A Factor Approach to Asset Allocation

Exposure to global market factors.

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It has become commonplace in constructing balanced investment portfolios to frame the decision in terms of exposure to various systematic market risks like broad equity risk or interest rate and credit risk. Investors can earn the risk premium associated with exposures to these systematic risks with relatively little effort and at low cost (by indexing). Market drift will cause the investor to rebalance the portfolio from time to time in order to maintain a constant relative exposure to the desired systematic risks.

Others have suggested that returns within a market can be generated by exposure to security characteristics like size, book-to-market, or momentum that explain the significant portion of the cross-sectional variation in individual security returns (see Fama and French [1992] and Jegadeesh and Titman [1993]). To the extent that returns to systematic market risk factors and security characteristic factors are not highly correlated, it may be possible to build portfolios with better risk characteristics by diversifying among these different types of factors.

We add another category of factors that can be used to diversify the exposures in a portfolio. We call these *global market factors*. Making an allocation to these factors in constructing a global portfolio requires the investor to actively rebalance the country composition of a global portfolio in order to maintain a constant factor exposure since the country exposure to a particular factor will likely change over time—much the way an individual security may change its exposure to an individual characteristic.

Our results allow us to 1) quantify the benefit of global investing from a factor-based framework in man-

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aging asset exposure, and 2) demonstrate the diversification benefits of the relatively low correlations among global market factors, systematic market factors, and cross-sectional security characteristic factors.

The equity and fixed-income markets considered in our analysis are those that have liquid derivative instruments. While this limits the length of the time period we can examine, it has the advantage that the active investment strategies evaluated in this study can be implemented relatively efficiently with the lower transaction costs of most derivatives. This is particularly important in the case of the global market factors that we discuss. Maintaining a constant exposure to these factors requires active rebalancing of the factor portfolio, as the exposures of the underlying assets will vary over time. Focusing on markets with active derivative contracts also ensures that the potential gains in performance we demonstrate are not simply the result of a liquidity premium or risk premium associated with investing in some non-U.S. security markets.

The specific equity, fixed-income, and currency markets we focus on are shown in Exhibit 1, along with the return index used to represent each market. All the currencies in our analysis have an active forward market, and an investor choosing to implement a version of the strategy described in this study would naturally use forwards to implement the strategy.

Both academicians and practitioners have analyzed the potential benefits of exploiting differential returns across asset markets based on fundamental factors (see Asness, Liew, and Stevens [1997]). The basic notion is that the expected returns of stocks and bonds across global markets reflect the economic conditions in each country—and that by virtue of the segmented nature of global markets, these differential returns can persist for sustained periods of time. When few investors rapidly arbitrage away these differential returns, the investors who are willing to accept a global investment view can exploit these differences by overweighting the markets with a better outlook and underweighting those with a less favorable outlook.

Despite the increasing globalization of the world economy, there is little evidence that security markets themselves are becoming more integrated—suggesting that the forecastability of the relative returns of global markets will continue into the future.[1]

We present an alternative to this commonly used country-based approach to global investing. We organize a global portfolio based on exposures to fundamental characteristics of markets within asset classes, in much the same way that the differential returns to individual stocks are related to their exposure to factors such as size, book-to-market, or momentum.

Several global market factors are systematically related to cross-sectional variation in return between global markets. We first describe the methodology used to estimate these factor returns. These global market factors are then compared in terms of their relative risk, return, and correlation characteristics to systematic market risks as well as common security characteristic factors.

We use a mean-variance framework to assess whether the cross-sectional returns to security characteristics and global market factors are sufficiently distinct from systematic market returns to expand the investment opportunity set. Finally, we examine whether global macro hedge funds might be accessing the returns to any of these factors in their investment strategies.

