# Risk Factor Investing: Insights for Portfolio Construction

Since its beginnings in 2003, Fiera Capital has experienced tremendous growth fueled by many important acquisitions. Whether it was to access a new distribution channel, establish a strategic geographical presence, reduce operating costs or gain access to key expertise in specific investment strategies, each one of them had a specific objective. Now close to 15 years after its creation, and with even more acquisitions and new ventures, Fiera Capital has a platform boasting an impressive depth of investment strategies that only a few investment managers worldwide can rival.

The Fiera Capital investment platform has grown over the years to ensure investors have access to a complete range of investment solutions that includes an important offering of non-traditional strategies such as Infrastructure, real estate, emerging

| INVESTMENT STRUCTURE | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| MULTI-ASSET CLASS & BALANCED SOLUTIONS | | FIXED INCOME | | CANADIAN EQUTITIES | | FOREIGN EQUITIES | | ALTERNATIVE STRATEGIES | |
| Balanced | Balanced plus | Universe | Preferred shares | Can equity | Can equity core | US equity | Global equity | Market neutral equity | Infrastructure |
| Advisory | Systematic strategies | Municipal | High yield | Can equity opportunities | High income | Int'l equity | All country world | Focused market neutral | Real estate |
| Liability driven investment | Overlay | Tactical | Global fixed income | Low volatility equity | Small cap | Us small-mid cap equity | Ethical esg | Long/short equity | Agriculture |
| | | Short-term | Short-mid term | Small cap core | Micro cap | Emerging markets | Frontier markets | Active trading | Diversified lending |
| | | Infra-structure debt | Long term | Ethical ESG | Ex energy | | Total equity | Multi-strategy income | Private equity |
| | | Credit | Index plus | | | | | Private lending | Mortgage |
| | | Strategic | Ethical | | | | | Income opportunities | |
| | | | | | | | | Eastern europe occo | |

markets equity, hedge funds, global farmland and timberland and, more recently, commercial mortgages and private equity.

Given the breadth and increased complexity of investment strategies, the challenge is to work with our investors and partners to build the best possible portfolios that meet their long term objectives. As a firm, we strongly believe that in order to achieve these long term goals for our clients, it is fundamental to have a robust portfolio construction process. The strategic asset allocation (SAA) process is the foundational piece on which all portfolios are built and is the main contributing factor to performance. It is therefore paramount to build an empirically sound, comprehensive and intuitive SAA model. We have therefore expanded our platform to include Multi-Asset Class Solutions (MACS); the natural next step to the growth of our investment platform.

Macs is a framework for strategic portfolio allocation using a disciplined process based on risk factor analysis. This is a simplified approach built on robust quantitative analysis that gives us the ability to look through the individual investment strategies to understand the main drivers of risk and return within the portfolio. We are able to decompose any investment strategy into common factors to get a complete picture of risk and diversification.

Sophisticated portfolio optimization and stochastic projections have been used by large institutional investors to build diversified portfolios for years. MACS is now available to all of our clients; we use a flexible and complete approach inspired by academic research and robust analyses championed by large institutional investors, such as cash flow projections and liquidity needs forecasting, as part of our process for all clients: pension plans (large or small), insurance companies, foundations as well as individual investors.

