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Diversification is one of the most fundamental concepts in investment theory and practice. It is famously referred to as the only "free lunch" in investing. Implicit in this statement is the notion that one can reduce a portfolio's volatility without reducing its expected return. Yet, diversification has come under attack after the 2007–2009 financial crisis, when diversification seemed to fail as virtually all long-only asset classes, other than high-quality sovereign debt, moved in the same direction (down). We argue that the attacks are undeserved. Instead, we believe that the problem is "user error"; most investors were never as diversified as they thought they were. There is ample room for improvement by shifting the focus from asset class diversification to factor diversification.

It is true that asset class correlations generally tend to rise during crises, and in the aftermath of the 2007–2009 financial crisis, correlations have generally remained elevated as markets switch between binary risk-on/risk-off environments. There are, however, at least three counter arguments to the death-of-diversification story. First, Asness, Israelov, and Liew [2011] stressed that while diversification often fails in short-term panics—especially one as systemic as the 2007–2009 financial crisis—it does effectively reduce downside risks over longer horizons. Second, high-quality bonds have fairly consistently provided positive returns during stressful market environments. Third, in this article, we argue and show that factor diversification has been more effective than asset-class diversification in general and, in particular, during crises. The last two arguments challenge the concentration in equity risk found in most institutional portfolios, which is also a central argument in favor of more risk-balanced, so-called risk parity, portfolios.

Traditional asset class diversification involves allocating nominal dollars to various asset classes and their subsets. Several large institutions have in recent years begun to explore an alternative perspective of factor allocation, asking: What are the most important factors driving our portfolio returns? Any asset can be viewed as a bundle of factors that reflect deeper risks and rewards, just as any food is a bundle of nutrients that sustain us; see Ang and Kjaer [2011]. The factor perspective involves at least two changes. First, focus is shifted from dollar allocations to risk allocations. This change in measurement units often reveals the dominant role of the most volatile asset classes and the portfolio's dependence on equity market direction. Second, portfolio analysis is extended beyond asset classes to dynamic strategy styles or to underlying risk factors. Style factors can be especially useful for analyzing active manager behavior and can provide excellent sources of diversification. Fundamental factors such as growth, inflation, and liquidity are naturally interesting, but they are inherently hard to measure. Most investors prefer investable factors and therefore use market-based proxies for such factors, for example, equities for growth, Treasuries for deflation, and commodities for inflation.

We first study histories of six well-known asset class and factor premia in the U.S. dating back to the 1920s. The average correlation across these premia is near zero, which suggests significant potential diversification benefits. We then contrast the effectiveness of asset class diversification and factor diversification in an empirical study with data since the 1970s. When judging diversified portfolios, our main performance metric is the portfolio Sharpe ratio, but we also study other portfolio characteristics. We show that asset class diversification across global stocks, bonds, and alternatives can boost the portfolio's Sharpe ratio from 0.3–0.4 to a respectable 0.48 for our asset class–diversified portfolio. But this result pales in comparison to the performance of the factor-diversified portfolio.

Our factor-diversified portfolio combines the U.S. equity premium with four widely known factor premia using long–short style portfolios: 1) value in stocks, 2) momentum in stocks, 3) carry-seeking strategies in the fixed income and currency markets, and 4) trend-following strategies in the equity, fixed income, currency, and commodity markets. The average Sharpe ratio among these constituents is high at 0.70 in part because trading costs and management fees have not been subtracted, but also because each constituent is already aggressively diversified. More importantly, the average correlation across the constituents is near zero compared to an average correlation of approximately 0.4 for the constituents of the asset class–diversified portfolio. As a result, diversification is much more effective. The factor-diversified portfolio's volatility falls to about half of the constituents' average volatility, correspondingly doubling the portfolio's Sharpe ratio to 1.44. In a long-only total return context, however, the market directionality remains dominant and diversification benefits are more modest.

The higher Sharpe ratio of the factor-diversified portfolio compared to the asset class–diversified portfolio can be attributed to two sources: 1) a higher average Sharpe ratio among the constituents and 2) lower correlations between the constituents. On paper, both sources appear equally important. In real-world applications, however, we expect the risk-reducing benefit associated with lower correlations to outweigh the better constituent Sharpe ratios. Factor-diversified portfolios likely incur higher transaction costs and fees than asset class–diversified portfolios, thereby narrowing the first edge. In contrast, we expect little decay in the second edge. The diversification advantage should prevail, mainly because the factor-diversified portfolio is not dominated by exposure to the equity market, echoing the risk parity approach.

Our article is related to the blossoming literature on factor diversification and on risk parity investing. Several recent studies have highlighted the benefits of factor diversification compared to asset class diversification and provided some empirical support: Ang, Goetzmann, and Schaefer [2009], Bender et al. [2010], Asness, Moskowitz, and Pedersen [2011], Blitz [2011], Hjalmarsson [2011], Ilmanen [2011], Jones [2011], Melas, Briand, and Urwin [2011], and Page and Taborsky [2011]. Multi-factor models have been used for equity portfolio analysis since the 1970s and for broader portfolios since at least the work of Fama and French [1993]. Risk parity investing emphasizes *balanced* contributions of various risk exposures to portfolio risk. Recent examples of this literature include Maillard, Roncalli, and Teïletche [2010], Lee [2011], Ruban and Melas [2011], and Asness, Frazzini, and Pedersen [2012]. Most risk parity products diversify across asset classes (or static market factors). Our extension of the risk parity approach to include both static *and* dynamic factors as constituents should benefit from more effective diversification and *possibly* also from higher stand-alone Sharpe ratios among constituents.