GLOBAL MARKET FACTORS

The global market factors we evaluate have been identified in other studies. Each factor is chosen for its demonstrated ability to explain the cross-section of market returns within a particular asset class (equity, fixed-income, and currency). We do not claim that these factors represent the complete set of global factors—rather that they represent factors investors commonly use to both evaluate and describe the relative return within an asset class.

Equity Markets:

- Earnings yield—Earnings divided by price (using IBES 12-month forecast earnings).
- Lagged price momentum—Market premium over the previous 12 months less the premium over the past month.

Fixed-Income Markets:

- Term structure: Differential between the ten-year government benchmark yield and the one-month euro rate.
- Real interest rates: Ten-year government benchmark yield minus annual inflation.

Currency Markets: Interest rate differential: Short-term interest rate differential relative to the U.S. dollar.

Modeling: The monthly return associated with investing in each one of these cross-sectional market factors is estimated using the regression:

EXHIBIT 1
Markets and Representative Indexes

Country	Equity	Fixed-Income	Currency
Australia	ASX200	10 Yr Governments	AUD
Hong Kong	Hang Seng		
Japan	Topix	JGBs	JPY
Canada	SPTSX60	10 Yr Governments	CAD
U.S.	S&P 500	10 Yr Treasuries	USD
U.K.	FTSE 100	Gilts	GBP
Switzerland	SMI		CHF
Sweden	OMX		
Euro Zone:		Bunds	EUR
France	CAC40		
Germany	DAX		
Italy	MIB30		
Netherlands	AEX		
Spain	IBEX		

$$R_{it} = \mu_t + \lambda_{jt} x_{ijt} + \varepsilon_{it}$$

where

R_{it} = monthly return on country market i in period t;[2]
μ_t = estimated average return across common asset markets (e.g., equity, fixed-income, and currency) in period t;
λ_{jt} = estimated payoff to factor j in period t;
x_{ijt} = standardized exposure of market i to factor j in period t; and
ε_{it} = residual for market i in period t.

The exposures are standardized to have zero mean and unit variance, so that the payoffs are comparable across factors. For example, in Exhibit 2 we show the earnings yield for the set of equity markets and their associated standardized exposures for December 2004. The estimated monthly payoff can therefore be interpreted as the return to a long-short factor portfolio with unit exposure to a particular factor. If there is no long-run return premium associated with a particular factor, the return on that long-short portfolio will be statistically indistinguishable from zero.

COMPARISON OF SYSTEMATIC MARKET RISKS, SECURITY FACTORS, AND MARKET FACTORS

Exposure to systematic market risks is thought to carry expected risk premiums as a reward for bearing the risks. Common sources of market risks are generally identified as broad equity market risk, credit risk, short-term interest rate risk, and longer-term (duration) interest rate risk. While these are the typical market risks in portfolios, investors continue to search for additional categories to add like commodities, inflation-protected securities, and below-investment-grade and emerging market securities that might enhance the diversification benefits. Individual security characteristic factors are represented by the returns from the Fama-French database representing U.S. market cap, U.S. equity momentum, U.S. earnings-to-price, and international earnings to price.

Exhibit 3 shows the annualized premiums, standard deviations, information ratios, and t-statistics for the market risk factors and security characteristics over 1989-2004 as well as the global market factor returns estimated as we have described. These global market factors focus specifically on explaining the cross-sectional variation across respective equity, fixed-income, and currency markets. With a focus on cross-sectional variation between markets within an asset category, we are limited to factors for which comparable data are available over an extended period.

Over 1989-2004 the t-statistics indicate that the average returns are statistically significantly different from zero—with the single exception of the return to the non-U.S. equity market risk premium. Notably, exposure to these global market factors provides a risk-reward tradeoff often better than that available by taking on the more conventional systematic market risk exposures listed first in Exhibit 3.

We can see that the return to the global earnings yield factor has the highest return-risk ratio of all the different types of factors considered. Notably, the currency differential factor, one not often considered in making asset allocation decisions, has a return per unit of risk higher than any of the systematic market factors.