## Asset Allocation Basics

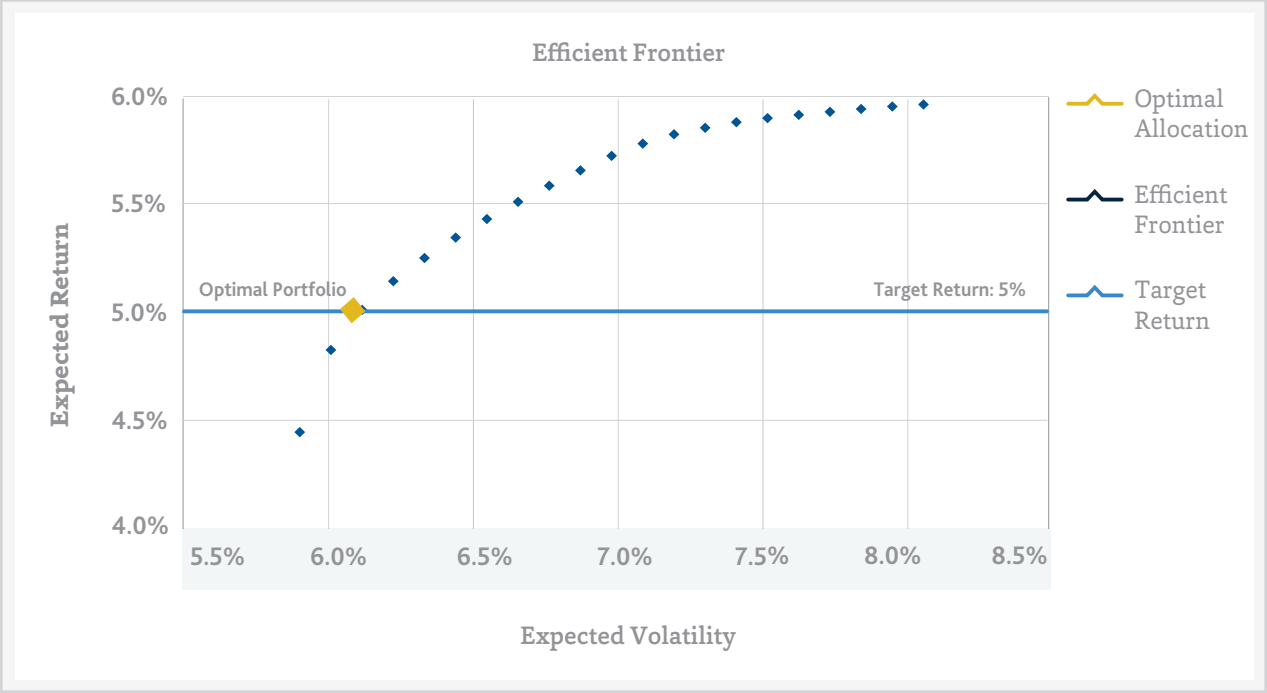
Asset class-based portfolio optimization is frequently applied in strategic asset allocation. The most common implementation is through the mean-variance framework introduced by Markowitz in 1952, a method which critically depends on investors' understanding of future return distributions of assets under consideration. This process, well known by large institutional investors, starts by determining a universe of investable assets and assigning them long term forward looking assumptions (expected return, volatility, and correlation amongst asset classes). It then includes objectives and constraints, and a portfolio optimization framework proceeds to create an efficient frontier from which an ideal portfolio is chosen

Portfolio optimization can be taken a step further by relying on stochastic or scenario-based projections to forecast other non-linear portfolio performance results, such as projected asset (and liability) values, probability of meeting targeted cash needs, maximum drawdown and other risks to meet specific investor needs.

Once the optimal portfolio is approved, the idea is then to find managers who are able to meet the investment mandate of each asset class. The allocation can be implemented either through a passive product or an active management strategy. In the latter case, alpha, or manager-added value, is recognized as a bonus, something that builds up a cushion in case of adverse situations (or simply generates added return for the portfolio). If the manager is shown to regularly beat his or her benchmark, the optimal portfolio target should be met in the long run, and if it's exceeded, all the better. But is that sufficient?

**Instead of being considered separately, asset returns can be described through a factor-based approach.** A substantial proportion of asset returns and risks are driven by exposure to common economic forces (factors). The foundational Capital Asset Pricing Model (Sharpe 1964, Lintner 1965, and Mossin 1966), which was enriched by the discovery of driving factors for major asset classes (Chen, Roll and Ross 1986), Litterman and Scheinkman 1991, Fama and French 1993, and Fama and French 2015), provided the basis for factor-based decomposition of return and risk. These academic findings lead to a factor-based investment approach that allows investors to allocate assets based on underlying driving factors and to potentially construct more efficient portfolios.

## GRAPH 1: Efficient Frontier Illustration




For illustration purposes only

## Reconciling active portfolio management and long term asset allocation

Active managers are not their benchmark. The traditional approach to evaluating managers starts by asking whether they have beaten their benchmark over the long run (a positive), and whether they did so by taking on additional risk (a negative): we go further and ask how returns were achieved. We are able to decompose any investment strategy into underlying factors to get a complete picture of risk and diversification.