The article is organized as follows. The next section builds the intuition behind factor-diversified portfolios using a long-term dataset, which includes both static and dynamic factors, and provides a comparison of the effectiveness of diversification across static asset classes and across dynamic style factors over the period of 1973–2010. The last section addresses some of the reasons that explicit diversification by factor is not prevalent within the institutional investment community and considerations for investors who are contemplating deploying the approach. The data appendix outlines the construction of main data series and their sources.

UNDERSTANDING FACTOR DIVERSIFICATION

A key focus of financial research over the last three decades has been empirical documentation of sources of return beyond the equity premium and trying to understand why these *factors* should be rewarded with returns above the risk-free rate. At this point, financial research has identified at least six factors that have generated excess returns in the U.S. and international markets over more than 80 years. All returns that follow are reported as geometric means, before subtracting costs or fees.

1. *Equity premium (EQUITY):* The equity premium is a measure of the historical excess return of the equity market relative to government debt, most frequently short-term Treasury bills. Dimson, Marsh, and Staunton [2002, 2010] showed that bearing equity risk has been well rewarded over the long term in most economies. In the U.S. over the period 1927–2010, the equity premium has been 5.8% per year in excess of the return of one-month Treasury bills.
2. *Size premium (SML):* The size premium is a measure of the excess return of small-cap stocks relative to large-cap stocks. Fama and French [1992] produced probably the most famous study to document this premium, although earlier studies had found the effect as well; see Banz [1981]. In the U.S., this premium has averaged 2.8% per year over the period 1927–2010.
3. *Value premium (VMG):* The value premium is a measure of the excess return of value stocks, which are stocks with relatively low valuation ratios, over growth stocks. Fama and French [1992] documented this premium in the U.S. stock market, and Fama and French [1998] and others documented the same effect in international stock markets. In the U.S., this premium has averaged 3.9% per year over the period 1927–2010.
4. *Momentum premium (MOM):* The momentum premium is a measure of the return of stocks with relatively high recent returns minus the return of stocks with relatively low recent returns. This premium was first documented by Jegadeesh and Titman [1993] and Asness [1994]. It has also been documented in international markets by Fama and French [2011] and in international markets and other asset classes by Asness, Moskowitz, and Pedersen [2011]. In the U.S., this premium has averaged 7.7% per year over the period 1927–2010.
5. *Term premium (TERM):* The term premium is a measure of the performance of long-term government bonds relative to short-term government bonds. Dimson, Marsh, and Staunton [2002, 2010] documented this premium in a number of markets, although they showed that the premium has not been as reliable as the equity premium. In the U.S., this premium has averaged 1.8% per year over the period 1927–2010.
6. *Default premium (DEF):* The default premium measures how much investment-grade corporate bonds have outperformed government bonds of similar maturities. It might also be better termed the default and downgrade premium because losses associated with rating downgrades are much more likely than default losses for the AAA/AA- rated bonds used to proxy corporates. In the U.S., this premium has averaged 0.2% per year over the period 1927–2010. This premium is clearly the lowest, even in Sharpe ratio terms (see Exhibit 1) and likely involves the most measurement error.

In some of these cases, broad support seems to exist that the premium is a reward for bearing some form of systematic risk, for example, the equity premium and default premium. In other cases, such as value and momentum premia, it can be debated whether the premia are reward for bearing systematic risk, capturing market inefficiencies, or some combination of both. Even if these premia are partly attributable to market inefficiencies, it is far from clear that we should expect them to disappear over time. The behavioral patterns that lead to the premia in the first place may be surprisingly persistent, and limits to arbitrage can prevent smart investors from eliminating the opportunity.

Admittedly, historical average premia are always in-sample estimates. Permanent structural changes can influence the future level of all of these premia, including the equity premium. Exhibit 1 shows the risk and return characteristics of these factors over the period 1927–2010; see the Appendix for detailed descriptions of each factor.

The argument that we make for factor diversification partly rests on the expectation that the positive factor premia documented in Exhibit 1 will continue to persist. But the correlations (or relative lack thereof) of these premia with each other are at least as important. Exhibit 2 documents the monthly correlations of each of these six factor premia with each other over the period from January 1927 through December 2010.

EXHIBIT 1

Performance and Risk Statistics for Main U.S. Factors, 1927–2010[1]

	EQUITY	SML	VMG	MOM	TERM	DEF
Arithmetic Mean	8.0	3.8	4.9	9.7	2.2	0.3
Geometric Mean	5.8	2.8	3.9	7.7	1.8	0.2
Volatility	19.0	11.6	12.4	16.7	8.3	4.6
Skewness	0.17	2.17	1.82	–3.03	0.41	–0.24
Kurtosis	7.40	21.98	15.44	26.54	4.83	8.68
Sharpe Ratio	0.39	0.26	0.38	0.50	0.26	0.06
Maximum Drawdown	–85	–53	–46	–76	–59	–36

Source: The Kenneth French data library and Dimensional Fund Advisors, as described in the Appendix.

EXHIBIT 2

Correlations among the U.S. Factors, January 1927–December 2010

	EQUITY	SML	VMG	MOM	TERM	DEF
EQUITY	1.00					
SML	0.33	1.00				
VMG	0.23	0.10	1.00			
MOM	–0.34	–0.16	–0.40	1.00		
TERM	0.12	–0.05	0.03	0.04	1.00	
DEF	0.13	0.16	0.04	–0.18	–0.44	1.00

Notes: Average pair-wise correlation among six constituents: −0.03 (median 0.04).

Source: Authors' calculations based on sources named in the Sources of Exhibit 1.