DIVERSIFICATION BENEFITS

The correlations between the returns to systematic market risk factors with cross-sectional factors—security characteristics and global markets—are shown in Exhibit

EXHIBIT 2

Cross-Sectional Market Earnings Yield and Normalized Exposure for December 2004

Country	Earnings Yield (%)	Standardized Exposure
Australia	6.7	-0.3
Canada	7.1	0.2
France	7.7	1.1
Germany	7.6	0.9
Hong Kong	6.5	-0.6
Italy	6.5	-0.6
Japan	6.1	-1.1
The Netherlands	8.5	2.1
Spain	7.3	0.5
Sweden	6.9	0.0
Switzerland	7.1	0.2
U.K.	5.9	-1.4
U.S.	6.1	-1.1

4. Both types of cross-sectional factors have low correlations with systematic market factors, suggesting that combining them with more traditional systematic risk exposures in asset classes could yield substantial efficiency gains.

To evaluate whether the security characteristic factors are measuring the same phenomenon as the global market factors, we next evaluate the correlations for these cross-sectional sets of factors. Exhibit 5 shows the correlation between the two sets of factors to be quite low. The highest correlations occur between factors that are based on similar fundamental variables such as earnings yield and momentum. The correlation between the two earnings yield factors, global market earnings yield and the Fama and French international security-specific earnings yield factor, is 0.25. The highest estimated correlation is between the two momentum-related factors—a coefficient of 0.29. For the majority of the other global factors, there is virtually no correlation with the security characteristic factors.

To evaluate the efficiency gains from using such factor strategies, we examine the impact they have on a mean-variance investment frontier for the same markets used in the analysis. Estimates of returns and the risk structure needed to construct the efficient frontier are taken from the in-sample data over 1989-2004. The results of these optimizations are shown in Exhibit 6.

The first line represents the in-sample efficient frontier using just the traditional systematic market risk factors. Exposure to these factors would be achieved by investing in the broad asset categories associated with each of the market risk factors. The optimization is constructed so that exposures to the first three systematic risks sum to 100%, indicating that the portfolio is fully invested.

The term premium and credit risk exposures can be thought of as overlays on top of the base short-term

EXHIBIT 3

Annualized Payoffs 1989-2004

	Annualized Premium	Standard Deviation	Return/ Risk	T-Stat
Systematic Market Risks				
US Equity[a]	7.0%	14.5%	0.49	6.7
Non-US Equity[b]	0.5%	17.0%	0.03	0.5
Short-Term Interest Rate[c]	1.3%	1.9%	0.71	9.8
US Term Structure[d]	2.6%	9.0%	0.29	4.0
Default Risk[e]	0.9%	1.9%	0.47	6.6
Cross-Sectional Security Characteristic Factors				
Fama-French U.S. Momentum (Hi-Lo)	10.6%	16.8%	0.63	8.7
Fama-French U.S. Market Cap (Small-Large)	3.6%	16.2%	0.22	3.1
Fama-French U.S. Earnings to Price (Hi-Lo)	3.9%	10.2%	0.39	5.4
Fama-French International Earnings to Price (Hi-Lo)	7.0%	9.2%	0.76	10.6
Cross-Sectional Global Market Factors				
Earnings Yield	4.7%	5.4%	0.88	12.1
Price Momentum	1.5%	6.3%	0.24	3.3
Term Structure	1.2%	1.9%	0.61	8.4
Real Interest Rates	1.1%	2.2%	0.52	7.2
Interest Differential	2.8%	3.7%	0.76	10.5

[a]S&P 500 minus 3-month U.S. T-bill return.
[b]MSCI EAFE in USD minus 3-month U.S. T-bill return.
[c]Merrill Lynch 2-year Treasury index minus 3-month T-bill return.
[d]Merrill Lynch 30-year Treasury index minus Merrill Lynch 2-year Treasury index return.
[e]Merrill Lynch U.S.Corporate Master index minus Merrill Lynch High Quality Bond index return.

