



ENDOWMENTS & FOUNDATIONS GROUP

Factor Risk Management

A generalized methodology for multi-asset class portfolios

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J.P.Morgan
Asset Management

ABOUT
**J.P. MORGAN ENDOWMENTS &
FOUNDATIONS GROUP**

The J.P. Morgan Endowments & Foundations Group is a dedicated team of investment specialists leveraging the firm's global resources to provide customized solutions and advice for endowments, private and public foundations, and not-for-profits on their investment needs. J.P. Morgan is a trusted advisor to more than 5,000 charitable organizations, managing over \$40 billion of their assets (as of 12/31/10).

Foreword

The global financial crisis has underscored the need for greater transparency in multi-asset class portfolios and the importance of having a better understanding of the driving factors of return and volatility beyond traditional allocation labels. Factors reflect exposure behind the scenes and attempt to separate background market forces from genuine investment skill.



Monica Issar
Head of J.P. Morgan Endowments
& Foundations Group

At J.P. Morgan, our portfolio construction process seeks to quantify and manage risk and return at all phases of building client portfolios. With multi-asset class portfolios, this is becoming increasingly complex given the use of alternative and non-benchmarked traditional managers in shaping the risk/return dynamic of an overall portfolio. More information is needed to understand and allocate manager risk beyond simply examining historical monthly returns and manager-scripted style definitions. By doing so, we advance our understanding of what drives portfolio results to better manage portfolio risk and potentially enhance returns.

How we can yield greater transparency of risk taking through factor allocation frameworks lies at the heart of this article. Through factor analytics, we seek to break down monthly portfolio or manager returns, and separate the systematic or market risk (beta) a manager takes on in a portfolio from the manager-specific risk or true value added of a manager's investing (alpha).

Through this decomposition of portfolio volatility, we gain a better understanding of the various market exposures in a portfolio and the changes in those exposures over time. Our factor approach to managing assets seeks to create greater clarity around risk taking in an effort to generate greater returns subject to the same level of risk.

We are privileged to have the author, Tony Werley, as our Chief Strategist for the J.P. Morgan Endowments & Foundations Group. Prior to joining us, he was the Global Head of Portfolio Construction within the J.P. Morgan Private Bank. For more than 30 years, he has served in management, sales and investment capacities for both institutional and private clients, and was an early adopter of alternative strategies in multi-asset class portfolios.

The insights this article brings, we trust, will prove both enlightening and valuable for you and your organization as we all look to better understand portfolio risk and, ultimately, improve risk-adjusted returns.

A handwritten signature in black ink that reads "Monica". The signature is fluid and cursive, with a long horizontal stroke at the end.

Monica Issar
Head of J.P. Morgan Endowments & Foundations Group

The intuitive appeal of conventional risk management approaches can make them quite beguiling. Risk exposure is expressed using standard asset class buckets (e.g., equity, fixed income, alternatives and cash), and most investors have a generic understanding of the broad types of risk associated with specific asset classes. Yet this conventional approach does not provide enough market context, or market insight, to help investors judge whether their portfolio implementation is truly aligned with the risk-return objectives set out in their investment policy.

To be useful in making that judgment, allocation frameworks need to provide a simple, comprehensive description of *risk drivers* across the entirety of the portfolio, regardless of asset class description or investment vehicle. Investors with this level of transparency will have greater information that they need to have thoughtful discussions about opportunities and trade-offs, and to make fully informed decisions around portfolio implementation.

Throughout this discussion, we make the naïve assumption that the majority of risk is captured by a volatility (standard deviation) calculation. In reality, there are other types of risk, including liquidity, leverage and tail risks. These dimensions can also be addressed and deserve comment. That being said, this discussion attempts to lay a foundation for further analysis based on a volatility-centric view of risk.

Factor Allocation Frameworks— Greater Transparency of Risk Taking

One path to creating greater clarity of market risk is the construction of a factor allocation, an approach increasingly embraced by leading institutional investors and asset

managers. Factor allocations differ from asset allocations in that risks are aggregated by market exposures, not by asset classes or management format. Within this framework, an investor is compelled to consider: What is the summary of market risk in a portfolio once it is populated with traditional active managers, hedge funds, derivative structures and passive management vehicles?

