F5MOM: An Idiosyncratic Momentum Factor Based on the Fama-French Five Factor Model

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I wrote R code to test several momentum factors:

Exhibit 1: Quintile Portfolio Return Summary							
		Losers				Winners	
		1	2	3	4	5	WML
MOM	**mean**	0.89%	1.01%	0.93%	0.91%	0.89%	0.00%
	std dev	7.72%	5.16%	4.40%	4.04%	4.65%	6.22%
	t-stat	1.84	3.11	3.34	3.57	3.03	(0.01)
	ann sr	0.40	0.68	0.73	0.78	0.66	(0.00)
IMOM	**mean**	0.78%	1.11%	1.04%	0.94%	0.95%	0.18%
	std dev	6.87%	5.00%	4.10%	4.04%	4.68%	4.41%
	t-stat	1.75	3.42	3.91	3.61	3.14	0.62
	ann sr	0.39	0.77	0.88	0.81	0.70	0.14
F5MOM	**mean**	0.87%	0.91%	0.97%	1.04%	0.88%	0.01%
	std dev	6.46%	4.99%	4.29%	4.21%	4.56%	3.71%
	t-stat	2.09	2.83	3.48	3.81	3.00	0.04
	ann sr	0.47	0.63	0.78	0.85	0.67	0.01

Remarks:

1. Our factor F5MOM is a generalization of the IMOM factor of Chaves (2015). In the same way that IMOM adjusts stock returns for market risk using the CAPM, F5MOM adjusts stock returns using the 5 factor model of Fama and French (2015).
2. While Chaves (2015) found positive alpha for IMOM (and MOM), our results for all three factors, including F5MOM, are essentially flat.
3. Over the same sample period, one standard momentum factor based on all stocks also shows negligible alpha (i.e., SR of 0.12 for MOM, per Ken French's website). This suggests that our narrow universe, which included only members of the S&P 500, may not have been the primary cause of F5MOM's disappointing performance.
4. For all three factors, we observe that risk of the "Loser" quintile is substantially higher than that of the other quintiles, even as mean returns are broadly similar. Thus if the goal is to outperform the index, our results suggest that limiting exposure to the "Losers" quintile might help reduce risk and therefore increase SR.

Technical notes:

1. All R code written for this project is available at: https://github.com/wfallon/momentum.
2. All three momentum factors are based on a lag period of one month, and a measurement period of 11 months. The MOM factor is based on total returns, per Jegadeesh and Titman (1993). IMOM is based on market idiosyncratic returns, as per Chaves (2015), with residuals computed using CAPM regressions over a 36 month historical window. Our factor, F5MOM, is based on idiosyncratic returns computed from stock regressions using the factors of the Fama-French five factor model as regressors. Coefficient estimates are computed using a 36 month historical window.
3. Our winner minus loser (WML) portfolios used quintile spreads, following Chaves (2015). Quintiles, with approximately 100 stocks per portfolio, may be especially useful in diversifying our momentum portfolios, given our use of only 500 stocks. Our time period was limited to 12/31/97 through 12/31/2019 and ultimately yielded 240 monthly observations.
4. Mean and standard deviations are monthly. Sharpe ratios are annualized.

Exhibit 2: Fama-French 5 Factor Regressions								
		alpha	**MKT**	**HML**	**SMB**	**RMW**	**CMA**	**adj R2**
MOM	**estimate**	0.00	(0.44)	0.29	(0.78)	0.46	0.20	0.21
	std err	0.00	0.10	0.13	0.16	0.17	0.23	
	t-stat	0.12	(4.55)	2.21	(4.83)	2.71	0.87	
IMOM	**estimate**	0.00	(0.38)	0.25	(0.31)	0.29	0.18	0.20
	std err	0.00	0.07	0.10	0.12	0.13	0.17	
	t-stat	0.73	(5.33)	2.55	(2.67)	2.27	1.07	
F5MOM	**estimate**	0.00	(0.31)	0.15	(0.09)	0.44	(0.30)	0.27
	std err	0.00	0.06	0.08	0.09	0.10	0.13	
	t-stat	0.21	(5.48)	1.82	(0.99)	4.33	(2.20)	

Remarks:

1. All three momentum factors (dependent variables) show loadings on MKT, HML and RMW that are the same sign and broadly similar in magnitude. The sign of F5MOM's exposure to SMB is the same as that of MOM and IMOM, but its magnitude is far less. As well, in the case of CMA the sign flips with a higher magnitude.