We can understand which returns were driven by risk factors and which part of the performance cannot be explained by larger macroeconomic betas and is thus pure alpha. We have analyzed the performance of our managers over the life of their investments and have compared their exposures to different risk factors through return-based regressions

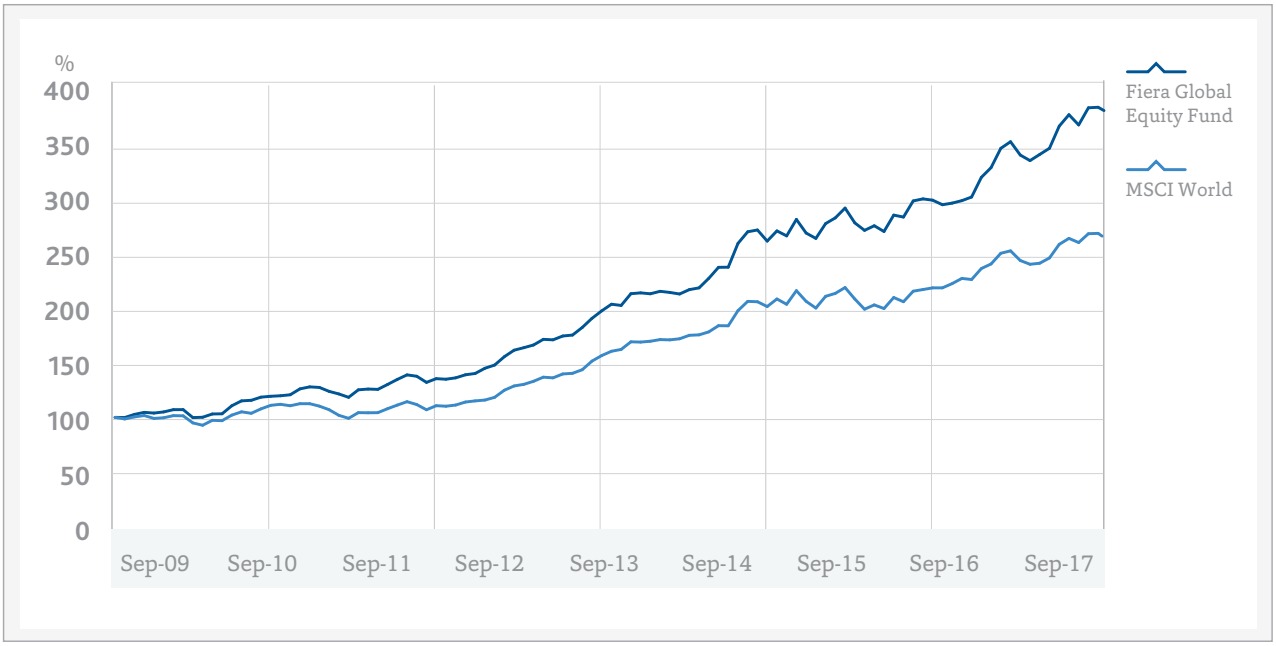
### Table 2: Manager vs. Benchmark Returns Summary Statistics: Fiera Global Equity Fund

| | ANNUALIZED RETURN | ANNUALIZED VOLATILITY | SHARPE RATIO | UP-MARKET CAPTURE RATIO | DOWN-MARKET CAPTURE RATIO |
|---|---|---|---|---|---|
| Fiera Global Equity Fund | 16.93% | 9.56% | 1.69 | 108.13% | 65.68% |
| MSCI World | 12.10% | 9.27% | 1.22 | N/A | N/A |

External Data Source: Bloomberg L.P.
Returns based on actual fund and index performances since inception (October 1, 2009)

## GRAPH 2 - A1: Manager vs. Benchmark Returns: Fiera Global Equity Fund

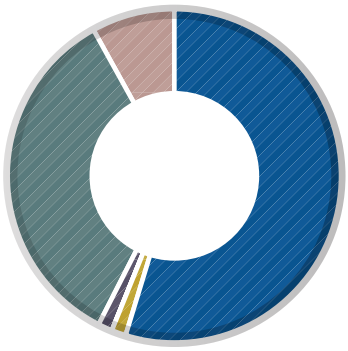
### Fiera Global Equity FundV.S. MSCI World (CAD Return)




External Data Source: Bloomberg L.P.
Returns based on actual fund and index performances since inception (October 1, 2009)