It's true that traditional asset allocation profiles may offer a measure of understanding around passive benchmark portfolio volatility. And assets grouped into the "alternatives" bucket do share issues around illiquidity, portfolio management tools (e.g., the ability to short or use leverage), fees and other non-quantitative defining characteristics (e.g., fees, "Key Man" and business model risks). But even as the vehicles and strategies may differ, many of these asset classes and strategies share many of the same risks. For example, an equity long-biased hedge fund strategy may have similar equity market exposures to a traditional "long-only" equity portfolio. Event-driven hedge fund strategies, such as merger arbitrage and distressed debt, have a meaningful level of equity market exposure that should likewise be aggregated as part of the total "equity risk" of a portfolio.

EXHIBIT 1: FOUNDATION PORTFOLIO FACTOR ALLOCATION
ASSET ALLOCATION

Asset Class	Strategic Allocation (%)
EQUITIES	38.0
U.S.	19.0
Large Cap	14.0
Core	10.0
Value	4.0
Growth	0.0
Structured Investments	0.0
Small/Mid Cap	5.0
International	19.0
Core EAFE	10.0
Asia ex-Japan/Emerging Markets	9.0
Structured Investments	0.0
ALTERNATIVES	30.0
Hedge Funds	15.0
Diversified Strategies	2.0
Single Strategies (Non-Diversified)	13.0
Opportunistic/Macro	4.0
Equity Long-Bias	4.0
Event-Driven	3.0
Distressed	0.0
Relative Value	2.0
Private Capital	6.0
Direct Real Estate	4.0
Hard Assets	5.0
FIXED INCOME & CASH	32.0
U.S. Taxable Fixed Income	30.0
Core	5.0
Corporates	5.0
High Yield/Bank Loans	12.0
Inflation	2.0
Non-USD/Emerging Markets Debt	6.0
Currency Strategies	0.0
Cash	2.0
TOTAL	100.0

Equity

Hedge Funds

Private Equity

Real Estate

Hard Assets

Fixed Income

FACTOR ALLOCATION

Asset Class	Strategic Allocation (%)
EQUITY FACTORS	51.0
Public Market	38.0
U.S. Large Cap	14.0
Core	10.0
Value	4.0
Growth	0.0
U.S. Small/Mid Cap	5.0
International	19.0
Core EAFE	10.0
Asia ex-Japan/Emerging Markets	9.0
Absolute Return	7.0
Equity Long-Bias	4.0
Event-Driven	3.0
Core	3.0
Distressed	0.0
Private Market	6.0
Private Equity	6.0
FIXED INCOME/FX FACTORS	34.0
Public Market	32.0
Fixed Income	9.0
Core	5.0
International Core	0.0
Inflation	2.0
Cash	2.0
Extended	23.0
Corporate Bonds	5.0
High Yield/Bank Loans	12.0
Emerging Markets Debt	6.0
Foreign Exchange	0.0
Absolute Return	2.0
Relative Value/Credit	2.0
Private Market	0.0
Mezzanine Debt	0.0
NON BENCHMARKED/MULTIFACTORS	6.0
Absolute Return	6.0
Diversified Strategies	2.0
Opportunistic/Macro	4.0
REAL ASSETS	9.0
Real Estate	4.0
Core/Core Plus	4.0
Development/Opportunistic	0.0
Infrastructure	0.0
Commodities	5.0
TOTAL	100.0

Equity Factors
51%

Fixed Income/
FX Factors
34%

Non-
Benchmarked
6%

Real Assets
9%

Source: J.P. Morgan sample endowment and foundation asset allocation. As of April 2011.

For illustrative purposes only. Investment ideas presented herein may not be suitable for all investors.

Consider, too, the entire traditional equity and fixed income management universe, where a growing number of managers are benchmark agnostic or at least irreverent about adhering tightly to a benchmark. As opposed to benchmark-defined strategies, the pattern of risk taking within a wide-tracking error traditional portfolio is less transparent and may add to the portfolio's market estimation error factor.

Investors have the potential to improve the transparency of portfolio risk by directly addressing its specific market exposures whether through traditional or alternative strategies. Estimating true market exposures (or redundancy of equity, fixed income or commodity risk) across the entire portfolio can be an important tool in both clarifying and managing portfolio risk.

Factor Allocation vs. Asset Allocation: A Simple Example

To illustrate the utility of factor analysis, **Exhibit 1** takes a hypothetical traditional allocation profile and translates it into a factor profile. As highlighted above, the key innovation of the factor allocation is to “look through” the asset allocation, putting aside traditional benchmark and vehicle classifications, to highlight the core drivers of market exposure. The result is a regrouping of the allocation profile according to the defined set of factors that drive risk and return.

