Long-Only Style Investing:
Don't Just Mix, Integrate

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Portfolio implementation is critical, although often underappreciated, for investment success. We show how seemingly minor differences in portfolio construction can lead to major differences in portfolio efficacy for long-only style investing. Style portfolios, sometimes referred to as "smart beta," are based on well-known and generally accepted factors, which can make implementation a distinguishing feature of success. Moreover, many style investors are long-only, a constraint that may lead to substantial portfolio distortions with suboptimal implementations.[1,2]

We specifically look at different ways of combining styles; hence, our focus is on investors who are interested in investing in more than one style. To frame our discussion, we consider an investor who already knows her preferred allocation across styles and how to define each style.[3] How might the multistyle portfolio be implemented? Perhaps the most obvious option is what we refer to as the *portfolio mix*, or building a portfolio by combining separate long-only portfolios for each individual style. This approach may seem appealing because it is simple and flexible, giving investors control over allocations across styles and allowing them to select different managers for different styles. An equally intuitive and simple approach is selecting a manager who will create an *integrated portfolio* by first building an aggregate ranking of stocks that includes all the styles the investor cares about and the investor's desired allocation across styles, and then using this ranking to build a multistyle, long-only portfolio in a single step. The two approaches can be implemented using indexes, ETFs, or active portfolios managed by investment managers.

We first demonstrate the differences in construction and resulting performance between the two approaches using a simple simulation framework. The simulations help to highlight the economic intuition for why integrating styles in portfolio construction is particularly appealing when individual styles are negatively correlated (as are momentum and value, or value and quality), when investors seek higher risk, or when they combine many different styles.

We next estimate how large such benefits may be in practice. We focus on value and momentum, two well-known styles, and analyze the efficacy of building multistyle portfolios using both the portfolio mix and the integrated portfolio approaches.[4]

Integrating styles leads to first-order improvements in performance. Even at moderate levels of active risk of around 4%, the integrated portfolio outperforms the portfolio mix by about 1% per year and delivers a 40% higher information ratio.[5] The portfolio mix, by construction, has returns that lie in between the returns that can be earned by

the individual long-only style portfolios. The integrated portfolio, in contrast, may earn average returns that are higher than the highest return of individual single-style portfolios. This initially surprising result, seen also in Frazzini et al. [2013], arises because integrated portfolios are able to achieve larger style exposures, which translate into substantially better investment returns.[6]

An additional, albeit smaller, advantage of the integrated portfolio construction is its potential to net trades. This benefit arises because separately managed stand-alone style portfolios may be simultaneously buying and selling the same stock, with no net exposure but with round-trip trading costs. We find that such netting may reduce turnover by as much as 5%–10% per year (one sided).

Our results suggest that long-only smart beta investors should consider integrating styles in portfolio construction. We expect the benefits from integration to be substantial in all but a minority of cases. Such cases may include very low active risk: we show that investors targeting sub-1% tracking error will end up with very similar portfolios whether they integrate styles or not. Similarly, investors who combine styles that are very highly correlated (e.g., a book–to–market factor and an earnings–to–price factor) may gain relatively less from integrating styles. For most settings, however, integration benefits are too sizable to be ignored.

MIX VERSUS INTEGRATION: WHAT DRIVES PERFORMANCE DIFFERENCES?

Simulation Setup

Before discussing the performance implications of the two approaches, we first need to define what we mean by the *portfolio mix* and the *integrated portfolio*. To illustrate these concepts, consider a manager interested in momentum and value (our discussion easily generalizes to more than two styles). For each stock in the investment universe, the manager can calculate the expected return forecasts based solely on momentum (ER_{mom}) or solely on value (ER_{val}). We assume that the manager has a consistent process that translates stock-level expected returns and the target level of risk (tracking error, or TE) into a long-only portfolio, $Portfolio(ER, TE)$, for example via mean–variance optimization with a long-only and possibly other constraints. Now we can define the two implementations, assuming the same risk target TE_{target}.

- To build the *portfolio mix*, the manager builds two separate *stand-alone style* portfolios, one using just the momentum expected returns, and the other using just the value expected returns.[7] Assuming the manager's preferred weight on momentum is w_{mom},

$$Portfolio_{Mix}$$
$$= w_{mom} \cdot Portfolio(ER_{mom}, TE_{target,mom})$$
$$+ (1 - w_{mom}) \cdot Portfolio(ER_{val}, TE_{target,val})$$

- For the *integrated portfolio*, the manager first combines information from both styles to form the overall expected return forecast for each stock,

$$ER_{integrated} = w_{mom} ER_{mom} + (1 - w_{mom}) ER_{val}$$

The manager then runs the portfolio construction process once:

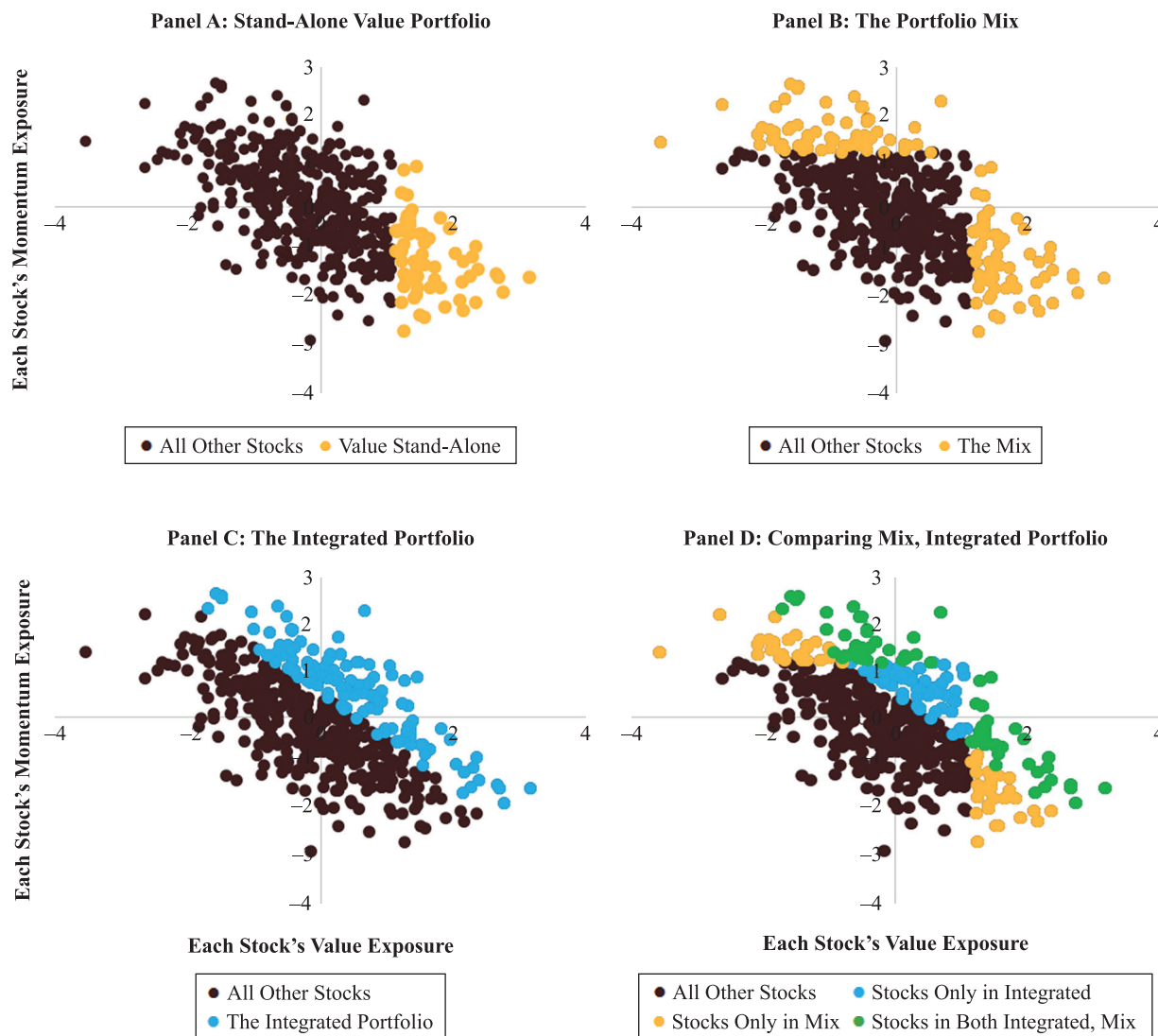$$Portfolio_{integrated} = Portfolio(ER_{integrated}, TE_{target,integrated})$$

This seemingly minor difference in portfolio construction can lead to major differences in portfolio efficacy and ultimately returns. At some level, this is not too surprising. When making any decision, it is more efficient to consider all available information at the same time rather than apply it piecemeal. In our context, if we build a constrained momentum portfolio that ignores any information from the value style, and a constrained value portfolio that ignores all information about momentum, then we are effectively handicapping ourselves by leaving relevant data out of both decision processes.

To get a sense for why these portfolios differ, it helps to walk through a straightforward example. For this, we run a simulation, generating random momentum and value expected returns (assuming a correlation of -0.6 between the two) for 500 stocks. We can then visualize the individual stocks as scatter points in Exhibit 1, with coordinates corresponding to the value exposure (ER_{val}) on the horizontal axis and the momentum exposure (ER_{mom}) on the vertical axis. Stocks that are most desirable, with highest exposures to both styles, are in the top right (northeast) corner. We assume for simplicity that the investor wants equal exposure to both styles (our analysis easily generalizes to any other desired allocation to the two styles).

Overlap and Differences in the Portfolio Mix and the Integrated Portfolio

Panel A: Stand-Alone Value Portfolio

Panel B: The Portfolio Mix

Panel C: The Integrated Portfolio

Panel D: Comparing Mix, Integrated Portfolio

Each Stock's Momentum Exposure

Each Stock's Value Exposure

- All Other Stocks   • Value Stand-Alone
- All Other Stocks   • The Mix
- All Other Stocks
- The Integrated Portfolio

- All Other Stocks   • Stocks Only in Integrated
- Stocks Only in Mix   • Stocks in Both Integrated, Mix

Notes: We use a random number generator to simulate 500 stocks with exposures to momentum and value, and build the portfolio mix and integrated port-folios that each hold 25% of stocks. The plots, going clockwise from top left, highlight stocks in a stand-alone value-only portfolio (highlighted in yellow in Panel A); stocks in the portfolio mix (the combination of momentum and value; yellow stocks in Panel B); stocks in the integrated portfolio that builds an equally weighted composite of value and momentum exposures (blue stocks in Panel C); and differences in the stocks in the integrated portfolio and in the portfolio mix (Panel D). In this last panel, stocks that are held only in the integrated portfolio are depicted in blue, stocks that are held only in the combination of stand-alone value-momentum portfolios are depicted in yellow, and stocks common to both approaches are in green (a blend of yellow and blue).

We begin with a very straightforward thresholding rule: we consider long-only portfolios that only hold stocks with highest style exposures (in later sections, we consider fully optimized portfolios). For example, the stand-alone value portfolio would only contain stocks with a high enough ER_{val}—stocks highlighted in yellow in Exhibit 1, Panel A. Similarly, the portfolio mix that combines value and momentum invests only in those stocks that have either high enough ER_{val} or high enough ER_{mom}. Graphically, these stocks are highlighted in Exhibit 1, Panel B. We build the mix so that it captures 25% of the total number of stocks. This means that the two stand-alone style portfolios hold relatively fewer stocks, which could be interpreted as running them at a higher TE target.