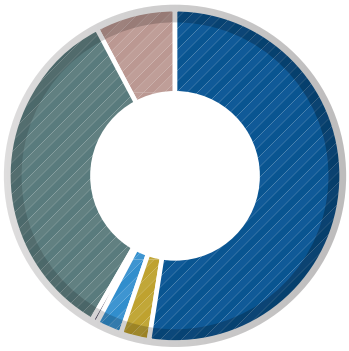
## GRAPH 2 - A2: Risk Decomposition: Fiera Global Equity Fund and MSCI World

### Proportion of Risk Contributed by Each Factor - MSCI World



| | |
|---|---|
| Developed Markets Growth | 54.58% |
| Emerging Markets Growth | 1.36% |
| Inflation | 0.46% |
| Commodity | 1.55% |
| Currency | 34.20% |
| Illiquidity | 7.86% |

### Proportion of Risk Contributed by Each Factor - Fiera Global Equity Fund



| | |
|---|---|
| Developed Markets Growth | 52.66% |
| Emerging Markets Growth | 2.88% |
| Inflation | 2.36% |
| Commodity | 0.53% |
| Currency | 34.01% |
| Illiquidity | 7.56% |

Decomposition based on actual fund and index performances since inception (October 1, 2009)

We see in the preceding charts that our Global Equity portfolio manager has a higher reliance on the Emerging Market risk factor at a proportion of 2.88% of total volatility than the benchmark at 1.36% - more than double. The difference reflects a geographical tilt in the fund to Emerging Market securities. The Global Equity fund is also more exposed to the Inflation risk factor and less exposed to the Commodity risk factor, which could have contributed to portfolio performance considering the turbulences of the commodity market during the period studied of October 2009 to March 2018.

The means by which a manager achieved their performance matters to overall asset allocation, because there are commonalities to underlying asset manager styles across asset classes. For instance, reliance on pro-cyclical inflation would be shared at least between equity, fixed income and real asset managers. Due to their investment styles, managers across asset allocations may therefore have correlation profiles that are not captured by their broader benchmark. Putting aside reliance on underlying exposures may, in the worst cases, overstate correlation in stressed economic periods, and diversification may not be available when investors most need it.

How can we reconcile manager-added value with long-term asset allocation?

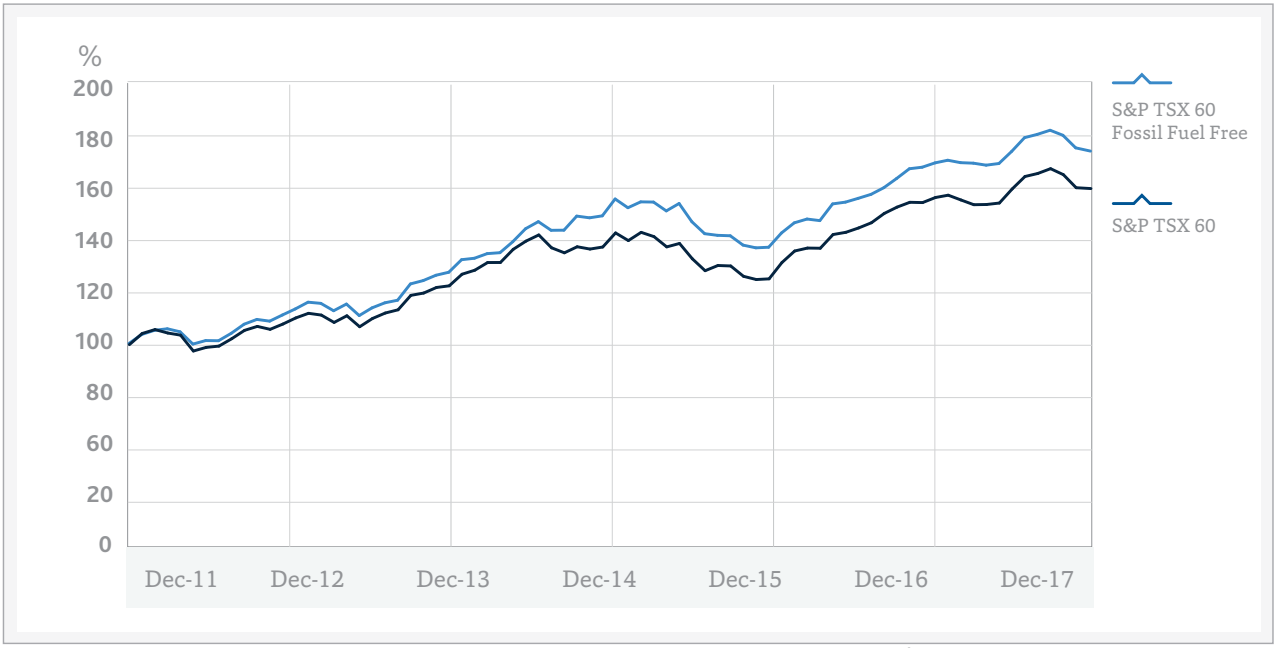
Assigning a single value to expected return and volatility alpha does not suffice, and it would be unreasonable to expect a manager to avoid risk and still add performance steadily through any cycle. Establishing expected return and volatility might not be so difficult, but how do you assign correlations to manager styles? By looking for common underlying risk factors and understanding how managers rely on them in their investment process, we are able to understand how our managers will react throughout different phases of the economic cycle.

