

P E R S P E C T I V E

Looking for the Intuition Underlying Multi-Factor Stock Selection

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After a very tough 2018 for many quantitative strategies, particularly in market-neutral stock selection,¹ one hurdle many investors face is getting some basic intuition about results, and even more elementary, about what one actually owns in such a portfolio. This matters as the more intuitive something is the easier it is, all else equal, to stick with it. I can't fully fix this problem. A multi-factor process, by design, lacks simple one-liner explanations. Frankly, that's much of the idea of diversifying across factors and stocks. But, while I can't fix this completely, I do hope I can help.

I'm going to use a very simple two-factor quantitative model. To [nobody's surprise](#) I choose one value factor and one momentum factor for this example. Whenever I use a simple model for exposition I get paranoid that readers will think this is the state of our art. It's not. It's just two of our family of factor types (i.e., value and momentum but not low risk or quality or fundamental momentum or factors based on "big data" and other more subtle relationships) and it uses only one indicator for each.² The measure of value I'm using is enterprise value-to-sales and the measure of momentum I'm using is one-year prior return.³ In both cases I measure the factor "intra-industry," meaning a cheap stock is one cheaper than its industry peers and vice versa (same for momentum). This is a small nod towards how we do it in real life, but only a small and imperfect one.⁴ This is still only an illustrative model – though I think the intuition it supplies generalizes well.

First, I'm going to form equal-weight portfolios.⁵ Given this weighting scheme, I run the risk of studying expensive-to-trade and expensive-to-short stocks making the results potentially unrealistic. To address this, I examine a universe of only the approximately 1,000 largest / most liquid U.S. stocks.⁶ I also look only at gross returns. How much you can capture after trading costs is an important and [fascinating](#) topic, but not today's topic.

Next, I form a value long-short portfolio by going long the 1/3 of stocks in my universe with the lowest enterprise value-to-sales (vs. their industry) and short the 1/3 most expensive, rebalanced monthly. I do the same for one-year trailing momentum. Finally, I form a combination portfolio that ranks all stocks separately on both the valuation and momentum measures, averages the ranks, and goes long the 1/3 with the best average rank and short the 1/3 with the worst.

Some results.⁷

Hypothetical Long-Short Portfolio Return Summary 1980-2018

Long-Short Portfolio	Return over Cash (%/yr)	Volatility (%/yr)	Sharpe Ratio	Monthly Correlation to the Market
Value	4.5	7.2	0.63	0.13
Momentum	2.9	9.8	0.29	-0.23
Combo	6.1	5.0	1.23	-0.20

Source: AQR. For illustrative purposes only. Not representative of an actual portfolio AQR manages. Hypothetical data has inherent limitations, some of which are described in the disclosures. This hypothetical performance does not reflect the deduction of any trading or management fees, which as mentioned, would further reduce the actual return. Market portfolio is represented by the Rm-Rf described in the Fama/French Factors. Please see important disclosures at the end of this document.

The value long-short portfolio has delivered 4.5% gross-of-fees and costs over cash with 7.2% annual volatility for a Sharpe ratio of 0.63. Its monthly correlation with the market portfolio (from [Ken French's website](#)) is 0.13. So, pretty darn market neutral. Doing the same for momentum you find a return of 2.9% over cash with 9.8% annual volatility for a Sharpe ratio of 0.29 (and market correlation of -0.23).⁸

You know what's coming right? (Well, you do if you read the table!) The stand-alone value and momentum market-neutral portfolios are -0.71 correlated over this 1980-2018 period (using monthly returns). Forming the portfolio on the average of the two factor ranks leads to a long-short portfolio delivering 6.1% over cash with 5.0% annual volatility or a Sharpe ratio of 1.23 with a correlation to the long-only market of -0.20. Such is the power of diversification.

So, everyone would greatly prefer the combo portfolio (1.23 Sharpe ratio and higher total returns,⁹ either stand-alone good, but still vastly inferior, single factor portfolios, right? Well, I hope so. But let's consider the intuition that jumps out at you from each and how easy it will be to stick with each (again, they are connected as strong intuition really helps stick-to-it-ness!) before deciding.

To start, let's examine the characteristics, not just the returns, of the long-short portfolio formed on value.