The integrated portfolio is based on a forecast of returns that takes both styles into account. This measure tilts toward stocks that look favorable on both factors, away from stocks that look unfavorable on both, and will be neutral on stocks where the styles disagree and offset one another. Exhibit 1, Panel C highlights in blue stocks with the highest overall return forecast, defined simply as the average exposure to the two styles. We chose the top quartile of stocks on this metric, such that the integrated portfolios in Exhibit 1, Panel C and the portfolio mix in Exhibit 1, Panel B hold the same number of stocks (in our simulations, this is equivalent to the portfolios having the same TE).

These simple graphical illustrations highlight important differences between the mix and the integrated portfolio. If a stock makes it into one of the stand-alone style portfolios, then it is held in the portfolio mix, even if it has a strong negative exposure to the other style. Thus, the mix may hold securities that have low or even negative overall expected returns because of style disagreement. We plot these "mix only" stocks in yellow in Exhibit 1, Panel D. Conversely, the "integrated only" stocks, plotted in blue, are held in the integrated portfolio even though they are in neither the momentum nor the value index. These are stocks that look decent according to both factors, even though they do not have a high-enough style exposure to justify inclusion in a stand-alone style portfolio. A simple example here would be a stock that is cheap, although not among the cheapest, and that has had some positive momentum, although not so strong as to make that stock too expensive. Finally, both portfolios hold stocks, marked in green (i.e., yellow and blue overlapped), that have high exposure to one of the styles and are at least reasonably attractive on the other style as well. The punchline is that the integrated portfolio can better identify stocks with attractive returns and avoid stocks with inferior expected returns.

What Do Integration Benefits Depend On?

The earlier example suggests that the integrated portfolio leads to more efficient style exposures than those of the portfolio mix. The next step is to gauge (i) the magnitude of the efficiency gain we should expect, and (ii) what situations will lead to this choice being more/less important. In particular, we will show that the performance differences are larger when

- the combined styles are negatively correlated, everything else equal;
- investors target relatively higher tracking error (TE), everything else equal; and
- more individual styles are being combined, everything else equal.

We demonstrate this through simulation, choosing reasonable baseline parameters and then illustrating the impact as we vary one parameter (e.g., the correlation between styles) while keeping other parameters constant. For simplicity, we assume that individual stocks have the same volatility (30%) and that they are uncorrelated beyond their style exposures. We further assume that the two styles are equally attractive, meaning that exposure to either style earns the same compensation. With these assumptions, we simulate our 500-stock universe and define the benchmark to be a portfolio that puts equal weight on every stock in the universe.

As discussed previously, for the portfolio mix, we build stand-alone style portfolios by running separate optimizations for each style. Since we assume equal style efficacy, we mix the styles using the simple average of the underlying stand-alone style indexes.[8] The construction of the integrated portfolio is a one-step procedure, optimizing the portfolio on its aggregated ERs from all styles.

Correlation. With these assumptions, we can assess how variations in the parameters change the attractiveness of the mix and of the integrated portfolio. The first quantity we focus on is the correlation between the two styles. We keep a consistent TE target (2.5%) and simulate two styles with ER correlation varying from −0.9 to 0.9. To meaningfully compare portfolios across these scenarios, we need to normalize the attractiveness of the styles for each value of the correlation. For example, if we simply decreased the correlation between styles without changing style attractiveness, the increased diversification between styles would make all implementations more attractive. Thus, to make the comparisons cleaner, in all simulations we normalize the expected returns of individual styles such that the Sharpe ratio of an ideal long–short view (i.e., a completely unconstrained portfolio that fully incorporates all information the manager has) is 1.0. Exhibit 2, Panel A shows how the correlation affects portfolio information ratios.

EXHIBIT 2
Integration Benefits Increase When Correlation between Styles Is Low
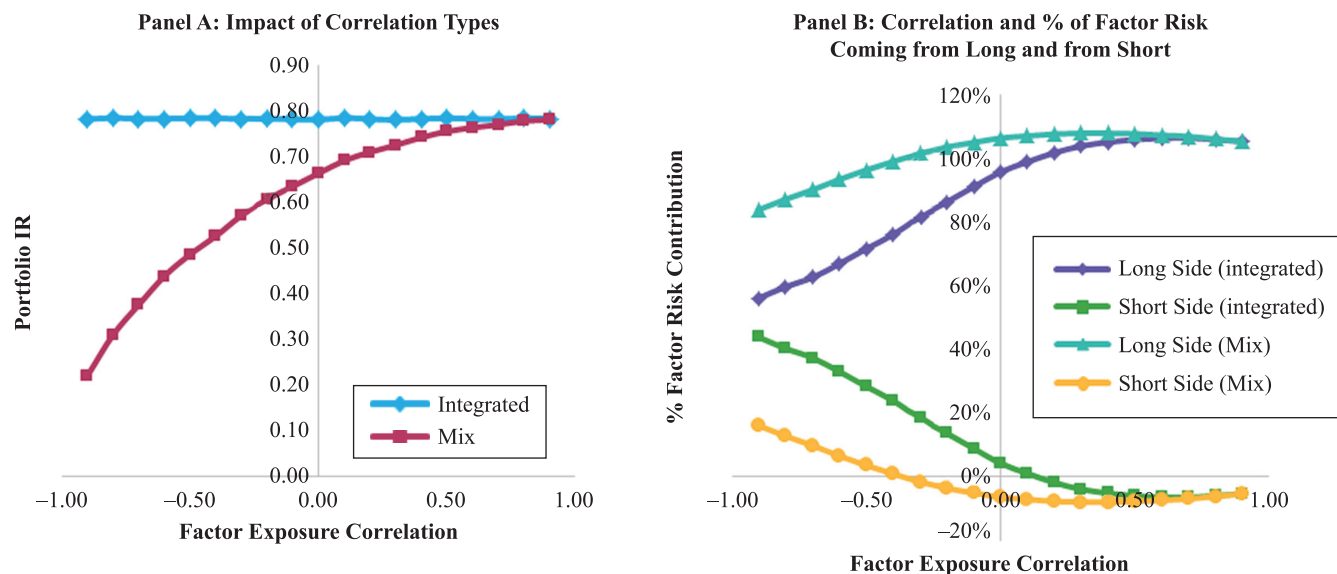
Panel A: Impact of Correlation Types

