Appendix to Zoom in on Momentum[1]

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Abstract

This appendix supplements tables and figures to Zoom in on Momentum.

JEL classification: G11; G12

Keywords: Momentum; Monotonicity; Cross-section

Table A1—which contains average returns for 10 momentum,[4] size, book-to-market, operating profitability, investment, earnings/price, cashflow/price, dividend yield, short-term reversal, long-term reversal, accruals, market beta, net share issues, variance, and residual variance portfolios from Professor Kenneth R. French's website[5]—indicates that momentum portfolios achieve both stronger long-short profitability and return monotonicity than other anomaly portfolios. It also provides the portfolios' average long-short returns and Patton–Timmermann (2010) monotonicity-relation (MR) test statistics. The test's null (alternative) hypothesis is a flat or weakly decreasing (a strictly increasing) pattern.

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[3] First draft: December 9, 2020.
[4] The results of 10 equal-weighted momentum portfolios are also provided.
[5] https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

The MR statistic (0.14%) and the average long-short return (14.0%) are greatest for the momentum portfolios. In detail, the average returns of the fourth and the fifth momentum portfolio exhibit the least difference[6]. The *p*-value of this difference rejects the null hypothesis of a flat or weakly decreasing pattern at the 0.1% level.[7] In contrast with the momentum portfolios though, other anomaly portfolios, reveal a trade-off between the long-short return and the MR statistic. For example, the residual variance portfolios show a strong long-short return (7.4%) but a weak MR statistic (−1.83%). The accruals portfolios indicate a strong MR statistic (−0.38%) but a weak long-short return (4.4%). Therefore, the cross-section of momentum returns appears more informative than those of other anomaly returns.[8]

Table A2 extends Table A1, which only examines 14 anomalies from Professor French's website, by reporting the long-short performance and return monotonicity of 10 or fewer portfolios sorted by 185 anomalies from Professor Hou, Xue, and Zhang's website.[9]

Table A3, extending Table 2 in the main document, which only displays WML_n's factor regression results, exhibits the mean absolute alphas and Gibbons–Ross–Shanken (1989) statistics of 10, 25, 50, 100 portfolios, respectively, sorted by momentum. Similarly, Table A4 reexamines factor regressions in Table 2 in the main document, *i.e.,* regresses WML_{10} on Mkt_RF, SMB_{10}, HML_{10}, RMW_{10}, and CMA_{10}, and then WML_{25} on Mkt_RF, SMB_{25}, HML_{25}, RMW_{25}, and CMA_{25}, and so on.

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[6] $\text{MR} = \min_{i=2,\ldots,N} \hat{\Delta}_i$, where $\hat{\Delta}_i = \hat{\mu}_i - \hat{\mu}_{i-1}$ (Patton and Timmermann, 2010).

[7] The non-tabulated MR statistics from the 20, 25, and 50 momentum portfolios are −0.80% (p=0.007), −0.99% (0.005), and −2.75% (0.179), respectively.

[8] The non-tabulated MR statistic from the July-to-June momentum portfolios is −0.31% (0.015).

[9] https://global-q.org/testingportfolios.html.

Table A5 reexamines spanning regressions in Table 3 in the main document with three different typs of factor momentum strategies: the Leippold–Yang (2021) 12-month (LY_{12}) factor momentum and the Arnott–Kalesnik–Linnainmaa (2023) one- (AKL_1) and six-month (AKL_6) factor momentum.

Tables A6, A7, and A8 supplement Table 5 in the main document, which only shows the factor regression results of recent and intermediate horizon past performance WML_ns (Novy-Marx, 2012), presenting their summary statistics (As Table 1 in the main document does), spanning regression results (Table 3), and market timing regression results (Table 4), respectively.

Similarly, Table A10 shows the factor regression results of residual momentum (Blitz, Huij, and Martens, 2011) WML_ns, and Tables A9, A11, and A12 supplement Table A10 presenting their summary statistics, spanning regression results, and market timing regression results, respectively.

Table A13 provides the spanning regression results of 5×5 and 5×10 two-way portfolios sorted by both momentum and each of other four anomalies, namely size, book-to-market, operating profitability, and investment.

Tables A14, A15, A16, and A17 inspect if the difference between the performance of the more- and fewer-portfolio momentum factors is robust to industry momentum (Moskowitz and Grinblatt, 1999), portfolio momentum (Lewellen, 2002), and macromomentum (Bhojraj and Swaminathan, 2006).

Figure A1 corresponds to Figure 3 in the main document, which cross-sectionally investigates the performance of 10, 25, 50, and 100 value-weighted portfolios sorted by

momentum, but instead considers their equal-weighted counterparts. Similarly, Figure A3 instead explores value-weighted portfolios sorted by residual momentum.

Figure A2, supplementing Table A5, illustrates the spanning alphas of WML_ns on the Leippold–Yang (2021) 12-month (LY_{12}) factor momentum and the Arnott–Kalesnik–Linnainmaa (2023) one- (AKL_1) and six-month (AKL_6) factor momentum as the functions of the number of portfolios.

Figure A4, following Daniel and Moskowitz (2016), shades bear-down and bear-up markets on Figure 4 in the main document, which contains the cumulative returns of WML_ns and $vWML_n$s, to study the influence of momentum crashes. In turn, Figure A5 plots the time-varying betas of these WML_ns and $vWML_n$s in the bear markets. Similarly, Figure A6 includes the cumulative returns of recent and intermediate horizon past performance momentum, and Figure A7 does those of residual momentum.

Figure A8, mapping to Figure 5 in the main document, which only considers conventional one-year momentum, illustrates the long-short average returns and Fama–French (2018) alphas of recent past performance (t−6,t−2), intermediate horizon past performance (t−12,t−7), and less-biased (t−11,t−3) momentum (Gong, Liu, and Liu, 2015) as the functions of the number of portfolios. Similarly, Figures A9 and A10 do those of residual and alpha (Hühn and Scholz, 2018; Zaremba, Umutlu, and Karathanasopoulos, 2019) momentum, respectively. In turn, Figure A11 considers their Hou–Mo–Xue–Zhang (2020) and Daniel–Hirshleifer–Sun (2020) alphas.

Figure A12, in addition to Figure 6 in the main document, which only considers the long-short average returns and Fama–French (2018) alphas, depicts the Hou–Mo–Xue–Zhang (2020) and Daniel–Hirshleifer–Sun (2020) alphas of the size (SMB), book-to-market (HML),

operating profitability (RMW), and investment (CMA) strategies as the functions of the number of portfolios. In addition to these four anomalies, Figures A13 and A14 delve into 49 anomalies in Kozak (2020) and 128 anomalies in Chen and Zimmermann (2022), respectively.

Figure A15 reports the average returns and monotonicity-relation statistics (Patton and Timmermann, 2010) of 5×5 two-way portfolios sorted by both momentum and each of other four anomalies, namely size, book-to-market, operating profitability, and investment.

Figure A16 presents the 10-year postholding period cumulative returns (Jegadeesh and Titman, 2001) of full, recent, and intermediate horizon past performance WML_ns. In turn, Figure A17 scrutinizes the influence of past momentum performance (PMP) quintiles (Ali, Daniel, and Hirshleifer, 2017) on these cumulative returns, the two standard error bands of which are shown in Figure A18.

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Table A1. Monotonicity tests.

The table shows Patton–Timmermann (2010) monotonicity test results based on 10 value-weighted portfolios formed on momentum (Pr_12_2), size (ME), book-to-market (BE-ME), operating profitability (OP), investment (INV), earnings/price (E-P), cashflow/price (CF-P), dividend yield (D-P), short-term reversal (Pr_1_0), long-term reversal (Pr_60_13), accruals (AC), market beta (BETA), net share issues (NI), variance (VAR), and residual variance (RESVAR). The portfolios are from Professor Kenneth R. French's website. Asterisks (daggers) indicate equal-weighted (reverse-ordered) portfolios. Each column begins in the starting month and ends in December 2019. Return averages (Lo, P2-P9, Hi), high-minus-low averages (HML), and monotonicity-relation statistics (MR) are annualized. The *t*-statistics are in parenthesis, and *p*-values are in brackets. The test's null (alternative) hypothesis is a flat or weakly decreasing (a strictly increasing) pattern.

Portfolio	Pr_12_2	Pr_12_2*	ME†	BE-ME	OP	INV†	E-P	CF-P
Starting	192701	192701	192607	192607	196307	196307	195107	195106
Low	4.0	11.3	10.7	10.5	9.1	8.8	11.1	10.9
P2	8.4	13.1	12.1	11.9	9.6	12.0	10.2	11.6
P3	9.1	13.4	12.9	11.4	10.1	11.0	11.8	11.1
P4	10.6	14.6	13.2	11.4	10.7	11.9	11.5	11.9
P5	10.8	14.6	14.1	12.2	12.0	11.4	11.9	12.5
P6	11.5	15.9	13.9	12.7	11.0	11.5	13.5	12.0
P7	12.2	16.0	14.4	11.9	10.6	11.7	14.1	13.3
P8	13.4	17.1	14.9	14.4	12.4	12.5	14.7	13.7
P9	14.4	18.9	14.9	15.8	12.8	13.9	15.6	14.6
High	18.0	21.2	16.3	15.9	12.0	13.6	16.3	15.9
HML	14.0	9.9	5.6	5.5	2.9	4.7	5.2	5.1
	(5.0)	(3.6)	(2.1)	(2.4)	(1.6)	(3.2)	(3.1)	(3.0)
MR	0.14	-0.01	-0.23	-0.82	-0.97	-1.02	-0.82	-0.48
	[0.001]	[0.005]	[0.075]	[0.192]	[0.196]	[0.270]	[0.158]	[0.028]
Portfolio	D-P	Pr_1_0†	Pr_60_13†	AC†	BETA	NI†	VAR†	RESVAR†
Starting	192707	192602	193101	196307	196307	196307	196307	196307
Low	10.5	6.0	10.9	8.9	11.3	6.4	4.7	4.0
P2	11.4	9.8	11.0	10.3	10.9	8.2	11.6	11.6
P3	10.9	10.9	12.7	11.7	11.7	10.1	13.6	14.2
P4	12.3	11.6	12.4	11.4	12.8	11.2	13.7	12.4
P5	10.6	11.9	12.1	11.0	11.3	12.7	13.1	13.9
P6	11.7	12.5	13.0	11.5	12.3	13.1	12.1	12.7
P7	12.7	12.3	12.6	11.6	11.0	12.1	11.7	12.3
P8	12.9	13.6	14.3	12.0	12.7	10.7	11.8	11.2
P9	12.6	14.0	14.6	13.1	12.1	10.7	12.0	11.9
High	12.2	16.3	16.6	13.3	12.1	11.5	10.5	11.4
HML	1.7	10.3	5.7	4.4	0.8	5.2	5.8	7.4
	(0.9)	(4.9)	(2.4)	(3.4)	(0.3)	(3.5)	(1.6)	(2.3)
MR	-1.66	-0.20	-0.38	-0.38	-1.47	-1.43	-1.56	-1.83
	[0.796]	[0.006]	[0.027]	[0.001]	[0.575]	[0.281]	[0.577]	[0.729]

Table A2. Monotonicity tests: other anomaly portfolios.

The table shows Patton–Timmermann (2010) monotonicity test results based on value-weighted portfolios formed on 185 anomalies (Hou *et al.*, 2021, Hou, Xue, and Zhang, 2020). The portfolios are from Professors Kewei Hou, Chen Xue, and Lu Zhang's website. Asterisks mean reverse-ordered portfolios. Each anomaly shows the number of portfolios, the starting month, the high-minus-low average (HML) and its *t*-statistic, and the monotonicity-relation statistic (MR) and its bootstrap *p*-value. The ending month is December 2019. HMLs and MRs are annualized. Anomalies are sorted by HML, the *t*-statistics are in parentheses, and bootstrap *p*-values are in brackets. The test's null (alternative) hypothesis is a flat or weakly decreasing (a strictly increasing) pattern.

Anomaly	N portfolios	Starting	HML	t-statistic	MR	p-value
prior 11-month returns, 1-month holding period	10	196701	13.77	(4.1)	-0.20	[0.002]
quarterly R&D expense-to-market, 1-month holding period	10	199001	13.02	(3.2)	-3.28	[0.422]
expected growth, 1-month holding period	10	196701	12.64	(6.8)	0.25	[0.000]
changes in analyst earnings forecasts, 1-month holding period	10	197603	11.35	(4.7)	-1.10	[0.035]
seasonality, average return across months t-72, t-84, t-96, t-108, and t-120	10	196701	9.90	(5.2)	-1.38	[0.284]
expected growth, 6-month holding period	10	196701	9.89	(5.6)	0.46	[0.000]
quarterly R&D expense-to-market, 12-month holding period	10	199001	9.84	(3.0)	-1.09	[0.112]
quarterly earnings-to-price, 1-month holding period	10	196701	9.74	(4.6)	-0.82	[0.058]
prior 6-month returns, 6-month holding period	10	196701	9.65	(3.8)	-0.68	[0.320]
quarterly R&D expense-to-market, 6-month holding period	10	199001	9.41	(2.6)	-1.67	[0.236]
prior 11-month returns, 6-month holding period	10	196701	9.38	(3.3)	-0.31	[0.069]
customer momentum, 1-month holding period	5	197907	9.20	(3.8)	-0.09	[0.010]
R&D expense-to-market	10	197607	9.16	(3.3)	-0.82	[0.020]
quarterly operating profits-to-lagged assets, 1-month holding period	10	197601	9.15	(4.1)	-0.82	[0.051]
revisions in analyst earnings forecasts, 1-month holding period	10	197607	8.92	(3.3)	-1.29	[0.177]
4-quarter changes in return on equity, 1-month holding period	10	196701	8.87	(5.6)	-0.57	[0.014]
customer industries momentum, 1-month holding period	10	196701	8.76	(3.5)	-2.50	[0.475]
cumulative abnormal returns around earnings announcement dates, 1-month holding period	10	197201	8.65	(5.4)	-1.23	[0.222]
supplier industries momentum, 1-month holding period	10	196701	8.53	(3.4)	-0.96	[0.020]
seasonality, average return across months t-24, t-36, t-48, and t-60	10	196701	8.52	(4.7)	-1.12	[0.184]
expected growth, 12-month holding period	10	196701	8.40	(5.0)	0.06	[0.000]
quarterly assets turnover, 1-month holding period	10	197201	8.08	(4.1)	-2.78	[0.818]
operating cash flow-to-assets	10	196701	8.01	(4.2)	-1.18	[0.244]
return on equity, 1-month holding period	10	196701	8.00	(3.4)	-1.07	[0.186]
failure probability, 6-month holding period*	10	197601	7.96	(2.3)	-0.28	[0.040]
quarterly return on net operating assets, 1-month holding period	10	197601	7.80	(3.2)	-1.03	[0.163]
net stock issues*	10	196701	7.79	(5.4)	-3.02	[0.950]
industry momentum, 1-month holding period	9	196701	7.72	(2.7)	0.04	[0.000]
quarterly operating profits-to-lagged book equity, 1-month holding period	10	197201	7.65	(3.3)	-1.12	[0.166]
seasonality, average return across months t-132, t-144, t-156, t-168, and t-180	10	196701	7.54	(4.5)	-2.61	[0.875]
prior 6-month returns, 1-month holding period	10	196701	7.43	(2.3)	-1.12	[0.254]
industry momentum, 12-month holding period	9	196701	7.33	(3.6)	-0.58	[0.330]
industry lead-lag effect in prior returns, 1-month holding period	9	196701	7.33	(3.1)	-0.78	[0.048]

Table A2. *Continued.* Monotonicity tests: other anomaly portfolios.