2. The residual alpha is insignificant for all three momentum factors. This suggest that the exposure provided by any of the three is "spanned" or well-explained by the existing factors in the Fama-French model.

Exhibit 3: S&P 500 Explanatory Regressions								
	alpha	**MKT**	**HML**	**SMB**	**RMW**	**CMA**	**F5MOM**	**ADJ R2**
estimate	0.00	1.12	0.04	0.20	0.17	0.12		0.93
std err	0.00	0.02	0.03	0.04	0.04	0.05		
t-stat	2.45	50.40	1.35	5.55	4.19	2.36		
estimate	0.01		0.10	0.77	(0.68)	(0.68)		0.23
std err	0.00		0.11	0.12	0.12	0.17		
t-stat	4.11		0.88	6.41	(5.50)	(3.94)		
estimate	0.00	1.08	0.06	0.19	0.23	0.08	(0.14)	0.94
std err	0.00	0.02	0.03	0.03	0.04	0.05	0.02	
t-stat	2.70	48.77	2.13	5.55	5.92	1.66	(5.90)	
estimate	0.01		0.17	0.64	(0.32)	(0.72)	(0.53)	0.36
std err	0.00		0.10	0.11	0.12	0.16	0.08	
t-stat	4.06		1.68	5.74	(2.59)	(4.58)	(7.10)	

Remarks:

1. Each sub-panel above reports the results of regressions of the S&P500 against combinations of variables drawn from the Fama-French five factor model.
2. The regressions that include MKT as an independent variable are reported per the specification; obviously in both cases this regressor is essentially an echo of the dependent variable making these two regressions hard to interpret.
3. It appears that our momentum factor F5MOM plays the most prominent role in explaining S&P500 returns, as it has the largest t-stat of any independent variable, and the increase in R2 with its inclusion is sizable.

Issues, Ideas, and Next Steps

1. Time did not permit extending the sample through to November 30, 2020. It would have been interesting to examine the performance of all of the MOM factors during this period, given November's volatility.

2. It is worth observing (see appendix 1) that, during the momentum crash period ending May 2009, F5MOM's performance was marginally superior to MOM and IMOM (though normalized performance was closer, with z-scores of 6.0, 5.7, and 5.0, respectively).

	MOM_WML	IMOM_WML	F5MOM_WML
2/28/09	7.0%	6.2%	4.5%
3/31/09	-12.6%	-9.0%	-5.4%
4/30/09	-38.7%	-22.7%	-15.3%
5/31/09	-13.8%	-11.7%	-11.6%
6/30/09	6.3%	5.2%	5.0%
3/31-5/31	-65.1%	-43.4%	-32.4%

3. The presence of a "crash" in the sample suggests there may be some benefit to timing the momentum factor. Consider the following argument. During periods when the market has underperformed, it is likely that stocks on the short side of the factor have become far riskier – as they have "doubly underperformed" due to both market losses and their own losses. Thus, in the event of a rally, they can rise far further than they can continue to fall, which suggests greater left tail risk. This is roughly the argument of Daniel and Moskowitz (2015). Thus it may make sense during these periods to either sit on the sidelines or even short the factor. Below are the strategy results that split F5MOM's performance into two periods, one in which the SP500 has performed well (>0), the other poorly (<0) over the preceding 12 months. Also shown are the results of splitting the sample into periods when VIX is "high" and when VIX is "low", based on the arbitrarily chosen VIX value of 20.0 (results are similar for other nearby breakpoints).

	F5MOM Unconditional	F5MOM [SP(0,12) > 0]	NEG F5MOM [SP(0,12) < 0]	Conditional Combined	F5MOM [VIX < 20]	NEG F5MOM [VIX > 20]	Conditional Combined
Ann Mu	0.1%	3.1%	13.3%	5.0%	6.0%	12.0%	7.9%
Ann SD	12.8%	10.1%	20.9%	12.8%	9.6%	17.3%	12.6%
Ann SR	0.01	0.31	0.64	0.39	0.62	0.69	0.63
N Obsn	240	196	44	240	162	78	240

While the risk of data-mining is ever present, these results could be the basis for additional research.

References

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Fama, E.F. and French, K.R., 2015. A five-factor asset pricing model. *Journal of financial economics*, *116*(1), pp.1-22.