Panel B: Correlation and % of Factor Risk Coming from Long and from Short

Notes: We use a random number generator to simulate 500 stocks with exposures to momentum and value and build long-only portfolios that target individual styles (optimized on single-style exposures), a portfolio mix that equal-weights stand-alone style portfolios, and the integrated portfolio optimized on the aggregate score of stocks across both styles. Panel A shows how the information ratio of these portfolios depends on the correlation between styles, while Panel B presents the fraction of risk coming from stocks the styles find attractive and unattractive (the long- and the short-side of the theoretical view), as a function of the correlation between styles. In each of the scenarios we consider, the attractiveness of styles depends on the simulation parameters (here, the correlation between styles). For comparisons to be meaningful, for each simulation we normalize the parameters so that the theoretically ideal long–short portfolio incorporating the two styles has a Sharpe ratio of 1.00.

First, the portfolio construction choice appears to be a first-order decision. Over much of the parameter space, the integrated approach delivers substantially larger information ratios than the portfolio mix.

Second, the benefits of integration are particularly high when style correlation is negative. Stand-alone style portfolios are then more likely to hold stocks with offsetting exposures, neutralizing the benefits of the two styles. As the correlation increases, stocks selected on their exposure to one factor are increasingly likely to have a positive exposure to the other style as well. At the extreme, when the correlation reaches 1.00, the two styles are perfectly overlapping and the portfolio mix and the integrated portfolio become identical. Recall that for the simulations presented in Exhibit 1, the correlation in exposures was assumed to be −0.6, which is broadly consistent with empirical data on momentum and value. Given this level of correlation, integration generates an information ratio that is about twice as high as that of the portfolio mix. The benefits will be lower for styles that are less strongly negatively correlated (e.g., quality

and value), but will remain sizable even for styles with zero-to-low positive correlation. We can pinpoint one specific reason why the information ratio increases so much. Exhibit 2, Panel B plots the contribution to portfolio risk from the long and the short side of the two styles. In the ideal implementation, a long–short style portfolio would not only invest in stocks with high ER, but could also short stocks with low ER. Of course, that is impossible for long-only portfolios. Since these portfolios can at most underweight stocks with low ER, we can expect them to derive most of their risk from the long side of styles. The exhibit indeed shows that views on which stocks are attractive drive well over half of portfolio risk for both approaches we consider. However, views on unattractive stocks (the short side of the view) are much better reflected in the integrated portfolio than in the portfolio mix. In fact, when the two styles are close to perfectly negatively correlated, the contribution of the short side reaches 50% for the integrated portfolio, close to the theoretical ideal.[9] This is related to our earlier discussion of how the integrated portfolio avoids

buying stocks that look good on one dimension but have an offsetting exposure to the other style. Integration avoids such problematic offsets precisely by taking into account information from the styles' short sides that is being ignored in the mix construction.

Concentration. We next investigate concentration, or the level of risk targeted in the portfolio. We simulate the two styles with an ER correlation of −0.6 and build portfolios across a range of TE targets (0.2%– 4.0%). Exhibit 3 indicates that the higher the target tracking error, the lower the IR of both the mix and the integrated portfolio. The decrease is a consequence of the long-only constraint. At very low levels of the tracking error, the constraint is not binding as all desired underweights are smaller than the respective stocks' benchmark weights and thus can be easily implemented in a long-only format. Consequently, the attractiveness of the portfolio mix and the integrated portfolio is very similar for low values of TE. However, as target risk increases, long-only portfolios that seek higher risk need to become increasingly concentrated, distorting the active portfolio further and further away from the ideal long/short view. This distortion disproportionately hurts the portfolio mix, as it is imposed multiple times (once for each individual style portfolio, versus only once for the single integrated optimization).

While we focused here on a particular type of long-only portfolio implementation (selecting the highest expected return stocks in the universe subject to portfolio constraints whether through an optimization or simple thresholding rule), the benefits of integration would also accrue to other types of long-only portfolio constructions—for example, a portfolio that holds all the stocks in the universe, but whose tilts away from the cap-weighed benchmark are informed by the signal. Furthermore, integration would also benefit, albeit to a lesser extent, a relaxed-constraint or long–short multistyle portfolio subject to trading or risk management constraints. The larger the distortion needed to satisfy the constraints, the more important it is to use all available information in portfolio construction decisions, leading to a widening advantage for the integrated implementation.[10]

Number of styles. Finally, our examples so far were based on two styles only. In practice, investors may be interested in a larger number of styles—for example, managers such as AQR and Goldman Sachs offer multistyle strategies that combine value, momentum,

EXHIBIT 3
Integration Benefits Increase When Investors Seek More Active Risk
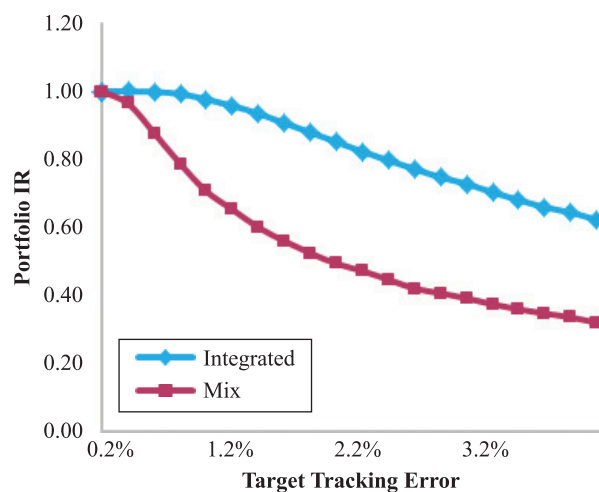
Notes: Using the same simulation framework as in Exhibit 2, we compare the IRs of the integrated portfolio and the portfolio mix as a function of the target TE.