Anomaly	N portfolios	Starting	HML	t-statistic	MR	p-value
industry momentum, 6-month holding period	9	196701	7.25	(3.0)	-0.59	[0.223]
net payout yield	10	197207	7.21	(3.6)	-0.28	[0.001]
earnings predictability*	10	196701	7.16	(3.6)	-2.19	[0.766]
organizational capital-to-assets	10	196701	7.14	(3.4)	-1.49	[0.451]
cash-based operating profits-to-lagged assets	10	196701	7.11	(3.9)	-0.65	[0.043]
quarterly assets turnover, 6-month holding period	10	197201	7.05	(3.7)	-1.65	[0.604]
quarterly enterprise multiple, 1-month holding period*	10	197601	7.03	(3.2)	-0.58	[0.020]
advertising expense-to-market	10	197307	7.00	(2.6)	-1.35	[0.126]
11-month residual momentum, 1-month holding period	10	196701	6.97	(3.8)	-1.17	[0.278]
industry lead-lag effect in earnings surprises, 1-month holding period	9	196701	6.90	(3.6)	-1.70	[0.496]
52-week high, 6-month holding period	10	196701	6.88	(2.2)	-0.47	[0.245]
seasonality, return in month t-12	10	196701	6.86	(3.2)	-0.91	[0.123]
seasonality, average return from month t-11 to t-1	10	196701	6.85	(2.0)	-1.73	[0.576]
quarterly gross profits-to-lagged assets, 1-month holding period	10	197601	6.72	(4.1)	-0.89	[0.084]
return on assets, 1-month holding period	10	197201	6.71	(2.8)	-1.11	[0.151]
composite equity issuance*	10	196701	6.68	(3.6)	-1.40	[0.353]
quarterly operating profits-to-lagged assets, 6-month holding period	10	197601	6.62	(3.3)	-0.49	[0.026]
seasonality, average return across months t-192, t-204, t-216, t-228, and t-240	10	196701	6.59	(3.6)	-1.67	[0.313]
operating cash flow-to-price	10	197207	6.54	(2.7)	-0.49	[0.015]
percent discretionary accruals*	10	196701	6.51	(4.7)	-0.82	[0.046]
4-quarter changes in return on assets, 1-month holding period	10	197301	6.44	(3.6)	-0.45	[0.002]
prior 6-month returns, 12-month holding period	10	196701	6.38	(3.1)	-0.24	[0.096]
changes in analyst earnings forecasts, 6-month holding period	10	197603	6.36	(3.5)	-0.48	[0.047]
idiosyncratic volatility estimated from the Fama-French 3-factor model, 1-month holding period*	10	196701	6.35	(1.9)	-1.92	[0.778]
industry-adjusted organizational capital-to-assets	10	196701	6.31	(4.3)	-0.50	[0.005]
quarterly sales-to-price, 1-month holding period	10	196701	6.13	(2.4)	-0.88	[0.122]
quarterly cash-based operating profits-to-lagged assets, 1-month holding period	10	197601	6.12	(3.5)	-1.20	[0.158]
quarterly operating profits-to-lagged assets, 12-month holding period	10	197601	6.11	(3.2)	-0.54	[0.079]
quarterly operating leverage, 1-month holding period	10	197301	6.10	(3.1)	-1.63	[0.361]
quarterly earnings-to-price, 6-month holding period	10	196701	6.08	(3.1)	-0.34	[0.036]
quarterly operating leverage, 12-month holding period	10	197301	6.06	(3.3)	-0.87	[0.127]
segment momentum, 1-month holding period	10	197707	6.04	(2.2)	-1.07	[0.031]
quarterly operating cash flow-to-price, 1-month holding period	10	198501	5.98	(2.0)	-0.94	[0.059]
idiosyncratic volatility estimated from the q-factor model, 1-month holding period*	10	196702	5.97	(1.8)	-2.27	[0.889]
quarterly operating leverage, 6-month holding period	10	197301	5.97	(3.1)	-1.24	[0.267]
quarterly assets turnover, 12-month holding period	10	197201	5.93	(3.2)	-1.35	[0.533]
quarterly cash flow-to-price, 1-month holding period	10	196701	5.91	(2.5)	-1.40	[0.276]
quarterly capital turnover, 1-month holding period	10	197201	5.83	(3.0)	-1.27	[0.174]

Table A2. *Continued.* Monotonicity tests: other anomaly portfolios.

Anomaly	N portfolios	Starting	HML	t-statistic	MR	p-value
quarterly R&D expense-to-sales, 12-month holding period	10	199001	5.79	(2.0)	-1.61	[0.129]
quarterly asset liquidity, 6-month holding period	10	197601	5.78	(2.8)	-0.10	[0.001]
quarterly R&D expense-to-sales, 6-month holding period	10	199001	5.74	(2.0)	-1.53	[0.076]
quarterly cash-based operating profits-to-lagged assets, 6-month holding period	10	197601	5.71	(3.9)	-0.16	[0.000]
quarterly fundamental score, 6-month holding period	7	198501	5.69	(2.5)	-1.24	[0.524]
quarterly sales-to-price, 6-month holding period	10	196701	5.68	(2.4)	-0.45	[0.058]
quarterly asset liquidity, 1-month holding period	10	197601	5.66	(2.6)	-1.04	[0.182]
quarterly cash-based operating profits-to-lagged assets, 12-month holding period	10	197601	5.65	(4.2)	-0.20	[0.004]
operating profits-to-assets	10	196701	5.60	(2.8)	-1.53	[0.426]
net operating assets*	10	196701	5.59	(3.9)	-3.14	[0.962]
changes in net operating assets*	10	196701	5.58	(3.7)	-1.76	[0.680]
quarterly fundamental score, 1-month holding period	7	198501	5.54	(2.0)	-0.97	[0.190]
changes in net non-cash working capital*	10	196701	5.53	(3.7)	-0.81	[0.075]
11-month residual momentum, 6-month holding period	10	196701	5.49	(3.6)	-0.23	[0.039]
52-week high, 12-month holding period	10	196701	5.46	(2.0)	-0.04	[0.031]
quarterly capital turnover, 6-month holding period	10	197201	5.44	(2.9)	-1.90	[0.694]
revisions in analyst earnings forecasts, 6-month holding period	10	197607	5.37	(2.3)	-0.78	[0.121]
operating leverage	10	196701	5.35	(3.1)	-1.26	[0.210]
R&D capital-to-assets	10	198007	5.34	(2.0)	-2.41	[0.518]
6-month residual momentum, 6-month holding period	10	196701	5.29	(3.9)	-0.41	[0.171]
prior 11-month returns, 12-month holding period	10	196701	5.25	(2.2)	-0.29	[0.098]
quarterly sales-to-price, 12-month holding period	10	196701	5.22	(2.4)	-0.34	[0.034]
seasonality, average return from month t-120 to t-61 except for months t-72, t-84, t-96, t-108, and t-120*	10	196701	5.21	(2.5)	-1.30	[0.272]
quarterly return on net operating assets, 6-month holding period	10	197601	5.19	(2.3)	-0.36	[0.012]
discretionary accruals*	10	196701	5.16	(3.6)	-1.12	[0.199]
changes in PPE and inventory scaled by lagged assets*	10	196701	5.12	(3.5)	-1.64	[0.625]
standard unexpected earnings, 1-month holding period	10	196701	5.12	(3.2)	-1.61	[0.542]
percent operating accruals*	10	196701	5.06	(3.5)	-0.62	[0.017]
quarterly operating profits-to-lagged book equity, 6-month holding period	10	197201	5.04	(2.3)	-0.99	[0.247]
enterprise multiple*	10	196701	4.99	(2.5)	-0.17	[0.001]
quarterly O-score, 1-month holding period*	10	197601	4.99	(2.1)	-1.29	[0.306]
return on equity, 6-month holding period	10	196701	4.93	(2.2)	-1.18	[0.532]
quarterly capital turnover, 12-month holding period	10	197201	4.91	(2.7)	-1.34	[0.482]
percent total accruals*	10	196701	4.87	(3.2)	-1.25	[0.242]
assets turnover	10	196701	4.87	(2.5)	-0.69	[0.036]
investment growth*	10	196701	4.86	(3.6)	-1.40	[0.370]
total volatility, 1-month holding period*	10	196701	4.82	(1.3)	-1.89	[0.706]
gross profits-to-assets	10	196701	4.80	(3.1)	-0.46	[0.003]

Table A2. *Continued.* Monotonicity tests: other anomaly portfolios.

Anomaly	N portfolios	Starting	HML	t-statistic	MR	p-value
sales-to-price	10	196701	4.79	(2.2)	-0.33	[0.006]
quarterly asset liquidity, 12-month holding period	10	197601	4.75	(2.4)	-0.29	[0.013]
quarterly investment-to-assets (asset growth), 6-month holding period*	10	197301	4.72	(2.6)	-0.57	[0.050]
inventory changes*	10	196701	4.66	(3.1)	-0.98	[0.100]
seasonality, average return from month t-60 to t-13 except for months t-24, t-36, t-48, and t-60*	10	196701	4.66	(1.9)	-1.13	[0.220]
industry-adjusted real estate ratio	10	197007	4.62	(2.6)	-0.99	[0.039]
quarterly gross profits-to-lagged assets, 6-month holding period	10	197601	4.61	(3.0)	-0.62	[0.038]
quarterly cash flow-to-price, 6-month holding period	10	196701	4.61	(2.2)	-0.27	[0.017]
book-to-market equity	10	196701	4.56	(2.1)	-0.83	[0.120]
revenue surprises, 1-month holding period	10	196701	4.52	(2.8)	-1.94	[0.751]
systematic volatility, 1-month holding period*	10	198602	4.46	(1.7)	-1.85	[0.506]
4-quarter changes in return on equity, 6-month holding period	10	196701	4.46	(3.4)	-0.59	[0.066]
payout yield	10	197207	4.45	(2.0)	-0.68	[0.026]
quarterly investment-to-assets (asset growth), 12-month holding period*	10	197301	4.42	(2.6)	-0.46	[0.054]
quarterly earnings-to-price, 12-month holding period	10	196701	4.32	(2.4)	-0.37	[0.075]
changes in non-current operating assets*	10	196701	4.31	(3.1)	-0.88	[0.079]
changes in net non-current operating assets*	10	196701	4.27	(3.2)	-1.25	[0.296]
quarterly fundamental score, 12-month holding period	7	198501	4.23	(2.0)	-0.73	[0.306]
6-month residual momentum, 12-month holding period	10	196701	4.23	(3.8)	-0.19	[0.067]
investment-to-assets (asset growth)*	10	196701	4.23	(2.5)	-0.72	[0.062]
cumulative abnormal returns around earnings announcement dates, 6-month holding period	10	197201	4.19	(3.8)	-0.36	[0.010]
quarterly gross profits-to-lagged assets, 12-month holding period	10	197601	4.10	(2.7)	-0.32	[0.003]
quarterly book-to-market equity, 12-month holding period	10	196701	4.09	(1.8)	-0.35	[0.048]
capital turnover	10	196701	4.08	(2.3)	-2.65	[0.840]
analyst-based intrinsic value-to-market	10	197607	4.07	(1.7)	-2.91	[0.856]
industry lead-lag effect in prior returns, 12-month holding period	9	196701	4.04	(4.2)	0.03	[0.000]
dollar trading volume, 12-month holding period*	10	196701	4.03	(2.1)	-0.25	[0.078]
industry lead-lag effect in prior returns, 6-month holding period	9	196701	4.03	(3.3)	-0.18	[0.006]
earnings-to-price	10	196701	4.02	(1.8)	-1.76	[0.670]
inventory growth*	10	196701	3.92	(2.7)	-2.62	[0.915]
intangible return*	10	196701	3.91	(1.7)	-1.48	[0.443]
quarterly sales growth, 1-month holding period	10	196701	3.90	(2.0)	-1.73	[0.647]
the number of quarters with consecutive earnings increase, 1-month holding period	9	196901	3.85	(2.9)	-1.20	[0.168]
equity duration*	10	196701	3.82	(1.8)	-1.65	[0.579]
cash flow-to-price	10	196701	3.78	(1.7)	-1.07	[0.221]
quarterly enterprise multiple, 12-month holding period*	10	197601	3.74	(1.9)	-0.80	[0.368]
earnings timeliness	10	196701	3.73	(2.5)	-0.71	[0.018]
changes in analyst earnings forecasts, 12-month holding period	10	197603	3.68	(2.5)	-0.37	[0.034]

Table A2. *Continued.* Monotonicity tests: other anomaly portfolios.

