollar). The carry trade objective is two-fold: the first is to earn the spread between the two interest rates, and the second, which is perhaps most important for Global Macro managers, is to capture a widening currency spread (that is, an expectation that the currency bought will appreciate against the currency sold). Managers may also engage in reverse currency carry trades by shorting a high yielding currency and going long a currency with low yield, in the expectation that the currency spread and rate differential will contract.

  The main risk for this trade is the same as in any pair trade - that the expected relationship actually reverses. For example, the currency bought might depreciate (rather than appreciate) against the currency sold to such a magnitude that it erodes the earnings of the yield spread. Furthermore, a carry trade is usually implemented with several turns of leverage (often 8 to 10 times), which helps magnify returns but can produce outsized losses if the trade is not managed appropriately.

- **Momentum/Trend Following:** This was, and continues to be, the main source of return for most systematic macro managers, and is also utilized by discretionary managers. Momentum, or trend following, refers to the practice of buying prior winners and selling prior losers with the expectation that the winners will continue

[8] This was the precursor to the Euro (currency).

to do well and the losers will continue to perform poorly. This trade can be implemented in most asset classes but is most popular among commodities, currencies, and equity futures.

Momentum can be implemented using models with different time frames: short term can be as short as a matter of hours to less than a month; medium term (most common) is generally based on one month to six month signals; and long term momentum looks at signals longer than six months. These strategies, as their name suggests, are most successful in trending markets, but are very exposed during mean-reverting markets, especially when trends break. Furthermore, volatile yet trendless environments represent a risk for momentum strategies, as those environments lead them to enter and exit trades continuously without gaining profits, resulting in losses and excessive transaction costs.[9]

- **Long Volatility:** Rather than a specific trade, long volatility refers to a strategic position that can be implemented through a wide array of trades. This is a common profile for tail-risk hedging funds. Most traditional assets and especially equities, are "short volatility," that is, they decline in value when market volatility increases. By having a positive exposure to the volatility of equities or bonds (i.e., they increase in value when volatility increases), these funds can effectively hedge the negative performance of such assets during times of increasing volatility. However, this may come at the expense of trailing most assets or even experiencing losses during times of declining market volatility.[10]

  A long volatility trade is usually implemented through options, and it implies buying, not selling, both puts or calls. Buying an option can be analogous to buying insurance, so it makes sense that a tail-risk hedging fund has a profile similar to that of buying insurance on an asset or group of assets. Furthermore, a long position in an option, holding all else equal, is always favored by an increase in volatility,[11] hence the long volatility profile. As with other derivatives, options can also be used as return enhancers within the long volatility profile. For example, if a manager has a view that an asset's price will increase (decrease) in value, she can buy a call (put) that will give a long volatility profile as well as unlimited gains and limited losses.

[9] Please refer to the Appendix for an illustration of trend following strategies.

[10] Explicit Long Volatility Strategies (i.e. those implemented through options) are also referred to as "Negative Carry" strategies, highlighting the fact that they may generate losses during calm markets. In general, these losses are attributed to the premium outlay required to establish long positions in options.

[11] The volatility of the underlying asset is an input of the famous Black Scholes Merton option pricing model, and an increase in volatility, holding all else equal, generates an increase in the price of an option (either put or call), which translates into a positive return for the holder of a long position. This relationship holds true for all option pricing models.

Performance, a tale of Volatility?

After reviewing some of the popular trades used by Global Macro managers, we argue that some periods are more favorable than others for Global Macro strategies. Managers (and computer models) implement trades based on economic views of market disruptions and imbalances, so deviations from perceived true value across the globe and in all instruments are the main sources of expected return.

This is where volatility comes into play. Volatility is usually seen as one of the main sources of risk for all finance assets.[12] Although not directly observable like prices, volatility can also be high or low. When volatility is high and increasing, it usually signals times of turbulence and negative returns for most assets.[13] It is in this high volatility environment that Global Macro managers can best perform; disruptions to markets create an ideal framework for managers to implement trades that can profit from not just the disruptions, but from the return to fundamental value that should follow the disruptions in long term, mean-reverting markets. Calmer, non-volatile times are usually benign for traditional assets such as equities, and without as many disruptions, Global Macro strategies will be hard-pressed to outperform an equity-dominated portfolio. The diversification benefits arising from volatility can make Global Macro a valuable asset class for an institutional portfolio.

PERFORMANCE AND CHARACTERISTICS OF GLOBAL MACRO STRATEGIES[14]

Although Meketa Investment Group considers Global Macro strategies as defensive, meaning their main objective is offering "protection" during times of negative equity returns, they have historically been able to provide adequate stand-alone absolute and risk adjusted returns relative to traditional assets such as equities and bonds.[15]

Table 1. Trailing Period Returns

Annualized Monthly Returns: January 2001– June 2017[16]

	3 YR (%)	5 YR (%)	10 YR (%)	15 YR (%)
Discretionary Macro	1.2	1.0	2.2	4.6
Systematic Macro	0.8	0.0	2.2	3.2
MSCI ACWI	4.8	10.5	3.7	7.3
S&P 500	9.6	14.6	7.2	8.3
Barclays Aggregate	2.5	2.2	4.5	4.5

[12] The *only* source of risk in a Markowitz – mean-variance – world.