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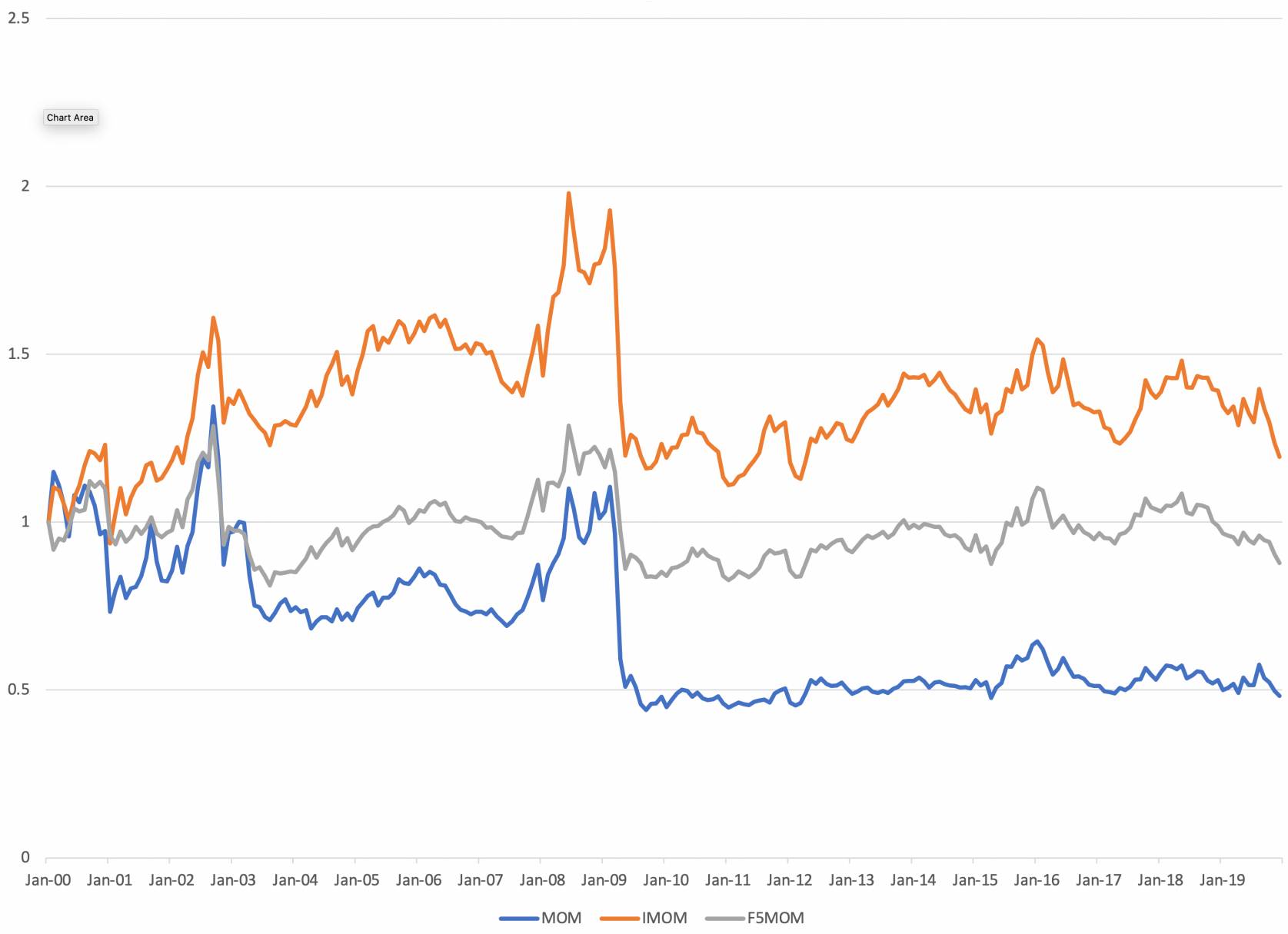
Appendix 1: WML Momentum Factor NAV Growth