Hypothetical Value Long-Short Portfolio Average Characteristics

1980-2018

	Enterprise Value-to-Sales	Price Momentum (%)
Long side (Top 1/3)	1.4x	9.3
Short side (Bottom 1/3)	6.0x	23.4

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The enterprise value-to-sales of the expensive 1/3 (i.e., the shorts) is 6.0x. For the cheap 1/3 (i.e., the longs) it's 1.4x. The ratio of 6.0 over 1.4 is 4.3. So, on this measure, the shorts are 4.3 times more expensive than the longs. Of course, being pure value comes with a cost. The long cheap 1/3 has an average one-year momentum of positive 9.3%, but the short expensive 1/3 has an average momentum of 23.4% for a difference of 14.1% in the wrong direction (the value portfolio is fighting the momentum effect).¹⁰ All of this is intuitive and the behavior of this portfolio will generally match that intuition. In a very big year for value in general (measured in any reasonable way), it is almost guaranteed to rise. When it goes up and down, it will correspond strongly and intuitively to what most are observing in the market about how the "expensive glamour stocks" are doing against "cheap turnaround stories." Your portfolio results will, for good or bad, feel right compared to what you're watching on cable financial news (though why you're watching that we don't know!). But, of course, all this simple intuition gets you a 0.63 gross Sharpe ratio.

Next, let's similarly examine the pure momentum long-short portfolio.

Hypothetical Momentum Long-Short Portfolio Average Characteristics

1980-2018

	Enterprise Value-to-Sales	Price Momentum (%)
Long side (Top 1/3)	3.7x	42.9
Short side (Bottom 1/3)	2.5x	-10.1

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The long 1/3 (best momentum) averages 42.9% on the prior year return score (yeah, it's huge, but that's what we sorted on). The short (worst momentum) averages -10.1%, for a 53% spread in momentum from the longs to the shorts. Of course, momentum has the opposite problem to value. It's expensive. The high momentum 1/3 of the universe (the longs) had an average enterprise value-to-sales of 3.7x while the low momentum 1/3 (the shorts) came in at 2.5x. So the high momentum longs averaged about 1.5 times more expensive than the low momentum shorts. Clearly neither the pure value nor the pure momentum portfolio can have all good things (i.e., good value and momentum). But the pure momentum portfolio will also be very intuitive. When it's up, it will very likely be when you're hearing and reading about the high flyers continuing their high flying (and vice versa when they "crash to earth"). In this case, this easy intuition comes with a Sharpe ratio of 0.29.

As we know, the combo long-short portfolio is way better than stand-alone value or momentum (as reported in our backtests here; but we think the evidence for this, in much broader backtests and through many years of real life trading, is [staggering](#)). As we saw above, the combo delivers about double the Sharpe ratio of the better of the two stand-alone portfolios with the same near zero (actually slightly negative) correlation to the long-only market and more return per dollar of the long-short portfolio. Now let's look at its stats on value and momentum.

1980-2018

	Enterprise Value-to-Sales	Price Momentum (%)
Long side (Top 1/3)	2.0x	30.4
Short side (Bottom 1/3)	4.2x	0.2

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The value portfolio saw its expensive (short) side 4.3 times more expensive than the cheap (long) side. That is, it's a really big value bet. For the combo portfolio you only get 2.1 times more expensive (4.2 divided by 2.0 from the above table). That's still a substantial difference, but not nearly as cheap vs. expensive as pure value. The momentum portfolio saw the good (long) momentum side exceed the bad (short) momentum side by 53% per annum. For the combo it's 30.2%. Again, pretty darn good, but nowhere near as good as single factor momentum. But, of course, the key is the combo portfolio is significantly better on both measures where the single factor portfolios were great on one but mildly to pretty bad on the other.

It seems obvious that the intuition behind explaining the performance of a pure value or pure momentum portfolio would be much stronger than the combo portfolio. This is because the combo portfolio is not as extreme a bet on either and because, in the case of these two factors, the intuitions of value and momentum reinforce each other for the single factor constructions (being long value and short momentum, as the value long-short portfolio is, both yield similar intuition as to what's been working and not working lately).