[13] We will see ahead how equities perform poorly during times of high volatility.

[14] Discretionary and Systematic Macro returns are all shown net of fees.

[15] It is worth noting that the performance period studied in Table 1 coincided with two strong bull markets for equities, periods that, as we will argue later, are not favorable for Global Macro strategies.

[16] Because of the manner in which hedge fund indices are constructed, they are prone to biases in the data (e.g., self-reporting bias, survivor bias, etc.). Hence, historical returns and statistics based on them should be viewed with at least a little healthy skepticism.

Their historical defensive attributes have made Global Macro strategies attractive as diversifiers to traditional equity and bond portfolios. As illustrated in Table 2, Global Macro strategies in general have been less volatile than equities, with comparable risk adjusted returns and significantly lower drawdowns.

Table 2. Risk Table

Monthly Returns: January 2001– June 2017

	Discretionary Macro	Systematic Macro	MSCI ACWI	S&P 500	Barclays Aggregate
Standard Deviation	4.8%	6.3%	15.7%	14.5%	3.5%
Sharpe Ratio	0.73	0.30	0.22	0.30	0.99
Max Drawdown	-8.0%	-9.9%	-54.9%	-50.9%	-3.8%
Average Gain	1.4%	1.6%	3.3%	2.9%	0.9%
Average Loss	-0.8%	-1.2%	-3.6%	-3.8%	-0.7%
Skewness	0.39	0.34	-0.73	-0.65	-0.35
Excess Kurtosis	0.41	0.62	1.97	1.37	1.47
Beta - MSCI ACWI	0.09	-0.03	1.00	0.89	-0.01
Beta - S&P 500	0.06	-0.06	1.03	1.00	-0.03
Beta - Barclays Aggregate	0.29	0.46	-0.19	-0.46	1.00

In addition to volatility, skewness and "excess" kurtosis[17] (two statistical metrics that characterize distributions of returns) provide great insight into how Global Macro strategies can behave defensively relative to asset classes such as equity and even fixed income.

Most institutional portfolios are driven by equity returns, which have historically been volatile, negatively skewed, and with high excess kurtosis (i.e., larger and more common extreme negative events than a normal distribution). In contrast, we observed that Global Macro strategies have in general been less volatile, positively skewed, and with lower excess kurtosis than equities. All of this means that while equities tend to be commonly[18] exposed to large negative tail events, Global Macro conversely has been more commonly exposed to positive tail events, with a smaller occurrence of extreme events in general.

The concepts of volatility, skewness, and kurtosis may seem abstract, but adding Global Macro to an equity-driven portfolio can effectively introduce all desired defensive characteristics: lower volatility, drawdown protection, and perhaps most important, better behavior during tail events without necessarily compromising expected return; this is what diversification is all about.

[17] Skewness refers to the symmetry of a return distribution. A normal distribution has no skewness because it is completely symmetric; there is equal probability for positive and negative tail events. However, a distribution with positive (negative) skew has higher than normal probability of experiencing positive (negative) tail events. Excess kurtosis on the other hand, refers to the size of the peak and tails of a distribution of returns relative to a normal distribution. A return distribution with positive (negative) excess kurtosis has larger (smaller) tails than a normal distribution, which means higher (lower) probability of experiencing tail events or extreme returns.

[18] At least more commonly than what a normal distribution would suggest.

Moving ahead to a correlation analysis, both Discretionary and Systematic Global Macro strategies have exhibited very low correlations to equities and bonds, ranging from 0.18 to 0.25 for discretionary and -0.13 to 0.25 for Systematic, which, coupled with their stand-alone returns, should lead to diversification benefits when included in an equity and bond portfolio.

Table 3. Correlation of Global Macro to Equities and Bonds

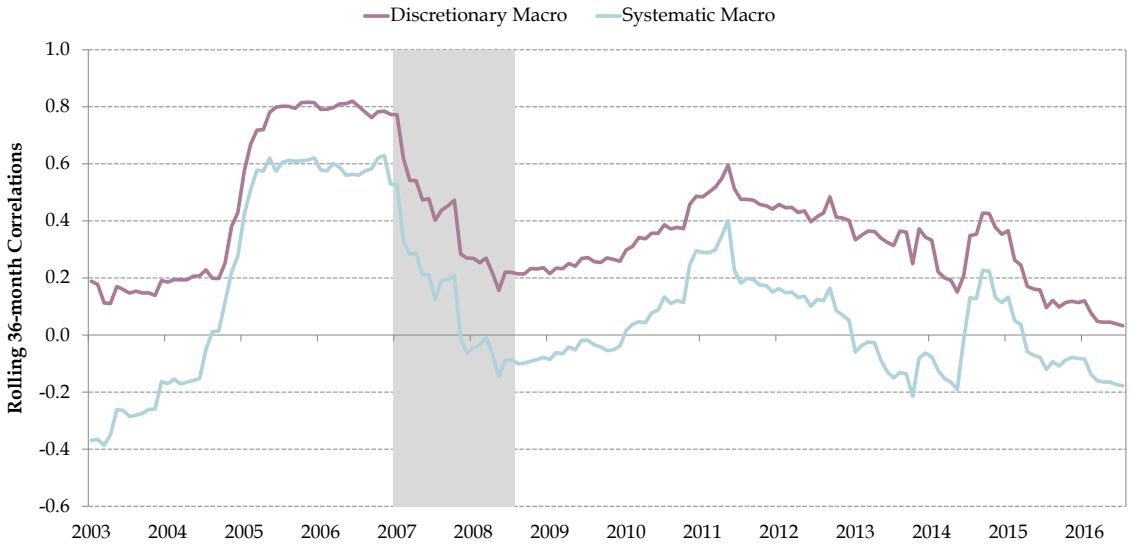
Monthly Returns: January 2001– June 2017