In this example, 32 separate sub-investment strategies are grouped into six main traditional asset classes: equity, hedge funds, private equity, real estate, hard assets and fixed income. But as noted earlier, many of these classifications are less than fully descriptive of the *risks* actually taken within each sub-strategy.

As is typically the case, factor exposures are calculated using historical data. This limitation may be addressed by checking for the stability of factor exposures or by weighting statistically significant but changing factor exposures more toward recent historical examples.

A full 15% of the profile's risk is masked by its classification as “hedge fund risk,” when in fact it's overwhelmingly stock, bond and hard asset risk. Specifically, the risks inherent in the sub-investment strategies “event driven” and “relative value” hedge funds can be reclassified into the core market risk drivers

of equity, fixed income and, to a lesser extent, hard assets. Likewise, the “private equity” asset class is primarily described by equity risk, especially when the risks of the median or average private equity manager are considered. Real estate and hard assets also share some common characteristics.

In all these cases, traditional allocation schemes prefer to highlight differences in the return patterns of these asset classes, rather than the commonality of their market drivers. In the last case—real estate and hard assets—the common driver would be a hard asset factor. So while conventional schemes would treat them separately, a factor approach would cast both real estate and hard assets in the same bucket as “real assets.”

Ultimately, using a factor allocation, we can recast the 32 sub-strategies as essentially three broad risk groupings: equity, fixed income and real assets. A fourth sub-category of non-benchmarked risk is a combination of all three core risk categories, though execution strategies in this last bucket rotate in and out of the three risk classes, or employ stock/bond mix with some variation of risk taking over time. With further work shown later, we can even redistribute hybrid risks into one of the three risk categories.

Creating a common risk summary— including execution vehicles—gives better insights into the management of the entire portfolio.

The result is compelling. In contrast to the standard allocation profile, which indicates a 38% allocation to equity risk in the portfolio, the factor profile indicates there is likely a 51% allocation to equity risk, with even more equity risk residing within the non-benchmark category. The fixed income factors total 34%, with even more fixed income risk residing within the non-benchmark category.

With this more focused risk assessment versus the less intuitive traditional asset breakdown, we have incrementally

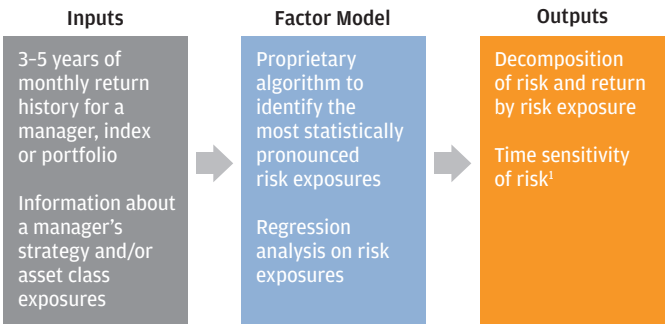
advanced our understanding of what potentially drives portfolio results. If we can aggregate all our risks (across emerging equity, U.S. equity, high yield bonds, commodities, etc.), then we are better prepared to make decisions about the risk budgeting of those exposures. Creating a common risk summary—including execution vehicles—provides better insights into the management of the entire portfolio.

A Universal Factor Model

A factor model is a statistical tool that helps transform return series data into information about a portfolio's market exposures, or risk factors. There are many approaches to developing factor models. Some use economic factors (e.g., inflation), while others use market factors (e.g., equity risk). We chose the latter approach as more pragmatic, for even if one can regroup strategies according to macroeconomic risk, it does not lead intuitively to clear choices about what to do about those risks.