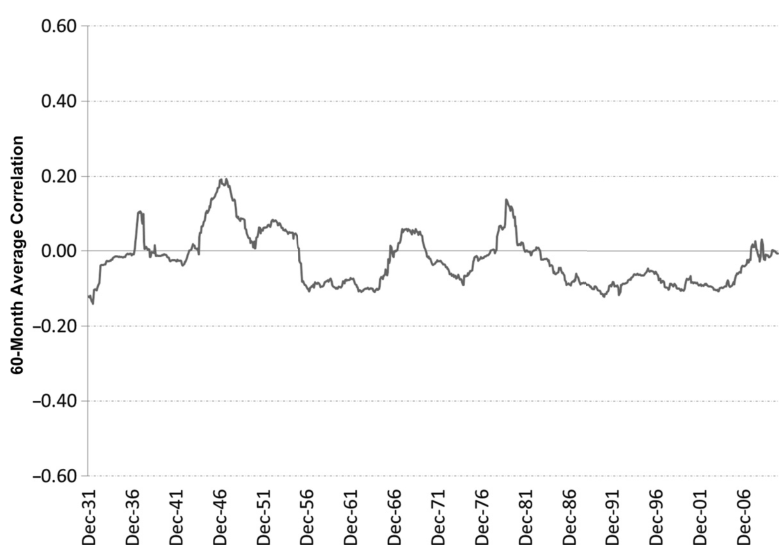
The near-zero average correlation across the factors indicates that even naive diversification techniques would have led to very substantial reductions in portfolio volatility. Exhibit 3 shows that the rolling 60-month average pair-wise correlation of the six factors is between −0.14 and +0.19 in all periods, with no obvious time trend. (The lower feasible bound is −0.20, so we are seeing some impressive diversification here.) Further, calculating the average pair-wise correlation of the six factors in the worst quartile of return months for the EQUITY factor gives an average correlation of −0.03, indicating that correlations do not seem to spike during times when diversification is needed most.

CONTRASTING THE EFFECTIVENESS OF ASSET CLASS DIVERSIFICATION WITH DYNAMIC FACTOR DIVERSIFICATION

The factors in the previous section include both static asset-class premia and more-dynamic style premia. While the classifications are debatable, we label asset class premia as static factors and style premia as dynamic factors.[2] Our main goal is to empirically compare the effectiveness of two approaches to diversification. The common institutional practice in recent decades has been asset class diversification, starting with U.S. stocks, then U.S. bonds, then looking beyond national borders, and finally, to a more limited extent, extending to various alternative assets—that is, from a local 60/40 portfolio, to a global 60/40 portfolio, and finally to an endowment-model portfolio. The second approach—alternative or complementary—involves diversification into various dynamic factors. Using data since the 1970s, we create 1) an asset class–diversified portfolio with five equally weighted asset-class building blocks and 2) a dynamic factor-diversified portfolio with value, momentum, carry, and trend style premia (with the former two in stocks and the latter two in a more macro context) plus U.S. large-cap equities. This design makes it easy to

EXHIBIT 3

Average Pair-Wise Correlation of the Main U.S. Factors, January 1927–December 2010



Source: Authors' calculations based on sources named in the Sources of Exhibit 1.

EXHIBIT 4

Asset Class Diversification: Performance Statistics, 1973–2010

	Asset-Diversified Portfolio	U.S. Stocks	Non-U.S. Stocks	Global Gov't Bonds	Global Non-Gov't Bonds	Other (EM Stocks, Small-Cap Stocks, Commodity Futures, Property)	*Average Across Five Asset Classes*
Arithmetic Mean	10.47	11.27	11.93	7.96	8.38	13.50	*10.61*
Geometric Mean	9.85	9.53	9.67	7.83	8.05	11.90	*9.40*
Volatility	**9.14**	15.86	17.44	4.60	6.88	14.61	***11.88***
Skewness	–0.62	–0.40	–0.39	0.83	0.66	–0.98	*–0.05*
Kurtosis	2.37	1.84	1.23	6.13	6.02	4.46	*3.94*
Sharpe Ratio	**0.48**	0.31	0.31	0.48	0.37	0.52	***0.40***
Max Drawdown	–36	–51	–56	–7	–19	–57	*–38*

Notes: Portfolio volatility is 77% of the five constituents' average volatility (9.14/11.88); that is, diversification reduces volatility by 2.74% (11.88 – 9.14).

Source: Bloomberg (for asset class series by MSCI, Citigroup, Standard & Poor's, and Global Property Research), Barclays Capital Live, and the Kenneth French data library, spliced with data series for the 1970s–1980s, as described in the Appendix.

compare whether it has been better to diversify out of U.S. stocks into other asset classes or into style factors, or in other words, whether static or dynamic factors have been more effective diversifiers.

EXHIBIT 5

Asset Class Diversification: Correlations, 1973–2010

	Asset Portfolio	U.S. Stocks	Non-U.S. Stocks	Global Gov't	Global Non-Gov't	Other
Asset Portfolio	1.00					
U.S. Stocks	0.87	1.00				
Non-U.S. Stocks	0.86	0.63	1.00			
Global Gov't	0.32	0.16	0.11	1.00		
Global Non-Gov't	0.48	0.34	0.22	0.87	1.00	
Other	0.83	0.66	0.69	–0.03	0.13	1.00

Note: Average pair-wise correlation among five constituents: 0.38 (median 0.28).

Sources: Authors' calculations based on sources named in Source note to Exhibit 4.