	Discretionary Global Macro	Systematic Global Macro	MSCI ACWI	S&P 500	Barclays Aggregate
Discretionary Global Macro	1.00				
Systematic Global Macro	0.80	1.00			
MSCI ACWI	0.25	-0.06	1.00		
S&P 500	0.18	-0.13	0.96	1.00	
Barclays Aggregate	0.20	0.25	-0.04	-0.11	1.00

Chart 4 shows that correlations go through cycles, with discretionary and systematic macro strategies' rolling correlations to equities topping out at 0.8 and 0.6, respectively. However, it is worth noting that true to their defensive capabilities, correlations actually decreased, and decreased substantially during periods of equity drawdown (e.g. U.S. recession).

Chart 4. Rolling 36-month Correlations to MSCI ACWI

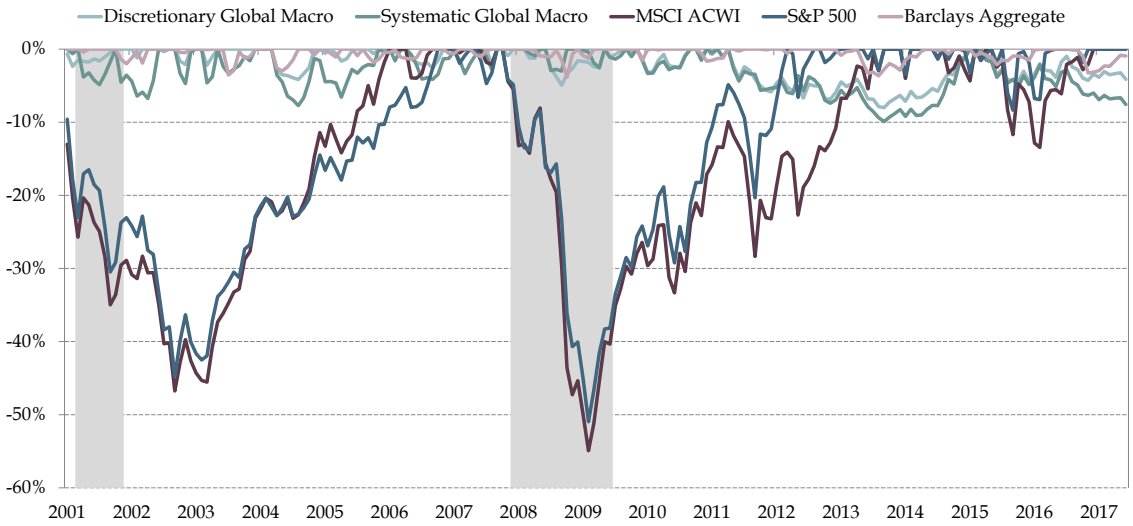
Monthly Returns: January 2001– June 2017



Furthermore, Global Macro strategies have been historically effective at protecting returns during equity drawdowns, another defensive characteristic that is comparable to that of fixed income.

Chart 5. Drawdowns

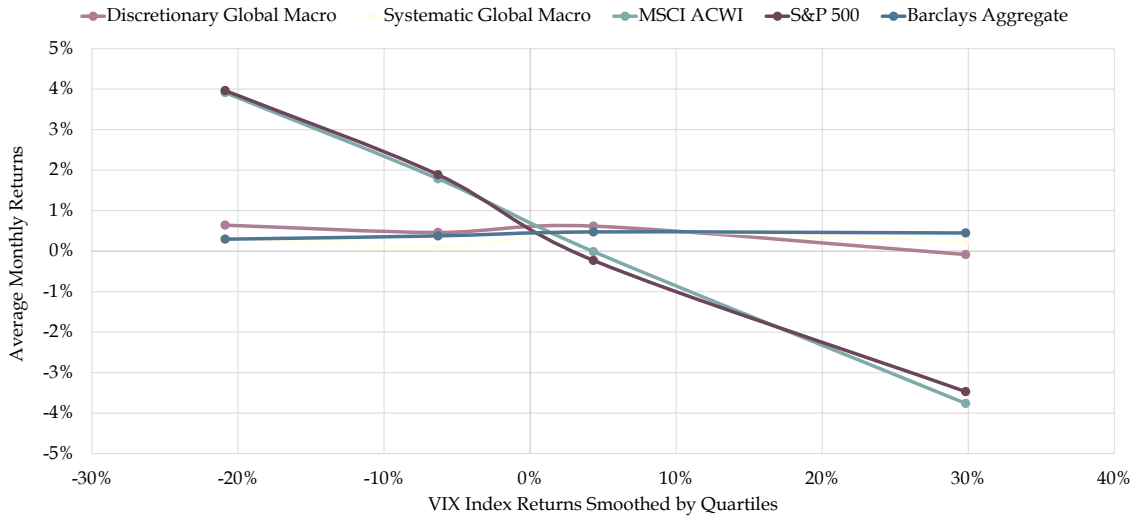
Monthly Returns: January 2001– June 2017.