Appendix 2: Covariance Matrix of Primary Variables

	MOM_1	MOM_2	MOM_3	MOM_4	MOM_5	MOM_WML	IMOM_1	IMOM_2	IMOM_3	IMOM_4	IMOM_5	IMOM_WML	F5MOM_1	F5MOM_2	F5MOM_3	F5MOM_4	F5MOM_5	M_WML	SP5_SP5	FF5_Mkt-RF	FF5_SMB	FF5_HML	FF5_RMW	FF5_CMA	FF5_RF
mu, annual	10.7%	12.1%	11.1%	10.9%	10.7%	0.0%	9.3%	13.3%	12.4%	11.3%	11.4%	2.1%	10.5%	10.9%	11.6%	12.4%	10.6%	**0.1%**	10.91%	6.3%	3.5%	1.3%	3.6%	2.9%	1.8%
sd, annual	26.7%	17.9%	15.2%	14.0%	16.1%	21.5%	23.8%	17.3%	14.2%	14.0%	16.2%	15.3%	22.4%	17.3%	14.9%	14.6%	15.8%	**12.8%**	16.87%	15.4%	10.8%	10.9%	10.1%	7.5%	0.6%
sr, annual	0.40	0.68	0.73	0.78	0.66	(0.00)	0.39	0.77	0.88	0.81	0.70	0.14	0.47	0.63	0.78	0.85	0.67	**0.01**	0.65	0.41	0.33	0.12	0.36	0.39	3.10
MOM_1	1.00	0.92	0.85	0.78	0.59	(0.80)	0.97	0.90	0.84	0.79	0.74	(0.73)	0.96	0.91	0.84	0.82	0.79	**(0.70)**	0.92	0.81	0.21	0.16	(0.33)	(0.08)	(0.04)
MOM_2	0.92	1.00	0.95	0.89	0.69	(0.63)	0.94	0.97	0.95	0.91	0.83	(0.58)	0.93	0.97	0.94	0.93	0.88	**(0.54)**	0.96	0.85	0.15	0.24	(0.19)	(0.01)	(0.03)
MOM_3	0.85	0.95	1.00	0.95	0.78	(0.48)	0.89	0.96	0.98	0.96	0.88	(0.44)	0.89	0.95	0.97	0.97	0.93	**(0.41)**	0.97	0.88	0.16	0.23	(0.18)	(0.01)	(0.06)
MOM_4	0.78	0.89	0.95	1.00	0.86	(0.32)	0.83	0.91	0.96	0.97	0.92	(0.32)	0.85	0.91	0.95	0.96	0.95	**(0.31)**	0.95	0.89	0.15	0.16	(0.18)	(0.07)	(0.05)
MOM_5	0.59	0.69	0.78	0.86	1.00	0.01	0.69	0.75	0.81	0.85	0.94	(0.08)	0.73	0.76	0.83	0.83	0.90	**(0.18)**	0.83	0.87	0.33	(0.05)	(0.37)	(0.18)	(0.03)
MOM_WML	(0.80)	(0.63)	(0.48)	(0.32)	0.01	1.00	(0.71)	(0.58)	(0.45)	(0.36)	(0.23)	0.86	(0.65)	(0.58)	(0.44)	(0.41)	(0.32)	**0.75**	(0.52)	(0.36)	(0.01)	(0.23)	0.14	(0.03)	0.03
IMOM_1	0.97	0.94	0.89	0.83	0.69	(0.71)	1.00	0.92	0.87	0.83	0.77	(0.74)	0.98	0.94	0.88	0.85	0.82	**(0.69)**	0.94	0.87	0.22	0.14	(0.36)	(0.08)	(0.05)
IMOM_2	0.90	0.97	0.96	0.91	0.75	(0.58)	0.92	1.00	0.94	0.91	0.82	(0.56)	0.92	0.98	0.95	0.94	0.87	**(0.54)**	0.96	0.88	0.18	0.22	(0.21)	(0.02)	(0.03)
IMOM_3	0.84	0.95	0.98	0.96	0.81	(0.45)	0.87	0.94	1.00	0.95	0.88	(0.43)	0.88	0.95	0.97	0.96	0.92	**(0.41)**	0.96	0.89	0.16	0.24	(0.19)	0.01	(0.02)
IMOM_4	0.79	0.91	0.96	0.97	0.85	(0.36)	0.83	0.91	0.95	1.00	0.90	(0.33)	0.83	0.92	0.96	0.97	0.94	**(0.30)**	0.94	0.87	0.15	0.24	(0.15)	0.02	(0.01)
IMOM_5	0.74	0.83	0.88	0.92	0.94	(0.23)	0.77	0.82	0.88	0.90	1.00	(0.14)	0.81	0.84	0.88	0.91	0.96	**(0.25)**	0.91	0.88	0.32	0.15	(0.32)	(0.02)	(0.05)