By selecting a common set of market exposures, we can summarize and describe the portfolio's market risk succinctly. Of course, we always have considerable discretion as to the number and type of independent market factors. That being said, there are three major approaches to factor analysis. The first of these, known as principal component analysis, is frequently used by academics but is used less frequently by practitioners. It transforms portfolio risk drivers (i.e., volatility characteristics of each asset class) into unique components but fails to identify them in traditional market beta terms. While this is an interesting and insightful approach, it tends

EXHIBIT 2: THE PRIVATE BANK FACTOR MODEL: A STATISTICAL TOOL FOR ANALYZING NON-TRADITIONAL INVESTMENT STRATEGIES



¹ Market exposures can change over time (see following pages for more information).

to be less useful in helping practitioners pinpoint risk as precisely as desired. The second approach projects all risks onto a reasonably small and static number of independent but intuitive factors such as equity risk (S&P 500) or value-growth bias (RUSSELL 1000 VALUE-RUSSELL 1000 GROWTH). This approach is widely used and can be an enlightening exercise for any allocator. The third approach uses a wider set of potential factors but includes a systematic method for factor selection. While this technique can be much more effective in identifying unique risks, using a wider net of potential factors usually means accepting some amount of collinearity (factor correlation). Using factors with overlapping risk is widely known to cause factor stability problems. As a result, some intelligent overlay and safeguards should be in place. J.P. Morgan typically makes use of the second and third approach as well as a hybrid of the two.

The broad workings of a factor model are illustrated in **Exhibit 2**.

EXHIBIT 3: FREQUENTLY OBSERVED FACTORS AND THEIR SOURCE WITHIN A MULTI-ASSET CLASS PORTFOLIO

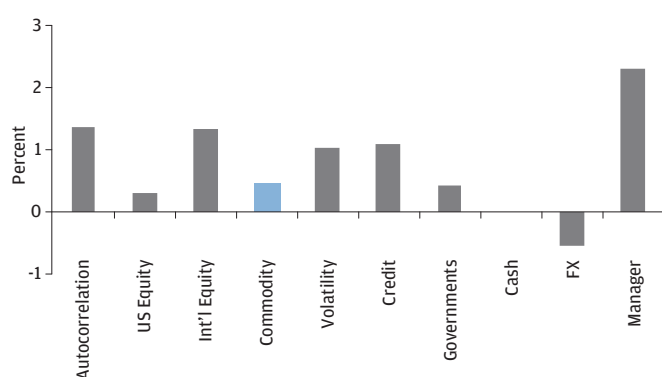
Factors	Strategy with Corresponding Factor Exposure
Government Fixed Income	Dedicated fixed income • Diversified hedge funds • Non-benchmarked traditional managers
Foreign Exchange	Emerging equity managers • Emerging fixed income managers • Macro hedge fund managers
U.S. Equity	Equity long-bias hedge funds • Event-driven hedge funds • U.S. large cap portfolios
International Equity	EAFE portfolios • Long-bias • Emerging markets equity funds • Equity long-bias hedge funds
Credit Fixed Income	High yield fixed income • Relative value hedge funds • Event-driven hedge funds
Commodities	Diversified hedge funds • Equity long-bias hedge funds • Equity funds • Macro funds
Volatility	Macro hedge funds

Change in implied volatility →

Source: J.P. Morgan. For illustrative purposes only.

As outlined on the previous page, there are several choices that practitioners have when creating a factor model. Different constructs have various advantages and disadvantages, and the approach to model selection should be based on context. For discussion purposes, we suggest there are two main categorical contexts: portfolio analysis and manager evaluation. For example, if the goal of a factor analysis is to assist in portfolio construction, and you want to project a large number of complex asset classes onto a common set of risk factors, you will probably want a different model selection methodology than if you are trying to evaluate the alpha/beta ratio for a small cap Japanese equity manager. For the latter, one should have some very specific factors that can capture the manager's real market exposure. Projecting the manager's returns onto a universal equity risk factor (SP500) will likely provide you with misleading information. To address the issue of portfolio- versus manager-level analysis within the same tool, we believe a universal factor model can be constructed that allows the needs of both applications to be addressed simultaneously. A systematic factor selection approach is employed, enabling the concentrated set of independent factors for broad portfolio purposes, and for manager or strategy level analysis, a customized set of factors are also enabled. Like any analytical tool, judgment is always a part of the process, and in the case of the universal factor model approach, the selection of relevant factors is a key part of the analysis.

EXHIBIT 4: VOLATILITY DECOMPOSITION: EXAMPLE



If the total portfolio volatility was 6.4%, 0.5% of this (7% of the total) resulted from the portfolio's commodity exposure. If the risk profile remained constant, the volatility of the portfolio would increase if the underlying components became more volatile.

Note: The total portfolio volatility is the sum of the volatilities of the underlying components.

Source: J.P. Morgan. For illustrative purposes only.