Moreover, related to our earlier point about volatility and market disruptions, the chart below shows the performance of Global Macro, equities, and bonds at different volatility periods. As we observe, there is a clear negative relationship between volatility levels and performance for equities. However, global macro strategies, similarly to fixed income, have historically been able to weather high volatility periods, though at the expense of muted performance in low or decreasing volatility periods. In summary, while high volatility is generally bad for equities, Global Macro strategies can serve as an effective portfolio hedge during such periods.

Chart 6. Performance by Volatility Quartiles[19]

Monthly Returns: January 2001– June 2017



[19] Volatility is proxied by the VIX Index which measures the market expectations of volatility through S&P 500 index options.

IMPLEMENTATION ISSUES (FEES, LIQUIDITY)

The average management fee for commingled Global Macro strategies is 1.6%, with a wide range from 0.0% to 6.0%.[20] In addition, it is common for Global Macro strategies to charge a performance fee. The average is 18%, but there is a range from 0% to 35%. Operational costs also vary widely. Based upon our analysis of invested funds, we anticipate operating costs to range between 0.1% and 0.4%, depending on the fund size and the type of strategy; systematic strategies may incur higher operating expenses if they require a more costly data and trading infrastructure. As is always the case, fees are negotiable depending on the size of the investment.

The majority of Global Macro managers offer commingled investment vehicles. There are firms that are willing to offer separate accounts, but investors should be aware of how they tap into the trading infrastructure of the manager. Managers in this category have also embraced the use of daily liquid mutual funds. Systematic Macro is most prevalent in the mutual fund offerings.

Liquidity for Global Macro managers ranges widely from daily-liquid Exchange Traded Funds to quarterly-open limited partnerships. The limited partnerships may carry various lock up or gate provisions[21] based on the limited partnership agreement. The Global Macro manager may offer a lower liquidity schedule in exchange for a lower management fee. Investors should be fully aware of illiquid securities used by or available to the individual manager, to gain perspective on the proper liquidity profile. Generally speaking, Meketa Investment Group recommends that investors access Global Macro strategies through limited partnership vehicles.

RETURN DISPERSION ISSUES

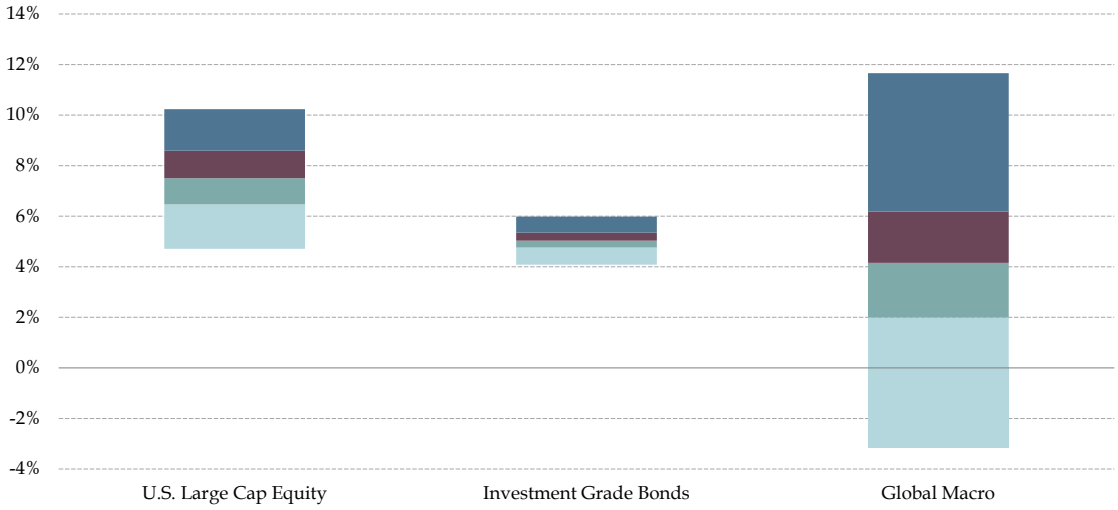
Global Macro managers, as previously discussed, have a wide range of potential investments. Portfolios may vary dramatically by asset class, specific securities invested, and geographic exposure. Typically, Global Macro managers have the greatest amount of latitude of any active investment manager. The result is a significant amount of dispersion around the peer average and possibly the rest of an investor's portfolio. The chart below depicts the Global Macro peer universe relative to U.S. large cap stocks and investment grade fixed income.