- Our asset class–diversified portfolio consists of five components: 20% U.S. large-cap equities, 20% developed market equities excluding the U.S., 20% global government bonds, 20% global fixed income excluding governments, and 20% other (in this case, 5% U.S. small caps, 5% emerging market equities, 5% commodity futures, and 5% global property stocks). The components are rebalanced each month to the preceding specified weights. This composite turns out to be a reasonable proxy for the global market-cap portfolio.
- The factor-diversified portfolio contains the four arguably best-known style premia: value and momentum strategies for stocks (the global long–short portfolio returns of Asness, Moskowitz, and Pedersen [2011]) and carry and trend strategies for liquid macro-asset trading (Ilmanen [2011] and Moskowitz, Ooi, and Pedersen [forthcoming]).[3] Ilmanen [2011] described behavioral and risk-based explanations for each strategy's long-run success. For symmetry with the five-component asset class–diversified portfolio, the four style premium components are weighted equally and combined with a 20% allocation to U.S. large-cap equities (equity premium proxy), rebalanced monthly to equal weights.

Exhibits 4 through 7 show the performance and correlation statistics for the constituents of the asset class–diversified and factor-diversified portfolios, as well as some statistics for the portfolios themselves (on which we focus). We make the total returns of the factor portfolios in Exhibit 6 comparable to the long-only asset portfolios in Exhibit 4 by adding the Treasury bill return to the long–short factor portfolio returns.

EXHIBIT 6
Factor Diversification: Performance Statistics, 1973–2010

	Factor-Diversified Portfolio	Equity Premium/ U.S.	Value Style/ GSS	Momentum Style/GSS	Carry Style/ Macro	Trend Style/ Macro	*Average Across Five Asset Classes*
Arithmetic Mean	13.45	11.27	11.41	11.34	15.52	19.65	*13.84*
Geometric Mean	13.26	9.53	10.76	10.73	14.02	18.63	*12.73*
Volatility	**4.99**	15.86	8.51	10.04	10.07	10.01	***10.90***
Skewness	–1.20	–0.40	–0.20	–0.37	–2.81	0.68	*–0.62*
Kurtosis	5.62	1.84	8.15	4.76	29.77	6.66	*10.23*
Sharpe Ratio	**1.44**	0.31	0.61	0.52	0.82	1.22	***0.70***
Max Drawdown	–17	–51	–42	–29	–52	–26	*–40*

Notes: Portfolio volatility is 46% of the five constituents' average volatility (4.99/10.90); that is, diversification reduces volatility by 5.91% (10.90 − 4.99). GSS refers to global stock selection.

Sources: Bloomberg, style composites created by Asness, Moskowitz, and Pedersen [2011], Ilmanen [2011], and Moskowitz, Ooi, and Pedersen [forthcoming], spliced with some data series for 1970s–1980s, as described in the Appendix.

EXHIBIT 7
Factor Diversification: Correlations, 1973–2010

	Factor Portfolio	Equity Premium	Value Style	Momentum Style	Carry Style	Trend Style
Factor Portfolio	1.00					
Equity Premium	0.65	1.00				
Value Style	0.07	–0.04	1.00			
Momentum Style	0.25	–0.11	**–0.53**	1.00		
Carry Style	0.53	0.35	0.15	–0.10	1.00	
Trend Style	0.57	0.00	–0.13	0.28	–0.09	1.00

Notes: Average pair-wise correlation among five constituents: −0.02 (median −0.07).

Source: Authors' calculations based on sources named in Sources note to Exhibit 6.

Factor Diversification Is More Effective at Reducing Portfolio Volatility and Market Directionality

Asset class diversification can only modestly improve the portfolio Sharpe ratio because the average correlation among the five constituents is relatively high at +0.38. Still, the Sharpe ratio of the asset class–diversified portfolio is 0.48, compared to 0.31 for U.S. stocks and 0.40 for the average of the five constituents. This improvement reflects portfolio volatility being 77% of the constituents' average volatility.

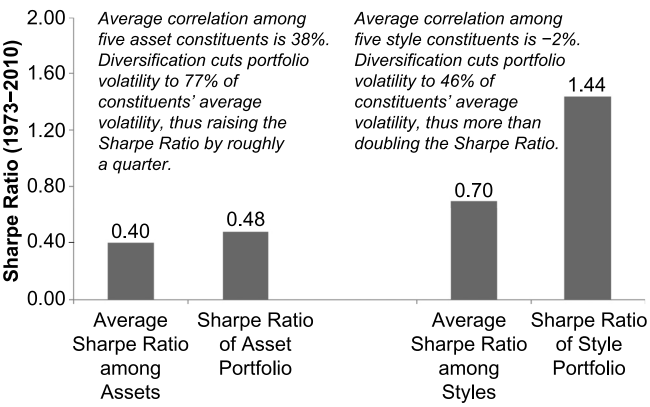
Factor diversification is highly effective because the average correlation between the five constituents is virtually zero (–0.02). Only the carry style has a significant positive correlation with the equity market, and the negative correlation between value and momentum in stocks is an especially powerful diversifier. As a result, portfolio volatility falls to less than half of the constituents' average volatility (5.0% versus 10.9%). In turn, the portfolio Sharpe ratio doubles to 1.44 from the constituents' average Sharpe ratio of 0.70.[4]

Exhibit 8 shows that the factor-diversified portfolio's Sharpe ratio edge over the asset class–diversified portfolio (1.44 versus 0.48) can be attributed to both 1) better constituent Sharpe ratios and 2) better diversification abilities. On paper, the decomposition suggests that the two sources are equally important.[5] We are more confident, however, that in future real-world application the diversification edge will prevail, more so than the constituents' Sharpe ratio edge. The main reason for doubting the latter is that we have not subtracted trading costs or fees from these investments, and these tend to be larger for dynamic strategies.[6]

The cost/fee argument also suggests that investors should take the 1.44 Sharpe ratio of the factor-diversified portfolio with many grains of salt. Questions also arise about overfitting, sustainability, capacity, and leverage; see the concluding section. But the Sharpe ratio boost is so large that there is room to account for these concerns.