In addition to manager style, there are a number of investment implementations decisions that may affect the risk factor-based profile of an investment and change some of its characteristics. Style factors come to mind here, but also preferences on quality (ex. limitations on BBB credit as part of a bond mandate) or short/long curve bias will affect asset class return characteristics.

ESG filters are another example of an investment choice that changes the asset class performance profile. For instance, an investment product that has a "green" profile will by design avoid certain polluting industries.

## GRAPH 3 - A1: Constrained V.S. Unconstrained Benchmark Returns: Fossil Fuel Filter

### S&P TSX 60 V.S. S&P TSX 60 Fossil Fuel Free




External Data Source: Bloomberg L.P.
Returns based on actual fund and index performances since inception (October 1, 2009)

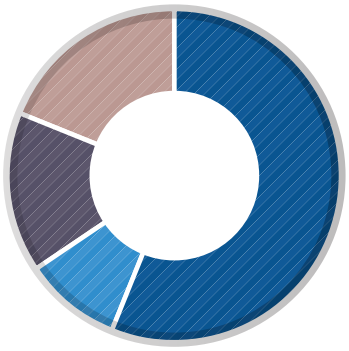
## Table 3: Constrained V.S. Unconstrained Benchmark Returns Summary Statistics: Fossil Fuel Filter

| | ANNUALIZED RETURN | ANNUALIZED VOLATILITY | SHARPE RATIO |
|---|---|---|---|
| **S&P TSX 60 Fossil Fuel free** | **9.46%** | **7.32%** | **1.19** |
| **S&P TSX 60** | **7.96%** | **7.87%** | **0.91** |

External Data Source: Bloomberg L.P. and Factset
Returns based on actual index performances since January 2012

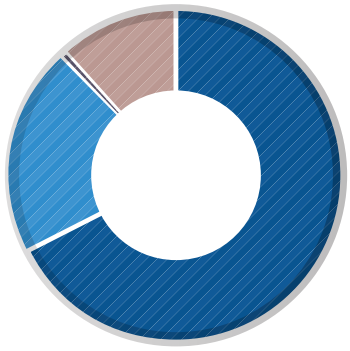
## Table 5: Risk Decomposition: Constrained V.S. Unconstrained Benchmark Returns - Fossil Fuel Filter

Proportion of Risk Contributed by Each Factor - S&P TSX 60



| | |
|---|---|
| Developed Markets Growth | 56.18% |
| Inflation | 18.80% |
| Commodity | 15.37% |
| Illiquidity | 9.64% |

Proportion of Risk Contributed by Each Factor - S&P TSX 60 Fossil Fuel Free



| | |
|---|---|
| Developed Markets Growth | 67.68% |
| Inflation | 20.52% |
| Commodity | 0.41% |
| Illiquidity | 11.39% |

Decomposition based on index performances since January 2012

In this example, we apply a fossil fuel free filter to S&P TSX 60 Index and examine risk contribution through our factor system. After applying the fossil fuel free filter, the proportion of total volatility contributed by the commodity factor reduced from 15.37% to 0.41%. The reduced proportion is distributed among DM Growth, Inflation and Illiquidity factors. Moreover, the change in commodity exposure caused total volatility to reduce from 7.87% to 7.32%.

The reduction in commodity dependence alone also leads to an annualized return difference of 0.6% during the period of January 2012 to March 2018.

**Risk factors prove valuable in understanding the specificities of active portfolio management.** Through an integrated factor-based investment approach, an investor can understand the portfolio properties resulting from investment decisions, and incorporate such information in portfolio construction process.

