Our Model Goes to Six and Saves Value From Redundancy Along the Way

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First, I must issue a disclaimer. This is for wonks already immersed in the factor literature. There's lots of inside baseball, assumed terminology, etc., in this one. I explain what I'm doing along the way, but rarely from scratch. If this stuff is brand new to you and you still understand it all you are way smarter than me (you are allowed to find that to be faint praise). There's nothing more mathematical here than a regression model but there is lots of shop talk. So, if "factor wonk" doesn't describe you, you probably have friends and a social life, so that's nice, but this piece won't make much sense (consider it even).

Professors Eugene Fama and Ken French are at it again producing great research and advancing what we know about how markets work. Today I refer specifically to their latest and greatest Five Factor Model (FFM) and the papers they have written explaining it and using it.

Of course, while I start with praise, and definitely do not come to bury, I am indeed here to quibble (Shakespeare took liberties – this is what Mark Antony actually said). These quibbles will be familiar ones and draw on our long history of believing both value and momentum work but work best together and that value is best measured using up-to-date timely, not lagged, measures of price, a seemingly small thing that we find is not so small. Some of the below is a more informal version of some of the topics we're going to address in a forthcoming companion piece to our paper on myths about momentum investing, this time focusing on value.

Replicating Fama and French

First we start with explaining and replicating the first panel of Table 6 in Fama and French's Five-Factor Model paper. We're actually never going to advance past that table, except for some tweaks to it, so I really hope they did some good stuff in Table 6! The factors in question, following Fama and French, and referencing them for the details, are (all for U.S. stocks):

RM-RF The return spread between the capitalization weighted stock market and cash.
SMB The return spread of small minus large stocks (i.e., the size effect).
HML The return spread of cheap minus expensive stocks (i.e., the value effect).
RMW The return spread of the most profitable firms minus the least profitable.
CMA The return spread of firms that invest conservatively minus aggressively.

The first three are the famous Fama-French "Three Factor Model" (TFM) with the last two being the newer factors that bring them to five. I refer you to Fama-French for the univariate statistics and motivation behind the idea that more profitable firms outperform less profitable firms, and that firms that invest more conservatively outperform the more aggressive ones. I do self-servingly note that profitability already forms an integral part of our approach, and that the Fama-French investing factor is strongly related to the payout factor we consider part of a firm's overall "quality." Both factors have been used at AQR, in highly related forms, for many years in managing institutional portfolios. Thus we started out as FFMFs (five factor model fans, obviously).

Fama and French's Table 6 regresses the monthly returns on each factor from July of 1963 through December of 2013 on the other four factors. Here's our version (it replicates theirs with the sole aesthetic difference that we present the intercept in percent per annum; the regression coefficients are on top; the t-stats are on bottom in parentheses, and all data is from Ken French's website):

Table 1

	Intercept	RM-RF	SMB	HML	RMW	CMA	R²
RM-RF	9.8% (4.94)		0.25 (4.45)	0.03 (0.37)	-0.40 (-4.84)	-0.91 (-7.82)	24%
SMB	4.6% (3.22)	0.13 (4.45)		0.05 (0.81)	-0.48 (-8.42)	-0.17 (-1.92)	18%
HML	-0.5% (-0.46)	0.01 (0.37)	0.02 (0.81)		0.23 (5.39)	1.04 (23.04)	52%
RMW	5.2% (5.44)	-0.09 (-4.84)	-0.22 (-8.42)	0.20 (5.39)		-0.44 (-7.85)	22%
CMA	3.3% (5.03)	-0.10 (-7.82)	-0.04 (-1.92)	0.45 (23.04)	-0.21 (-7.85)		57%

Let's go through each regression quickly.

The market factor RM-RF is positively correlated to small stocks (who have higher market betas) and negatively correlated to more profitable and more conservatively invested stocks (who have lower market betas). These covariances don't come close to explaining away the market factor. In fact they go more the other way. The market delivers 9.8% excess return (the intercept) versus the other factors per annum, with strong statistical significance.