Exhibit 8

Decomposing the Benefits of Factor Diversification, 1973–2010



Source: Authors' calculations based on sources named in Sources to Exhibits 4 and 6.

It is hard *not* to conclude that smart investors should include cost-effectively sourced dynamic factor premia into long-term portfolio allocations.

The main benefit is risk reduction. Lower correlations across factors than asset classes (see Exhibit 9)[7] as well as lower market directionality (the factor [asset] -diversified portfolio has a 0.64 [0.87] correlation with U.S. stocks)[8] helped the factor-diversified portfolio achieve the following:

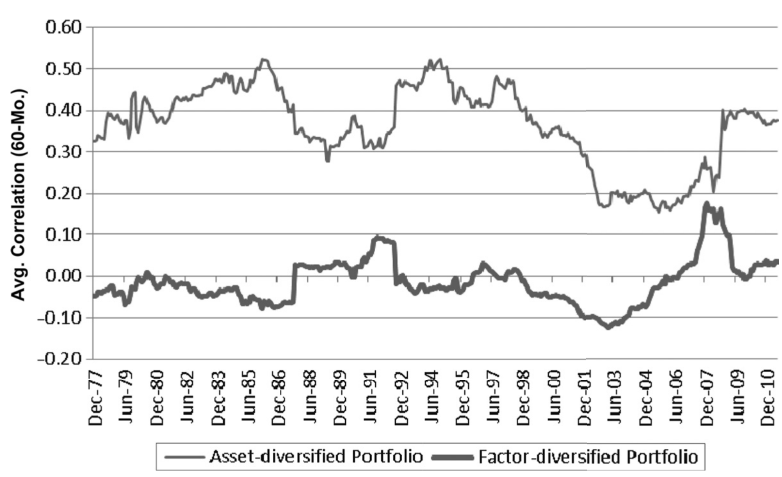
- *Smaller drawdowns*: Maximum peak-to-trough drawdown in February 2009 was –36% for the asset-diversified portfolio, compared to –17% for the factor-diversified portfolio. Before 2008, the drawdowns were clearly less severe, the next-worst being –20% for the former and –7% for the latter. Both portfolios had similar maximum drawdowns when averaged across constituents (near –40%), but as a portfolio, factor diversification exhibited half the maximum drawdown of asset-diversification (see Exhibits 4 and 6). This lower drawdown mainly reflects the factor portfolio's lower volatility. In contrast, skewness and kurtosis were worse for the factor portfolio than for the asset portfolio, mainly due to the exceptional higher moments of the carry factor portfolio.
- *Better recession hedging ability*: During months of economic contraction, as defined by the National Bureau of Economic Research, the asset class–diversified portfolio earned, on average, 0.1%, while the factor-diversified portfolio earned 0.7%. During business cycle expansions, both portfolios earned 1.0%–1.1% average monthly returns.
- *Better tail performance in equity bear markets*: During the 46 worst months for U.S. stocks (10% of the sample), the asset class–diversified portfolio lost, on average, 3.8%, while the factor-diversified portfolio lost only 0.9%. During the other 90% of the sample, both portfolios earned a 1.3% average monthly return.

A Long-Only Constraint Reduces Effectiveness

If we use long-only portfolios for value and momentum styles (30% of best value-sorted or momentum-sorted stocks each month) but still allow shorting/leverage in carry and trend styles,[9] a decent chunk of diversification ability is lost. Both value and momentum portfolios become highly correlated with the equity premium (0.71–0.73 with U.S. equities and 0.87–0.90 with global equities), and the negative correlation between value and momentum long–short portfolios turns positive (0.73) in the long-only context.[10] The factor-diversified portfolio

Exhibit 9

Average (60-month rolling) Pair-Wise Correlations of the Five Constituents



Source: Authors' calculations based on sources named in Sources to Exhibits 4 and 6.

now suffers from the familiar equity market directionality; its correlation with U.S. stocks is 0.87 and with the asset class–diversified portfolio is 0.92. As a result, diversification reduces the portfolio volatility only to 9.5% (72% of the constituents' 13.2% average volatility). The portfolio Sharpe ratio rises, therefore, from 0.68 to "only" 0.86. The 0.86 Sharpe ratio remains much higher than the 0.48 of the asset class–diversified portfolio. This improvement reflects the benefit of a value and momentum overlay on a market-cap-weighted equity portfolio (about one-third) and the better performance of trend and carry portfolios relative to bonds and alternatives as complements to the all-equity portfolio (about two-thirds).

Volatility Weighting Improves Effectiveness

In the spirit of risk parity investing, we explore an "equal-volatility" approach instead of the previous equal-nominal allocations. We create even more balanced portfolio diversification by scaling up lower-volatility constituents. Specifically, when we multiply each constituent by the ratio of 15% (an arbitrary long-run volatility target) divided by past 36-month rolling annualized volatility, all portfolio Sharpe ratios improve by 0.1–0.2. Part of this improvement reflects the fact that most series benefit from constant-volatility targeting alone: average Sharpe ratios for both asset classes and dynamic factors rise by about 0.05. Better diversification helps portfolio volatilities fall a bit further (to 70% for assets, instead of 77%, and to 44% for factors, instead of 46%). The resulting Sharpe ratios for the equal-volatility-variant asset class–diversified portfolio and factor-diversified portfolios are 0.68 and 1.69, respectively (compared to equal-nominal-variant Sharpe ratios of 0.57 and 1.53, respectively, over the matching 1976–2010 sample period). Even for the long-only portfolio, equal-volatility weighting boosts the Sharpe ratio from 0.94 to 1.07.[11]

Note that using equal-nominal or equal-volatility weighting of constituents underutilizes the correlation information. This is deliberate. If we assume equal Sharpe ratios among constituents, a mean–variance optimizer would assign larger (smaller) weights to better (worse) diversifiers. But low correlations across factors or across asset classes can exhibit significant sampling variation and sign changes—even if they are persistent and predictable over shorter horizons. Equal weighting of constituents is a heuristic and surprisingly robust approach whose diversification benefits are great when low-correlated constituents are combined, but it makes no use of specific in-sample correlations. Conservative use of the more detailed information in long-run or recent correlations may give further benefits in portfolio construction, but naive use can lead to overfitting and unhelpful turnover. These topics are beyond this article.