[20] Source: HFRI Macro funds. Funds reporting as of June 2017 were included. Sample size is 292 funds.

[21] A gate provision is a restriction placed by a hedge fund manager on her fund to limit the amount of redemptions (or withdrawals) during the fund's specified redemption period.
Initially, gate provisions were created to help hedge fund managers deal with periods of increased redemption requests without creating disruptions to the remaining investors in the fund.
However, during the Global Financial Crisis of 2008, when investors were looking for liquidity from their hedge fund investments, they were confronted on some instances with some managers invoking their gate provisions to postpone (and sometimes even suspend) redemption requests on strategies that were for the most part believed to be highly liquid.
Nowadays the activation of a gate provision by a manager is largely seen as a negative event by investors, as the general reasons for their occurrence include: outsized losses or underperformance, large amount of total redemptions that can threaten business continuity for the fund, and liquidity mismatch between portfolio assets and fund terms (i.e. a hedge fund that offers daily/monthly liquidity but invests in illiquid assets such as distressed credit).

Chart 7. Manager Return Dispersion[22]

10-Year Annualized Returns as of June 2017



ALLOCATING TO GLOBAL MACRO

As we have noted throughout this paper, Global Macro strategies can be valuable diversifiers to equity and bond portfolios. Their attractive defensive characteristics can provide clear benefits to an equity-driven portfolio. In particular, their positive skewness serves as a hedge during extreme negative events, reducing downside risk in an overall portfolio. There are two other options that tend to present a similar portfolio complement, both with their own risks; long term U.S. Treasuries, which carry interest rate risk, and put options/tail risk insurance, which are generally exposed to negative carry.

Below, we provide general allocation guidelines for Global Macro strategies in institutional portfolios, in the context of the most common allocation cases:

1. Global Macro as a stand-alone asset class: If Global Macro is considered as a stand-alone asset class in an institutional portfolio, it is usually allocated 5% to 10% of the overall portfolio. Lower allocations will make it difficult, or sometimes even impossible, for a defensive strategy to provide diversification benefits to portfolios with a high exposure to equity.
2. Global Macro as part of a balanced hedge fund program: When building a balanced hedge fund program that combines allocations to both directional and defensive strategies, Global Macro allocations can range from 10% to 50% depending on the overall program objectives. As they do with equity, Global Macro strategies can provide diversification benefits to more directional hedge fund strategies, such as long short equity and event driven, among others.

[22] Source: HFRI, eVestment.

3. Global Macro as part of a defensive hedge fund program: when added to a defensive hedge fund program, Global Macro strategies generally constitute a large portion of the program, ranging from 50% to 75%. The program may extend to relative value fixed income hedge fund strategies, which can have similar defensive characteristics to traditional fixed income assets.
4. Global Macro as part of a Risk Mitigating Strategy.[23] When building a program that has all traditional asset classes available, Global Macro may comprise 25% to 75% of the Risk Mitigating Strategy portfolio. Investors may introduce cash, TIPS, and long-term Treasuries to complement the Global Macro managers.

Finally, given the high level of return dispersion in the asset class, investors may consider diversifying their global macro exposure by allocating to more than one manager. However, while the number of managers selected should be proportional to the size of the total global macro allocation, Meketa Investment Group generally favors holding a lower number of managers. Similar to adding assets to a portfolio, the incremental diversification benefit from adding each new manager is reduced, and may even disappear, as the number of managers already in the portfolio increases.

[23] A Risk Mitigating Strategy portfolio is similar in principle to a Defensive Hedge Fund Program (No. 3). The main distinction arises from the fact that the Risk Mitigating portfolio can include traditional asset classes such as Cash, TIPS, and long term Treasuries.

SUMMARY AND CONCLUSIONS

As the name of the strategy suggests, Global Macro portfolio managers make investment decisions based on the global macroeconomic landscape. Both discretionary and systematic Global Macro managers have a very broad investable universe and are able to employ a wide array of trades, such as currency carry, relative value, momentum, and others, in order to profit from perceived value disruptions in global markets.

Given their constant lookout for market disruptions and expected ability to profit from them, Global Macro strategies tend to perform best during turbulent or volatile markets, which are historically difficult periods for traditional assets such as equities.

Global Macro's historically positive performance during volatile periods is one of the main reasons these strategies are deemed defensive, because they have protected returns for a portfolio when equity markets are experiencing drawdowns. However, in addition to their performance in volatile markets and drawdown protection, we noted that Global Macro strategies have had decent stand-alone risk adjusted returns, attractive correlations relative to equities, and tend to exhibit positive skew and tail-hedging behaviors. All these characteristics are invaluable to investors looking for diversifying qualities for an institutional portfolio that derives the majority of its risk and return from equity-like strategies.

Global Macro strategies are a valuable defensive tool for institutional investors; their risk adjusted returns and diversifying characteristics lead us to recommend that these strategies be included in all defensive and balanced hedge fund programs. We also believe that they merit evaluation for inclusion as a stand-alone asset class in an equity-driven portfolio.