The size factor is quite similar (positively correlated to RM-RF, negative to RMW and CMA) with a slightly smaller though still significant intercept.

Fama and French's result for HML, the value factor, is the most shocking. Indeed it may be the blockbuster result of their paper. After accounting for considerable positive covariance with profitability (cheaper firms are correlated with more profitable firms – note, when CMA is not included this reverts to a small negative covariance as is, perhaps, more intuitive) and conservatism in investing (cheaper firms are correlated with firms that invest more conservatively) there is no intercept left. In fact it's a tad negative. This table is one version of their now famous result that the value factor, HML, is "redundant." That does not mean value is an ineffective strategy, far from it. It simply means that after accounting for the two new factors, and the standard market and small factors, value doesn't add additional return. In finance geek speak the two new factors "subsume" value. If you find this at all disturbing, we are here to help, as by the end of this piece we will have resurrected value as completely non-redundant.

Our Factor Model Goes to Six

Next, as you probably knew was coming, we're just going to add the momentum factor (UMD is long winners and short losers and also from Ken French's website) to the exercise.

Table 2

	Intercept	RM-RF	SMB	HML	RMW	CMA	UMD	R²
RM-RF	10.7% (5.36)		0.25 (4.55)	-0.03 (-0.35)	-0.36 (-4.36)	-0.85 (-7.24)	-0.12 (-3.03)	25%
SMB	4.3% (2.98)	0.13 (4.55)		0.06 (1.05)	-0.49 (-8.49)	-0.18 (-2.05)	0.03 (1.10)	18%
HML	0.5% (0.51)	-0.01 (-0.35)	0.03 (1.05)		0.24 (5.97)	1.03 (23.38)	-0.11 (-5.92)	54%
RMW	4.6% (4.76)	-0.08 (-4.36)	-0.22 (-8.49)	0.23 (5.97)		-0.46 (-8.17)	0.06 (3.20)	23%
CMA	2.9% (4.36)	-0.09 (-7.24)	-0.04 (-2.05)	0.46 (23.38)	-0.22 (-8.17)		0.04 (3.20)	58%
UMD	8.7% (4.11)	-0.13 (-3.03)	0.07 (1.10)	-0.50 (-5.92)	0.28 (3.12)	0.41 (3.20)		8%

We're going to focus only on HML and UMD (quick summary of the others: RM-RF is slightly short momentum net of the other factors, and thus it's intercept slightly increases from before, and RMW and CMA are slightly long momentum, thus their intercepts slightly decrease, but none of these are greatly affected).

HML is negatively correlated with UMD (t-statistic of -5.92). This is enough to increase its intercept by about 1%, but not to get it nearly as large as the others or to a level of statistical significance. It's not quite as redundant as before, but you'll have to wait a bit longer for us to save value from the dustbin of history.

The UMD row is little surprise to those who follow the literature. As Fama and French note, even with its negative correlation to value, UMD is largely independent of the other factors (8% R^2). Fama and French see this result as justification, along with just trying to limit dimensionality, for leaving momentum out (note they have a Five not Six Factor Model!). They are right under their metric of usefulness – I just think their metric here leaves something to be desired. It is indeed a justification to exclude momentum if your goal is to explain the cross-section of portfolio returns assuming the portfolios are formed on any of the factors save momentum itself. But, if your goal is not this exercise, but, say, the formation of the best portfolio to invest in, or for that matter performance attribution where investors may be following momentum strategies, well, then leaving it out is an odd choice. In fact, one might view the holy grail of investing as coming up with factors that are uncorrelated to your existing set, but have high average returns (the even holier grail is negatively correlated high mean factors, we save that for bit later). The momentum row, and its large positive and statistically significant intercept, says that is indeed what you have in UMD. So, we're pretty comfortable saying the Five Factor Model is awesome. However, for building real world portfolios, for performance attribution uses, in fact for most things save explaining the Five Factor Model itself, there is no reason, aside from disbelieving the ubiquitous data on momentum, for leaving out UMD. At this point we think, while future research including our own might add, subtract, or change the form of these, that at least a Six Factor Model (SFM) is clearly warranted. Note, Fama and French would not be surprised at our results here; they note how powerful momentum is net of their Five Factor Model. Where we disagree is they don't see this as a crying need to dial it up to six!