ANOTHER PERSPECTIVE: ADDING STYLE PREMIA TO AN ASSET-DIVERSIFIED PORTFOLIO

Few investors would make the full leap from asset class diversification to factor diversification. Nor do we suggest that asset class diversification is not helpful. A more realistic idea is to take as a starting point the asset class–diversified portfolio as a proxy for a typical institutional portfolio or a broad market-cap portfolio, and combine it with a small allocation to the composite of the four dynamic style factors (Value, Momentum, Carry, and Trend).[12] Exhibit 10 shows that a 20% nominal allocation

EXHIBIT 10

Combining the Asset-Diversified Portfolio with the Four Style Factor Premia, 1973–2010

	1 (Asset Only)	2	3	4	5	6 (Style Only)
Weight of Asset-Diversified Portfolio	*100*	*80*	*60*	*40*	*20*	*0*
Weight of Four-Style Portfolio	*0*	*20*	*40*	*60*	*80*	*100*
Arithmetic Mean	10.47	11.19	11.91	12.64	13.36	14.09
Geometric Mean	9.85	10.73	11.58	12.39	13.17	13.92
Volatility	9.14	7.54	6.08	4.91	4.26	4.36
Skewness	–0.62	–0.79	–1.04	–1.30	–1.15	–0.37
Kurtosis	2.37	3.21	4.60	6.29	6.21	3.68
Sharpe Ratio	0.48	0.67	0.94	1.30	1.66	1.77
Maximum Drawdown	–36	–30	–25	–19	–14	–12
Correlation with U.S. Stocks	0.87	0.85	0.82	0.71	0.47	0.12
Asset-Diversified Portfolio's Contribution to Total Portfolio Risk	100	99	96	85	60	0

Source: Authors' calculations based on sources named in Sources to Exhibits 4 and 6.

to style premia could have made a meaningful impact on performance and risk, even though the asset class–diversified portfolio still dominates portfolio risk due to its greater weight and higher volatility.

CHALLENGES AND CONCLUSIONS

The empirical results that we report appear to be so compelling that the reader may wonder why every investor is not doing this.

The main reasons are:

- lack of familiarity
- distrust in sustainability of factor premia
- no consensus on which factors to include
- aversion to shorting and leverage

Many investors are simply unaware of the evidence that we present in this article. Another reason for the slow pick-up is the intangible discomfort of unconventionality among institutional investors (maverick risk). All investment approaches can have multiyear stretches of disappointing performance, but those that differ from peer practice involve greater career risk.

Investors are right to be skeptical regarding any claims based on past performance and doubly skeptical when past success is mainly of a simulated variety, as we present in this article. They can ask whether the experience was a mirage, perhaps reflecting 1) data-mining biases that made researchers select these particular factors with the benefit of hindsight or 2) trading costs and other market frictions that would have eaten away most of the article profits. Or they can accept that a real opportunity existed in the past but doubt it will be sustained because the anomaly has become widely known[13] (and thus crowded) or because some structural change has modified the environment; for example, Regulation FD in 2000 made earnings news "travel faster" and conceivably reduced momentum. There are plausible responses to each of these concerns—academics and practitioners have debated them for at least 20 years—but there is no way to remove all of the doubt. Perhaps, it is just as well. All active strategies need someone "on the other side" because only the market portfolio can be held by everyone.

Beyond the equity premium, little consensus exists regarding which factors should earn significant long-run rewards and which have sufficient capacity to accommodate large funds. The resulting ambiguity has further limited investor interest. Moreover, many investors prefer return sources justified by rational risk premia rather than market inefficiencies. Ilmanen [2011] surveyed theories and empirical evidence on a wide range of static and dynamic factor premia. In this article, we focus on the best-known factors and present them in plain-vanilla form, but we apply them in highly diverse contexts.[14] Other factor premia, such as those related to illiquidity, low beta, quality, volatility selling, and certain arbitrage strategies could also be considered or the factors could be classified in an altogether different fashion.

Investors may also be unwilling or unable to use short selling and direct leverage in their own trading and, perhaps, even in delegated asset management. General aversion to leverage increased after 2008, partly for good reasons. Leverage presents its own risks, including the ability to maintain the exposure through inevitable tough times. Well-diversified leveraged portfolios are more likely to face forced deleveraging when financing conditions tighten sharply, and a common liquidity risk exposure makes fundamentally uncorrelated strategies correlated. Such risks are serious but arguably more manageable than concentration risk.

In our view, factor diversification is the best answer for the many investors whose portfolio risk is dominated by stock market directionality and who will take the time to understand the approach and its potential benefits. Leverage aversion may be the main reason why investors forfeit the opportunity for more effective diversification and instead accept the concentrated equity market risk in their portfolios. Finally, although factor diversification is more effective in the long–short context, when shorting and leverage techniques are allowed, it does not follow that long-only investors should ignore factor diversification. Our findings concur with Blitz [2011]: The benefits are meaningful even for long-only investors.