Anomaly	N portfolios	Starting	HML	t-statistic	MR	p-value
11-month residual momentum, 12-month holding period	10	196701	3.67	(2.8)	-0.38	[0.281]
book-to-June-end market equity	10	196701	3.63	(1.6)	-0.62	[0.052]
customer industries momentum, 6-month holding period	10	196701	3.61	(3.0)	-1.41	[0.722]
quarterly cash flow-to-price, 12-month holding period	10	196701	3.61	(1.8)	-0.10	[0.013]
changes in book equity*	10	196701	3.59	(2.1)	-0.65	[0.035]
quarterly enterprise multiple, 6-month holding period*	10	197601	3.57	(1.7)	-0.83	[0.242]
idiosyncratic skewness estimated from the Fama-French 3-factor model, 1-month holding period	10	196701	3.55	(3.1)	-1.57	[0.580]
2-year investment growth*	10	196701	3.51	(2.4)	-1.62	[0.467]
short-term reversal*	10	196701	3.47	(1.4)	-1.99	[0.781]
long-term reversal, 6-month holding period*	10	196701	3.39	(1.5)	-0.69	[0.192]
changes in long-term net operating assets*	10	196701	3.38	(2.2)	-0.95	[0.106]
percent changes in investment relative to industry*	10	196701	3.36	(2.6)	-0.65	[0.026]
4-quarter changes in return on assets, 6-month holding period	10	197301	3.34	(2.2)	-1.79	[0.790]
operating accruals*	10	196701	3.34	(2.3)	-1.24	[0.320]
customer industries momentum, 12-month holding period	10	196701	3.32	(3.4)	-0.96	[0.714]
Roe-based intrinsic value-to-market	10	196701	3.22	(1.5)	-1.83	[0.655]
enterprise book-to-price	10	196701	3.19	(1.4)	-0.79	[0.058]
industry concentration in sales*	10	196701	3.18	(1.9)	-2.54	[0.508]
long-term reversal, 1-month holding period*	10	196701	3.16	(1.3)	-0.56	[0.026]
long-term reversal, 12-month holding period*	10	196701	3.15	(1.5)	-0.28	[0.050]
operating profits-to-book equity	10	196701	3.12	(1.5)	-1.35	[0.401]
changes in net financial assets	10	196701	3.08	(2.3)	-1.73	[0.601]
4-quarter changes in return on equity, 12-month holding period	10	196701	3.03	(2.7)	-0.37	[0.032]
changes in current operating assets*	10	196701	3.00	(1.9)	-1.20	[0.221]
changes in financial liabilities*	10	196701	2.97	(2.4)	-1.13	[0.233]
abnormal corporate investment*	10	196701	2.94	(2.0)	-1.48	[0.418]
cumulative abnormal returns around earnings announcement dates, 12-month holding period	10	197201	2.89	(3.3)	-0.39	[0.039]
idiosyncratic skewness estimated from the q-factor model, 1-month holding period	10	196702	2.79	(2.5)	-1.92	[0.817]
total accruals*	10	196701	2.69	(1.8)	-0.71	[0.040]
dividend yield	10	196701	2.68	(1.0)	-1.11	[0.233]
net debt financing*	10	197207	2.61	(1.9)	-0.74	[0.027]
effective tax rate	10	196701	2.51	(2.0)	-1.60	[0.446]
quarterly tax income-to-book income, 12-month holding period	10	196701	2.41	(2.1)	-1.57	[0.816]
the market equity*	10	196701	1.96	(0.8)	-0.63	[0.196]
segment momentum, 12-month holding period	10	197707	1.90	(2.2)	-0.20	[0.004]
standard unexpected earnings, 6-month holding period	10	196701	1.85	(1.3)	-1.88	[0.945]
customer momentum, 12-month holding period	5	197907	1.73	(2.1)	-0.71	[0.436]
market beta, 1-month holding period	10	196701	0.14	(0.0)	-0.69	[0.100]

Table A3. Number of momentum portfolios and performance of factor models.
The table shows the mean absolute alphas (MA α) and the Gibbons–Ross–Shanken (1989) *F*-statistics of the 10, 25, 50, and 100 momentum portfolios, respectively. Each panel shows the covered months. Alphas are annualized. *p*-values are in brackets.

N	10	25	50	100
CAPM (192701–201912)				
MA α	3.87	4.06	4.10	4.11
GRS F	6.66	3.89	2.49	1.96
	[0.000]	[0.000]	[0.000]	[0.000]
Fama–French (1993) three-factor model (192701–201912)				
MA α	4.54	4.74	4.81	4.79
GRS F	8.17	4.54	2.72	2.03
	[0.000]	[0.000]	[0.000]	[0.000]
Fama–French (2018) five-factor model (196307–201912)				
MA α	3.39	3.58	3.70	3.72
GRS F	4.85	2.74	2.16	1.81
	[0.000]	[0.000]	[0.000]	[0.000]
Hou–Mo–Xue–Zhang (2020) five-factor model (196701–201912)				
MA α	1.35	1.39	1.64	1.85
GRS F	1.69	1.26	1.40	1.26
	[0.080]	[0.177]	[0.040]	[0.059]
Stambaugh–Yuan (2017) four-factor model (196301–201612)				
MA α	1.26	1.42	1.75	1.98
GRS F	2.34	1.84	1.83	1.61
	[0.010]	[0.008]	[0.001]	[0.001]
Daniel–Hirshleifer–Sun (2020) three-factor model (197207–201812)				
MA α	1.50	1.57	1.73	2.01
GRS F	2.66	1.63	1.45	1.33
	[0.003]	[0.028]	[0.028]	[0.028]

Table A4. Zoom in on others: factor regressions.

This table shows time-series regression results of the form $y_t=\alpha+\boldsymbol{\beta}'\mathbf{x}_t+\varepsilon_t$, where y is the winner-minus-loser (WML_n) return based on 10, 25, 50, or 100 momentum portfolios, and **x** is the Fama–French (2015) five factors based on 10, 25, 50, or 100 corresponding portfolios: the market (Mkt_RF), small-minus-big (SMB_n), high-minus-low (HML_n), robust-minus-weak (RMW_n), and conservative-minus-aggressive (CMA_n) factors. Except Mkt_RF, factors in the first column are two-way sorted and from Professor Kenneth R. French's website, and those in the other columns are one-way sorted and based on CRSP. The data span July 1963 to December 2019. *t*-statistics are in parentheses, and alphas are annualized.

	French	WML_{10}	WML_{25}	WML_{50}	WML_{100}
α	8.72	17.47	28.24	35.42	37.78
	(3.44)	(5.47)	(7.73)	(7.20)	(5.69)
Mkt_RF	-0.15	-0.00	-0.00	-0.00	-0.00
	(-1.96)	(-1.75)	(-1.79)	(-1.58)	(-1.12)
SMB_n	0.05	0.03	-0.20	-0.29	-0.39
	(0.47)	(0.17)	(-0.95)	(-1.16)	(-1.51)
HML_n	-0.52	-0.39	-0.32	-0.16	-0.28
	(-3.20)	(-2.44)	(-2.16)	(-1.18)	(-1.74)
RMW_n	0.22	0.12	-0.04	0.22	0.14
	(0.87)	(0.73)	(-0.22)	(1.14)	(0.70)
CMA_n	0.33	0.24	0.18	-0.08	-0.02
	(1.32)	(1.19)	(0.82)	(-0.40)	(-0.13)
R^2	9.49	7.55	8.39	8.08	8.59

Table A5. Factor momentum: spanning regressions.

This table shows time-series regression results of the form $y_t=\alpha+\beta x_t+\varepsilon_t$, where y is either the simple or the volatility-managed winner-minus-loser (WML_n) return based on 10, 25, 50, or 100 momentum portfolios, and x is one or more factor momentum strategies—the Leippold–Yang (2021) 12-month (LY_{12}) factor momentum and the Arnott–Kalesnik–Linnainmaa (2023) one- (AKL_1) and six-month (AKL_6) factor momentum—based on 210 US equity factors. The 210 factors are from Professor Markus Leippold's website (https://osf.io/6sxc8). The first four columns regress simple WML_ns on simple factor momentum, and the last four columns regress volatility-managed WML_ns on volatility-managed factor momentum. Similar to Moreira and Muir (2017), volatility-managed factor momentum scales non-managed factor momentum by the inverse of its conditional variance proxied by the previous year's realized variance. The data span July 1966 to December 2018. *t*-statistics are in parentheses, and alphas are annualized.

	Simple winner-minus-loser				Volatility-managed winner-minus-loser			
	WML_{10}	WML_{25}	WML_{50}	WML_{100}	$vWML_{10}$	$vWML_{25}$	$vWML_{50}$	$vWML_{100}$
Panel A. Leippold–Yang (2021) 12-month factor momentum (LY_{12})								
α	9.07	17.37	23.22	25.50	15.15	25.34	34.41	41.20
	(2.80)	(4.48)	(4.19)	(3.22)	(3.91)	(5.17)	(5.13)	(4.85)
(v)LY_{12}	3.92	4.57	4.97	5.01	2.92	3.14	3.13	3.66
	(7.51)	(7.12)	(6.10)	(5.11)	(9.49)	(10.00)	(8.40)	(7.52)
R^2	42.50	34.93	27.78	16.29	23.51	16.42	11.03	8.67
Panel B. Arnott–Kalesnik–Linnainmaa (2023) one-month factor momentum (AKL_1)								
α	14.10	23.29	30.82	34.02	17.09	27.23	36.49	44.17
	(5.05)	(6.66)	(6.71)	(5.37)	(4.40)	(5.58)	(5.43)	(4.87)
(v)AKL_1	0.14	0.16	0.08	0.00	0.27	0.30	0.29	0.30
	(1.18)	(1.19)	(0.42)	(0.01)	(3.18)	(2.66)	(2.02)	(1.70)
R^2	0.84	0.65	0.10	0.00	3.03	2.32	1.43	0.88
Panel C. Arnott–Kalesnik–Linnainmaa (2023) six-month factor momentum (AKL_6)								
α	10.71	19.25	26.23	29.08	14.34	23.93	34.10	39.53
	(3.38)	(4.97)	(5.37)	(4.34)	(3.67)	(5.14)	(5.03)	(4.71)
(v)AKL_6	1.38	1.62	1.50	1.36	1.63	1.88	1.61	2.20
	(2.82)	(2.86)	(2.33)	(1.68)	(4.32)	(3.45)	(2.56)	(2.58)
R^2	5.53	4.59	2.64	1.26	7.65	6.18	3.06	3.28
Panel D. All three types of factor momentum (LY_{12}, AKL_1, and AKL_6)								
α	10.18	18.68	26.43	29.91	12.24	21.55	31.78	37.43
	(4.06)	(5.70)	(5.99)	(4.80)	(3.47)	(4.66)	(4.74)	(4.32)
(v)LY_{12}	4.18	4.87	5.47	5.62	2.65	2.76	2.92	3.25
	(6.80)	(6.56)	(5.80)	(4.62)	(9.27)	(7.98)	(7.69)	(6.41)
(v)AKL_1	0.05	0.05	-0.03	-0.10	0.13	0.15	0.14	0.12
	(0.45)	(0.43)	(-0.20)	(-0.44)	(1.94)	(1.55)	(1.07)	(0.78)
(v)AKL_6	-0.59	-0.67	-1.00	-1.16	0.37	0.57	0.23	0.68
	(-1.25)	(-1.26)	(-1.57)	(-1.37)	(0.96)	(0.96)	(0.35)	(0.75)
R^2	43.29	35.55	28.76	17.18	24.61	17.51	11.44	9.09

Table A6. Term structure of momentum: summary statistics.

The table shows summary statistics for $WML_n^{6,2}$ (top-left four columns), $vWML_n^{6,2}$ (top-right), $WML_n^{12,7}$ (bottom-left), and $vWML_n^{12,7}$ (bottom-right), where $WML^{6,2}$ and $WML^{12,7}$ are the simple WML strategies based on recent (five months from t−6 to t−2) and intermediate horizon (six months from t−12 to t−7) past performance, respectively (Novy-Marx, 2012; Goyal and Wahal 2015), and $vWML^{6,2}$ and $vWML^{12,7}$ are their volatility-managed counterparts, respectively (Moreira and Muir, 2017). The data span July 1926 ($WML^{6,2}$), August 1926 ($vWML^{6,2}$), January 1927 ($WML^{12,7}$), and February 1927 ($vWML^{12,7}$) to December 2019, respectively. Average returns, standard deviations, and Sharpe ratios are annualized.

		Simple winner-minus-loser				Volatility-managed winner-minus-loser			
		WML_{10}	WML_{25}	WML_{50}	WML_{100}	$vWML_{10}$	$vWML_{25}$	$vWML_{50}$	$vWML_{100}$
(6,2) winner-minus-loser	Mean	8.62	15.82	19.98	23.51	23.37	31.03	38.11	47.12
	St dev	24.73	31.45	38.06	48.63	24.74	31.46	38.08	48.66
	Sharpe	0.35	0.50	0.52	0.48	0.94	0.99	1.00	0.97
	Skew	-2.34	-2.08	-1.65	-2.15	1.88	1.91	1.73	1.78
	Kurt	16.60	21.28	18.11	19.51	9.79	12.28	12.90	11.81
	Min	-67.19	-98.89	-105.86	-123.49	-23.25	-38.84	-68.81	-71.57
	Q1	-1.93	-2.23	-2.71	-3.31	-1.29	-1.47	-1.69	-2.09
	Med	1.15	1.84	2.32	2.55	0.80	1.15	1.33	1.61
	Q3	4.16	5.60	6.66	8.41	4.07	5.01	6.00	7.37
	Max	28.56	61.90	79.53	94.72	58.98	86.16	101.04	126.82
(12,7) winner-minus-loser	Mean	13.03	21.59	23.48	27.06	20.69	30.45	31.95	32.01
	St dev	23.47	28.86	32.96	42.84	23.48	28.87	32.97	42.86
	Sharpe	0.56	0.75	0.71	0.63	0.88	1.05	0.97	0.75
	Skew	-3.97	-2.60	-2.38	-3.28	0.93	0.82	0.68	3.02
	Kurt	49.97	30.02	26.97	46.34	7.54	4.00	10.31	36.53
	Min	-95.46	-99.37	-102.74	-177.35	-34.81	-36.65	-54.28	-70.82
	Q1	-1.65	-1.90	-2.04	-2.89	-1.32	-1.31	-1.22	-1.82
	Med	1.35	1.93	2.41	2.55	0.95	1.31	1.50	1.30
	Q3	4.19	5.54	6.65	7.60	3.94	5.74	5.84	6.33
	Max	24.88	33.84	54.78	79.76	53.34	44.60	81.12	164.00

Table A7. Term structure of momentum: spanning regressions.

This table shows spanning regression results of the more-portfolio momentum factors on their fewer-portfolio counterparts (top) and of the volatility-managed momentum factors on their simple counterparts (bottom). The top panel regresses the more-portfolio simple (left)/volatility-managed (right) recent (top)/intermediate horizon (bottom) past performance momentum factors on their fewer-portfolio counterparts, respectively (Novy-Marx, 2012; Goyal and Wahal, 2015). The bottom panel regresses the volatility-managed recent (left)/intermediate horizon (right) factors on their simple counterparts, respectively (Moreira and Muir, 2017). The data span July 1926 ($WML^{6,2}$), August 1926 ($vWML^{6,2}$), January 1927 ($WML^{12,7}$), and February 1927 ($vWML^{12,7}$) to December 2019, respectively. The *t*-statistics are in parentheses, and alphas are annualized.

