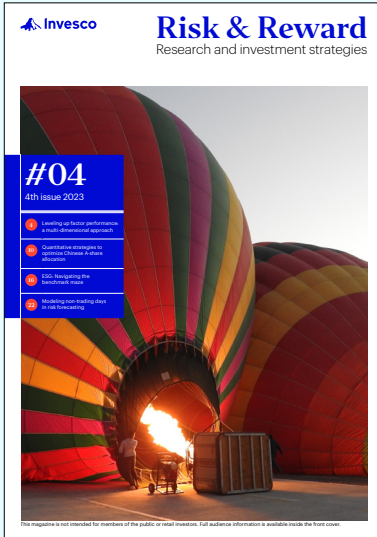


Leveling up factor performance: a multi-dimensional approach

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In its 34th year, Risk and Reward provides a platform for Invesco's investment professionals to produce original research and investment strategy content. This Q4 2023 edition contains three additional articles. Contact your local Invesco representative for the full edition.

Factor investing has revolutionized the way investors construct their portfolios – through a simple, transparent, rules-based approach that relies on factors to manage key drivers of risks and returns. But naïve implementation of factor strategies may prevent investors from unleashing a factor's full potential. We show how investors can potentially improve factor premiums by diversifying across signals and removing exposures to unrewarded risks.

A factor investor should, first and foremost, take a stand on which factors to harvest.¹ But, the factor view shouldn't stop there, as subtle differences in factor definition can profoundly impact performance. A crucial decision to make is whether to rely on a single or multiple signals. This choice is central to the success of a factor-based strategy and warrants careful consideration – alongside market and industry neutralization.

In this article, we'll explore how investors can enhance their factor investing strategies by diversifying across multiple correlated factor characteristics and effectively managing unrewarded market and industry risks.² We provide stylized examples and evidence pertaining to the benefits of such an approach for single and multi-factor investors.

Simple and multi-dimensional factor views compared

Capturing a factor through a single signal may be sufficient to generate absolute returns, but it is not optimal from a risk-return perspective. As factor behavior is complex and multidimensional, there is no one perfect signal that can explain it in full. Rather, a single signal merely serves as an approximation of what a factor should encapsulate.

When aggregating multiple signals to capture factor behavior, we adopt a portfolio-oriented approach, diversifying across signals. The signals we use should adhere to several principles: Firstly, they should align with a singular economic rationale, such as the idea that undervalued stocks tend to outperform their overvalued counterparts. Additionally, these signals may exhibit strong positive –



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yet still imperfect – correlations among themselves, allowing the potential for some extra alpha. This collection of signals may provide diversification benefits, notably in terms of risk and drawdown reduction.

It's important to note that, while combining correlated signals to a factor can offer advantages, the diversification benefits may not be as evident as when combining negatively correlated factors, such as value and momentum. To truly appreciate the value of diversification, one must extend beyond the simplified example of just two signals and delve into the realm of incorporating numerous signals, a practice commonly employed by practitioners in the field. In doing so, the true potential of diversification becomes apparent and reinforces the wisdom of adopting a multifaceted approach to factor investing.

We will now show why combining multiple signals makes sense using the value, momentum and quality factors in a simplified setting.

Value

Value investing strategies involve the selection of stocks that, considering their fundamental characteristics, are priced more attractively than their peers. This approach is rooted in the findings of Fama and French (1992), who show that cheaper stocks tend to outperform more expensive stocks on a risk-adjusted basis. Investors can use various metrics to find stocks that are priced below their fundamental value, which is the essence of value investing. Fama and French themselves used the book yield. However, instead of the valuation, we can also look at a company's ability to generate cash flows. Foerster, Tsagarelis and Wang (2018), for example, show that firms with a higher cash flow-to-price ratio tend to outperform on a risk-adjusted basis.

Rather than looking at a firm's valuation or cash flows separately, a prudent strategy may be to diversify across multiple imperfectly but positively correlated characteristics to help mitigate the risk associated with a single signal. Individual characteristics, although positively correlated, might still exhibit different sensitivities to various market environments and thus not perform consistently across all market conditions. By combining them, investors can create a more robust definition of value that is less susceptible to the idiosyncrasies of any one metric and helps identify genuine value opportunities across various market scenarios.

Momentum

Momentum investing revolves around the pursuit of stocks that exhibit discernible trends in their price movements. It draws upon the notion that market sentiment can often resemble the wisdom of crowds, where investor behavior can sway collectively, resulting at times in either irrational exuberance or inexplicable pessimism. Academic studies have corroborated the phenomenon that stocks

displaying upward momentum tend to sustain their ascent in the short to medium term, while – conversely – a similar persistence can be observed in downward-moving stocks. Momentum strategies therefore assess stocks based on their recent performance, typically gauged over a period of 3 to 12 months (Jegadeesh and Titman, 1993).