quality, and low beta/volatility, while MSCI offers multistyle products that combine value, momentum, size, and quality. Thus, we simulate a varying number of (equally effective) styles, assuming for simplicity that they are uncorrelated to one another, and build portfolios targeting a consistent 2.5% TE (we again normalize the attractiveness of styles, as in the earlier section on correlation). Intuitively, the benefits of integration should be greater when the number of the underlying styles is larger. For example, with more styles, it is more likely that a single-style portfolio includes stocks with unattractive exposures to at least one of the remaining styles. Exhibit 4 confirms that conjecture: the integrated portfolio is increasingly attractive relative to the mix when the number of styles increases. For a portfolio taking 2.5% active risk, integrating three uncorrelated styles generates a 33% IR improvement versus a simple mix, and integrating six to seven styles doubles the IR.

Overall, we've highlighted a number of dimensions that influence how impactful style implementation is for the investor. The arguments we discussed hold in general, not only for the specific choices we made in the simulation. In particular, they hold for both the fully optimized portfolios and for simpler cutoff-based portfolios. In fact, we expect similar effects to arise more

Exhibit 4
Integration Benefits Increase When Investors Combine More Styles
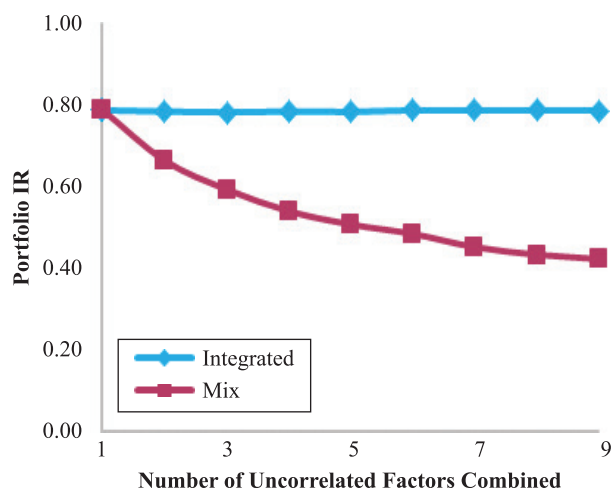
Notes: Using the same simulation framework as in Exhibit 2, we compare the IRs of the integrated portfolio and the portfolio mix as a function of the number of factors (investment styles) that are being combined in the portfolio. For this simulation, we assume individual factors are uncorrelated.

generally for any portfolio subject to constraints. Even fully fledged long–short portfolios may have constraints on leverage, positions in individual securities, or sectors, and so on. These constraints will distort the portfolio away from the theoretically ideal view. Combinations of single-style portfolios similar to the mix approach effectively suffer these distortions every time a stand-alone portfolio is constructed. In contrast, the integrated construction with its single optimization only distorts the portfolio once.

HOW LARGE ARE INTEGRATION BENEFITS IN PRACTICE?

We estimate the benefits of integration using the same two styles that we used for our simulation above: value and momentum. We build realistic simulations of long-only equity portfolios that seek exposure to these styles, incorporating trading costs and typical risk management considerations such as sector exposure constraints.

Since the focus of this article is implementation, we employ the simplest and most popular signals for the two styles: for momentum, returns over the past year, skipping the most recent month; for value, the book-to-price ratio. These are arguably the best-known signals for the two styles, and they have been thoroughly vetted in the academic literature; for example, Fama and French [1992, 1993], for value, and Jegadeesh and Titman [1993], and Asness [1994] for momentum. We use the same signal construction as Asness et al. [2015] but build long-only instead of long–short portfolios.[11] Our hypothetical portfolios are based on liquid, large stocks in developed countries (roughly the MSCI World benchmark universe) over the period from February 1993 to December 2015. To minimize any unintended differences between the two implementations, we use identical style signals, the same weighting scheme across styles, and similar optimization methodologies. Both implementations weight the value and momentum styles at 50% each, a weighting scheme designed to provide a balanced contribution to risk from each style. All portfolios are rebalanced monthly.

Exhibit 5, Panel A presents the realized performance and efficiency characteristics of the long-only integrated portfolio relative to the simple mix and to the stand-alone single-style long-only portfolios. Importantly, the two alternative multistyle implementations are intentionally managed to take similar tracking error of 4% per year.

Despite using identical signals and providing similar levels of active risk, the integrated portfolio outperforms the simple mix across every performance metric. Exhibit 5, Panel A shows that the annualized average excess return versus the benchmark, impressive as it is at 2.5%, for the portfolio mix, is dwarfed by the 3.6% excess return of the integrated construction. The difference in realized returns translates into an increase in information ratio from 0.6 for the portfolio mix to 0.9 for the integrated portfolio, a substantial 40% improvement.[12] These differences are economically meaningful and highly statistically significant. As we discussed earlier, the negative correlation between the two styles we consider here, value and momentum, contributes to the magnitude of the differences, but we would still expect to find substantial benefits of integration for styles that are not as highly negatively correlated (e.g., value, quality, and size), particularly when more than two styles are combined.