APPENDIX

For the long data history (1927–2010), we use static and dynamic factor data as described by the following:

Static:

- EQUITY: The return of the U.S. stock market in excess of the one-month Treasury bill return per the Kenneth French website. The data library can be accessed at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

- TERM: This is the return of long-term Treasury bonds minus the return of one-month Treasury bills per Dimensional Returns 2.0 or Morningstar [2011].
- DEF: This is the return of high-grade long-term corporate bonds minus the return of long-term Treasury bonds per Dimensional Returns 2.0 or Morningstar [2011].[15]

Dynamic:

- SML: Small minus large, or the return of U.S. small-cap stocks minus the return of U.S. large-cap stocks per the Kenneth French website. This is the same factor as SMB, which is prevalent in the literature.
- VMG: Value minus growth, or the return of U.S. value stocks minus the return of U.S. growth stocks per the Kenneth French website. This is the same factor as HML, which is prevalent in the literature.
- MOM: This is the stock momentum factor, or the return of U.S. stocks with relatively high returns over the prior 12 months (skipping the most recent month) minus the returns of U.S. stocks with relatively low returns over the prior 12 months (skipping the most recent month). This factor is per the Kenneth French website and is often referred to as UMD in the literature.

For the shorter data history (1973–2010), we use static and dynamic factor data as described by the following:

Static:

- U.S. large-cap equity returns (MSCI U.S. total return; GDDUUS Index in Bloomberg).
- Developed equity market returns excluding U.S. (MSCI World, ex-U.S.; GDDUWXUS Index in Bloomberg).
- Global government bonds (Citigroup World Government Bond Index, hedged to U.S. dollars; SBWGC in Bloomberg).
- Global non-government bonds (Barclays Capital Global Aggregate Index excluding Treasuries and government-related bonds, hedged to U.S. dollars; per Barclays Capital Live).
- Other is an equally weighted combination of small-cap stocks, emerging market stocks, commodity futures, and property. The U.S. small-cap stocks also proxy for non-U.S. small-caps and private equity and are represented by the smallest quintile of the value-weighted equity market sourced from the Kenneth French website. Emerging market equities are represented by the MSCI's "free" GDUUEFG Index in Bloomberg. Commodity futures also proxy for natural resources and are represented by the S&P GSCI Index (SPGSCITR Index in Bloomberg). Global property stocks also proxy for unlisted real estate and are represented by the Global Property Research's GGENGLOB Index in Bloomberg.

The asset class–diversified portfolio consists of the preceding five components, rebalanced to equal 20% weights each month. This composite can be viewed as a proxy for the global market-cap portfolio. Any such proxies, however, involve huge issues of investability and data availability, and our monthly rebalancing scheme maintains constant asset-class weights over time instead of evolving market-capitalization weights. The composite can also be viewed as a modern version of the 60/40 stock/bond portfolio in which the equity portion includes some alternative asset classes. If alternatives were taken from the bond portion, portfolio risk would be even more dominated by equity-directional risk.

Dynamic:

- The Value style return is a global stock selection strategy: long–short portfolio returns based on sorting stocks by the book-to-market ratio, averaging results from the U.S., Japan, U.K., and Europe ex-U.K., as described by Asness, Moskowitz, and Pedersen [2011].
- The Momentum style return is another global stock selection strategy, just like the Value style return except that last-year-return-but-skip-last-month is the sorting signal instead of the book-to-market ratio.
- The Carry style return is based on yield-seeking strategies among liquid macro assets, not on stock selection. The carry composite comprises four currency and fixed-income carry strategies as described in Ilmanen's [2011] chapter 13.5.
- The Trend style return is based on trend-following strategies among liquid macro assets, not on stock selection. The trend composite comprises strategies going long or short almost 60 liquid assets (equity index futures, fixed-income futures, currency forwards, and commodity futures) based on past-year returns, as described by Moskowitz, Ooi, and Pedersen [forthcoming].

The factor-diversified portfolio contains the four best-known dynamic style premia. To compute total returns for these long–short portfolios, we add to their monthly returns the one-month Treasury bill rate. For symmetry with the five-component asset class–diversified portfolio, the four style-premium components are weighted equally and combined with 20% in U.S. large-cap equities (as an equity premium proxy).

We use monthly return histories of the constituents of the asset class–diversified and factor-diversified portfolios going back to 1973. In most series, we must resort to narrower datasets, especially in the first decade. Among asset classes, the more distant fixed-income evidence is based on

U.S. Treasuries (before 1985) and U.S. credits (before 2001), a narrower set of emerging market stocks (S&P IFC indices before 1988; see Dimson, Marsh, and Staunton [2002, 2010]), and U.S. REITs (before 1984). Among style premia, value returns are available only for U.S. stocks before 1981, and the universes for carry and trend strategies become incrementally narrower before the early 1990s.

In this article, we document evidence for the period 1973–2010, but the results are similar for more recent windows, such as 1991–2010, when we have virtually all return series available.

ENDNOTES

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[1]In all exhibits, arithmetic mean returns are based on annual returns; the other statistics are based on monthly data.

[2]Static factor premia involve investments that require limited portfolio rebalancing, unlike dynamic factor premia. The boundary is fuzzy. Asset-class excess returns over the riskless rate—for example, from holding a value-weighted stock market index—are the prototypical static factor premia, yet even these portfolios require some asset turnover due to, for example, new issuance and new entries to an index. Momentum strategy profits are at the other extreme: the prototypical dynamic factor premia with more than 100% annual turnover. Term premia and default premia are associated with asset classes and are typically classified as static factor premia. But because popular proxies are often based on a subset of the asset class and involve reasonable turnover—say, 20-year government bonds and AAA/AA- rated long-dated corporate bonds—this classification is not clear cut. Small-cap premia and value premia are also based on a subset of the equity market and involve moderate turnover, yet they are typically classified as dynamic style premia. Finally, only the equity premium and term premium are excess returns over "riskless" Treasury bills; other premia are excess returns of one risky-asset portfolio over another risky-asset portfolio.