EXHIBIT 4

Correlations of Systematic Market Risks with Cross-Sectional Factors 1989-2004

	Non-U.S. Equity Premium	U.S. Equity Premium	Short-Term Rate Premium	Term Structure Premium	Default Risk Premium
Global Market Factors					
Earnings Yield	-0.04	0.17	0.04	-0.08	0.02
Price Momentum	0.04	-0.07	0.14	0.22	-0.05
Term Structure	-0.02	-0.01	0.19	0.15	0.03
Real Interest Rates	0.00	0.17	0.26	0.24	0.13
Interest Differential	0.05	0.09	0.01	0.08	0.16
Security Characteristic Factors					
Fama-French U.S. Momentum (Hi-Lo)	0.06	-0.23	0.21	0.14	-0.26
Fama-French U.S. Market Cap (Small-Large)	-0.13	-0.22	-0.16	-0.15	0.23
Fama-French U.S. Earnings to Price (Hi-Lo)	0.07	-0.25	0.15	0.16	0.04
Fama-French International Earnings to Price (Hi-Lo)	-0.05	-0.10	-0.11	-0.06	0.15

EXHIBIT 5

Correlation of Cross-Sectional Global Market Factors with Cross-Sectional Security Characteristics

	Earnings Yield	Price Momentum	Term Structure	Real Interest Rates	Interest Differential
Global Market Factors					
Earnings Yield	1.00				
Price Momentum	-0.26	1.00			
Term Structure	-0.01	0.05	1.00		
Real Interest Rates	0.03	0.19	0.23	1.00	
Interest Differential	-0.18	0.17	0.21	0.07	1.00
Security Characteristic Factors					
Fama-French U.S. Momentum (Hi-Lo)	-0.19	0.29	-0.02	0.08	-0.03
Fama-French U.S. Market Cap (Small-Large)	-0.07	0.04	-0.01	-0.13	-0.02
Fama-French U.S. Earnings to Price (Hi-Lo)	0.08	0.03	0.12	0.00	0.07
Fama-French International Earnings to Price (Hi-Lo)	0.25	-0.09	0.03	0.01	0.11

interest rate exposure. We include for comparison a 50/50 blend of the MSCI World equity index and the Citibank World Government bond index.

The second line in Exhibit 6 represents the expansion of the frontier that would have been available by adding the Fama-French security characteristics. The efficient frontier expands because the returns to these characteristics are not highly correlated with the systematic market risk factors, and because their information ratios are attractive.

The third line allows the use of global market factors in addition to the others. Again the efficient frontier expands because the global market factors are also not highly correlated with the others and have attractive information ratios. The efficient frontier has been expanded beyond that using just the systematic market risks by adding a broader set of choices in constructing the portfolio.

As an example, Exhibit 7 shows the suggested portfolio allocations for three different portfolios, each with the same 10% volatility based on the efficient portfolio frontiers in Exhibit 6. To interpret the results in Exhibit 7, note again that allocations to the first three systematic market risks sum to 100%, indicating that the portfolio is fully invested. These systematic risk exposures could be achieved either by investing in appropriate physical assets or by using derivatives overlaid on cash equivalents in the required amounts. Exposure can be added to capture the term premium and credit risk by substituting physical assets for cash with the requisite exposures or by using appropriate derivative overlays.