Decomposing Hedge Fund Risk Using a Factor-Based Model

The results of this type of analysis can be particularly helpful when studying hedge funds—from a manager due diligence perspective as well as from a portfolio construction perspective. While this trend is changing, many managers are not willing to provide investors with full transparency into their holdings. Even if a fund is providing its investors with an asset class breakdown via a monthly risk report, it's still a puzzle to figure out how this might translate into factor exposures and market betas. Unfortunately, many hedge funds do not provide intra-month estimates. This means that a returns-based analysis is going to be built on monthly observations, and extra caution should be applied.

From a manager due diligence perspective, factor analysis can be a powerful tool, as it aids J.P. Morgan with verifying historical market and strategy exposures that we obtain from the manager. In the event the results of the factor investigation do not match our understanding of the manager's strategy, interesting exchanges typically take place.

In **Exhibit 4**, we apply our factor model algorithm to a live hedge fund, which like the vast majority of funds does not provide its investors with full, portfolio-level transparency. Here, we show the risk decomposition of the fund rolled up into a universal market factor set. These 10 separate market factor exposures include:

- U.S. and international market equities combined contribute approximately 26% percent of the portfolio's total risk or volatility.
- Commodities contributed a more modest 7% or so.
- Credit risk contributed the largest single asset class risk contribution of approximately 17%.

We believe this set of market factors adequately spans the risk space in most portfolios and that understanding a fund's exposures to each is a good first step toward fitting the fund into a portfolio context.

It's worth drawing attention to the “manager” component of the factor decomposition. This is essentially the residual risk that cannot be explained by the other factors. For hedge funds, this is a close proxy for alpha risk, or the risk associated with alpha generation. From a portfolio construction perspective, this is the best form of risk to have, as it very rapidly diversifies away in a traditional portfolio. As we saw in the simple example above, straight market risk (particularly equity-oriented risk) simply adds to pre-existing risk factors.

Of course, since many funds substantially change their exposures and risk taking to react to evolving market conditions, it's important to understand the time sensitivity of results, and regularly updating factor sensitivity is critical (quarterly recommended). That being said, we have found that factor exposures of portfolios of hedge funds (>10 funds) tend to be fairly stable over time. This fact has given rise to the cottage industry of hedge fund replication. While this industry is quickly growing, we have been much more interested in the alpha potential in hedge funds than their market exposures.