		Simple WML			Volatility-managed WML		
		WML_{25}	WML_{50}	WML_{100}	$vWML_{25}$	$vWML_{50}$	$vWML_{100}$
(6,2) winner-minus-loser	α	6.25	2.99	1.95	9.55	8.87	12.34
		(3.91)	(1.63)	(0.72)	(4.09)	(3.45)	(3.36)
	WML_{10}	1.11			0.92		
		(59.78)			(35.02)		
	WML_{25}		1.07			0.94	
			(64.39)			(41.47)	
	WML_{50}			1.08			0.91
				(52.72)			(34.13)
	R^2	76.13	78.73	71.27	52.29	60.58	51.00
(12,7) winner-minus-loser	α	7.30	1.66	4.24	11.49	4.95	1.42
		(5.32)	(1.02)	(1.41)	(5.57)	(2.20)	(0.45)
	WML_{10}	1.10			0.92		
		(65.81)			(37.28)		
	WML_{25}		1.01			0.89	
			(63.49)			(41.14)	
	WML_{50}			0.97			0.96
				(37.57)			(36.33)
	R^2	79.54	78.35	55.89	55.53	60.32	54.26

	(6,2) winner-minus-loser				(12,7) winner-minus-loser			
	$vWML_{10}$	$vWML_{25}$	$vWML_{50}$	$vWML_{100}$	$vWML_{10}$	$vWML_{25}$	$vWML_{50}$	$vWML_{100}$
α	19.08	22.44	26.89	35.17	14.18	18.95	20.19	18.79
	(8.55)	(8.12)	(8.14)	(8.03)	(6.64)	(7.31)	(6.68)	(4.77)
WML_n	0.50	0.54	0.56	0.51	0.50	0.53	0.50	0.49
	(19.27)	(21.66)	(22.59)	(19.72)	(19.34)	(21.03)	(19.36)	(18.72)
R^2	24.92	29.53	31.32	25.79	25.15	28.44	25.19	23.95

Table A8. Term structure of momentum: market timing regressions.

This table shows Daniel and Moskowitz's (2016) market timing regression results of the following form.

$$y_t = \alpha + [\beta_0 + I^B_{t-1}(\beta_B + I^U_t \beta_{BU})]R^e_{Mt} + \varepsilon_t,$$

where y is one of the simple (left)/volatility-managed (right) recent (top)/intermediate horizon (bottom) past performance winner-minus-lose returns based on 10, 25, 50, or 100 momentum portfolios, I^B is a bear-market indicator that equals 1 if the trailing two-year cumulative market return is negative and 0 otherwise, I^U is an up-market indicator that equals 1 if the contemporaneous excess market return is positive and 0 otherwise, and $R_M{}^e$ is the excess market return. The data span July 1926 ($WML^{6,2}$), August 1926 ($vWML^{6,2}$), January 1927 ($WML^{12,7}$), and February 1927 ($vWML^{12,7}$) to December 2019, respectively. The *t*-statistics are in parentheses, and alphas are annualized.

		Simple winner-minus-loser				Volatility-managed winner-minus-loser			
		WML_{10}	WML_{25}	WML_{50}	WML_{100}	$vWML_{10}$	$vWML_{25}$	$vWML_{50}$	$vWML_{100}$
(6,2) winner-minus-loser	α	15.34	21.41	25.28	31.61	26.35	34.82	43.78	52.07
		(6.49)	(6.65)	(6.23)	(6.15)	(9.60)	(9.97)	(10.37)	(9.61)
	Mkt_RF	-0.11	-0.04	-0.09	-0.04	-0.05	-0.02	-0.07	0.00
		(-2.34)	(-0.67)	(-1.15)	(-0.38)	(-0.90)	(-0.31)	(-0.86)	(-0.00)
	Bear	-0.30	-0.44	-0.36	-0.39	0.14	0.10	0.25	0.19
		(-3.11)	(-3.36)	(-2.18)	(-1.87)	(1.27)	(0.69)	(1.44)	(0.87)
	BearUp	-0.84	-0.69	-0.54	-1.02	-0.38	-0.46	-0.66	-0.61
		(-7.69)	(-4.69)	(-2.90)	(-4.33)	(-3.01)	(-2.85)	(-3.41)	(-2.43)
	Sum	-1.25	-1.18	-1.00	-1.46	-0.29	-0.38	-0.49	-0.41
		(-1.25)	(-13.04)	(-8.74)	(-10.08)	(-3.71)	(-3.87)	(-4.08)	(-2.71)
	R^2	26.30	15.09	7.64	9.13	1.35	1.37	1.63	0.74
(12,7) winner-minus-loser	α	15.05	22.94	25.33	29.40	21.20	32.05	33.67	34.77
		(6.41)	(7.92)	(7.48)	(6.43)	(8.13)	(10.02)	(9.18)	(7.29)
	Mkt_RF	0.11	0.14	0.13	0.10	0.05	0.10	0.08	0.09
		(2.22)	(2.45)	(1.88)	(1.08)	(0.88)	(1.52)	(1.11)	(0.93)
	Bear	-0.69	-0.95	-0.90	-0.83	-0.11	-0.09	-0.03	0.01
		(-7.17)	(-7.98)	(-6.45)	(-4.43)	(-1.01)	(-0.71)	(-0.18)	(0.05)
	BearUp	-0.32	-0.23	-0.29	-0.26	-0.11	-0.27	-0.27	-0.41
		(-2.92)	(-1.70)	(-1.84)	(-1.22)	(-0.95)	(-1.83)	(-1.59)	(-1.85)
	Sum	-0.90	-1.03	-1.05	-0.99	-0.18	-0.26	-0.21	-0.31
		(-13.62)	(-12.63)	(-11.04)	(-7.68)	(-2.39)	(-2.94)	(-2.06)	(-2.28)
	R^2	18.70	17.92	13.78	7.18	0.65	1.01	0.52	0.59

Table A9. Residual momentum: summary statistics.

This table, like Table 2, shows summary statistics for simple (left)/volatility-managed (right) WML_ns based on 10/25/50/100 value-weighted residual momentum portfolios (Blitz, Huij, and Martens, 2011) based on full (top)/recent/intermediate horizon (bottom) past performance. Average returns, standard deviations, and Sharpe ratios are annualized.

	Simple winner-minus-loser				Volatility-managed winner-minus-loser			
	WML_{10}	WML_{25}	WML_{50}	WML_{100}	$vWML_{10}$	$vWML_{25}$	$vWML_{50}$	$vWML_{100}$
Mean	8.59	9.69	10.91	11.92	8.69	11.10	11.57	13.88
St dev	12.55	16.80	18.87	24.17	12.56	16.78	18.88	24.17
Sharpe	0.68	0.58	0.58	0.49	0.69	0.66	0.61	0.57
Skew	-0.38	-0.93	-0.57	-2.17	1.76	1.06	0.26	0.17
Kurt	7.09	15.60	5.97	24.63	15.07	7.51	4.88	9.22
Min	-20.98	-47.51	-41.57	-85.42	-15.85	-17.77	-30.90	-59.67
Q1	-1.20	-1.43	-1.93	-2.41	-0.86	-1.16	-1.55	-1.89
Med	0.66	0.83	0.97	0.95	0.40	0.57	0.69	0.53
Q3	2.66	3.14	4.03	4.62	1.95	2.66	3.28	3.75
Max	26.97	38.62	23.61	24.97	39.21	36.72	28.95	40.45

		Simple winner-minus-loser				Volatility-managed winner-minus-loser			
		WML_{10}	WML_{25}	WML_{50}	WML_{100}	$vWML_{10}$	$vWML_{25}$	$vWML_{50}$	$vWML_{100}$
(6,2) winner-minus-loser	Mean	1.04	1.78	1.78	1.15	1.93	2.91	4.71	6.37
	St dev	12.98	14.80	18.39	21.51	12.97	14.81	18.39	21.51
	Sharpe	0.08	0.12	0.10	0.05	0.15	0.20	0.26	0.30
	Skew	-2.27	-0.56	-0.84	-0.81	-0.12	0.32	0.51	0.39
	Kurt	23.49	5.89	6.82	5.02	4.50	6.48	4.79	3.24
	Min	-42.99	-31.17	-38.19	-43.24	-22.86	-23.67	-21.33	-26.79
	Q1	-1.54	-1.91	-2.31	-2.75	-1.43	-1.65	-2.08	-2.39
	Med	0.15	0.18	0.33	0.46	0.11	0.12	0.25	0.30
	Q3	2.00	2.48	2.89	3.45	1.84	2.05	2.48	3.20
	Max	15.11	20.04	29.41	27.40	19.49	28.68	30.21	34.65
(12,7) winner-minus-loser	Mean	7.91	10.47	11.01	14.12	7.48	8.45	8.42	9.33
	St dev	11.28	14.79	17.08	22.57	11.27	14.74	17.06	22.59
	Sharpe	0.70	0.71	0.65	0.63	0.66	0.57	0.49	0.41
	Skew	0.84	0.70	0.70	2.06	1.12	0.34	0.62	-0.54
	Kurt	5.97	6.81	4.75	20.33	6.23	7.65	7.09	14.85
	Min	-13.10	-18.60	-16.28	-22.77	-13.47	-26.42	-28.43	-66.06
	Q1	-1.12	-1.48	-1.86	-2.16	-0.90	-1.17	-1.37	-1.69
	Med	0.57	0.67	0.83	1.03	0.33	0.41	0.46	0.60
	Q3	2.31	3.17	3.46	4.14	1.79	2.28	2.53	3.25
	Max	23.64	33.64	33.33	77.26	21.50	29.35	33.76	45.02

Table A10. Residual momentum: factor regressions.

This table shows time-series regression results of the form $y_t=\alpha+\boldsymbol{\beta}'\mathbf{x}_t+\varepsilon_t$, where y is one of the simple/volatility-managed WML returns based on 10/25/50/100 residual momentum portfolios (Blitz, Huij, and Martens, 2011) based on full (Panels A and B)/recent/intermediate horizon (Panels C and D) past performance, and **x** is either Hou–Mo–Xue–Zhang (2020) five factors (Panels A and C) or Daniel–Hirshleifer–Sun (2020) three-factors (Panels B and D). Each panel shows the covered months. Alphas are annualized.

	Simple winner-minus-loser				Volatility-managed winner-minus-loser			
	WML_{10}	WML_{25}	WML_{50}	WML_{100}	$vWML_{10}$	$vWML_{25}$	$vWML_{50}$	$vWML_{100}$
	Panel A. Hou–Mo–Xue–Zhang (2020) five-factor model (196701-201912)							
α	2.34	3.67	7.26	10.79	2.93	3.58	5.22	9.65
	(1.25)	(1.52)	(2.43)	(3.12)	(1.39)	(1.29)	(1.62)	(2.32)
R_MKT	0.03	0.02	0.01	-0.08	0.10	0.10	0.10	0.02
	(0.76)	(0.38)	(0.16)	(-1.17)	(2.64)	(1.91)	(1.69)	(0.29)
R_ME	0.12	0.10	0.08	0.06	0.08	0.11	0.09	0.03
	(2.45)	(1.68)	(1.08)	(0.70)	(1.50)	(1.52)	(1.13)	(0.30)
R_IA	0.05	0.16	0.05	0.02	0.10	0.14	0.08	0.09
	(0.68)	(1.54)	(0.36)	(0.17)	(1.09)	(1.18)	(0.58)	(0.50)
R_ROE	0.28	0.36	0.37	0.62	0.10	0.12	0.11	0.25
	(4.37)	(4.42)	(3.66)	(5.25)	(1.35)	(1.33)	(0.99)	(1.80)
R_EG	0.33	0.28	0.20	0.18	0.44	0.54	0.51	0.28
	(3.53)	(2.31)	(1.32)	(1.07)	(4.14)	(3.91)	(3.18)	(1.36)
R^2	8.95	7.50	4.06	7.95	5.10	4.75	2.92	1.76
	Panel B. Daniel–Hirshleifer–Sun (2020) three-factor model (197207-201812)							
α	1.82	2.85	4.20	7.52	2.65	3.80	4.79	5.53
	(0.97)	(1.16)	(1.40)	(2.15)	(1.26)	(1.37)	(1.49)	(1.34)
Mkt_RF	0.04	0.04	0.05	-0.03	0.12	0.11	0.13	0.12
	(19.01)	(15.11)	(14.95)	(15.12)	(12.90)	(10.26)	(8.81)	(6.68)
PEAD	0.69	0.71	0.87	1.02	0.53	0.55	0.55	0.53
	(9.10)	(7.23)	(7.15)	(7.23)	(6.17)	(4.91)	(4.22)	(3.19)
FIN	0.14	0.18	0.17	0.18	0.19	0.20	0.21	0.26
	(3.28)	(3.22)	(2.43)	(2.22)	(3.91)	(3.11)	(2.86)	(2.77)
R^2	14.03	9.97	9.06	9.89	8.18	5.29	4.13	2.85

Table A10. *Continued.* Residual momentum: factor regressions.