Appendix I: Benchmarks

Throughout this paper, Discretionary and Systematic Global Macro Strategies were represented by the following benchmarks:

- Discretionary Global Macro: HFRI Macro Index
  - This index is the most widely used benchmark for Global Macro hedge funds due to its long track record going back to 1990 and broad coverage of the asset class. The index currently shows equal weighted performance of 416 Global Macro strategies. Funds included in the index must have at least $50 million under management or have been active for at least 12 months.
- Systematic Global Macro: Barclay CTA Index
  - This benchmark is the leading index for performance of CTAs. It has a long track record, going back to 1980, and currently shows equal weighted performance of 522 CTAs, which provides broad exposure to the asset class. Furthermore, to be included in the index, advisors must have four years of prior performance history, which reduces member turnover.

The use of benchmarks to proxy the performance of asset classes, and especially hedge funds, can present several issues, including but not limited to:

- Non-Investable: a non-investable benchmark prevents investors from accessing the return streams they are using to characterize an asset class.
- Non-Measurable: mostly applicable to hedge fund benchmarks or benchmarks of underlying managers (instead of benchmarks of securities), investors are not able to measure the returns of the benchmark independently, because the returns of the underlying managers are not always publicly and readily available.
- Trading costs: most index construction methodologies do not incorporate trading costs associated with rebalancing the index. Even if the benchmark is investable, a fund that tracks it will incur trading costs that will detract from performance.
- Self-reporting bias: mostly applicable to hedge fund benchmarks (i.e. Global Macro), this issue arises because constituents self-report their results and are free to do so as long as they like. This can cause an upward bias in benchmark returns where only successful managers have incentives to report their returns to the index.

Appendix II: Illustration of Trend-Following Strategies Based on Societe Generale Prime Services SG Trend Indicator

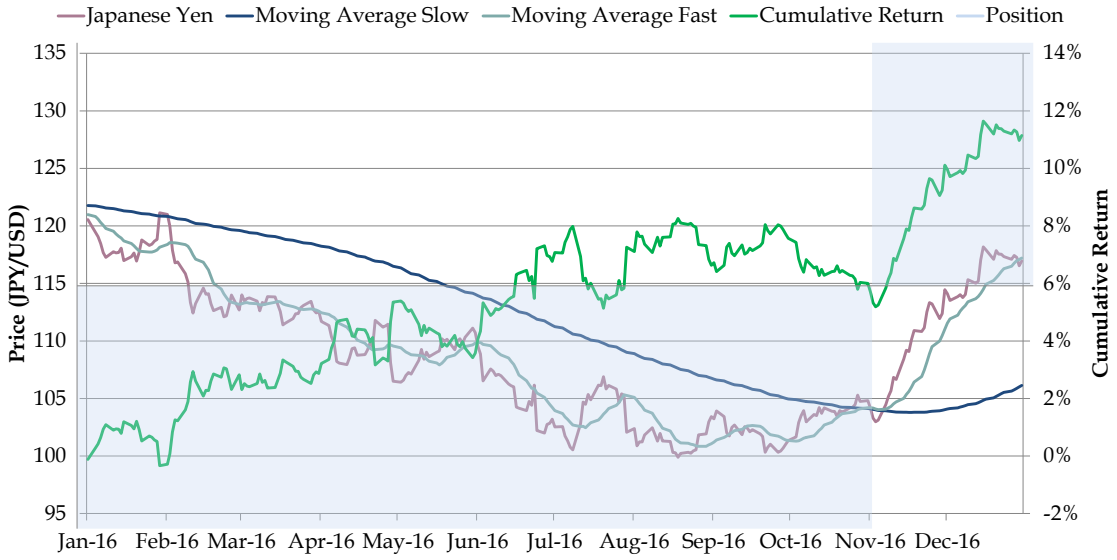
To illustrate the behavior of trend following strategies, below we set up two examples of the behavior of a simple trend following signal, applied to real world asset returns. The trend following signal is the following: we will go long (short) the asset whenever the fast moving average (14 days) is above (below) the slow moving average (6 months).

We must caution the reader that the examples below are shown for illustration purposes only. They do not reflect how a real world strategy would have fared in the same environment, as they do not incorporate any risk management metrics or market frictions such as cost of trading and market impact.

1. **Trending Market - Japanese Yen during 2016 calendar year**: As we see in the chart below, the Japanese Yen had a relatively smooth trending behavior, consistently appreciating in value over the first 10 to 11 months of the year, which were successfully captured by our signal being short USD all this time. Around mid-November (right after the U.S. presidential election) we saw a change in the trend, which our strategy eventually captured by changing to a long position, but not without suffering a dip in performance from it. As expected, the trend following signal successfully captured a trending market but suffered during the only inflection point (i.e. sharp trend reversal).