Perhaps a subtle point is that by construction, the style mix will have better returns than the worst-performing style, but will lag the best-performing style

Comparing Performance of the Portfolio Mix and the Integrated Approach

Panel A: Portfolio Mix versus Integrated Portfolio: Performance Summary

	Value Stand-Alone	Momentum Stand-Alone	Portfolio Mix	Integrated Portfolio
Excess Return	1.7%	3.4%	2.5%	3.6%
Tracking Error	7.9%	7.7%	4.1%	4.1%
Information Ratio	0.21	0.44	0.62	0.87
Transfer Coefficient	0.67	0.69	0.28	0.59
Portfolio-Model Correlation	0.25	0.18	0.11	0.32

Panel B: Various Groupings of Stocks: Alphas versus the Cap-Weighted Market

	Yellow Stocks (mix only)	Blue Stocks (integrated only)	Green Stocks (in both portfolios)
Average number of stocks	253.6	178.3	164.1
Alpha to MSCI World	1.4%	3.2%	4.2%
t-statistic	(0.96)	(3.09)	(3.67)
Average weight in the respective portfolio	52%	45%	

Notes: Panel A compares excess returns vs. the MSCI World (net) benchmark, tracking error, and information ratio (all net of estimated transaction costs but gross of management fees) for the stand-alone value and momentum portfolios and for the mix portfolio that combines them, as well as for the integrated style portfolio that integrates these two styles in portfolio construction. We also present the transfer coefficient (ex ante return correlation between the portfolio and a model) and the correlation between the portfolio and model weights, vs. both the respective underlying model views (e.g., value only for the stand-alone value, or the multistyle value–momentum model for the portfolio mix and the integrated portfolio). Portfolios are built over a universe similar to MSCI World, over the sample of February 1993 to December 2015. In Panel B, we compare the performance of different groups of stocks presented in Exhibit 1, Panel D: yellow stocks held only in the index mix (i.e., in one of the stand-alone style portfolios, but not in the integrated portfolio), blue stocks held only in the integrated portfolio, and green stocks held in both the integrated portfolio and the portfolio mix. We report the average number of stocks in each group, the alpha of the equal-weighted portfolios of these stocks vs. the MSCI World (net) benchmark, and the weight of a given group of stocks in its respective portfolio.

in the mix over any given period.[13] In our historical backtest, as indicted in Exhibit 5, the portfolio mix posted better average returns than value, but lagged momentum. Impressively, the integrated approach not only outperformed the portfolio mix, but also out-performed either of the two stand-alone single style portfolios.

We can map these large return differences back to our theoretical reasoning in the prior section. We can attribute performance to the three groups of stocks we highlighted in Exhibit 1, Panel D: the stocks held in the integrated portfolio but not in the stand-alone style portfolios, the stocks that appear in the stand-alone style portfolios but not in the integrated portfolio, and the stocks common to both approaches. Exhibit 5, Panel B shows that the portfolio of stocks that are unique to the integrated portfolio (the blue stocks in Exhibit 1, Panel D) earn a substantial alpha to the market, 3.2% annualized and highly statistically significant (*t*-stat = 3.1). In con-

trast, stocks that are held only in the mix (the yellow stocks in Exhibit 1, Panel D) have a much smaller alpha of 1.4% that is statistically insignificant (*t*-stat = 1). (The reported alphas are equal-weighted; portfolio-weighted results are very similar.) This confirms that stocks with balanced, positive exposures to both styles realize higher excess returns on average and hence are better bets than stocks that may have an extreme exposure to one style, but at best modest exposure to other factors.

The integrated portfolio differs not only in which stocks it holds, but also in the weight it assigns to its holdings. Most vividly, over half of the weight of the portfolio mix (52%) is in the yellow stocks in Exhibit 1, Panel D, whose excess returns are least attractive. Thus, the portfolio mix not only includes stocks with less alpha, but also assigns a disproportionately large weight to such stocks. In contrast, the integrated approach avoids stocks with insignificant alpha (the yellow stocks) and extends the pool of attractive stocks (the blue stocks in

Exhibit 1, Panel D). This suggests that the main benefit of integration comes from improved capture of the underlying styles, as opposed to somehow identifying stocks with strictly better performance than those shared in the two approaches.

To further substantiate this claim, Exhibit 5 also shows the transfer coefficient and the correlation of active weights between each portfolio and its corresponding ideal, unconstrained long–short underlying view.[14] Higher values for these metrics correspond to more efficient signal implementation. The transfer coefficient for the integrated approach (0.6) is twice higher than that of the portfolio mix (0.3). Similarly, the active portfolio correlation to the long–short model view is three times higher for the integrated approach than for the mix approach. Interestingly, the transfer coefficient and portfolio-view correlation of the integrated approach are similar to those of the stand-alone style portfolios, further confirming that the drawbacks of the portfolio mix construction are attributable to its two-stage approach to portfolio implementation.[15]

Finally, the mix and integrated implementation generate portfolios that are meaningfully different from each other. In Exhibit 5, we focus on portfolios with the active risk of about 4%. For these portfolios, the annualized realized tracking error between their return series is 3.2% and the correlation of their monthly active return is just 0.53. Not surprisingly, the portfolios are even more dissimilar at higher active risk targets.

Targeting Higher Risk

Our prior discussion suggested that the portfolio mix becomes increasingly unattractive at higher levels of risk. To verify this, we build a frontier of integrated and mix portfolios, comparable in terms of their realized active risk, with realized TE from 1% to about 6%. We present the results in Exhibit 6, focusing both on ex ante improvements (Panel A, the transfer coefficient mentioned earlier) as well as improvements in realized performance (Panel B, the information ratio).