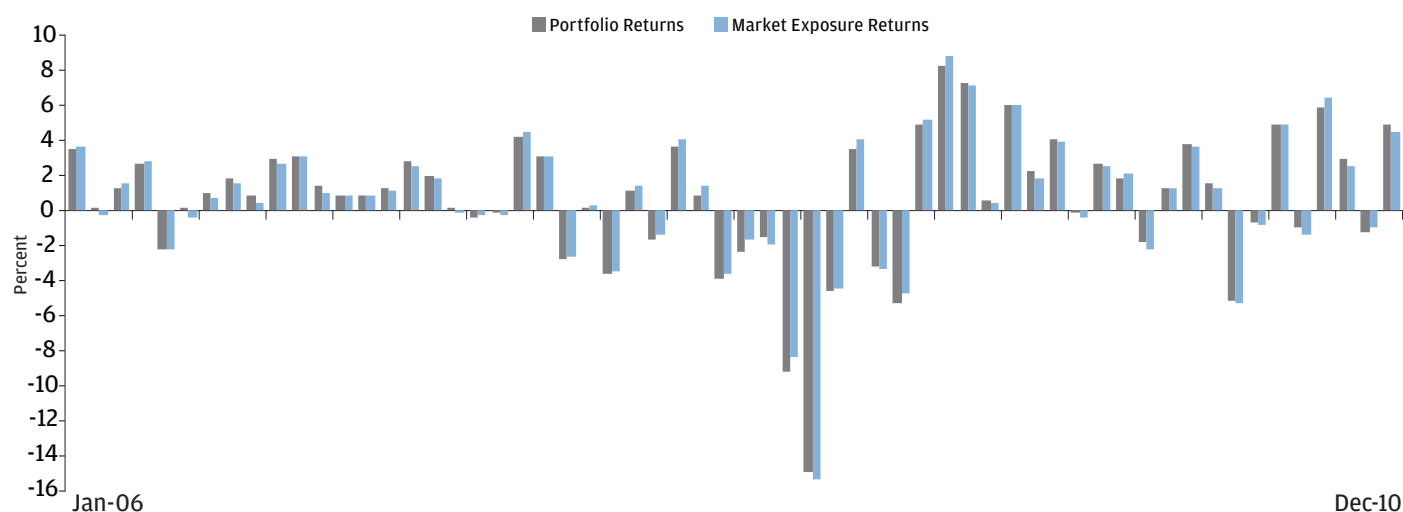
(Re)Benchmarking Performance

Once factor exposures have been established, it then becomes a straightforward exercise to use the factor exposures together with factor returns to create a custom benchmark for a portfolio or fund. **Exhibit 5** compares the return of a J.P. Morgan illustrative endowment and foundation portfolio (see **Exhibit 6**) to the performance of its custom factor benchmark. It can be casually observed in this example that this factor model was successful in identifying the pattern of risk taking on a monthly basis. When combined with traditional benchmarking techniques, we believe this approach provides a powerful component to performance evaluation.

Extra Credit: Risk-Related Extensions

Factor modeling's most important application, however, may be in future risk assessment. Up to this point all discussion has been focused around assessment of current portfolio risk. Stress testing and scenario simulations using previously derived market factor exposures provide a unique perspective on

EXHIBIT 5: ACTUAL MONTHLY PORTFOLIO RETURNS PLOTTED WITH THE COMBINED RETURNS OF THE PORTFOLIO'S MARKET EXPOSURES AS IDENTIFIED BY THE FACTOR MODEL



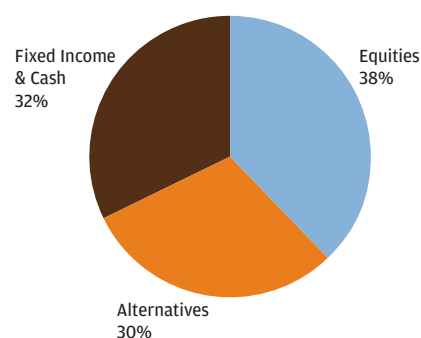
Sources: J.P. Morgan, Bloomberg and HFRI. As of December 2010.

Investment ideas presented herein may not be suitable for all investors. The performance above is shown for illustrative purposes only and is not meant to be representative of actual results. No representation is being made that any portfolio will or is likely to achieve performance similar to those shown. Actual account performance may differ.

Past performance is not a guarantee of comparable future results. Total return assumes the reinvestment of income. Performance results are net of investment management fees.

EXHIBIT 6: ILLUSTRATIVE ENDOWMENT AND FOUNDATION ALLOCATION

Asset Class	Strategic Allocation (%)
EQUITIES	38.0
U.S. Large Cap	10.0
U.S. Large Cap Value	4.0
U.S. Mid Cap	5.0
EAFE Equity	10.0
Asia ex-Japan Equity	5.0
Emerging Markets Equity	4.0
ALTERNATIVES	30.0
Diversified Hedge Funds	3.0
Event-Driven Hedge Funds	3.0
Long-Bias Hedge Funds	4.0
Relative Value Hedge Funds	2.0
Macro Hedge Funds	4.0
Private Equity	4.0
Mezzanine Debt	2.0
U.S. Direct Real Estate	5.0
U.S. Value Added Real Estate	0.0
Commodities	5.0
FIXED INCOME & CASH	32.0
Tips	2.0
U.S. Aggregate Bonds	5.0
U.S. Investment Grade Corporate Bonds	5.0
U.S. High Yield Bonds	12.0
Emerging Markets Sovereign Debt	6.0
Currency Strategies	0.0
U.S. Cash	2.0
TOTAL	100.0



Sources: J.P. Morgan, Bloomberg and HFRI.
As of April 2011.

portfolio risk. The most important of a portfolio's factor betas could be applied to either a stress scenario, such as September 2008, or a customized simulation reflecting a more likely future scenario. The output from such scenario testing, historical or forward-looking, could provide portfolio policymakers with new information for making or validating risk level decisions.

Conclusion: The Value of a Factor Approach

As investors continue to grapple with the challenges of risk management, especially in the wake of recent events, factor analysis can offer a practical new approach. Factor analysis helps to aggregate risk in a way that provides both transparency and insight, demystifying portfolio risk at a macro level and giving investment policymakers new tools to model and manage it. As always, we welcome your comments and questions, and we would be pleased to schedule a demonstration of our factor modeling technologies at the request of clients.

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