[3]Momentum and trend styles are closely related because both involve buying recent winners and/or selling recent losers. Momentum is commonly used for cross-sectional series, such as with long–short portfolios (often done in stock selection), whereas trend following refers to a time series, such as trading a single asset on a long–short basis (often done in liquid futures).

[4]Grinold's [1989] fundamental law of active management (FLAM) suggests that (under restrictive assumptions) the portfolio Sharpe ratio increases with the square root of its breadth, measured by the number of independent bets in a year. Ignoring the time dimension, four uncorrelated investments with similar risk–return characteristics halve the portfolio volatility and double its Sharpe ratio. Given the observed doubling of the Sharpe ratio from 0.7 to 1.4, the five constituents of the factor-diversified portfolio seem to behave like four uncorrelated investments. At least we are in the right ballpark. Analyses like this should be taken lightly because the FLAM's assumptions are never satisfied in the real world. For example, we do not have exactly equal Sharpe ratios and volatilities among constituents, nor zero correlations across each pair, even if the average correlation is –0.02.

[5]The relative average Sharpe ratio among the two portfolio's constituents is 1.75 (0.70/0.40), whereas the relative Sharpe ratio boost due to diversification is 1.71 ([1.44/0.70]/[0.48/0.40]). The product of 1.75 and 1.71 is 3.00, the relative Sharpe ratio of the factor-diversified portfolio versus the asset class–diversified portfolio (1.44/0.48).

[6]Trading costs are investor specific and thus hard to measure, in addition to varying over time and across market segments and being higher for more dynamic strategies. Small trading size raises fixed costs, and large size increases market impact costs, especially for impatient liquidity demanders. An important part of real-world investing skill is the expertise to cost-effectively harvest the various style premia. Typical recent trading costs for institutional investors would likely detract at most 0.1 Sharpe ratio units from the dynamic macro strategy returns that we report (i.e., returns would fall by a tenth of portfolio volatility) but would detract more from the higher-turnover momentum strategy. All trading costs were clearly higher in past decades, however, and this point detracts from the returns investors could have realized especially in the case of long–short strategies.

Asset management fees can eat more performance than trading costs. For example, if we apply a 2% fixed fee and a 20% performance fee on a fund with 10% volatility and Sharpe ratio 1.0 after trading costs but before fees, the manager will keep 4% while the investor will earn net 6% return and achieve a Sharpe ratio of 0.6. (For convenience, we assume a 2% cash return to offset the 2% fixed fee, so that the performance fee is paid on the 10% gross return. In practice, alternative beta premia, such as these style premia, may be available at lower fees than "2+20").

[7]The average pair-wise correlation across factors spiked outside the +/–0.10 range only during the recent financial crisis, and even then only to 0.18, staying below the average pair-wise correlation among asset classes. If the equity premium were excluded from the factors, the peak average pair-wise correlation would have been even lower (0.11).

[8]These directional correlations are so high partly because U.S. stocks constitute 20% of each portfolio.

[9]There are two main reasons to use leverage: first, to scale up low-volatility assets (to bring them onto a level playing field with more volatile assets, which often have embedded leverage), and second, to counterbalance the diversification-induced decline in portfolio volatility. For example, in order for the trend strategy to achieve 10% portfolio volatility, each asset position needs to be scaled to 30%–40% return volatility.

The leverage and shorting in carry and trend styles can be achieved using exchange-traded futures and currency forwards, which allow for high cash balances and for a low risk of forced delevering and counterparty default, as well as excellent liquidity (low trading costs and high capacity). These features make leverage in carry and trend styles less dangerous and more manageable than, say, levering illiquid and already-volatile assets with borrowed money or repo financing. Many long-only investors thus allow the use of leverage and derivatives shorting, while prohibiting the short-selling of cash equities.

[10]The correlations turn positive in total return space but remain negative in active return space (for which we analyze excess returns over an equity market benchmark).

[11]To save space, we do not display the long-only and equal-volatility results in a tabular form.

[12]The four style factor portfolio excludes the U.S. equity premium from the five-factor diversified portfolio that we describe earlier in the article because it is already one of the five constituents of the asset-diversified portfolio. Leaving out the equity premium improves the Sharpe ratio of the four style factor portfolio.

[13]A more subtle argument is that anomalies were less exploitable in the past when trading costs were higher, allowing higher pre-cost premia. Now that trading costs and other limits to arbitrage have declined over time, future pre-cost factor premia may be smaller. This argument mainly applies for market inefficiencies. If factor premia represent rational risk premia, they should persist even if the anomaly is widely known and trading costs are low.

[14]Possible refinements to the plain-vanilla strategies that we describe include dynamic volatility targeting, weighting investments based on signal strength, industry-neutralization in stock selection strategies, and broader use of indicators to represent a style. Note that our analysis does not involve any tactical asset allocation or market/style/factor timing; these are extensions that could be considered. The simpler variants that we describe already give promising long-run performance, in part because we apply each style factor to a large number of assets by diversifying stock selection strategies across four regions and carry and trend strategies across many asset classes.

[15]For even longer histories of equity and term premia in several countries, see Dimson, Marsh, and Staunton [2002, 2010]. For further evidence and discussion of these premia, see Ilmanen's [2011] chapters 8–10. For a critical evaluation of the DEF premium, see Hallerbach and Houweling [2011].

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