IMOM_WML	(0.73)	(0.58)	(0.44)	(0.32)	(0.08)	0.86	(0.74)	(0.56)	(0.43)	(0.33)	(0.14)	1.00	(0.65)	(0.57)	(0.43)	(0.37)	(0.26)	**0.82**	(0.51)	(0.42)	(0.01)	(0.07)	0.21	0.10	0.02
F5MOM_1	0.96	0.93	0.89	0.85	0.73	(0.65)	0.98	0.92	0.88	0.83	0.81	(0.65)	1.00	0.92	0.88	0.85	0.83	**(0.72)**	0.95	0.88	0.26	0.14	(0.38)	(0.03)	(0.04)
F5MOM_2	0.91	0.97	0.95	0.91	0.76	(0.58)	0.94	0.98	0.95	0.92	0.84	(0.57)	0.92	1.00	0.94	0.93	0.88	**(0.52)**	0.97	0.89	0.16	0.21	(0.22)	(0.05)	(0.06)
F5MOM_3	0.84	0.94	0.97	0.95	0.83	(0.44)	0.88	0.95	0.97	0.96	0.88	(0.43)	0.88	0.94	1.00	0.95	0.91	**(0.41)**	0.96	0.90	0.16	0.21	(0.19)	(0.03)	(0.03)
F5MOM_4	0.82	0.93	0.97	0.96	0.83	(0.41)	0.85	0.94	0.96	0.97	0.91	(0.37)	0.85	0.93	0.95	1.00	0.94	**(0.33)**	0.96	0.88	0.18	0.26	(0.15)	(0.01)	(0.04)
F5MOM_5	0.79	0.88	0.93	0.95	0.90	(0.32)	0.82	0.87	0.92	0.94	0.96	(0.26)	0.83	0.88	0.91	0.94	1.00	**(0.21)**	0.94	0.89	0.24	0.19	(0.24)	(0.06)	(0.05)
F5MOM_WML	**(0.70)**	**(0.54)**	**(0.41)**	**(0.31)**	**(0.18)**	**0.75**	**(0.69)**	**(0.54)**	**(0.41)**	**(0.30)**	**(0.25)**	**0.82**	**(0.72)**	**(0.52)**	**(0.41)**	**(0.33)**	**(0.21)**	**1.00**	**(0.50)**	**(0.45)**	**(0.15)**	**(0.01)**	**0.38**	**(0.02)**	**0.02**
SP5_SP5	0.92	0.96	0.97	0.95	0.83	(0.52)	0.94	0.96	0.96	0.94	0.91	(0.51)	0.95	0.97	0.96	0.96	0.94	**(0.50)**	1.00	0.94	0.23	0.13	(0.31)	(0.11)	(0.04)
FF5_Mkt-RF	0.81	0.85	0.88	0.89	0.87	(0.36)	0.87	0.88	0.89	0.87	0.88	(0.42)	0.88	0.89	0.90	0.88	0.89	**(0.45)**	0.94	1.00	0.25	(0.10)	(0.47)	(0.29)	(0.11)
FF5_SMB	0.21	0.15	0.16	0.15	0.33	(0.01)	0.22	0.18	0.16	0.15	0.32	(0.01)	0.26	0.16	0.16	0.18	0.24	**(0.15)**	0.23	0.25	1.00	(0.06)	(0.48)	0.01	0.01
FF5_HML	0.16	0.24	0.23	0.16	(0.05)	(0.23)	0.14	0.22	0.24	0.24	0.15	(0.07)	0.14	0.21	0.21	0.26	0.19	**(0.01)**	0.13	(0.10)	(0.06)	1.00	0.45	0.64	0.10
FF5_RMW	(0.33)	(0.19)	(0.18)	(0.18)	(0.37)	0.14	(0.36)	(0.21)	(0.19)	(0.15)	(0.32)	0.21	(0.38)	(0.22)	(0.19)	(0.15)	(0.24)	**0.38**	(0.31)	(0.47)	(0.48)	0.45	1.00	0.30	0.06
FF5_CMA	(0.08)	(0.01)	(0.01)	(0.07)	(0.18)	(0.03)	(0.08)	(0.02)	0.01	0.02	(0.02)	0.10	(0.03)	(0.05)	(0.03)	(0.01)	(0.06)	**(0.02)**	(0.11)	(0.29)	0.01	0.64	0.30	1.00	0.11
FF5_RF	(0.04)	(0.03)	(0.06)	(0.05)	(0.03)	0.03	(0.05)	(0.03)	(0.02)	(0.01)	(0.05)	0.02	(0.04)	(0.06)	(0.03)	(0.04)	(0.05)	**0.02**	(0.04)	(0.11)	0.01	0.10	0.06	0.11	1.00