But we're not done. Value is still lying there redundant (and we're going to partially take back one of those six factors soon so don't get too attached to that figure).

The Devil's Finest Trick Is to Persuade You That Value Does Exist

To save value we're going to have to change it. As we discuss in Asness and Frazzini (2013), Fama and French's industry-standard construction of HML uses annual rebalancing in June, using book-to-price as the valuation measure to decide "H" and "L," and both book and price as of the prior December. That is, both book and price are six months old upon portfolio formation, and grow to eighteen months old by the time the portfolio is rebalanced next. Regarding the initial six month lag, there is a clear reason to do this for the "book" in book-to-price. You do not have accounting information for December 31 fiscal year-end firms on December 31. The choice of a six month lag is to make the probability very high that you would have this information when you rebalance and therefore not suffer from look-ahead bias (trading, in a backtest, on information you wouldn't really have known at that point). But, you do have a choice with price. You could use, as Fama and French did, price from the same date as book (six months old growing to eighteen months old by the next rebalance) so they match perfectly. That clearly has a lot of intuitive attraction, and we might've also made it our first choice if coming up with all this from scratch, as it means you are using the actual book-to-price from a certain date. Any mismatch of the date of price and the date of book means the book-to-price formed from that mismatch was never the true measure even for a moment. Yet we argue for just such a mismatch. We argue it for two reasons:

1. We have shown that if all you knew is price fell dramatically (and vice versa for all these examples) since you last had an accurate matched-in-time book-to-price, your best guess would clearly be that book-to-price went up. That is, even when looked at over multiple years, book does not tend to fall as much as price. Put more simply, if you're standing in June, and price has sharply fallen since December, you are highly likely to have a cheaper stock and the original Fama-French version of HML misses this additional cheapness. Ignoring this price movement throws away information that is definitely available in a timely way without look-ahead bias.

2. A properly constructed value strategy is naturally (and to us quite beautifully) negatively correlated with momentum. If price falls sharply momentum gets worse, but, as discussed in 1) above, the stock also generally gets cheaper, thus better according to "value." Throwing in a six month lag in price that grows to eighteen months before the next rebalance throws away much of this natural, elegant, and intuitive negative correlation.

After making these arguments Asness and Frazzini construct two simple alternatives to Fama and French's HML. The first version preserves all aspects of their methodology, including annual rebalancing only at the end of June and using book from December 31 of last 2013, except for using price from June 30 of 2014 (instead of December 31 of las 2013) to calculate book-to-price when the portfolio is rebalanced on June 30. The second version changes value to rebalance monthly just like momentum is rebalanced monthly in most authors' tests, including Fama and French's construction of the UMD factor. In this monthly version, the one we'll test here, you reconstruct HML every month always using the same book value Fama and French's HML would use, but using the latest month's up to date price. Asness and Frazzini discuss the somewhat higher turnover that comes from updating monthly, but find performance increases from using this more updated HML, in the presence of momentum, far outstrip any reasonable extra costs. We call this version HML-DEV after the title of that paper "The Devil in HML's Details" and show the results of re-running Fama and French's Table 6 replacing their HML with HML DEV:

Table 3

	Intercept	RM-RF	SMB	HML-DEV	RMW	CMA	R²
RM-RF	9.7% (4.91)		0.25 (4.44)	0.11 (2.05)	-0.39 (-4.83)	-0.97 (-10.35)	25%
SMB	4.6% (3.21)	0.13 (4.44)		0.00 (0.12)	-0.47 (-8.43)	-0.12 (-1.68)	18%
HML-DEV	0.2% (0.15)	0.06 (2.05)	0.00 (0.12)		-0.02 (-0.29)	0.95 (14.24)	28%
RMW	5.4% (5.47)	-0.10 (-4.83)	-0.23 (-8.43)	-0.01 (-0.29)		-0.23 (-4.64)	18%
CMA	4.3% (5.53)	-0.16 (-10.35)	-0.04 (-1.68)	0.27 (14.24)	-0.15 (-4.64)		40%

This above is, for the most part, a non-event as it's little changed versus Table 6 of Fama and French (our Table 1). Some odd things do change in a small way. The positive marginal correlation of RMW with value goes away as we move from Fama-French HML to HML-DEV and the positive correlation of CMA with value falls somewhat. But both RMW and CMA still sport highly significant intercepts (RMW's is actually 20 bps higher as its negative correlation with CMA is less extreme with HML-DEV instead of Fama-French HML in the mix, and CMA's is 100 bps higher). The changes to RM-RF and SMB are even smaller. Even HML-DEV, while mirroring the above difference in loadings, sees an intercept that is not radically different from using Famal**I**French HML. It comes in at an insignificant positive instead of an insignificant negative. So it's still redundant if a tiny bit less so. Everything else but HML-DEV has a strong intercept when tested against all the other factors.

OK, so you know what's coming next right? We now add UMD to the above table. So what follows is the first panel from Table 6 of Fama and French, but now with HML-DEV instead of their HML, and with UMD added as a factor.

Table 4

	Intercept	RM-RF	SMB	HML-DEV	RMW	CMA	UMD	R²
RM-RF	10.8% (5.32)		0.25 (4.55)	-0.03 (-0.31)	-0.37 (-4.55)	-0.85 (-7.86)	-0.13 (-2.25)	25%
SMB	4.0% (2.73)	0.13 (4.55)		0.07 (1.16)	-0.47 (-8.53)	-0.17 (-2.15)	0.06 (1.45)	18%
HML-DEV	4.9% (4.74)	-0.01 (-0.31)	0.03 (1.16)		0.07 (1.61)	0.89 (20.01)	-0.52 (-27.32)	68%
RMW	4.7% (4.61)	-0.09 (-4.55)	-0.23 (-8.53)	0.06 (1.61)		-0.29 (-5.26)	0.07 (2.43)	19%
CMA	1.4% (1.94)	-0.11 (-7.86)	-0.04 (-2.15)	0.45 (20.01)	-0.15 (-5.26)		0.22 (12.24)	52%
UMD	9.2% (6.32)	-0.07 (-2.25)	0.06 (1.45)	-1.07 (-27.32)	0.14 (2.43)	0.90 (12.24)		57%

Shazam, shazam, shazam! Now those are some different results. They are only a bit different, but not significantly so for RM-RF, SMB, and RMW, and we'll pass on discussing these small changes. But, the results for CMA, UMD, and, drum-roll please, HML-DEV or value, change *a lot*.

CMA gets driven significantly lower, low enough that if this was the first thing you saw you probably wouldn't consider it a successful factor. The intercept is economically small and its t-statistic comes close but doesn't break 2.0. What's going on? Well, hold on to something. Remember, in the Fama-French table CMA had a rather huge loading on their original version of HML. Then when we switched to HML-DEV (Table 3) this slope remained large but not as large. Then when we added in UMD in Table 4 it exploded again with large positive loadings on our more timely value and on momentum (HML-DEV and UMD). If you look at the ratio of the coefficients it's about 2/3 value 1/3 momentum. Asness and Frazzini find that one way to view Fama-French HML is approximately an 80/20 portfolio of timely value (HML-