Achieving high levels of active risk is generally difficult for optimally diversified multistyle portfolios. However, it is considerably more challenging for the portfolio mix approach, as the separate style portfolios need to target increasingly higher levels of active risk. For example, for the portfolio mix to realize TE of 4%, the style stand-alone portfolios need to target TEs above 7%.[16] Targeting such a high TE induces substantial portfolio distortions away from the unconstrained long–short view. Consequently, the transfer coefficient of the portfolio mix drops from about 0.7 at 1% TE to 0.2

E X H I B I T 6
Ex ante and Realized Benefits of Integration as a Function of Target Tracking Error

Panel A: Ex ante Improvements: Transfer Coefficient

Panel B: Realized Improvements: Information Ratio
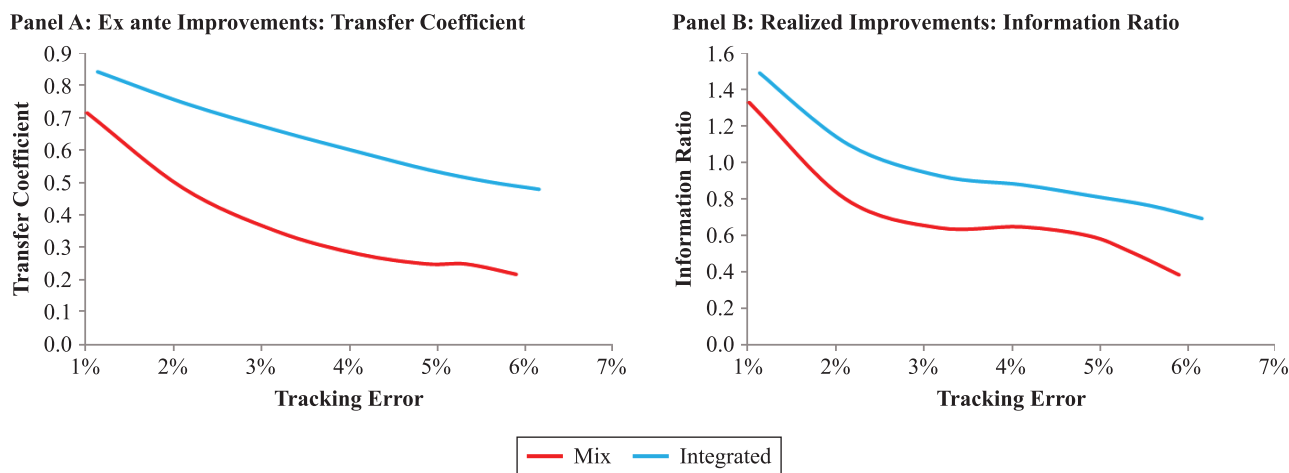
Mix   Integrated

Notes: Panel A shows the transfer coefficient (the ex ante, risk model–based correlation between portfolio returns and the return of the underlying model view) of the portfolio mix and the integrated portfolio that seeks exposure to value and momentum at different levels of realized tracking error. Panel B depicts the realized information ratio of these portfolios, again as a function of realized tracking error. Portfolios are built over a universe similar to MSCI World, over the period of February 1993 to December 2015. Information ratio is net of estimated transaction costs.

toward the higher end of the risk frontier. In contrast, the transfer coefficient of the integrated approach is not only higher at each TE target, starting from 0.8 at the 1% TE, but also decreases more slowly as risk increases, to about 0.5 at higher TE levels.

Improvements are also readily apparent ex post. Exhibit 6, Panel B shows that the difference in realized information ratios is relatively small at low TEs—the integrated approach outperforms by 12% (1.33 versus 1.49) at 1% TE. The gap triples to 36% (0.64 versus 0.87) at 4% TE target, and becomes even wider at higher risk targets (e.g., 49% for 6% TE). Empirically the gap shrinks slightly around 4% TE, which we ascribe to noise in our data; even so, the improvements from integration are already sizable in this TE region.

Turnover Netting

In addition to the performance implications we discussed earlier, integration of styles may improve trading efficiency. Rebalancing the portfolio mix could potentially involve selling a stock from one of the stand-alone style portfolios and buying the same stock in the other one. For example, a stock that is rapidly increasing in price could fall out of the value portfolio because it becomes too expensive, but could be included in the momentum portfolio precisely because of its price appreciation.

To assess how important this turnover netting may be, we compute the difference between the weighted average realized turnover of the stand-alone value and momentum portfolios and the turnover of a similarly weighted, combined portfolio of the two styles that first nets trades across the styles before going to the market. These savings will depend on portfolio constraints, particularly constraints on turnover and active risk. Not surprisingly, turnover savings are modest when overall turnover is constrained to be very low. The savings increase with the turnover constraint, reaching 5% one-sided for portfolios with annual turnover of around 100% and 10% one-sided for turnover unconstrained portfolios. That last number means that in the average year, the portfolio mix buys 10% and sells 10% of its net asset value (NAV) in identical stocks, paying transaction costs and potential taxes on each side but without any change in style exposures at the overall portfolio level. Generally, such turnover savings from netting are larger for portfolios that include a larger number of weakly correlated styles as well as for portfolios that target lower active risk. The net returns implications of the avoidable turnover depend on the trading costs that the portfolio manager faces. Perhaps surprisingly, we find transaction cost savings to be an order of magnitude lower than the alpha capture gains, although their impact would still be sizable for small-cap and emerging multistyle portfolios that face higher transaction costs.[17]

CONCLUSION

We investigate two popular approaches to long-only style investing that are often considered as potential starting points for smart beta investors: the *portfolio mix* that builds a style portfolio from stand-alone style portfolios and the *integrated portfolio* that integrates styles directly in the portfolio construction process.

Our key finding is that integrating styles in long-only portfolio construction has a first order effect on performance, generating benefits by avoiding stocks with offsetting style exposures and including stocks with balanced positive style exposures.

Empirically, integration improves excess returns by about 1% per year and increases the information ratio by 40% relative to the portfolio mix. These magnitudes are substantially larger than any plausible differences in headline fees between the two approaches. This means that when fees are evaluated per unit of return, the integrated approach is likely to be meaningfully more attractive to investors.