			Simple winner-minus-loser				Volatility-managed winner-minus-loser			
			WML_{10}	WML_{25}	WML_{50}	WML_{100}	$vWML_{10}$	$vWML_{25}$	$vWML_{50}$	$vWML_{100}$
Panel C. Hou–Mo–Xue–Zhang (2020) five-factor model (196701-201912)	(6,2) winner-minus-loser	α	-3.37	-4.51	-4.50	-5.54	-2.75	-1.52	1.31	6.53
			(-1.86)	(-2.01)	(-1.69)	(-1.77)	(-1.25)	(-0.59)	(0.42)	(1.72)
		R_MKT	-0.01	-0.03	0.02	-0.03	0.03	-0.01	0.00	-0.11
			(-0.42)	(-0.61)	(0.32)	(-0.57)	(0.71)	(-0.15)	(0.02)	(-1.61)
		R_ME	0.11	0.10	0.09	0.10	0.05	0.02	-0.01	-0.04
			(2.33)	(1.77)	(1.38)	(1.20)	(0.84)	(0.36)	(-0.12)	(-0.40)
		R_IA	0.16	0.29	0.29	0.29	0.07	0.11	0.08	-0.09
			(2.10)	(3.04)	(2.59)	(2.23)	(0.77)	(0.99)	(0.64)	(-0.56)
		R_ROE	0.18	0.39	0.36	0.63	0.05	0.11	0.10	0.20
			(2.95)	(5.18)	(3.93)	(5.96)	(0.70)	(1.28)	(0.94)	(1.58)
		R_EG	0.22	0.15	0.24	0.19	0.28	0.13	0.11	-0.04
			(2.43)	(1.31)	(1.79)	(1.24)	(2.56)	(0.98)	(0.70)	(-0.21)
		R^2	6.21	9.48	6.70	10.42	2.11	1.28	0.69	1.29
	(12,7) winner-minus-loser	α	5.33	8.54	8.64	10.25	4.49	5.92	5.77	8.33
			(3.16)	(3.90)	(3.31)	(3.22)	(2.33)	(2.31)	(1.88)	(2.01)
		R_MKT	0.06	0.05	0.07	0.09	0.12	0.16	0.18	0.11
			(1.83)	(1.13)	(1.36)	(1.49)	(3.33)	(3.28)	(3.12)	(1.39)
		R_ME	-0.01	-0.03	-0.09	-0.11	-0.02	-0.01	-0.05	-0.08
			(-0.26)	(-0.56)	(-1.34)	(-1.42)	(-0.38)	(-0.12)	(-0.58)	(-0.73)
		R_IA	-0.15	-0.18	-0.30	-0.31	-0.04	-0.09	-0.22	-0.33
			(-2.17)	(-1.90)	(-2.73)	(-2.28)	(-0.44)	(-0.87)	(-1.69)	(-1.89)
		R_ROE	0.18	0.27	0.23	0.34	0.14	0.17	0.16	0.26
			(3.15)	(3.63)	(2.61)	(3.12)	(2.21)	(1.99)	(1.56)	(1.88)
		R_EG	0.22	0.18	0.36	0.30	0.31	0.44	0.58	0.39
			(2.55)	(1.69)	(2.75)	(1.87)	(3.18)	(3.44)	(3.78)	(1.89)
		R^2	5.65	5.32	6.14	5.55	5.03	5.06	5.42	3.02
Panel D. Daniel–Hirshleifer–Sun (2020) three-factor model (197207-201812)	(6,2) winner-minus-loser	α	-4.20	-5.98	-4.11	-7.70	-2.76	-3.01	1.73	1.20
			(-2.31)	(-2.65)	(-1.51)	(-2.38)	(-1.24)	(-1.20)	(0.55)	(0.31)
		Mkt_RF	0.03	0.04	0.06	0.03	0.06	0.03	0.03	-0.05
			(14.33)	(13.98)	(10.31)	(11.69)	(6.35)	(6.93)	(3.72)	(6.12)
		PEAD	0.50	0.61	0.54	0.73	0.27	0.34	0.23	0.46
			(6.86)	(6.69)	(4.93)	(5.59)	(3.04)	(3.32)	(1.78)	(2.93)
		FIN	0.18	0.31	0.27	0.37	0.13	0.16	0.13	0.09
			(4.45)	(6.01)	(4.42)	(5.02)	(2.58)	(2.88)	(1.87)	(1.02)
		R^2	10.76	13.07	7.19	9.75	2.55	3.37	1.16	2.09
	(12,7) winner-minus-loser	α	6.47	8.10	7.89	9.32	5.99	7.54	8.49	7.70
			(3.64)	(3.52)	(2.87)	(2.79)	(3.03)	(2.81)	(2.62)	(1.80)
		Mkt_RF	0.05	0.04	0.06	0.09	0.12	0.13	0.15	0.13
			(9.57)	(10.13)	(10.25)	(7.59)	(8.73)	(7.11)	(5.89)	(4.46)
		PEAD	0.33	0.45	0.54	0.49	0.33	0.37	0.37	0.37
			(4.58)	(4.85)	(4.90)	(3.63)	(4.18)	(3.40)	(2.82)	(2.13)
		FIN	0.02	0.02	0.06	0.10	0.10	0.10	0.10	0.12
			(0.40)	(0.48)	(0.97)	(1.38)	(2.20)	(1.64)	(1.31)	(1.25)
		R^2	3.82	4.08	4.20	2.55	4.25	2.82	2.12	1.17

Table A11. Residual momentum: spanning regressions.

This table, like Table 4, shows time-series regression results of the form $y_t=\alpha+\boldsymbol{\beta}'\mathbf{x}_t+\varepsilon_t$, where y is one of the simple/volatility-managed WML return based on 25, 50, or 100 residual momentum portfolios, and **x** is the corresponding WML return based on 10, 25, 50, or 100 residual momentum portfolios. Panels D and E relate WMLs based on 11-month simple and residual returns. The *t*-statistics are in parentheses, and alphas are annualized.

	Panel A. Simple winner-minus-loser					
	WML_{25}	WML_{50}	WML_{50}	WML_{100}	WML_{100}	WML_{100}
α	0.24	2.02	1.95	2.59	2.58	1.07
	(0.23)	(1.37)	(1.77)	(1.21)	(1.36)	(1.60)
WML_{10}	1.10	1.03		1.09		
	(47.51)	(31.22)		(22.50)		
WML_{25}			0.92		0.96	
			(47.70)		(33.51)	
WML_{50}						0.99
						(44.36)
R^2	67.55	47.35	67.73	31.83	44.97	60.35
	Panel B. Volatility-managed winner-minus-loser					
	$vWML_{25}$	$vWML_{50}$	$vWML_{50}$	$vWML_{100}$	$vWML_{100}$	$vWML_{100}$
α	2.81	4.01	2.35	6.31	5.59	3.56
	(2.23)	(2.42)	(2.94)	(1.73)	(1.81)	(2.16)
$vWML_{10}$	0.95	0.87		0.87		
	(33.56)	(23.36)		(16.71)		
$vWML_{25}$			0.83		0.75	
			(36.02)		(19.96)	
$vWML_{50}$						0.89
						(32.03)
R^2	50.99	33.51	54.51	20.49	26.90	48.65

	Panel C. Volatility-managed winner-minus-loser by simple winner-minus-loser									
	$vWML_{10}$	$vWML_{25}$	$vWML_{25}$	$vWML_{50}$	$vWML_{50}$	$vWML_{50}$	$vWML_{100}$	$vWML_{100}$	$vWML_{100}$	$vWML_{100}$
α	2.89	4.96	4.87	5.61	5.72	4.01	7.70	8.25	6.69	6.23
	(2.83)	(2.64)	(2.95)	(2.23)	(2.37)	(2.76)	(1.67)	(1.70)	(1.81)	(2.04)
WML_{10}	0.68	0.72		0.69			0.72			
	(42.59)	(25.39)		(21.50)			(16.07)			
WML_{25}			0.65		0.61			0.59		
			(35.99)		(25.99)			(18.70)		
WML_{50}						0.69			0.66	
						(40.77)			(26.79)	
WML_{100}										0.65
										(38.48)
R^2	45.64	28.69	42.27	21.33	29.37	48.06	14.03	16.68	26.59	41.71

	Panel D. $y = WML^{residual}$					*Panel E.* $y = WML^{simple}$			
	WML_{10}^{res}	WML_{25}^{res}	WML_{50}^{res}	WML_{100}^{res}		WML_{10}^{sim}	WML_{25}^{sim}	WML_{50}^{sim}	WML_{100}^{sim}
α	4.99	4.42	5.67	6.15	α	3.54	11.65	18.11	24.21
	(4.51)	(2.85)	(3.08)	(2.56)		(1.47)	(3.60)	(4.43)	(4.75)
WML_n^{sim}	0.26	0.24	0.19	0.17	WML_n^{res}	1.21	1.05	0.93	0.79
	(22.20)	(19.20)	(15.00)	(13.01)		(22.20)	(19.20)	(15.00)	(13.01)
R^2	31.25	25.37	17.19	13.50	R^2	31.25	25.37	17.19	13.50

Table A11. *Continued.* Residual momentum: spanning regressions.

Panel F. Pairwise simple/volatility-managed WMLs, recent/intermediate horizon

			Simple WML			Volatility-managed WML		
			WML_{25}	WML_{50}	WML_{100}	$vWML_{25}$	$vWML_{50}$	$vWML_{100}$
(6,2) winner-minus-loser		α	0.84	0.08	-0.40	1.48	2.23	3.13
			(0.88)	(0.06)	(-0.27)	(1.24)	(1.58)	(1.71)
		WML_{10}	0.90			0.74		
			(42.66)			(28.01)		
		WML_{25}		0.96			0.85	
				(39.63)			(31.01)	
		WML_{50}			0.88			0.69
					(37.24)			(24.02)
		R^2	62.68	59.16	56.13	42.01	47.03	34.76
(12,7) winner-minus-loser		α	2.08	1.31	3.26	2.20	1.33	1.57
			(2.23)	(1.20)	(2.03)	(1.81)	(1.06)	(0.91)
		WML_{10}	1.06			0.84		
			(45.31)			(27.37)		
		WML_{25}		0.93			0.84	
				(44.23)			(34.63)	
		WML_{50}			0.99			0.92
					(36.84)			(31.93)
		R^2	65.45	64.35	55.60	40.89	52.55	48.50

Panel G. Volatility-managed by simple WMLns, recent/intermediate horizon

	(6,2) winner-minus-loser				(12,7) winner-minus-loser			
	$vWML_{10}$	$vWML_{25}$	$vWML_{50}$	$vWML_{100}$	$vWML_{10}$	$vWML_{25}$	$vWML_{50}$	$vWML_{100}$
α	1.30	1.71	3.47	5.54	2.02	1.65	0.81	0.34
	(1.25)	(1.48)	(2.44)	(3.38)	(2.29)	(1.36)	(0.61)	(0.18)
WML_n	0.65	0.67	0.68	0.69	0.68	0.64	0.68	0.64
	(28.41)	(29.80)	(30.38)	(31.32)	(30.88)	(27.56)	(30.90)	(27.14)
R^2	42.70	45.05	46.02	47.52	46.82	41.22	46.86	40.48

		Panel H. $y = WML^{residual}$					*Panel I.* $y = WML^{simple}$			
		WML_{10}^{res}	WML_{25}^{res}	WML_{50}^{res}	WML_{100}^{res}		WML_{10}^{sim}	WML_{25}^{sim}	WML_{50}^{sim}	WML_{100}^{sim}
(6,2) WML	α	-1.35	-1.60	-1.47	-1.49	α	6.39	13.75	18.83	23.21
		(-1.24)	(-1.15)	(-0.80)	(-0.67)		(3.06)	(4.67)	(4.98)	(4.68)
	WML_n^{sim}	0.32	0.22	0.16	0.11	WML_n^{res}	1.16	0.99	0.70	0.57
		(25.02)	(17.28)	(11.75)	(8.52)		(25.02)	(17.28)	(11.75)	(8.52)
	R^2	36.61	21.60	11.29	6.28	R^2	36.61	21.60	11.29	6.28
(12,7) WML	α	6.54	8.11	9.16	13.79	α	8.49	15.89	19.56	26.05
		(5.60)	(5.24)	(5.06)	(5.72)		(3.46)	(5.30)	(5.61)	(5.71)
	WML_n^{sim}	0.11	0.12	0.08	0.01	WML_n^{res}	0.49	0.43	0.30	0.04
		(7.88)	(7.56)	(5.22)	(0.78)		(7.88)	(7.56)	(5.22)	(0.78)
	R^2	5.42	5.01	2.46	0.06	R^2	5.42	5.01	2.46	0.06

Table A12. Residual momentum: market timing regressions.

This table, like Table 5, shows Daniel and Moskowitz's (2016) market timing regression results of the following form.

$$y_t = \alpha + [\beta_0 + I^B_{t-1}(\beta_B + I^U_t \beta_{BU})]R^e_{Mt} + \varepsilon_t,$$

where y is one of the simple/volatility-managed full/recent/intermediate horizon past performance winner-minus-lose returns based on 10, 25, 50, or 100 residual momentum portfolios, I^B is a bear-market indicator, and I^U is an up-market indicator. The *t*-statistics are in parentheses, and alphas are annualized.

	Simple winner-minus-loser				Volatility-managed winner-minus-loser			
	WML_{10}	WML_{25}	WML_{50}	WML_{100}	$vWML_{10}$	$vWML_{25}$	$vWML_{50}$	$vWML_{100}$
α	9.30	10.94	11.61	15.18	9.30	12.05	11.98	14.77
	(6.99)	(6.17)	(5.74)	(6.02)	(6.68)	(6.47)	(5.71)	(5.50)
Mkt_RF	0.00	0.03	0.07	0.06	0.03	0.02	0.04	0.04
	(0.02)	(0.81)	(1.68)	(1.19)	(1.16)	(0.56)	(0.90)	(0.72)
Bear	-0.27	-0.35	-0.41	-0.42	-0.04	-0.03	-0.09	-0.07
	(-4.98)	(-4.89)	(-4.91)	(-4.05)	(-0.63)	(-0.39)	(-1.00)	(-0.59)
BearUp	-0.05	-0.15	-0.10	-0.45	-0.11	-0.15	-0.08	-0.15
	(-0.88)	(-1.79)	(-1.09)	(-3.87)	(-1.78)	(-1.75)	(-0.86)	(-1.24)
Sum	-0.32	-0.47	-0.44	-0.80	-0.12	-0.16	-0.13	-0.18
	(-1.43)	(-2.92)	(-1.77)	(-6.32)	(-2.91)	(-2.85)	(-1.40)	(-2.03)
R^2	9.56	10.22	7.64	12.33	0.96	0.88	0.58	0.59

		Simple winner-minus-loser				Volatility-managed winner-minus-loser			
		WML_{10}	WML_{25}	WML_{50}	WML_{100}	$vWML_{10}$	$vWML_{25}$	$vWML_{50}$	$vWML_{100}$
(6,2) winner-minus-loser	α	4.31	3.59	4.37	3.90	2.82	3.65	5.78	7.47
		(3.28)	(2.29)	(2.24)	(1.70)	(1.97)	(2.22)	(2.83)	(3.13)
	Mkt_RF	-0.05	-0.09	-0.07	-0.04	-0.04	-0.04	-0.04	-0.05
		(-1.85)	(-2.78)	(-1.88)	(-0.83)	(-1.29)	(-1.16)	(-0.85)	(-1.02)
	Bear	-0.10	-0.18	-0.19	-0.26	-0.01	-0.01	0.02	-0.02
		(-1.85)	(-2.74)	(-2.33)	(-2.75)	(-0.23)	(-0.08)	(0.24)	(-0.18)
	BearUp	-0.39	-0.13	-0.25	-0.30	-0.08	-0.06	-0.12	-0.10
		(-6.43)	(-1.82)	(-2.82)	(-2.85)	(-1.26)	(-0.83)	(-1.25)	(-0.91)
	Sum	-0.53	-0.39	-0.51	-0.59	-0.13	-0.11	-0.13	-0.17
		(-14.55)	(-8.98)	(-9.36)	(-9.27)	(-3.33)	(-2.31)	(-2.29)	(-2.48)
	R^2	17.50	9.64	9.14	8.74	1.28	0.67	0.55	0.73
(12,7) winner-minus-loser	α	5.16	6.65	7.69	8.47	7.19	7.94	8.14	9.03
		(4.21)	(4.14)	(4.10)	(3.50)	(5.73)	(4.84)	(4.29)	(3.59)
	Mkt_RF	0.04	0.06	0.08	0.06	0.03	0.08	0.06	0.06
		(1.77)	(1.85)	(2.14)	(1.29)	(1.29)	(2.28)	(1.58)	(1.15)
	Bear	-0.20	-0.34	-0.28	-0.19	-0.05	-0.11	-0.08	-0.02
		(-4.00)	(-5.16)	(-3.70)	(-1.90)	(-0.89)	(-1.64)	(-1.00)	(-0.19)
	BearUp	0.37	0.53	0.43	0.75	0.01	0.01	-0.01	-0.02
		(6.62)	(7.17)	(4.97)	(6.80)	(0.25)	(0.17)	(-0.12)	(-0.13)
	Sum	0.21	0.25	0.22	0.63	0.00	-0.02	-0.03	0.02
		(6.26)	(5.52)	(4.27)	(9.27)	(0.05)	(-0.48)	(-0.51)	(0.34)
	R^2	4.64	4.85	2.72	7.52	0.16	0.53	0.26	0.15

Table A13. Two-way portfolios: spanning regressions.