The security-specific exposures can be achieved

EXHIBIT 6
Ex Post Efficient Frontiers Using Market Factors

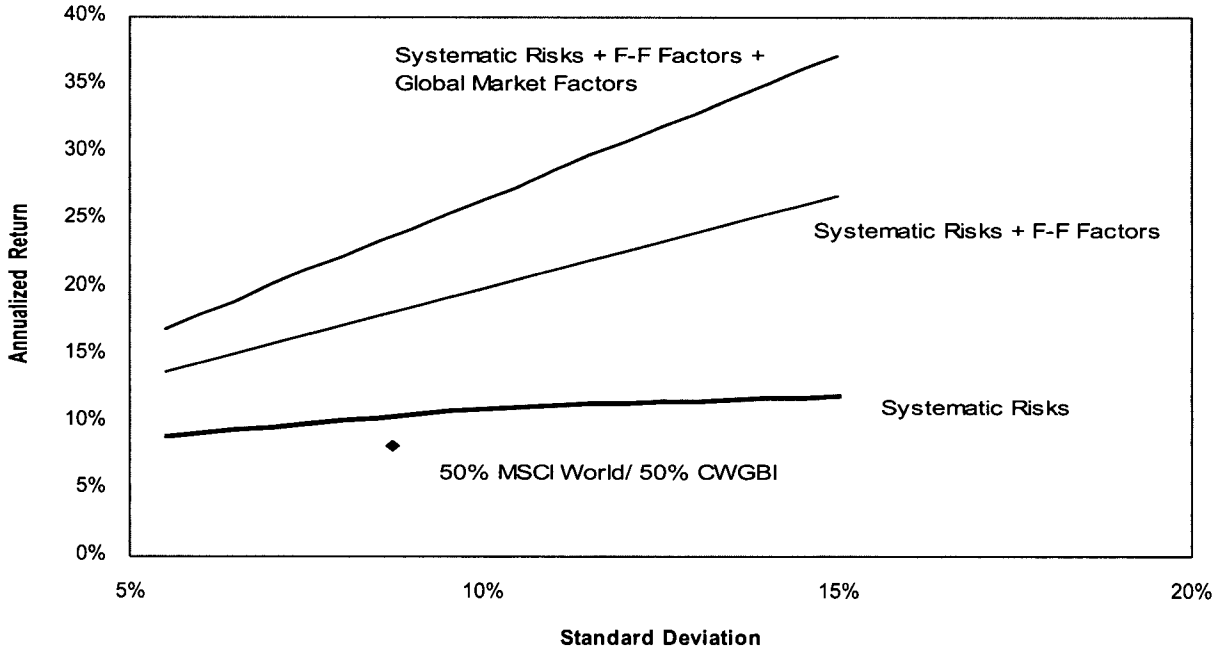

EXHIBIT 7
Portfolio Factor Allocations at 10% Volatility

	Efficient Frontier		
	L1	L2	L3
Systematic Market Risks			
U.S. Equity	53.5%	43.3%	24.1%
Non U.S. Equity	0.0%	0.0%	0.0%
Short-Term Bonds (2-year)	46.5%	56.7%	75.9%
	100.0%	100.0%	100.0%
U.S.Term Structure Premium	46.5%	10.0%	0.0%
Default Risk Premium	46.5%	5.9%	17.3%
Cross-Sectional Security Factors			
Fama-French U.S. Momentum		36.8%	24.0%
Fama-French U.S. Market Cap		17.0%	10.3%
Fama-French Earnings to Price		5.7%	0.0%
Fama-French International Earnings to Price		86.8%	43.7%
Cross-Sectional Global Market Factors			
Earnings Yield			109.1%
Price Momentum			48.6%
Term Structure			248.2%
Real Interest Rates			107.1%
Interest Differential			99.2%

L1: Systematic market risks only.
L2: Systematic market risks plus security characteristics.
L3: Systematic market risks plus both security and global market factors.

similarly. The investor may choose to configure physical equity positions so as to gain exposure to the desired characteristics (which may require some shorting or leverage) or may seek derivatives overlay solutions.

Exposure to the global market factors is probably best achieved with derivatives, where it is easier to take both long and short positions in country asset and currency markets. The total portfolio will likely require a combination of physical asset and derivatives positions to achieve the recommended exposures across all the systematic risks and factors. Each allocation contributes a portion of the 10% portfolio volatility.