We can also look at holdings to see how dramatically different the combo is from either single-factor portfolio (here we examine the final portfolio formation date of 11/30/2018). Out of the top 50 stocks (again out of approximately 1,000 stocks) in the combo portfolio there are 11 stocks that appear in the top 50 value portfolio long positions (and it only goes up to 17 appearing in the top 100 holdings of the value portfolio). Out of the top 50 stocks in the combo portfolio there are 12 stocks that appear in the top 50 stocks in the momentum portfolio (and only 20 that appear in even the top 100 holdings of the momentum portfolio). If you really want an extreme stat there is only one stock in the combo portfolio that appears in the top 50 holdings for both value and momentum (presumably a stock that was super-duper cheap a year ago and is still very cheap after a strong year).^{1,12}

All this goes to show how different the combo portfolio is from the single factor portfolios. Less extreme bets on either factor will lead to less clear intuitive links to what you're observing in the market day-by-day and month-by-month. The holdings are substantially different, another perspective on how intuition will be more difficult. The small overlap in the best/worst ranked stocks shows that, of course by construction, the combo portfolio isn't holding many super-duper cheap stocks, or many super-duper momentum stocks (or their opposites to short) but is making the best compromise it can. Those compromise names will rarely be the major "story" stocks that drive simple intuition.

Let's look at the difficulty in intuition another way. If value has a -2 standard deviation year, it will hurt, but it's going to be pretty intuitive (you'll really understand why you were hurt). If momentum has a +2 standard deviation year, it will be fun, and again easily intuitive. But imagine value has a +2.5 standard deviation year and momentum a -1.5. That will be a good year for the combo portfolio. Now imagine value has a +1.5 standard deviation year and momentum a -2.5. That will be a bad year for the combo. Do you really have strong intuition, from observing the market, from the media, or from talking with your crazy uncle who always wants to chat about the stock market because he knows you're in that field, about why one was up and the other down? I don't think so. And it does represent a legitimate problem for some.¹³

Of course, in reality, this is all a design feature, not a bug. Combining the signals can lead to much better (in our opinion, based on real life and extensive backtests) long-term results.¹⁴ and there is still intuition. There is intuition (and economic theory) for why value works on average, for why momentum works on average, and for why they're negatively correlated. It's just that particular results will be the sum of the two factors (and it only gets worse when we add more factors – worse, that is, on intuition even if better on long-term results) and whether they add to negative or positive and how big. That sum is what will not always come with screaming intuition. But we do have it for why we believe in the portfolio itself, and why the results shown here have been strong over time. I can't fix that the difference between 2.5/-1.5 being a good year and 1.5/-2.5 being a bad year isn't always compelling. But we can and should take solace in knowing that there is strong intuition behind each factor, the portfolio, and why we believe it should work over time.

Let's look at this one other way. We often get asked something like "with an individual stock I understand what I own, but what do I own in one of these market-neutral liquid alt things?"¹⁵ Well, you own a bet on a set of characteristics of diversified portfolios – both long and short. Unfortunately, while accurate, that's still too geeky and opaque. More concrete is to think of the long portfolio as a conglomerate (a single company) consisting of all the stocks (which is way lower risk than its component securities as it's so diversified). The short portfolio is a different conglomerate. So, what you own, or are betting on, is the difference in return between two diversified conglomerates (with both conglomerates being in a matching set of industries) that average 2x more expensive on the short vs. long side and 30% better momentum on the long vs. short side. In other words, you can think of these things much like you would individual stocks. It certainly doesn't always make money in the short-run (you might have noticed 2018!). But as seen here and in many other places, it has worked way more often than it has not, it has worked out on net over time, and it has worked out way better than choosing your long and short conglomerates on a single more intuitively simple factor. And, it has been generally uncorrelated to the market's return. If thought of in this way, I think it's

starting to get at least reasonably intuitive. You actually own something and are short something you can get your head around. But, alas, it will still never be as simple as the single-factor (or even single stock) versions. It should just be better.

Diversification is often called the only free lunch in investing. But, here, perhaps, we see that it has a more subtle cost coming through weaker intuition and harder story-telling (and thus portfolios that are harder to stick to – a prerequisite for any successful strategy). Perhaps this difficulty is why the strategy doesn't get easily arbitrated away and is still available to those who can weather its tough times? A single stock portfolio is super simple and performance is quite easily explainable after good and bad times. But it's a disastrous ex ante choice. While there may be exceptions, it seems the more truly diversified a portfolio is, often the less simple and intuitive are its returns. This isn't just about multi-factor quant long-short strategies. Imagine you take half your risk from a diversified traditional stock portfolio, and half from a diversified bond portfolio.¹⁶ Explaining why the stock or bond market went up or down on their own is probably pretty intuitive (i.e., if either was the whole portfolio). But, explaining why one went up, the other down, and even more so, why the sum of those two came out positive or negative this time, likely less so. But, like for our examples above, it's also likely a considerably better portfolio ex ante than only one or the other. Now, because we believe that diversification really, truly helps improve portfolios, our approach is still, despite the more difficult intuition, to choose diversification seven days a week, including in multi-factor market neutral investments. But, that comes with a burden. The burden is trying to mitigate this cost of foregone simple intuition. Hopefully I've taken a small step here!