## Reducing the dimensions of the asset allocation problem

The Global MSCI Equity Index currently can at least be categorized based on the interaction of six investment styles (size, value, momentum, quality, yield, and volatility), three major markets (Developed, Emerging and Frontier) and eleven sectors. The same is true for the Canadian bond Universe which can be split into three maturity categories (Short, Mid, Long), seven rating categories (AAA, AA, A, BBB, BB, B, High Yield), and more than seven issuer / issuance types (Federal, Provincial, Municipal, Corporate, Inflation Linked, Securitization, Industrial) according to FTSE. This implies that an asset allocation-based model that would take into account all such specificities would need a huge set of expected returns, volatilities, and correlations; a task that is simply not feasible.

Using risk factor-based allocation greatly reduces the complexity of the asset allocation problem. By finding underlying common factors that explain most of the investment performance, we are able to greatly reduce the number of assumptions necessary. Through our risk factor-based approach, rather than starting the asset allocation work by going through an exhaustive list of assets and finding their underlying distribution for forecasting purposes, we take a step back. In factor-based asset allocation, we do more work upfront, finding the underlying factors which can explain the return characteristics of assets. This later means that rather than forecasting all asset classes, we simply have to forecast the underlying factors thus materially reducing the number of forecasts needed.

**Through our research, we found that the following 10 risk factors were successful in explaining the return and volatility pattern of the majority of benchmarks and of our funds.**

### Fiera MACS Risk Factors and their Definition

| RISK FACTOR | DEFINITION |
|---|---|
| Developed Market (DM) Growth | Risk associated with exposure to developed market economic growth |
| Emerging Market (EM) Growth | Risk associated with exposure to emerging market economic growth |
| Real Rate | Risk associated with exposure to unexpected change in real rates |
| Inflation | Risk associated with unexpected change in inflation rates |
| Credit Premium | Risk associated with corporate bond issuer downgrade or default |
| Slope Premium | Risk associated with change in the slope of the yield curve |
| Commodity | Risk associated with uncertainty in commodity prices |
| Currency (FX) | Risk associated with foreign investments arising from uncertainty in foreign exchange rates from the perspective of a Canadian investor |
| Real Assets | Risk associated with exposure to real assets such as brick & mortar properties or land |
| Illiquidity | Risk associated with potential loss due to scarcity of assets or unavailability of buyers at a specified price |

| MACS RISK FACTOR ACCEPTANCE FRAMEWORK | | |
|---|---|---|
| Interpretability | Numerical Property | Explanatory Power |
| Economic rationale: Factors should reflect macroeconomics forces specific to different asset classes | Low correlation: Factors should have low correlation to each othering market growth | High explanatory power: Core factors should explain the majority of asset returns, especially for traditional strategies |
| Help understanding: Factors should be simple to interpret and they should enhance understanding of the portfolio construction process | Stability: Factor exposure of the different asset classes should be stable over timein real rates | Asset-class specific: Factors naturally related to an asset class (such as real rates are to bonds) should be effective in explaining its returns |
| Integration with tactical views: Factors should be able to be based on real-time market data and to showcase the effect of tactical market positioning | Ease of construction: For an equivalent explanatory power, the factor construction that is the simplest should be used | Incremental explanatory power: A factor should only be included if it proves to enhance the overall factor set's ability to explain returns in a statistically-significant manner, otherwise it should not be included |
| Low dimensionality: The size of the factor set should be limited to the smallest possible number such that once combined, the factors will suffice to explain return dynamics across asset classes | | |

We set out to find a set of common factors that captures significant return variation across asset strategies, both for our funds and for market benchmarks. We had three criteria for inclusion: Interpretability, Numerical Property and Explanatory Power.