Exhibit 8 shows the percentage contributions of each component to the overall portfolio volatility.[3] The contributions of the various factors are clearly evident; much of the volatility comes from exposure to the individual security and global market factors because of the diversification benefits they provide relative to traditional systematic market risks. They tend to have low cross-correlations and higher information ratios than the systematic market risks.

The benefit of using a factor-based approach to asset allocation is evidenced by the dramatic difference in

EXHIBIT 8

Percentage Contributions to 10% Total Volatility

	Efficient Frontier		
	L1	L2	L3
Systematic Market Risks	**100.0%**	**21.8%**	**11.9%**
U.S. Equity Premium	72.2%	18.5%	8.0%
Non-U.S. Equity Premium	0.0%	0.0%	0.0%
Short-Term Risk Premium	1.3%	1.0%	3.1%
US Term Structure Premium	21.2%	1.9%	0.0%
Default Risk Premium	5.3%	0.4%	0.8%
Cross-Sectional Security Factors		**78.2%**	**28.7%**
Fama-French U.S. Momentum		27.7%	11.7%
Fama-French U.S. Market Cap		4.3%	1.8%
Fama-French Earnings to Price		2.8%	0.0%
Fama-French International Earnings to Price		43.4%	15.3%
Cross-Sectional Global Market Factors			**59.3%**
Earnings Yield			25.5%
Price Momentum			3.4%
Term Structure			11.4%
Real Interest Rates			5.1%
Interest Differential			13.9%

L1: Systematic market risks only.
L2: Systematic market risks plus security characteristics.
L3: Systematic market risks plus both security and global market factors.

the sources of risk in each portfolio. The portfolio whose exposure is limited to just market factors has 72% of its risk stemming from exposure to U.S. equities—much like the typical U.S. institutional portfolio. The allocations that have cross-sectional exposure to securities have only 22% of risk allocation to the equity market. Including global market factors reduces the optimal equity risk allocation to only 12%.

There are some biases in the results because the mean-variance analysis uses in-sample data over the time period—and as such represents an ex post frontier. This is true of the systematic market risks included in the analysis as well as the factors. Consequently, the expansion of the efficient frontier pictured in Exhibit 6 is meant only to illustrate the potential advantages of building portfolios by including cross-sectional factor exposures. The actual benefits from such an approach will depend on the extent and the persistence of actual factor returns and their covariance structure over time.

From an actual implementation perspective, it is important to emphasize the difference between the first optimization without the factor exposures and the two additional optimizations with factor exposures. To construct the investment opportunity set in the first case, the investor would hold a constant allocation to the underlying assets over time along with desired exposure to the term and credit premium. In the optimizations that include factors, the investor has an optimized core holding in assets and a constant allocation to factors.

Maintaining a constant exposure to factors, however, requires that allocations to the underlying securities and country markets change over time because the factor exposures of each individual security and country market are not constant. The expanded efficient frontiers are achievable only by holding a constantly changing allocation to securities and countries within each asset class in order to maintain a portfolio with constant cross-sectional factor exposures.

We might think of the desired factor exposures as adjustments to the core asset market allocations. The adjustments create a new efficient frontier because the expected factor payoffs and risk structure alter the traditional risk-return trade-offs for asset markets and their systematic risks. Investors would normally consider the efficient frontier to embody static market weights over time as long as expected risk-return estimates for systematic risks are stationary. When factor exposures are introduced, the expanded efficient frontier would embody constant factor exposures over time but not constant market or security weights, even though the expected risk-return relationships for systematic risks are stationary.

Because factor exposures of individual asset markets and securities change over time, holding constant asset market weights will force factor exposures to drift through time. Holding constant factor exposures, though, will force individual asset market and security weights to drift over time. The investor is hard pressed to keep them all constant simultaneously as long as individual security characteristics and country market factor exposures are not static.