Importantly, the benefits, large as they are, do not mean that the portfolio mix will always lag the integrated portfolio. It is less attractive, on average, but there may be periods when it outperforms. Ironically, such periods are likely to coincide with poor performance of the styles the portfolios are tracking. Since the integrated portfolio gives investors a more efficient exposure to these styles, it can be expected to underperform the mix when the styles themselves disappoint.

Finally, there are specific portfolio needs that may entice investors to invest in a portfolio mix (or, indeed, in a stand-alone style portfolio). For example, some investors may prefer to hire different managers for different styles. For others, monitoring and performance may be easier with stand-alone styles or with their mix. Finally, some may want to time styles by dynamically changing the weights to the stand-alone style portfolios. Our results suggest that such considerations would need

to be very important for investors to offset the direct performance benefits from integrating styles in long-only portfolio construction.

At a minimum, these results quantify the opportunity costs of using single styles, helping investors assess whether these other considerations are worth it.

ENDNOTES

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[1]Many papers address high-level implementation decisions (e.g., combining multiple styles versus a single style; long–short versus long-only strategies; etc.), but fewer studies delve deeper into implementation. Israel, Jiang, and Ross [2015] review the range of implementation choices style investors may consider. Hunstad and Dekhayser [2015] analyze how efficiently style portfolios reflect their underlying styles. Using a different framework, Clarke, de Silva, and Thorley [2015] and Bender and Wang [2016] address a similar question as we do, and also show that constructing a portfolio from factor subportfolios appears to be an inferior implementation choice.

[2]Implementation has been identified as a key driver of performance also in the broader context of actively managed portfolios. For example, Jacobs, Levy, and Starer [1999] pointed out that combining two separate portfolios is suboptimal and wrote that "the real benefits (…) are released only by an integrated approach." Jacobs and Levy [2006] rely on similar arguments to demonstrate the attractiveness of relaxed constraint portfolios. On a related note, Guerard, Markowitz, and Xu [2013] show that combining multiple signals into a composite indicator help identify potentially mispriced stocks.

[3]We take these choices as given, as there are already many excellent papers that discuss them. A sample from this large and growing literature may include Watson Wyatt [2007] (one of the first studies to propose what it termed "beta prime," and what became known as "smart beta"), Chow et al. [2011], Amenc, Goltz, and Martellini [2013], Blitz et al. [2014], or Kahn and Lemmon [2014]. We focus on equity applications here, as style investing is increasingly prevalent in this space.

[4]The value style favors investments that appear cheap based on their fundamental measures relative to price. The momentum style favors investments that have performed relatively well over the medium term. The two styles are strongly negatively correlated which, as we will discuss, influences the benefits of integration.

[5]The returns of the hypothetical portfolios discussed in this article are net of estimated transaction costs but gross of fees and are computed over February 1993 to December 2015. Please see the upcoming section on the benefits of integration for details on the construction of these portfolios.

[6]We estimate these benefits in a simple setting with only two styles, one signal per style, and very simple optimization. This deliberate simplicity likely understates potential gains from integration. Indeed, we found that combining three styles (value, momentum, and defensive) using a richer set of signals per style doubles the excess returns and the information ratio of the integrated portfolio relative to the mix. The tests, which use the same sample of stocks as the results presented in this article, are available from the authors upon request.

[7]Note that the TE target for the stand-alone styles needs to be larger than the intended target for the multistyle portfolio mix due to diversification between the styles.

[8]We run a standard mean–variance optimization, maximizing expected returns for a given TE target, and imposing the no-shorting and full-investment constraints (the results are very similar for simple cutoff-based portfolios). One challenge here is that there is no simple analytical mapping between the stand-alone style portfolio TE targets and the resulting combined portfolio TE. As a result, we have to calibrate the stand-alone style TE target so as to arrive at an apples-to-apples (i.e., matched TE) comparison versus the integrated portfolio.

[9]We note that for high correlations, the contribution from the short side actually becomes negative. We estimate the contribution using a simple regression that relates active portfolio bets to the long and short sides of the model. In other words, we are modeling a nonlinear phenomenon (optimization with a long-only constraint) in a linear setting, which may lead to some estimation biases. We expect such biases to affect the portfolio mix and the integrated portfolio similarly and not change the direction of the effect (i.e., integration capturing more risks from the short side).

[10]We note that this effect is not nearly as pronounced for long–short portfolios, which can increase risk by adjusting leverage rather than adjusting the actual portfolio holdings.

[11]Asness et al. [2015] deploy 80% of their active risk budget within industry and 20% across industries, motivated by, for example, Asness, Porter, and Stevens [2000]. We use the same approach for comparability.

[12]The improvement, sizable though it is, is smaller than what we found in the earlier section on the portfolio mix versus integrated portfolio. This is because we now account for estimated transaction costs and, unlike in the simulation, where we assumed we knew style exposures for each stock, we are estimating exposures from the data, etc.

[13]Frazzini et al. [2013] make a similar point in their paper. The portfolio mix is the weighted average of the long-only style portfolios it invests in, and hence its return is a weighted average of the returns of its components.

[14]The transfer coefficient is the ex ante (risk model–based) correlation between the portfolio return and the return on the theoretical long–short view. The correlation of active weights captures the similarity of the long-only portfolio's active weights to the weights of theoretical long-short view.

[15]High transfer coefficients indicate stand-alone style portfolios are relatively easier to implement, for example, require lower turnover or lower leverage of the ideal long–short view to reach a given level of TE. Of course, they poorly capture the full multistyle model, with transfer coefficients of only 0.1–0.2 and portfolio correlations below 0.2.

[16]The inability to target active risk directly at the overall portfolio level also results in larger time-varying realized active risk in the simple mix, which typically hurts portfolio performance.

[17]For a more detailed discussion of transaction costs, please see Frazzini, Israel, and Moskowitz [2015]; for a discussion of tax efficiency of styles, please see Israel and Moskowitz [2013].

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