Chart 8. Trending Market – Japanese Yen

2016 Calendar Year

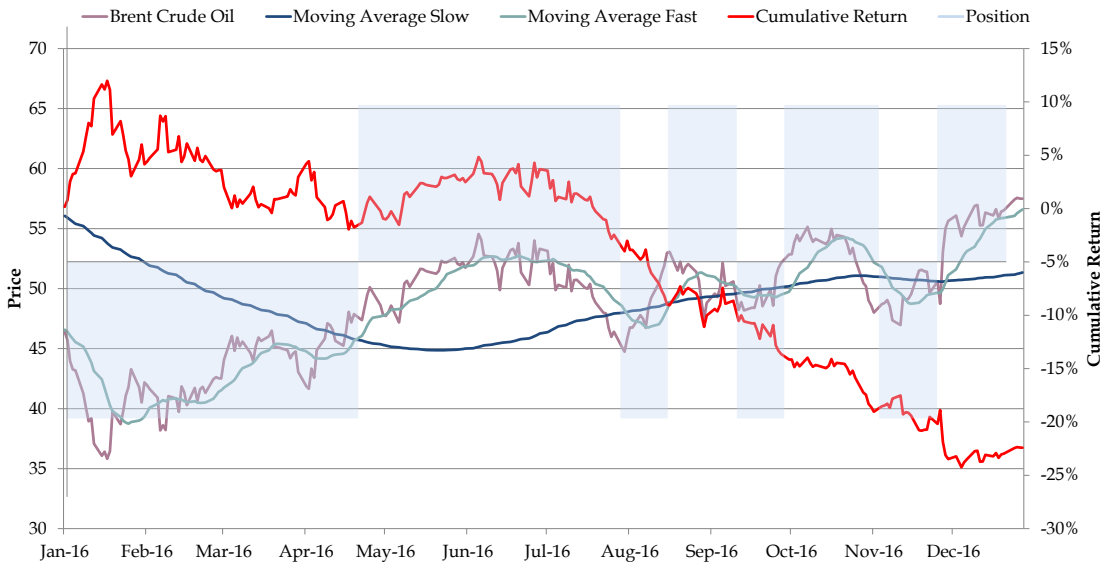


2. **Sideways Market –** Brent Oil during 2016 calendar year: Brent Oil exhibited the most damaging behavior for trend following strategies during the second half of the year; a volatile yet trendless or sideways market.

   As we can observe, the strategy experienced multiple inflection points during the year, with eight different signals to change positions. Even without considering the costs generated from consistently having to trade in and out of positions, our strategy suffered severe losses in this market.

Chart 9. Sideways Market – Brent Oil

2016 Calendar Year

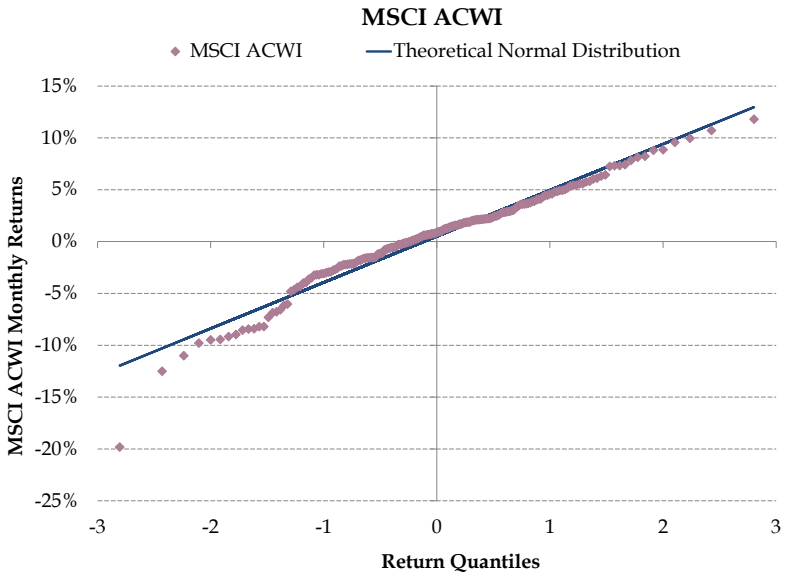


Appendix III: Convexity Analysis[24] – QQ Plot

It is possible to summarize most of the defensive characteristics of an investment strategy, Global Macro in this case, by looking at the shape of its returns' distribution and comparing it to a how a normal distribution with the same characteristics (mean and variance) would look.

Chart 10. Quantile-Quantile Plot - Equities[25]

Monthly Returns: January 2001– June 2017



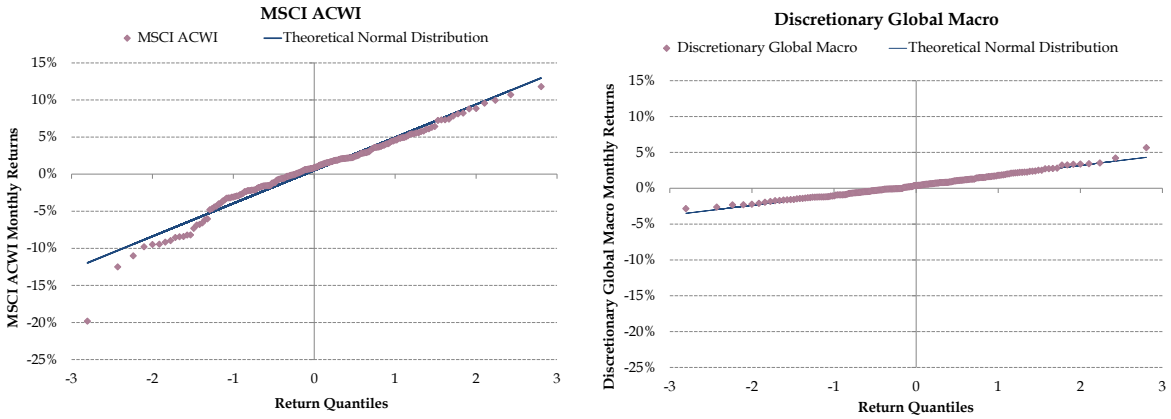
When looking at the chart above for the MSCI ACWI, we observe a negatively convex (or concave) distribution, that translates to some well-known equity return characteristics: the first its negative skew, which is confirmed by a larger than normal propensity for extreme negative (left tail) events and lower than normal probability of extreme positive returns. Furthermore, the slope of the normal line denotes a volatile strategy, as we will see when comparing it against others below.