While past price trends can be somewhat indicative of the future, alternative momentum factor definitions propose evaluating individual firm characteristics, such as idiosyncratic momentum in prices or earnings, as key expected return drivers. Combining standard momentum characteristics with such alternative facets of momentum could potentially create a more nuanced factor that considers both price-based and fundamental firm-specific information. A combined approach acknowledges that price movements may not always capture all relevant information about an asset's prospects and seeks to integrate additional sources that might help determine price trending behavior.

Quality

Quality investing strategies are geared toward identifying stocks with superior earnings quality. This entails seeking out stocks that exhibit profitability, a solid management and a track record of consistent earnings over an extended period. In essence, quality investing is the pursuit of companies that use their capital resources efficiently. Quality investors seek to optimize the value they receive for their investments, although their primary focus is on the earnings the companies generate.

An overly simplistic way to define the quality factor relies on a firm's return on equity to measure its financial health and gauge how efficiently it uses shareholder equity to generate returns. Alternative characteristics, such as gross profitability (as proposed by Novy Marx, 2013), use the core operational profitability of a firm, highlighting its competitive strengths. Combining return on equity and gross profitability creates a multifaceted quality factor definition that captures both a company's financial efficiency and its operational prowess. This holistic approach provides a more comprehensive view of a company's overall quality, enabling investors to identify firms with strong profitability, prudent financial management and competitive advantages, making it a robust strategy for quality-focused investing.

Multiple signals

We now compare the risk and return characteristics of factors based on one signal to those of factors based on multiple signals (two in our case). Our equity return data comes from Datastream and comprises both developed and emerging markets, with our regional definitions closely following the MSCI classification. For each company in our sample, we use quarterly balance sheet data from Compustat US

(for the US) and Worldscope (for all other countries). Our sample runs from January 1996 to June 2023.

For each factor, we now create value-weighted tercile long-short factor portfolios based on two factor signals – a standard and an alternative one – as well as a combination of both.

More specifically:

- for value, we use book-to-market equity ratios (B/P) and, alternatively, cash flow-to-price ratios (CFY);
- for momentum, we use prior 12 to 1-month return (12-1Mom) and, alternatively, a residual return post orthogonalization on a market factor model, also known as idiosyncratic momentum (iMom);
- for quality, we use return on equity (ROE) and, alternatively, gross profitability to total assets (GPA).

For developed as well as emerging markets, table 1 shows the return correlations between different specifications of the factor portfolios; table 2 shows their performance characteristics.

For each factor, the correlation coefficients are positive, confirming that our alternative factor signals capture similar dimensions to the conventional ones. However, although significantly positive, the correlations are imperfect, highlighting the complementary nature of our signals. Since the positive correlation is significantly lower in emerging markets, we expect more diversification benefits even with just a two-signal combination.³

As for the key performance statistics, our results show that – irrespective of the factor – adding the alternative signal results in higher risk-adjusted returns (IRs) and lower drawdowns.

Our examples, though certainly simplified, nevertheless show that a multidimensional approach is better than relying solely on a common signal with high conviction. Investors may expand their factor views by considering other signals that are correlated to B/P, 12-1Mom and ROE while still adding alpha and improving the risk-return profile.

Compensated and uncompensated factor risks

Despite these promising results, even dedicated factor investors would be unwise to disregard the uncompensated risks that come along with standard factor investing approaches. Harvesting factor premiums, whether based on single or multiple characteristics, may inadvertently create strong sector and regional biases, as well as unwanted exposures to market movements.

Such uncompensated risks are particularly prominent in single-factor approaches, but also exist in multi-factor portfolios. For example, value investors might focus on traditional industries such as retail, while momentum investors might prefer more dynamic industries like information technology.

By maintaining neutrality to sectors, regions and/or market movements, investors seek to isolate the pure effect of the targeted factor. This ensures that the factor's impact on portfolio returns remains distinct from the influence of sector or market-wide fluctuations. Industry neutrality prevents unintended sector bets, reducing the vulnerability of portfolios to industry-specific risks or economic cycles. In the same vein, region/country neutrality prevent unintended country bets, thus reducing the portfolio exposure to geopolitical risk. Finally, market neutrality ensures that the factor's performance isn't merely a reflection of broader market trends and enables a more precise



Irrespective of the factor – adding the alternative signal may result in higher risk-adjusted returns.