DEV) and momentum (UMD), with worse results as the version of momentum implied in original HML isn't the real momentum factor, but the avoidance of shorting momentum that comes from using a six to eighteen month lag in price. These results show that the huge loading of CMA on Fama-French HML was because it really wanted to load on both timely value *and* momentum and Fama-French HML approximates this combination closely enough, if inferiorly. Again, the combination of timely value and real momentum (not simply avoiding shorting it with a changing six to eighteen month lag structure) does much better than regular HML (as Asness and Frazzini show). The fact that this combination, HML-DEV and UMD, does much better than original HML is why CMA loading on it, not traditional HML, causes CMA to produce a far lower intercept (if you have a positive loading on stronger factors your intercept suffers). While it's still statistically almost, barely, but not quite interesting, we could fairly say that using up-to-date timely value, and making the obvious addition of momentum to the Five Factor Model, it's actually CMA that's mostly redundant.

Next look at UMD. It's the largest (t-statistic wise) intercept of the bunch, and the other factors, chiefly of course through UMD's very strong negative correlation with timely value, explain a significant amount of its returns (unlike UMD in Table 2 with its paltry R^2). You can no longer say, using up-to-date timely value, that portfolios formed on the other factors sans momentum are not affected by momentum (one of Fama and French's arguments for leaving momentum out). And certainly, again, if your goal is creating the best portfolio then you don't dismiss the factor with the strongest results!

Finally, the resurrection. Timely value, or HML-DEV, now has an economically and statistically large intercept. It's back baby! That's even with a very large loading on the still positive CMA factor. The negative correlation with the successful momentum factor is just that powerful. As we've argued many times, properly defined timely value and momentum are best thought of as a system. They are both strong alone, but much stronger together due to their negative correlation. Said another way, the univariate performance of each is even more impressive given each is effectively short the other, a successful factor on its own. Combining the two just means you are looking for cheap stocks (remember, price movements imply book-to-price movements so HML-DEV being more timely is also actually more "value" than is HML) with strong momentum, and historically, it works amazingly well on average.

Bottom Line: Ours Might Also Only Go to Five, But It's a Better Five, and We're Not Done

Fama and French's latest Five Factor Model is an impressive way to summarize the known playing field of factors, and brings some very good things to the table. However, for reasons we don't find convincing, it leaves out momentum. With no change necessary to the value factor it's absolutely compelling to add momentum back creating a better Six Factor Model. But, as we've argued elsewhere, the value factor should in fact be improved. If you change to more timely value then the momentum result is even stronger, as a matter of fact the strongest of all factors we test, and the value factor, rendered distressingly (for those of us who've considered ourselves value investors for many years!) redundant by the Five Factor Model, is easily resurrected. But, sadly in the process, and we readily admit other constructs, samples, and tests might save it too (we've only focused on the basic Fama-French 3x2 portfolio formation technique here over just this time period in just the USA), we have mostly lost the CMA factor. Thus we're still back at a Five Factor Model, just a better one, in our opinion, than we started with, and one with a very significant role for the stand-alone (timely) *very-non-redundant* value factor.

Finally, note, this is not our final word, or presumably the final word of others, on the best multi-factor model. Our ongoing research – for instance looking at quality measures that overlap with the profitability and investment factors studied here, but that also include growth and low risk measures, and examining these factors from the pricing not just the return side – has the potential to add yet more dimensionality to returns and make our problem of picking out the most parsimonious yet effective model even harder. Again, as mentioned earlier, our and other work has potential to resurrect (a theme today!) the investment factor from the purgatory of redundancy which we sentenced it to (for now) in place of value. Also we're currently examining how all of the different quality measures seem to have very strong implications for the small stock factor (a paper should be coming soon). Finally, while part of our quality paper, how all of these factors relate to the low-beta effect seems an interesting thing to examine further. Low-beta (or low-volatility, low-risk, or minimum variance, or whatever correlated versions are floating around) factors seem to be positively correlated with most of the other factors discussed herein, perhaps or perhaps not making it "subsumed," but certainly making it an interesting place for "one stop shopping." The work of a factor-wonk is, to date, never done.

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