[24] Convexity in this context refers to the shape of the distribution of returns of investment strategies when plotted using a QQ-Plot. It is worth mentioning that the concept of convexity is also used in finance in fixed income and options, to denote the non-linear relationship between changes in value and changes in interest rates and underlying assets for fixed income and options respectively.

[25] Refer to the appendix for further information of Quantile-Quantile plots.

Chart 11. Quantile-Quantile Plot – Discretionary Global Macro relative to MSCI ACWI

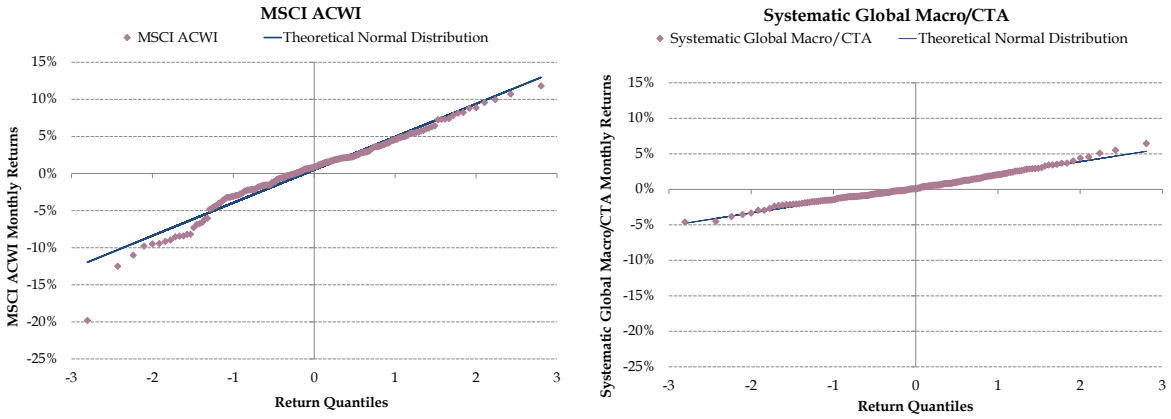
Monthly Returns: January 2001– June 2017



When plotting the historical return distribution of discretionary Global Macro, we can observe an inverse shape to that of equities. First, the lower slope of its curve denotes a much less volatile distribution of returns, and its **convexity** is a direct representation of a strategy that offers positively skewed returns, that is, lower than normal probability of extreme negative events, a higher than normal probability of extreme positive events. Looking below at the chart for systematic Global Macro leads to similar conclusions.

Chart 12. Quantile-Quantile Plot – Systematic Global Macro relative to MSCI ACWI

Monthly Returns: January 2001– June 2017.



QQ Plots

- The convexity charts shown above are Quantile-Quantile (QQ) plots: scatter plots designed to compare data to a theoretical distribution (a normal distribution in this case) to visually determine if returns are likely to have come from the known distribution. Empirical quantiles are plotted on the y-axis and the quantiles of the theoretical distribution are plotted on the x-axis. A reference line is also plotted. If the empirical data comes from the population of the chosen theoretical distribution, the points should fall approximately along the reference line. The

larger the departure from the reference line, the greater the evidence that the data comes from a population with a different distribution.

- The QQ-plots shown in the paper attempt to understand the concept of convexity in the shape of the distribution of returns of an investment strategy. The goal is to can gain perspective on how close the actual distribution of returns of a strategy matches a normal distribution and how did the strategy behave during tail events, again relative to a normal distribution. This is accomplished by comparing the realized return distribution of a given manager to a theoretical normal distribution with the same mean and standard deviation of returns.
  - A concave shape can be associated with a negative skew, with fatter left tails (more frequent extreme negative events) and thinner right tails (less frequent extreme positive events) than a normal distribution.
  - An "S" shape implies a manager who has greater than normal outcomes on the tails of its realized distribution.
  - A convex shape can be associated with a positive skew, with fatter right tails (more frequent extreme positive events) and thinner left tails (less frequent extreme negative events) than a normal distribution. If repeatable, this can be a valuable skill set to leverage because it represents both an attractive stand-alone stream of returns and one that can complement well other strategies such as equities, which tend to have concave shapes of returns relative to a normal distribution.

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