This table shows time-series regression results of the form $y_t=\alpha+\boldsymbol{\beta}'\mathbf{x}_t+\varepsilon_t$, where y is either the simple (left five columns) or the volatility-managed (right five columns) WML return based on 5×10 two-way momentum portfolios, and **x** is the corresponding WML return based on 5×5 two-way momentum portfolios. Panels A, B, C, and D relate size, book-to-market, operating profitability, and investment, respectively, to momentum. Panels E, F, G, and H relate each vWML to its WML. Each panel shows the covered months. ΔCER is a certainty equivalent return difference. (Campbell and Thompson, 2008; Cederburg *et al.*, 2020), the *t*-statistics are in parentheses, and alphas are annualized.

	WML_{10}					$vWML_{10}$				
	Panel A. Size (192701-201912)									
	1	2	3	4	5	1	2	3	4	5
α	2.73	1.82	2.28	3.06	2.44	4.02	3.83	6.56	3.02	8.62
	(2.31)	(1.79)	(1.81)	(2.50)	(1.30)	(3.70)	(2.49)	(3.79)	(1.61)	(3.29)
$(v)WML_5$	1.15	1.18	1.25	1.16	1.19	1.17	1.08	1.17	1.04	0.94
	(76.32)	(86.08)	(80.50)	(78.91)	(49.35)	(88.70)	(53.95)	(56.52)	(47.42)	(28.53)
R^2	85.17	87.96	86.47	86.06	71.37	88.59	74.18	75.92	69.11	46.01
ΔCER	1.05	0.64	0.66	1.16	0.01	3.02	-0.22	2.85	-1.31	1.90
	Panel B. Book-to-market (192701-201912)									
	1	2	3	4	5	1	2	3	4	5
α	6.06	8.15	2.93	3.27	3.39	8.13	11.33	8.24	6.46	10.59
	(3.28)	(4.19)	(1.79)	(1.96)	(1.83)	(3.75)	(4.99)	(3.83)	(2.94)	(4.10)
$(v)WML_5$	0.96	1.01	1.10	1.13	1.12	0.86	0.89	0.92	0.97	0.88
	(46.43)	(40.41)	(51.42)	(54.73)	(53.34)	(36.47)	(30.78)	(32.85)	(35.84)	(31.12)
R^2	66.16	59.44	70.36	72.89	71.92	54.87	45.98	49.22	53.57	46.66
ΔCER	1.84	3.06	0.56	0.68	0.89	1.95	4.41	2.47	1.17	2.86
	Panel C. Operating profitability (195107-201912)									
	1	2	3	4	5	1	2	3	4	5
α	5.25	4.81	1.70	3.61	4.15	12.47	6.56	6.35	4.73	7.21
	(3.26)	(2.85)	(0.84)	(2.11)	(2.36)	(4.82)	(2.85)	(2.44)	(2.15)	(3.61)
$(v)WML_5$	1.10	1.12	1.14	1.10	1.14	0.60	0.96	0.93	0.96	1.08
	(49.76)	(49.70)	(39.02)	(44.79)	(44.85)	(21.68)	(31.35)	(25.18)	(30.70)	(37.81)
R^2	75.12	75.08	65.00	71.03	71.06	36.46	54.55	43.63	53.59	63.63
ΔCER	2.65	1.88	-0.93	1.03	1.27	1.82	1.58	-1.05	-0.09	3.23
	Panel D. Investment (195207-201912)									
	1	2	3	4	5	1	2	3	4	5
α	0.14	5.86	21.01	1.43	1.72	6.86	9.99	17.02	7.26	2.61
	(0.09)	(1.92)	(3.25)	(0.81)	(1.28)	(2.88)	(2.44)	(2.73)	(3.04)	(1.52)
$(v)WML_5$	1.19	1.18	1.15	1.09	1.12	0.94	0.42	1.37	0.88	1.05
	(52.92)	(26.60)	(12.60)	(42.81)	(57.81)	(27.65)	(7.15)	(15.64)	(25.56)	(43.00)
R^2	77.65	46.68	16.42	69.40	80.53	48.75	5.96	23.27	44.74	69.61
ΔCER	-0.69	0.87	2.39	-0.32	-0.32	0.79	-2.49	0.76	1.78	-3.02

Table A13. *Continued.* Two-way portfolios: spanning regressions.

	$vWML_5$					$vWML_{10}$				
	Panel E. Size (192701-201912)									
	1	2	3	4	5	1	2	3	4	5
α	28.67	19.41	25.66	16.48	17.49	22.01	16.57	17.83	15.81	11.33
	(10.26)	(7.88)	(8.63)	(5.95)	(6.10)	(9.78)	(8.17)	(7.99)	(6.93)	(5.54)
$WML_{5(10)}$	0.42	0.54	0.50	0.55	0.57	0.41	0.49	0.49	0.49	0.56
	(14.79)	(20.64)	(18.19)	(20.62)	(21.60)	(14.25)	(18.06)	(17.66)	(17.82)	(21.30)
R^2	17.77	29.60	24.63	29.73	32.82	16.69	24.35	23.53	23.87	31.05
ΔCER	19.30	13.41	12.78	9.59	5.88	21.26	12.55	14.97	7.12	7.78
	Panel F. Book-to-market (192701-201912)									
	1	2	3	4	5	1	2	3	4	5
α	17.92	14.29	12.80	13.09	16.36	16.12	9.28	7.82	9.33	10.04
	(6.82)	(5.67)	(5.28)	(5.07)	(5.56)	(6.94)	(4.85)	(4.19)	(4.85)	(4.52)
$WML_{5(10)}$	0.56	0.57	0.59	0.59	0.55	0.51	0.57	0.58	0.61	0.57
	(22.43)	(23.42)	(24.48)	(24.55)	(21.74)	(19.61)	(23.06)	(23.81)	(25.50)	(22.92)
R^2	31.51	33.02	35.00	35.13	29.93	25.71	32.32	33.75	36.87	32.07
ΔCER	8.63	4.25	3.17	4.09	3.70	8.74	5.60	5.07	4.58	5.66
	Panel G. Operating profitability (195107-201912)									
	1	2	3	4	5	1	2	3	4	5
α	12.47	10.32	11.50	9.18	10.93	9.98	7.89	7.67	8.12	7.04
	(4.82)	(3.84)	(4.42)	(3.99)	(4.81)	(4.92)	(3.89)	(4.44)	(4.68)	(4.06)
$WML_{5(10)}$	0.60	0.61	0.65	0.70	0.72	0.60	0.63	0.70	0.70	0.70
	(21.68)	(22.20)	(24.39)	(27.64)	(30.00)	(21.52)	(23.02)	(28.14)	(28.21)	(27.69)
R^2	36.46	37.58	42.08	48.35	52.42	36.11	39.29	49.16	49.29	48.35
ΔCER	5.79	3.63	4.87	5.06	3.79	4.96	3.34	4.75	3.94	5.74
	Panel H. Investment (195207-201912)									
	1	2	3	4	5	1	2	3	4	5
α	14.27	7.73	19.21	9.41	13.00	8.75	7.53	5.58	5.44	11.63
	(5.56)	(2.22)	(2.93)	(4.13)	(5.72)	(4.98)	(4.24)	(3.01)	(3.04)	(6.53)
$WML_{5(10)}$	0.62	0.56	0.39	0.70	0.66	0.69	0.68	0.67	0.68	0.68
	(22.57)	(19.03)	(12.15)	(27.81)	(25.04)	(27.01)	(26.37)	(25.66)	(26.29)	(26.09)
R^2	38.79	30.98	15.46	48.94	43.72	47.49	46.29	44.92	46.14	45.75
ΔCER	6.02	4.20	2.28	2.26	10.96	7.50	0.83	0.65	4.36	8.27

Table A14. Industry momentum.

The table shows summary statistics and time-series regression results for 5 and 10 value-weighted momentum portfolios, respectively, based on 30 industry portfolios. Following Moskowitz and Grinblatt (1999), the momentum portfolios based on the 30 industry portfolios sort the industry portfolios on their past six-month returns. The regression results are based on either the market factor or Fama–French (1993) three factors. The data are from Professor Kenneth R. French's website and span January 1927 to December 2019. Average returns, standard deviations, Sharpe ratios, and alphas are annualized, and the *t*-statistics are in parentheses.

	5 and 10 momentum portfolios, respectively, from 30 industry portfolios (Moskowitz and Grinblatt, 1999)																	
	1	2	3	4	5	WML_5	1	2	3	4	5	6	7	8	9	10	WML_{10}	W_{10}–W_5
Mean	8.92	9.51	13.06	14.17	13.40	4.48	8.32	9.73	9.26	10.08	12.28	13.25	13.56	13.94	13.26	14.95	6.62	2.14
St Dev	22.75	20.70	19.55	18.63	19.14	15.91	24.98	22.17	21.97	20.90	21.14	20.02	19.59	19.88	19.10	21.24	20.20	11.23
Sharpe	0.25	0.30	0.50	0.58	0.53	0.28	0.20	0.29	0.27	0.33	0.43	0.50	0.52	0.54	0.52	0.55	0.33	0.19
Skew	0.88	0.95	0.28	-0.05	-0.31	-0.97	0.70	0.80	1.02	0.49	0.78	0.11	0.19	0.02	-0.16	-0.27	-0.63	0.04
Kurt	11.49	13.65	8.85	5.99	3.26	7.18	9.81	10.72	12.82	9.28	13.56	6.81	6.68	8.16	3.16	3.99	6.03	2.64
Min	-29.55	-29.18	-31.55	-31.84	-26.19	-35.46	-34.80	-28.88	-26.47	-35.71	-34.17	-29.80	-31.77	-31.96	-23.53	-30.18	-40.75	-17.01
Q1	-2.35	-1.90	-1.60	-1.70	-1.74	-1.88	-2.85	-2.44	-2.06	-1.90	-1.72	-1.76	-1.83	-1.62	-1.87	-1.89	-2.31	-1.33
Med	0.94	1.01	1.41	1.53	1.30	0.60	0.83	0.89	0.81	1.14	1.26	1.20	1.34	1.61	1.31	1.46	0.70	0.13
Q3	3.96	3.56	3.98	4.25	4.43	2.97	4.08	4.06	3.76	3.70	3.98	4.16	4.12	4.43	4.28	4.89	3.66	1.73
Max	54.82	60.82	46.09	35.52	33.60	21.60	57.99	59.42	64.44	48.76	58.93	44.71	44.73	44.84	32.58	39.92	28.03	14.77
α	-3.31	-2.05	1.84	3.34	2.70	6.00	-4.21	-2.15	-2.54	-1.28	0.72	2.18	2.64	2.96	2.77	3.94	8.16	2.15
	(-3.4)	(-2.5)	(2.7)	(5.0)	(3.1)	(3.7)	(-3.2)	(-2.1)	(-2.5)	(-1.3)	(0.8)	(2.4)	(3.0)	(3.2)	(2.9)	(3.3)	(3.9)	(1.8)
Mkt_RF	1.12	1.04	1.00	0.95	0.93	-0.19	1.16	1.08	1.07	1.02	1.04	0.98	0.96	0.97	0.91	0.97	-0.19	0.00
	(74.1)	(82.6)	(94.0)	(92.0)	(68.9)	(-7.6)	(56.1)	(68.5)	(68.4)	(67.6)	(72.6)	(70.2)	(70.9)	(68.4)	(60.4)	(52.5)	(-6.0)	(-0.1)
R^2	83.14	85.98	88.80	88.36	80.98	4.93	73.88	80.83	80.76	80.41	82.56	81.56	81.84	80.77	76.61	71.21	3.10	0.00
α	-3.57	-2.35	1.49	3.35	2.81	6.38	-4.80	-2.30	-2.88	-1.69	0.32	1.80	2.55	2.88	2.91	3.95	8.75	2.37
	(-3.7)	(-2.9)	(2.2)	(5.0)	(3.2)	(3.9)	(-3.7)	(-2.3)	(-2.9)	(-1.8)	(0.4)	(2.0)	(2.9)	(3.2)	(3.0)	(3.3)	(4.2)	(2.0)
Mkt_RF	1.11	1.02	0.98	0.96	0.93	-0.17	1.11	1.08	1.05	0.98	1.01	0.96	0.96	0.98	0.91	0.96	-0.15	0.03
	(67.7)	(75.8)	(87.3)	(86.7)	(63.9)	(-6.5)	(50.4)	(63.3)	(62.4)	(61.4)	(66.3)	(64.6)	(65.5)	(64.2)	(56.1)	(48.1)	(-4.2)	(1.4)
SMB	0.05	0.03	0.00	-0.07	0.06	0.01	0.19	-0.02	0.05	0.10	0.06	0.00	-0.01	-0.08	0.05	0.08	-0.11	-0.13
	(1.7)	(1.3)	(0.1)	(-3.9)	(2.5)	(0.3)	(5.2)	(-0.7)	(1.9)	(3.7)	(2.6)	(0.2)	(-0.5)	(-3.1)	(1.8)	(2.3)	(-2.0)	(-3.9)
HML	0.07	0.09	0.11	0.02	-0.05	-0.13	0.14	0.05	0.10	0.11	0.11	0.12	0.03	0.05	-0.06	-0.02	-0.16	-0.04
	(3.0)	(4.6)	(6.9)	(1.1)	(-2.6)	(-3.2)	(4.3)	(2.2)	(4.0)	(4.6)	(5.0)	(5.5)	(1.5)	(2.0)	(-2.5)	(-0.8)	(-3.2)	(-1.2)
R^2	83.33	86.26	89.26	88.53	81.19	5.80	74.97	80.91	81.10	81.03	83.06	82.06	81.88	80.99	76.80	71.36	4.37	1.55

Table A15. Portfolio momentum: 5×5 size and book-to-market and 5×5 operating profitability and investment portfolios.

The table shows summary statistics and time-series regression results for 5 and 10 value-weighted momentum portfolios, respectively, based on 5×5 size and book-to-market portfolios (Panel A) and 5×5 operating profitability and investment portfolios (Panel B), respectively. Following Lewellen (2002), the momentum portfolios based on the 5×5 portfolios sort the portfolios on their past 12-month returns. The regression results are based on either the market factor, Fama–French three (1993) factors, or Fama–French six (2018) factors. The data are from Professor Kenneth R. French's website. Each panel shows the covered months. Average returns, standard deviations, Sharpe ratios, and alphas are annualized, and the *t*-statistics are in parentheses.