[1] I choose market-neutral here as the cleanest example (and a very relevant one today), but the same ideas apply to any multi-factor process including traditional long-only multi-factor portfolios judged vs. a benchmark portfolio.

[2] We often use up to 25 different indicators to form a composite value measure for real life trading. For momentum we also use multiple measures including many types of fundamental momentum while here I'm only using price momentum.

[3] It is enterprise value-to-sales (enterprise value is the sum of the stock and bond capitalizations) not price-to-sales (stock price) because sales come before interest expense and thus you want to compare sales to the whole capital structure. The price momentum measure leaves off the immediate prior month as I first did in my 1994 [dissertation](#) and has become industry standard.

[4] Even the definition of "industry" can be nuanced and we have many flavors of that.

[5] Equal-weight, while not perfect, is better than value-weight at approximating how a long-short manager implements this type of strategy (even better would be some type of "signal weighting" but that would make the exercise more opaque).

[6] Stocks are defined as U.S. listed common stocks in Compustat/XpressFeed Global, with the country of risk also listed as U.S., as defined by MSCI.

[7] As I discussed, keep in mind these hypothetical results are gross returns, so on that front they are overstated. But, this model is a very simple subset of real-life models, so in this way they are possibly understated. Don't focus on the overall level of returns, it's not the point here.

[8] Typically we're used to seeing momentum deliver gross return results better than value. What's different here is enterprise value-to-sales is an empirically better measure than the classic price-to-book, particularly when done intra-industry, and intra-industry also makes the value results better than the momentum results (at least relative to the norm) as unlike value, momentum has efficacy across industries that's not being utilized here.

[9] It may be surprising that the combo portfolio has higher return than either value or momentum. Indeed, if you allocated half of your wealth to each of those factor portfolios, you would get average returns halfway between them (but still meaningful volatility reduction and thus Sharpe ratio increase). Here we create the combo portfolio by combining value and momentum ranks and then picking the top and bottom thirds from the combination. In other words, we look for stocks with a combination of good characteristics, rather than combining stocks that may score highly on one but not the other. This distinction matters but is not the main point here; interested readers can refer to my colleagues' article "[Don't Just Mix, Integrate](#)"

[10] These past return numbers may seem high. This momentum measure is the arithmetic average of equal weighted returns. Furthermore it is total return (including the risk-free rate). Finally, there is a look-ahead-bias in these numbers as simply being in our approximately top 1,000 universe lends a bias upwards to your prior year returns (i.e., if you dropped out of the universe you probably did poorly). This is not a look-ahead-bias in the portfolio returns I report – just one that benignly affects the level of the momentum measure.

[11] The corresponding numbers for the bottom are both 9 (9 stocks in the combo portfolio's bottom 50 appear in the bottom 50 holdings of the momentum portfolio, and 9 stocks in the combo portfolio's bottom 50 appear in the bottom 50 holdings of the value portfolio), and 17 and 18, for value and momentum respectively, for the bottom 100.

[12] The effects I highlight (e.g., little overlap of the combo holdings with the single-factor portfolios) will, of course, be most pronounced for negatively correlated factors like I've chosen in value and momentum. But those are an important part of our process. Value and momentum are still our "grandparent factors" and still quite important, so I think their choice is reasonable. And the logic still applies to factors that are merely uncorrelated.

[13] Though if you'll allow me one cheeky observation after a bad time for us – this same dynamic is at work in good years, which I remind you have significantly outnumbered the bad, and nobody ever seems to have a serious problem with the more complex intuition from multi-factor portfolios at those times! Consider the years after the GFC, prior to 2018, when the value factor in general did quite poorly but our stock selection strategy did well. That's perhaps not super intuitive, but seemed to be fine with everyone :).

[14] Moreover, this note focuses only on signal diversification. When we also deliberately diversify across a large number of stocks, any stock-specific stories are weakened (and those are also often very intuitive!). And when we look at multi-asset portfolios beyond stock selection, e.g., applying these ideas to bonds, currencies, equity country selection, etc., we again achieve even better diversification, but fewer intuitive stories for the total portfolio performance. But, that is the idea!

[15] Sometimes people say "liquid alt thingies" but I'm not naming names.

[16] Yes I said "risk" not dollars sneaking in a bit of [risk parity](#) to the discussion.

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