Table 1
Correlations of value, momentum and quality signals

Value	Developed markets			Emerging markets		
	B/P	CFY	Combination	B/P	CFY	Combination
B/P	100.0%	-	-	100.0%	-	-
CFY	73.5%	100.0%	-	48.5%	100.0%	-
Combination	93.5%	91.3%	100.0%	93.5%	69.6%	100.0%

Momentum	Developed markets			Emerging markets		
	12-1Mom	iMom	Combination	12-1Mom	iMom	Combination
12-1Mom	100.0%	-	-	100.0%	-	-
iMom	84.8%	100.0%	-	69.1%	100.0%	-
Combination	94.8%	93.8%	100.0%	90.5%	86.9%	100.0%

Quality	Developed markets			Emerging markets		
	ROE	GPA	Combination	ROE	GPA	Combination
ROE	100.0%	-	-	100.0%	-	-
GPA	78.7%	100.0%	-	58.3%	100.0%	-
Combination	94.5%	92.8%	100.0%	83.2%	88.6%	100.0%

Source: Invesco. Correlation coefficients between various value-weighted tercile long-short factor portfolios based on single and multiple factor signals. Data from January 1996 to June 2023. Factor strategy returns in USD and gross of fees and transaction costs.

Table 2

Performance characteristics of value, momentum and quality signals

Value	Developed markets			Emerging markets		
	B/P	CFY	Combination	B/P	CFY	Combination
Return (ann.)	0.5%	7.3%	4.9%	4.7%	11.7%	8.8%
Standard deviation	11.3%	12.3%	12.3%	11.9%	10.1%	11.8%
Information ratio	0.04	0.60	0.39	0.40	1.16	0.75
Average drawdown	-22.2%	-8.0%	-11.9%	-12.5%	-5.1%	-7.7%
Momentum	12-1Mom	iMom	Combination	12-1Mom	iMom	Combination
	Return (ann.)	4.8%	6.8%	6.4%	6.7%	11.6%
Standard deviation	15.1%	10.8%	13.8%	16.3%	12.5%	14.0%
Information ratio	0.32	0.63	0.46	0.41	0.93	0.80
Average drawdown	-18.6%	-8.3%	-13.7%	-24.7%	-6.0%	-10.7%
Quality	ROE	GPA	Combination	ROE	GPA	Combination
	Return (ann.)	4.9%	7.8%	7.3%	2.7%	5.4%
Standard deviation	9.9%	7.2%	8.9%	8.8%	8.5%	8.5%
Information ratio	0.50	1.08	0.83	0.31	0.64	0.55
Average drawdown	-13.9%	-7.2%	-10.1%	-7.7%	-4.2%	-4.7%

Source: Invesco. Performance characteristics of various value-weighted tercile long-short factor portfolios based single and multiple factor signals. Data from January 1996 to June 2023. Factor strategy returns in USD and gross of fees and transaction costs. **There is no guarantee these views will be realized.** See Simulated performance disclosure at the end of the article.

assessment of its ability to deliver consistent risk-adjusted returns.

To address these concerns, we have developed enhanced versions of all the above factor strategies, based on industry/region and beta-neutral signals.³ Table 3 shows the results.

Compared to our earlier results, the industry/region and market-neutral portfolios exhibit lower risk, significantly

higher IRs and significantly lower drawdowns. These improvements show the potential payoff of disentangling from rewarded and unrewarded factor risks.

Implications

To show the possible advantages of using neutralized multi-signal factors in a multi-factor portfolio, table 4 makes clear how factors (as opposed to signals within factors) exhibit negative or very low correlations to one another.⁴

Table 3

Performance characteristics of industry and market-neutral value, momentum and quality signals

Value	Developed markets			Emerging markets		
	B/P	CFY	Combination	B/P	CFY	Combination
Return (ann.)	2.0%	6.6%	5.9%	1.7%	5.6%	5.3%
Standard deviation	5.3%	4.3%	5.9%	8.3%	7.1%	6.7%
Information ratio	0.37	1.56	1.00	0.20	0.79	0.79
Average drawdown	-4.7%	-1.6%	-2.5%	-10.7%	-5.7%	-4.6%
Momentum	12-1Mom	iMom	Combination	12-1Mom	iMom	Combination
	Return (ann.)	2.9%	4.1%	4.8%	4.7%	7.0%
Standard deviation	9.5%	6.2%	8.5%	8.3%	5.6%	7.7%
Information ratio	0.31	0.67	0.56	0.56	1.25	1.02
Average drawdown	-12.9%	-5.5%	-8.1%	-8.1%	-5.0%	-5.8%
Quality	ROE	GPA	Combination	ROE	GPA	Combination
	Return (ann.)	3.8%	4.9%	4.4%	1.2%	4.0%
Standard deviation	5.7%	5.4%	5.2%	6.2%	5.9%	6.0%
Information ratio	0.67	0.90	0.85	0.20	0.67	0.61
Average drawdown	-8.7%	-5.9%	-9.6%	-10.8%	-5.0%	-5.7%

Source: Invesco. Performance characteristics of various value-weighted tercile long-short factor portfolios based on single and multiple factor signals. The signals are industry/region and market beta-neutral. Sample from January 1996 to June 2023. Factor strategy returns in USD and gross of fees and transaction costs. See simulated performance disclosure at the end of the article.