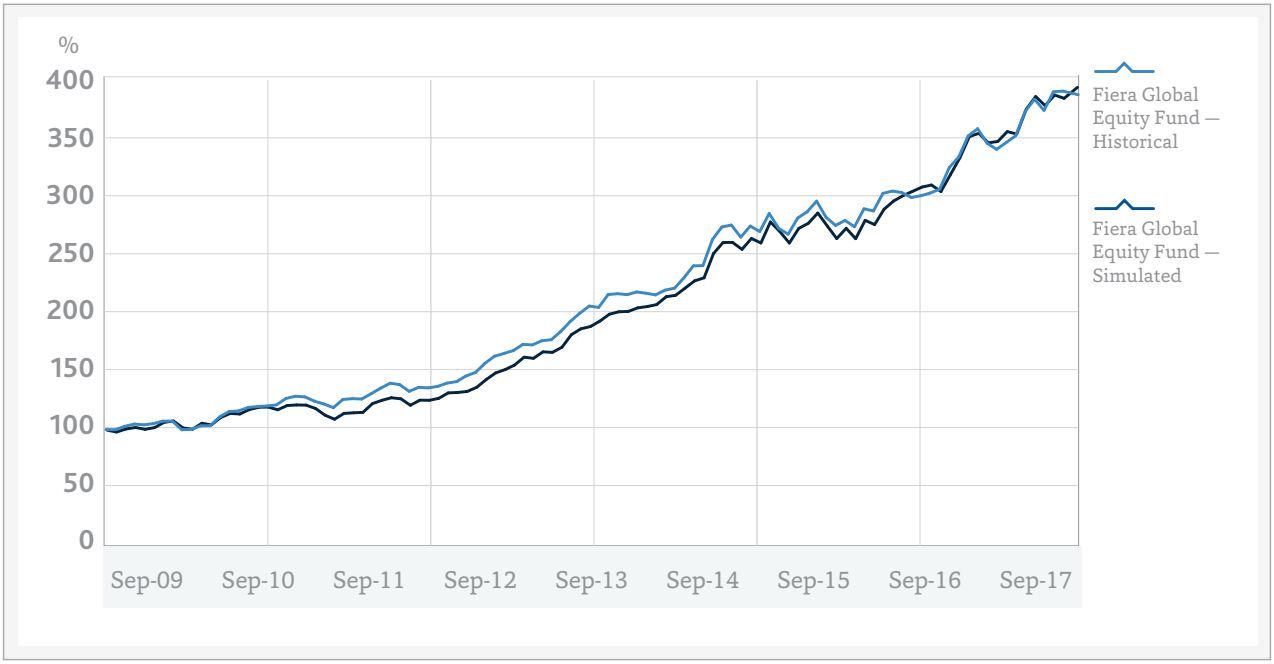
**The MACS Risk Factors prove efficient in reconstructing performance.** In Table 4, we compare performances of the Fiera Global Equity Fund with the performance results based on their risk factor exposures alone. We see that overall, risk factors are efficient in explaining historical portfolio returns.

### Table 4: Summary Statistics – Historical Manager Performance vs. Risk Factor Reconstructed Performance

| | ANNUALIZED RETURN | ANNUALIZED VOLATILITY | SHARPE RATIO | CORRELATIONS | |
|---|---|---|---|---|---|
| | | | | HISTORICAL | SIMULATED |
| **Fiera Global Equity Fund - Historical** | **16.93%** | **9.56%** | **1.69** | **1** | |
| **Fiera Global Equity Fund - Simulated** | **17.00%** | **9.64%** | **1.68** | **0.9** | **1** |

## Graph 4: Historical Manager Performance vs. Risk Factor-Reconstructed Performance

### Fiera Global Equity Historical PerformanceV.S. Factor-Simulated Performance




Source: Fiera Capital and Fiera MACS. Historical returns based on actual fund performance
Factor-reconstructed fund performances are based on actual historical factor returns and estimated factor exposures. Unexplained residual returns are randomly simulated.

**Not only do risk factors simplify the asset allocation problem, they also provide investors with a deeper knowledge of their portfolios by digging through all strategies and getting to simple, understandable macroeconomic forces that govern the investments. Additionally, we can expect greater stability of results as the asset allocation optimization process relies on far fewer variables for projections.**