Panel A. 5 and 10 momentum portfolios, respectively, from 5×5 size and book-to-market portfolios (192707–201912) (Lewellen, 2002)

	1	2	3	4	5	WML_5	1	2	3	4	5	6	7	8	9	10	WML_{10}	W_{10}–W_5
Mean	9.38	11.59	13.54	15.03	15.29	5.91	8.76	11.01	11.57	12.31	13.59	14.01	15.33	14.92	15.02	16.41	7.65	1.74
St Dev	24.48	22.47	21.53	21.36	22.95	16.25	27.59	24.30	23.87	22.86	21.77	23.30	22.85	21.74	23.84	23.86	18.82	10.88
Sharpe	0.25	0.37	0.48	0.55	0.52	0.36	0.20	0.32	0.35	0.40	0.47	0.46	0.53	0.54	0.49	0.55	0.41	0.16
Skew	1.21	1.35	0.26	0.73	1.11	-1.43	1.89	1.24	1.51	1.33	0.17	1.18	1.10	0.58	1.68	0.97	-1.32	-10.74
Kurt	17.02	17.34	8.66	10.33	14.12	29.55	20.28	17.62	18.63	16.19	6.75	17.65	13.14	9.37	20.59	11.40	17.37	245.49
Min	-37.65	-32.11	-33.45	-27.68	-28.64	-60.08	-33.82	-39.44	-32.79	-31.34	-33.84	-33.07	-30.75	-27.54	-29.63	-28.59	-54.37	-71.42
Q1	-2.09	-1.92	-1.76	-1.89	-1.79	-1.60	-2.47	-2.12	-2.06	-2.00	-1.81	-1.79	-1.98	-1.91	-1.91	-1.66	-1.62	-0.63
Med	1.03	1.27	1.44	1.56	1.52	0.59	0.89	1.16	1.18	1.22	1.46	1.53	1.36	1.59	1.54	1.47	0.80	0.12
Q3	3.93	4.01	4.30	4.38	4.41	2.56	3.93	4.05	4.00	4.19	4.24	4.18	4.64	4.35	4.48	4.75	3.20	1.02
Max	72.87	64.20	49.13	55.49	67.25	33.33	81.97	74.38	64.31	64.01	42.78	69.46	59.07	56.36	72.21	62.73	36.64	13.35
α	-3.33	-0.75	1.54	3.20	3.13	6.46	-4.75	-1.61	-1.11	-0.04	1.64	1.41	3.10	3.09	2.76	4.08	8.83	2.37
	(-3.0)	(-0.9)	(2.1)	(4.1)	(3.1)	(3.8)	(-3.3)	(-1.4)	(-1.1)	(-0.0)	(2.0)	(1.6)	(3.2)	(3.5)	(2.3)	(3.5)	(4.5)	(2.1)
Mkt_RF	1.19	1.14	1.10	1.08	1.12	-0.07	1.29	1.18	1.19	1.15	1.09	1.18	1.13	1.08	1.13	1.14	-0.15	-0.08
	(69.4)	(94.0)	(99.5)	(88.3)	(71.0)	(-2.7)	(58.1)	(68.4)	(78.9)	(83.3)	(84.9)	(88.3)	(76.0)	(78.2)	(62.0)	(64.0)	(-5.0)	(-4.6)
R^2	81.31	88.86	89.93	87.57	81.97	0.63	75.28	80.86	84.88	86.22	86.67	87.56	83.91	84.65	77.62	78.73	2.17	1.86
α	-4.28	-1.69	0.75	2.35	2.06	6.34	-6.22	-2.60	-2.25	-1.25	0.72	0.23	1.87	2.29	1.40	2.78	9.00	2.66
	(-4.1)	(-2.5)	(1.2)	(3.6)	(2.4)	(3.8)	(-4.9)	(-2.5)	(-2.6)	(-1.8)	(1.0)	(0.3)	(2.6)	(3.0)	(1.5)	(2.9)	(4.6)	(2.4)
Mkt_RF	1.12	1.07	1.04	0.99	1.00	-0.12	1.16	1.10	1.10	1.03	1.01	1.08	1.00	0.98	0.98	1.01	-0.15	-0.03
	(64.3)	(93.4)	(97.9)	(89.8)	(71.2)	(-4.2)	(54.2)	(63.5)	(76.9)	(87.9)	(83.8)	(92.2)	(82.5)	(77.8)	(64.1)	(63.3)	(-4.6)	(-1.7)
SMB	0.17	0.16	0.18	0.32	0.45	0.29	0.43	0.22	0.22	0.35	0.27	0.28	0.47	0.39	0.59	0.48	0.05	-0.24
	(5.8)	(8.6)	(10.5)	(18.0)	(19.7)	(6.3)	(12.2)	(7.9)	(9.6)	(17.9)	(13.8)	(14.8)	(23.8)	(18.9)	(23.6)	(18.4)	(1.0)	(-7.8)
HML	0.27	0.27	0.21	0.19	0.22	-0.04	0.37	0.27	0.31	0.30	0.23	0.31	0.27	0.15	0.28	0.30	-0.07	-0.03
	(10.5)	(16.0)	(13.6)	(11.9)	(10.9)	(-1.1)	(11.7)	(10.6)	(15.1)	(17.5)	(13.1)	(18.2)	(15.4)	(8.2)	(12.7)	(12.7)	(-1.5)	(-1.0)
R^2	83.56	91.51	92.15	91.38	87.80	4.09	80.58	83.58	88.39	91.37	90.08	91.85	90.88	89.04	86.66	85.58	2.43	7.13

Table A15. *Continued.* Portfolio momentum: 5×5 size and book-to-market and 5×5 operating profitability and investment portfolios.

Panel B. 5 and 10 momentum portfolios, respectively, from 5×5 operating profitability and investment portfolios (196407–201912)

	1	2	3	4	5	WML_5	1	2	3	4	5	6	7	8	9	10	WML_{10}	W_{10}–W_5
Mean	8.98	10.89	10.73	11.73	13.68	4.70	8.09	9.76	10.90	11.29	10.78	11.15	11.56	12.08	14.05	13.92	5.83	1.13
St Dev	17.72	15.84	15.29	15.46	16.00	10.16	18.61	17.57	16.36	16.22	15.45	15.73	15.54	16.16	16.14	16.92	12.01	5.68
Sharpe	0.25	0.40	0.40	0.46	0.57	0.46	0.19	0.30	0.39	0.41	0.40	0.42	0.45	0.47	0.59	0.55	0.49	0.20
Skew	-0.42	-0.55	-0.36	-0.45	-0.52	0.18	-0.38	-0.33	-0.49	-0.59	-0.33	-0.42	-0.46	-0.41	-0.53	-0.42	0.35	0.58
Kurt	2.46	2.43	1.25	2.62	2.02	4.19	1.92	3.05	2.19	2.58	1.48	1.42	2.45	2.87	2.88	1.50	3.88	3.30
Min	-22.37	-23.25	-19.61	-22.96	-23.93	-13.19	-23.91	-25.03	-23.95	-26.07	-18.12	-22.75	-22.20	-24.21	-27.28	-21.47	-12.51	-6.36
Q1	-1.94	-1.51	-1.49	-1.53	-1.60	-1.06	-2.31	-1.86	-1.56	-1.72	-1.53	-1.80	-1.39	-1.71	-1.60	-1.73	-1.37	-0.77
Med	0.92	1.18	1.19	1.15	1.43	0.45	0.91	0.99	1.01	1.09	1.12	1.20	1.23	1.30	1.48	1.44	0.53	-0.02
Q3	3.56	3.69	3.60	3.60	4.15	1.81	3.71	3.45	3.78	3.76	3.51	3.73	3.70	3.95	3.93	4.25	2.37	0.92
Max	20.26	16.36	16.88	19.16	15.79	17.21	20.66	23.39	16.74	15.85	19.11	14.24	18.66	21.64	17.38	16.39	20.77	9.24
α	-2.48	-0.05	0.07	0.97	2.85	5.32	-3.58	-1.49	-0.04	0.34	0.15	0.43	0.87	1.23	3.27	2.96	6.54	1.22
	(-3.0)	(-0.1)	(0.1)	(1.8)	(4.0)	(3.9)	(-3.7)	(-1.6)	(-0.1)	(0.5)	(0.2)	(0.6)	(1.3)	(1.6)	(4.0)	(3.2)	(4.1)	(1.6)
Mkt_RF	1.09	1.00	0.96	0.98	0.99	-0.10	1.12	1.05	1.00	1.01	0.95	0.97	0.97	0.99	0.98	1.01	-0.11	-0.01
	(69.6)	(102.3)	(91.9)	(96.4)	(73.9)	(-3.9)	(61.2)	(59.6)	(70.8)	(78.7)	(74.7)	(73.3)	(79.6)	(70.3)	(64.2)	(57.6)	(-3.7)	(-0.9)
R^2	87.93	94.04	92.71	93.33	89.15	2.19	84.95	84.24	88.30	90.32	89.37	88.99	90.52	88.16	86.11	83.32	2.02	0.13
α	1.00	-0.12	-0.58	-0.96	0.34	-0.66	-0.38	1.91	0.12	-0.03	-0.30	-0.63	-0.95	-1.00	0.47	0.45	0.83	1.49
	(1.4)	(-0.2)	(-1.0)	(-1.8)	(0.5)	(-0.6)	(-0.4)	(2.1)	(0.2)	(-0.0)	(-0.4)	(-0.9)	(-1.5)	(-1.3)	(0.6)	(0.5)	(0.6)	(1.9)
Mkt_RF	1.01	1.02	1.00	1.02	1.03	0.02	1.04	0.97	1.02	1.03	0.99	1.00	1.02	1.04	1.04	1.03	-0.01	-0.03
	(67.6)	(99.7)	(86.1)	(95.4)	(78.8)	(0.9)	(59.0)	(53.2)	(65.5)	(72.3)	(69.4)	(67.8)	(77.0)	(68.0)	(64.6)	(59.7)	(-0.5)	(-2.2)
SMB	-0.01	-0.02	-0.04	0.03	0.06	0.07	0.05	-0.01	-0.01	0.01	-0.06	0.01	0.03	0.06	0.04	0.11	0.06	-0.01
	(-0.3)	(-1.2)	(-2.3)	(2.0)	(3.6)	(2.2)	(2.1)	(-0.4)	(-0.5)	(0.5)	(-2.8)	(0.3)	(1.5)	(2.7)	(1.9)	(4.8)	(1.6)	(-0.4)
HML	0.00	0.06	0.06	0.06	-0.01	-0.01	0.02	-0.03	0.05	0.07	0.03	0.09	0.07	0.05	0.00	-0.01	-0.04	-0.02
	(0.2)	(2.8)	(2.4)	(2.7)	(-0.3)	(-0.3)	(0.7)	(-0.8)	(1.7)	(2.6)	(1.0)	(3.1)	(2.6)	(1.8)	(-0.0)	(-0.4)	(-0.7)	(-0.7)
RMW	-0.09	0.12	0.10	0.07	-0.02	0.07	-0.05	-0.12	0.07	0.13	0.08	0.12	0.09	0.03	0.08	-0.12	-0.07	-0.14
	(-3.2)	(5.9)	(4.4)	(3.6)	(-0.8)	(1.7)	(-1.4)	(-3.5)	(2.4)	(4.8)	(3.0)	(4.1)	(3.7)	(1.0)	(2.6)	(-3.5)	(-1.3)	(-4.7)
CMA	-0.19	0.04	0.06	0.12	0.14	0.33	-0.12	-0.18	0.08	0.02	0.10	0.05	0.16	0.14	0.24	0.11	0.23	-0.10
	(-4.4)	(1.4)	(1.8)	(4.1)	(3.8)	(5.0)	(-2.3)	(-3.5)	(1.7)	(0.4)	(2.5)	(1.1)	(4.2)	(3.2)	(5.3)	(2.3)	(2.9)	(-2.1)
UMD	-0.14	-0.05	-0.01	0.05	0.11	0.25	-0.16	-0.12	-0.06	-0.03	-0.02	0.00	0.02	0.07	0.08	0.14	0.30	0.05
	(-16.0)	(-8.1)	(-1.7)	(7.7)	(15.2)	(18.8)	(-15.8)	(-11.2)	(-6.6)	(-4.1)	(-2.6)	(-0.2)	(3.2)	(7.8)	(8.7)	(14.0)	(18.8)	(5.4)
R^2	91.86	95.15	93.38	94.45	92.34	40.12	89.56	87.50	89.55	91.16	90.15	89.76	91.66	89.73	88.42	87.98	38.52	9.14

Table A16. Macromomentum: 21 international equity indices.

The table shows summary statistics and time-series regression results for 3 and 7 value-weighted momentum portfolios, respectively, based on 21 international equity indices. Following Bhojraj and Swaminathan (2006), the momentum portfolios based on the 21 equity indices sort the indices on their past 12-month returns. The regression results are based on either the market factor or Fama–French three (1993) factors. The data are from AQR Capital Management's website and span January 1987 to December 2019. Average returns, standard deviations, Sharpe ratios, and alphas are annualized, and the *t*-statistics are in parentheses.