GLOBAL MACRO HEDGE FUNDS

Global macro investors may not consciously structure their portfolios according to the framework we have outlined, but it could be that the strategies they use might be capturing the effects of cross-sectional security and mar-

EXHIBIT 9

Risk and Factor Exposures of HFR Global Macro Index 1990-2004

Systematic Market Risks	Standardized Exposure	t-value
U.S. Equity Premium	0.47	5.67
Non-U.S. Equity Premium	-0.25	-4.01
Short-Term Risk Premium	0.03	0.40
US Term Structure Premium	0.15	1.82
Default Risk Premium	0.05	0.66
Cross-Sectional Security Characteristics		
Fama-French U.S. Momentum	0.24	3.57
Fama-French U.S. Market Cap	0.24	3.56
Fama-French U.S. Earning to Price	0.16	2.11
Fama-French International Earning to Price	-0.02	-0.22
Cross-Sectional Global Market Factors		
Earnings Yield	0.01	0.21
Price Momentum	0.12	1.87
Term Structure	-0.01	-0.17
Real Interest Rates	0.14	2.18
Interest Differential	0.03	0.45

Note: Standardized exposure represents the normal regression coefficients adjusted by the differences in factor standard deviations for ease in comparing the relative impacts of the factors.

ket factors as well as the traditional market risk factors. To explore this possibility, we regress the returns to the Hedge Fund Research global macro index on the returns to market risk factors and the cross-sectional security and global market factors. The resulting exposures suggest whether the returns to the global macro index could be capturing to some extent the returns to the additional factor exposures.

Exhibit 9 shows the exposures and the associated t-statistics. Notice that the index of managed global macro funds seems to capture some elements of all three categories. The systematic market risk exposures are particularly significant for the broad U.S. equity market risk premium, the non-U.S. equity market risk premium, and the U.S. term structure premium. The funds also seem to capture U.S. momentum, U.S. market cap, and U.S. earnings-to-price along with global market price momentum and real interest rates.

Other factors and risk premiums seem to be less significant for the managed funds included in the global macro index. These funds also appear, at least over this period, to have accurately forecasted the relative performance of U.S. versus non-U.S. markets, as witnessed by the positive coefficient on U.S. equities and the negative coefficient on non-U.S. equities. Notably, the sum of these coefficients indicates that these funds, on average, allocated only around 22% of their total risk to equity markets. This is similar to the optimal allocation shown in Exhibit 8.

This analysis suggests that at least some managers of global macro funds are currently using this factor-based approach to asset allocation to some extent.

SUMMARY

In much the same way that the cross-section of returns for individual stocks is related to fundamental characteristics, we find that the cross-sections of returns in global equity, fixed-income, and currency markets are also related to fundamental global market characteristics. The returns to these global market factors have historically had positive information ratios and are relatively uncorrelated with each other. Incorporating these cross-sectional global market factor exposures along with individual security characteristic factors into a global asset allocation framework tends to expand the efficient frontier of investment opportunities.

Such a factor-based approach to allocation—with cross-sectional security and global market factors—has a dramatic implication for the optimal allocation to equity market risk. Increasing the potential sources of return through these cross-sectional factors produces portfolios that are less reliant on the equity market premium as a source of return. The allocation to equity market risk drops from over 70% to around 12% when we use these factors in the asset allocation process.

In environments of lower-than-average market premiums, investors should increasingly focus on these and other cross-sectional factors as sources of portfolio return.

ENDNOTES

[1]For an econometric evaluation of capital market integration that results in the conclusion "while there is a perception that world capital markets have become more integrated, our country-specific investigation suggests that this is not always the case," see Bekaert and Harvey [1995, p. 403].

[2]The asset market returns are local returns over the local riskless rate in each country. The currency return used in the regression is the forward surprise, i.e., the raw currency return minus the forward premium or discount relative to the U.S. dollar.

[3]To calculate the percentage contribution, we allocate half of each pairwise covariance to each particular source.

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