## Building a portfolio of targeted diversified risk exposures

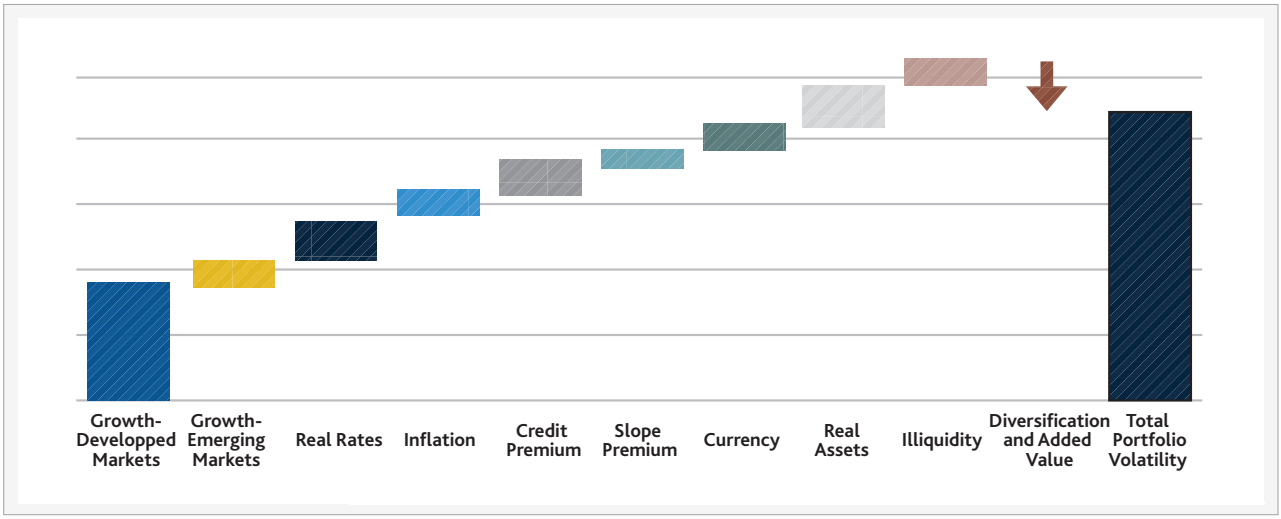
Risk factors offer investors a new perspective to understand, manage and monitor the underlying sources of exposure to risk-return factors for total portfolio optimization.
We offer a flexible approach to help strategize asset allocation; below are examples of optimization challenges tackled by MACS.

Through risk factor-based asset allocation, not only are we able to optimize portfolios in terms of traditional metrics such as target returns or minimized volatility, but we can incorporate long-term risk factor variables to meet the underlying needs of the investors.

## Table 5: Fiera MACS Optimization

| INVESTOR TYPE | EXAMPLE MACS OPTIMIZATION |
|---|---|
| Foundations and Endowments | Reach a defined spending policy target and sustain long-term goals |
| Insurance Companies | Enhance returns within regulatory framework while reducing capital charges |
| Defined Benefit Pension Plan | Limit funding status volatility, stabilize contributions and to enhance capital efficiency |
| Defined Contribution Pension Plan | Life cycle or risk taking capacity based on evolving allocations |
| Individuals and Family Offices | Personal goal-based optimization such as planned retirement or reinvestment and diversification, taking into account private equity investments |
| Structured and Goal-Based Mandates | Meet specific target liquidity needs |

## Diversified Portfolio Risk Factor Decomposition




Source: Fiera MACS. For illustration purpose only

The above-graph is an example of output from our proprietary methodology. What we observe is the decomposition of overall portfolio volatility by MACS Risk Factors, and understand how the portfolio is exposed to each factor. Each stacked bar shows the additional contribution to portfolio risk of the key risk exposures, building up to the total volatility. Additionally, we can also observe in the second to last column, the reduction in overall volatility that our customized solution generated from risk factor diversification.

We use the decomposed risk factor exposures to forecast portfolio behaviour. Our forecast can either take into account a macroeconomic environment based on passive market views or based on Fiera Capital's forecast of market conditions. We project portfolio performance based on a regime-switching model through which we forecast thousands of scenarios across different futures. Some scenarios exhibit a normal economic outlook while others are representative of stressed investment periods where returns are low, volatility is high and correlation

across asset-classes change. We are able to get a complete picture of ranges of outcomes and results based on the specific needs of the investor.

MACS puts the strategic asset allocation back at the forefront of portfolio construction. Rather than simply focusing on return and volatility, the primary objective is to offer a truly customized solution that gives clients the highest probability of meeting their specific investment objective.

## Authors

**Nicolas Papageorgiou,** Chief Investment Officer, Canadian Division
**Caroline Grandoit,** Assistant Vice President Multi-Asset Class Solutions
**Yi Fang,** Quantitative Analyst Multi-Asset Class Solutions
Helpful comments were provided by Tolga Cenesizoglu, Associate Professor Department of Finance at HEC Montreal.

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