Table 4
Factor correlations in standard and enhanced multi-factor strategies

Standard	Developed markets			Emerging markets		
	Value	Momentum	Quality	Value	Momentum	Quality
Value	100.0%	-	-	100.0%	-	-
Momentum	-64.3%	100.0%	-	-53.2%	100.0%	-
Quality	-22.3%	50.8%	100.0%	-59.6%	32.0%	100.0%

Enhanced	Developed markets			Emerging markets		
	Value*	Momentum*	Quality*	Value*	Momentum*	Quality*
Value*	100.0%	-	-	100.0%	-	-
Momentum*	-53.4%	100.0%	-	-43.3%	100.0%	-
Quality*	-41.6%	51.7%	100.0%	-30.0%	18.8%	100.0%

Source: Invesco. Correlation coefficients between various value-weighted tercile long-short factor portfolios based on single and multiple factor signals. Standard portfolios based on B/P (value), 12-1Mom (momentum) and ROE (quality). The enhanced factors (*) add the alternative factor signals (CFY, iMom and GPA) and are industry and market neutralized. Sample from January 1996 to June 2023. Factor strategy returns in USD and gross of fees and transaction costs.

Table 5
Performance characteristics of standard and enhanced multi-factor strategies

Model	Developed markets		Emerging markets	
	Standard (QMV)	Enhanced (QMV*)	Standard (QMV)	Enhanced (QMV*)
Return (ann.)	4.0%	5.1%	5.4%	5.8%
Standard deviation	6.1%	3.4%	5.2%	3.1%
Information ratio	0.65	1.49	1.04	1.84
Average drawdown	-5.3%	-2.2%	-4.0%	-1.2%

Source: Invesco. Performance characteristics of various value-weighted tercile long-short multi-factor portfolios based on single and multiple factor signals. Standard portfolios based on B/P (value), 12-1Mom (momentum) and ROE (quality). The enhanced (*) characteristics are industry/region and market beta neutral. For the enhanced portfolios, the alternative factor signals (CFY, iMom and GPA) are added and factors are industry and market neutralized. Factors (quality, momentum, value) are equally weighted. Sample from January 1996 to June 2023. Factor strategy returns in USD and gross of fees and transaction costs.

We now evaluate the performance characteristics for an investor who combines value, momentum and quality factors with equal weight (QMV). In the standard case, each factor is based on a single characteristic (B/P for value, 12-1Mom for momentum, and ROE for quality). In the enhanced case, the alternative factor signals (CFY, iMom and GPA) are added and the factors are neutralized against market and industry risks, as discussed above (QMV*). Table 5 shows the results.

According to these findings, a multi-factor combination delivers better results than any single factor component presented earlier. Moreover, the enhanced factor portfolio (QMV*) comes with higher returns, significantly lower risk, significantly higher IR and significantly smaller drawdowns than the standard portfolio (QMV).

Conclusion

We have shown that, due to the intricate and multifaceted nature of factor behavior, investors are better off embracing a multi-signal approach to defining factors. Diversifying factors across signals not only bolsters risk-adjusted returns but also curtails portfolio drawdowns. We have also underscored the importance of industry/region and market beta neutrality in the quest to remove unrewarded factor risks. By preserving neutrality to sectors, regions and market fluctuations, investors can isolate the core influence of the targeted factor, thereby reducing susceptibility to sector-specific perils and economic cycles. When combined, these two controls lead to an enhanced factor model that may outperform standard models across markets.

Notes

- 1 Gupta, Raol and Roscovan (2022) provide a comprehensive framework depicting how investors can select the factors that best align with their preferences and investment objectives.
- 2 Diversification does not ensure a profit or protect against loss.
- 3 There is no guarantee these views will be realized.
- 3 Our industry/region and beta neutralization is performed in two steps: In the first step, for each company and at every point in time, we subtract the average region/industry score from the raw score. In a second step, we orthogonalize the resulting score against industry dummies and market beta.
- 4 The correlation pattern tends to persist across regions that go beyond those considered in our study, although some time variation is possible.



The enhanced factor portfolio (QMV*) comes with higher returns, significantly lower risk, significantly higher IR and significantly smaller drawdowns.



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