	3 and 7 momentum portfolios, respectively, from 21 international equity indices (Bhojraj and Swaminathan, 2006)												
	1	2	3	WML_3	1	2	3	4	5	6	7	WML_7	$W_7–W_3$
Mean	7.01	10.17	11.48	4.47	8.01	8.36	10.29	12.17	10.49	10.50	18.74	10.73	6.26
St Dev	17.95	16.22	18.45	14.80	22.79	18.00	17.56	16.91	17.34	19.58	25.77	25.96	22.07
Sharpe	0.22	0.44	0.46	0.30	0.22	0.30	0.41	0.54	0.43	0.38	0.61	0.41	0.28
Skew	-0.32	-0.86	-0.57	0.67	0.20	-0.62	-0.67	-0.51	-0.53	-1.46	-0.22	0.09	-0.09
Kurt	2.09	2.21	2.77	2.99	2.05	3.32	3.22	1.56	2.19	9.03	4.59	2.15	4.13
Min	-25.99	-22.75	-26.55	-14.57	-22.43	-29.98	-26.70	-22.28	-21.98	-42.45	-42.45	-30.95	-30.12
Q1	-2.62	-1.69	-1.82	-2.30	-2.79	-1.94	-2.09	-1.94	-1.70	-1.99	-2.43	-3.54	-2.57
Med	0.92	1.60	1.46	0.08	0.87	0.92	1.21	1.46	1.21	1.26	1.73	0.47	0.67
Q3	3.65	3.79	3.91	2.71	4.08	3.81	3.99	3.95	3.62	4.18	5.91	5.08	3.79
Max	15.68	14.50	22.81	22.01	27.25	14.77	16.53	14.56	19.68	19.16	35.87	29.26	31.64
α	0.78	4.43	5.54	4.76	1.24	2.45	4.38	6.74	4.67	4.44	12.68	11.44	6.68
	(0.56)	(3.84)	(3.08)	(1.83)	(0.48)	(1.46)	(2.87)	(4.06)	(3.07)	(2.15)	(3.53)	(2.52)	(1.73)
MKT	1.06	0.97	1.01	-0.05	1.15	1.00	1.00	0.92	0.99	1.03	1.03	-0.12	-0.07
	(39.88)	(44.70)	(29.66)	(-0.99)	(23.68)	(31.69)	(34.87)	(29.39)	(34.35)	(26.34)	(15.17)	(-1.40)	(-0.97)
R^2	80.15	83.53	69.06	0.25	58.74	71.83	75.53	68.67	74.97	63.77	36.88	0.49	0.24
α	0.94	4.08	5.01	4.07	0.49	2.05	3.75	6.04	4.48	3.97	12.65	12.16	8.08
	(0.66)	(3.50)	(2.78)	(1.56)	(0.19)	(1.21)	(2.45)	(3.63)	(2.91)	(1.93)	(3.53)	(2.66)	(2.08)
MKT	1.06	0.98	1.01	-0.04	1.16	1.02	1.02	0.94	0.99	1.02	0.99	-0.17	-0.13
	(38.24)	(43.50)	(28.88)	(-0.86)	(23.16)	(31.04)	(34.30)	(29.05)	(33.13)	(25.57)	(14.26)	(-1.91)	(-1.67)
SMB	-0.04	0.02	0.17	0.21	0.08	-0.09	0.03	0.02	0.01	0.31	0.52	0.44	0.23
	(-0.70)	(0.32)	(2.14)	(1.87)	(0.72)	(-1.15)	(0.44)	(0.30)	(0.09)	(3.51)	(3.32)	(2.20)	(1.34)
HML	-0.05	0.10	0.18	0.22	0.22	0.09	0.17	0.19	0.05	0.19	0.11	-0.11	-0.34
	(-0.88)	(2.13)	(2.44)	(2.17)	(2.12)	(1.36)	(2.85)	(2.93)	(0.87)	(2.31)	(0.75)	(-0.61)	(-2.17)
R^2	80.21	83.72	69.80	2.10	59.23	72.08	76.03	69.35	75.02	65.21	38.63	1.88	2.04

Table A17. Portfolio momentum in Europe, Japan, and Asia Pacific ex Japan: 5×5 size and book-to-market and 2×4×4 size, operating profitability. and investment portfolios.
The table shows summary statistics and time-series regression results for 5 and 10 value-weighted momentum portfolios, respectively, based on 5×5 size and book-to-market portfolios and 2×4×4 size, operating profitability, and investment portfolios in Europe (Japan; Asia Pacific ex Japan) in Panels A and B (C and D; E and F), respectively. Following Lewellen (2002), the momentum portfolios based on the portfolios sort the portfolios on their past 12-month returns. The regression results are based on either the market factor or Fama–French three (1993) factors. The data are from Professor Kenneth R. French's website. The data span July 1991 to December 2019. Average returns, standard deviations, Sharpe ratios, and alphas are annualized, and the *t*-statistics are in parentheses.

Panel A. 5 and 10 momentum portfolios, respectively, from European 5×5 size and book-to-market portfolios

	1	2	3	4	5	WML_5	1	2	3	4	5	6	7	8	9	10	WML_{10}	W_{10}–W_5
Mean	6.52	7.76	9.87	10.47	13.10	6.59	6.48	6.00	6.60	8.17	9.61	10.68	10.31	10.19	11.81	14.54	8.06	1.48
St Dev	19.05	17.28	16.85	17.31	16.77	11.06	19.50	18.41	17.95	17.23	16.97	17.27	17.00	17.47	17.01	17.37	12.21	5.94
Sharpe	0.21	0.31	0.44	0.46	0.63	0.60	0.21	0.19	0.23	0.33	0.42	0.48	0.46	0.44	0.55	0.70	0.66	0.25
Skew	-0.48	-0.83	-0.71	-0.64	-0.52	-0.09	-0.46	-0.63	-0.83	-0.81	-0.69	-0.71	-0.88	-0.58	-0.49	-0.55	-0.25	0.17
Kurt	2.99	3.13	2.87	2.09	1.55	3.59	3.18	2.78	3.03	3.12	2.76	2.62	4.85	1.32	1.42	1.53	2.70	15.61
Min	-27.04	-26.43	-24.87	-23.91	-19.13	-13.65	-27.26	-26.60	-26.73	-26.05	-24.56	-25.03	-30.17	-19.74	-19.35	-18.98	-15.64	-12.40
Q1	-2.26	-2.01	-1.83	-1.93	-1.69	-1.10	-2.43	-2.28	-2.15	-1.89	-1.80	-1.81	-1.64	-1.84	-1.77	-1.44	-1.21	-0.47
Med	0.92	0.93	0.90	1.27	1.48	0.47	0.84	0.86	0.83	0.86	0.85	0.87	1.38	1.23	1.26	1.65	0.60	0.10
Q3	3.72	4.00	4.07	4.24	4.10	2.25	3.84	3.70	3.90	3.90	3.90	4.19	3.62	4.10	4.12	4.33	2.57	0.70
Max	23.33	15.16	16.10	16.54	16.34	14.46	24.56	17.29	14.53	16.29	15.81	16.34	17.13	16.08	16.33	16.35	13.38	10.61
α	-3.30	-1.49	0.71	1.16	4.21	7.51	-3.42	-3.52	-2.81	-1.00	0.48	1.49	1.22	0.95	2.86	5.62	9.04	1.53
	(-2.6)	(-1.5)	(0.9)	(1.3)	(3.7)	(3.7)	(-2.4)	(-2.8)	(-2.4)	(-0.9)	(0.5)	(1.4)	(1.2)	(0.9)	(2.4)	(4.0)	(4.0)	(1.4)
Mkt_RF	1.08	1.00	0.99	1.01	0.95	-0.14	1.09	1.04	1.02	0.99	0.98	0.99	0.98	1.00	0.96	0.95	-0.14	-0.01
	(49.9)	(58.7)	(68.6)	(63.8)	(47.4)	(-3.8)	(45.1)	(47.2)	(51.0)	(53.3)	(59.0)	(54.3)	(54.0)	(51.7)	(45.8)	(38.8)	(-3.6)	(-0.4)
R^2	87.99	91.02	93.26	92.30	86.84	4.09	85.68	86.75	88.45	89.32	91.10	89.65	89.55	88.73	86.07	81.58	3.75	0.04
α	-3.53	-1.95	0.44	0.94	4.18	7.70	-3.89	-3.66	-3.24	-1.49	0.03	1.10	0.82	0.76	2.70	5.64	9.53	1.82
	(-2.8)	(-2.2)	(0.6)	(1.2)	(3.9)	(3.8)	(-2.9)	(-2.9)	(-3.1)	(-1.5)	(0.0)	(1.2)	(1.0)	(0.8)	(2.4)	(4.4)	(4.2)	(1.6)
Mkt_RF	1.08	1.01	1.00	1.03	0.97	-0.11	1.10	1.05	1.04	1.00	1.00	1.01	1.00	1.03	0.98	0.99	-0.11	0.00
	(48.9)	(62.8)	(77.3)	(71.5)	(50.6)	(-3.1)	(46.0)	(46.9)	(56.2)	(58.5)	(66.7)	(64.1)	(65.7)	(60.0)	(49.4)	(43.4)	(-2.8)	(-0.0)
SMB	0.11	0.27	0.29	0.31	0.29	0.19	0.27	0.17	0.36	0.32	0.33	0.41	0.43	0.40	0.33	0.42	0.15	-0.03
	(2.2)	(7.6)	(10.2)	(9.9)	(7.1)	(2.4)	(5.2)	(3.4)	(9.0)	(8.8)	(10.1)	(11.8)	(13.0)	(10.9)	(7.8)	(8.6)	(1.8)	(-0.8)
HML	0.06	0.11	0.04	0.02	-0.05	-0.10	0.11	0.02	0.08	0.11	0.09	0.06	0.06	-0.01	-0.01	-0.09	-0.20	-0.10
	(1.4)	(3.4)	(1.5)	(0.7)	(-1.2)	(-1.5)	(2.4)	(0.4)	(2.2)	(3.2)	(3.2)	(1.8)	(1.9)	(-0.3)	(-0.2)	(-2.0)	(-2.5)	(-2.4)
R^2	88.22	92.52	94.85	94.02	88.61	6.38	86.91	87.20	90.75	91.47	93.29	92.70	93.04	91.66	88.19	85.09	6.54	1.92

Table A17. *Continued.* Portfolio momentum in Europe, Japan, and Asia Pacific ex Japan: 5×5 size and book-to-market and 2×4×4 size, operating profitability. and investment portfolios.

Panel B. 4 and 8 momentum portfolios, respectively, from European 2×4×4 size, operating profitability, and investment portfolios

	1	2	3	4	WML_4	1	2	3	4	5	6	7	8	WML_8	$W_8–W_4$
Mean	6.16	8.81	9.88	11.37	5.21	5.71	6.45	7.41	10.11	9.48	10.81	10.29	12.98	7.27	2.06
St Dev	19.16	17.31	16.47	16.50	9.83	19.90	19.08	18.10	17.09	16.35	16.95	16.85	17.05	12.36	6.10
Sharpe	0.19	0.37	0.45	0.54	0.53	0.16	0.21	0.27	0.45	0.43	0.49	0.46	0.62	0.59	0.34
Skew	-0.74	-0.46	-0.64	-0.52	0.03	-0.60	-0.95	-0.39	-0.44	-0.57	-0.63	-0.70	-0.36	0.07	0.44
Kurt	3.46	2.10	1.69	1.78	3.34	2.99	4.39	2.65	1.28	1.53	1.88	1.77	1.64	2.90	2.89
Min	-29.61	-23.23	-21.10	-20.65	-11.49	-29.31	-30.41	-25.43	-20.40	-20.29	-21.88	-20.47	-20.75	-12.96	-5.58
Q1	-2.37	-2.44	-1.77	-1.74	-0.94	-2.51	-2.22	-2.42	-2.25	-1.70	-1.66	-1.56	-1.64	-1.44	-0.66
Med	0.95	0.91	1.03	1.19	0.39	0.82	1.07	0.82	1.07	0.90	1.07	1.06	1.46	0.64	0.17
Q3	3.97	3.81	3.78	4.15	1.83	4.02	3.85	3.84	3.94	3.86	3.85	3.95	4.19	2.57	1.02
Max	19.41	18.57	12.39	16.38	13.53	20.97	20.03	20.76	16.24	12.86	15.44	14.63	18.80	16.08	8.49
α	-3.80	-0.64	0.78	2.40	6.19	-4.26	-3.43	-2.21	0.91	0.54	1.62	1.28	4.00	8.26	2.06
	(-3.4)	(-1.0)	(1.2)	(2.7)	(3.4)	(-2.8)	(-2.9)	(-2.4)	(1.0)	(0.6)	(1.9)	(1.2)	(3.3)	(3.6)	(1.8)
Mkt_RF	1.10	1.03	0.98	0.96	-0.14	1.11	1.09	1.06	0.99	0.95	0.99	0.96	0.96	-0.15	0.00
	(56.3)	(90.8)	(90.3)	(61.9)	(-4.6)	(42.2)	(52.8)	(64.8)	(61.5)	(66.3)	(66.3)	(52.5)	(45.9)	(-3.7)	(-0.1)
R^2	90.33	96.04	96.00	91.86	5.91	83.96	89.12	92.50	91.76	92.81	92.81	89.01	86.10	3.81	0.00
α	-4.16	-0.96	0.63	2.60	6.76	-4.74	-3.99	-2.69	0.51	0.39	1.35	1.30	3.86	8.60	1.85
	(-3.7)	(-1.5)	(1.0)	(3.0)	(3.8)	(-3.2)	(-3.4)	(-2.9)	(0.6)	(0.5)	(1.6)	(1.2)	(3.3)	(3.7)	(1.6)
Mkt_RF	1.10	1.03	0.98	0.98	-0.13	1.11	1.09	1.05	0.99	0.96	0.99	0.98	0.98	-0.13	-0.01
	(55.2)	(90.5)	(88.4)	(63.1)	(-3.9)	(42.0)	(52.4)	(64.7)	(61.4)	(65.5)	(65.3)	(52.8)	(47.4)	(-3.2)	(-0.3)
SMB	0.10	0.08	0.06	0.11	0.00	0.22	0.14	0.12	0.14	0.11	0.10	0.15	0.24	0.03	0.02
	(2.4)	(3.2)	(2.4)	(3.1)	(0.0)	(3.7)	(3.1)	(3.4)	(3.8)	(3.3)	(3.0)	(3.6)	(5.3)	(0.3)	(0.5)
HML	0.08	0.08	0.03	-0.12	-0.20	0.07	0.13	0.11	0.08	0.00	0.05	-0.07	-0.06	-0.13	0.06
	(2.1)	(3.5)	(1.2)	(-3.8)	(-3.1)	(1.4)	(3.2)	(3.4)	(2.5)	(0.1)	(1.7)	(-2.0)	(-1.5)	(-1.6)	(1.6)
R^2	90.61	96.29	96.09	92.39	8.57	84.68	89.74	93.00	92.25	93.04	93.06	89.52	87.23	4.58	0.85

Table A17. *Continued.* Portfolio momentum in Europe, Japan, and Asia Pacific ex Japan: 5×5 size and book-to-market and 2×4×4 size, operating profitability. and investment portfolios.

Panel C. 5 and 10 momentum portfolios, respectively, from Japanese 5×5 size and book-to-market portfolios

	1	2	3	4	5	WML_5	1	2	3	4	5	6	7	8	9	10	WML_{10}	W_{10}–W_5
Mean	2.38	3.08	3.43	5.63	5.96	3.58	0.98	3.58	2.26	4.42	3.74	4.02	5.70	6.37	8.30	6.01	5.04	1.45
St Dev	22.03	20.11	20.43	19.92	19.63	14.01	22.96	21.68	20.73	20.28	20.96	20.64	20.39	19.73	19.80	20.84	16.77	7.34
Sharpe	0.00	0.03	0.05	0.16	0.18	0.26	-0.06	0.05	-0.01	0.10	0.06	0.08	0.16	0.20	0.29	0.17	0.30	0.20
Skew	0.15	0.24	0.25	0.36	0.38	0.02	0.16	0.14	0.25	0.19	0.36	0.27	0.26	0.52	0.40	0.69	0.28	0.50
Kurt	1.02	1.04	1.24	1.38	1.39	2.56	1.16	0.72	1.02	0.95	1.39	1.29	1.61	1.25	1.00	3.13	3.50	9.87
Min	-18.04	-18.02	-18.31	-18.21	-16.32	-16.62	-19.55	-17.50	-18.87	-17.17	-18.00	-18.41	-20.28	-15.17	-15.07	-16.93	-19.38	-12.73
Q1	-3.30	-3.20	-3.24	-2.68	-3.20	-1.66	-3.99	-3.48	-3.39	-3.41	-3.17	-2.96	-2.75	-2.67	-3.16	-3.14	-1.85	-0.73
Med	0.66	0.22	0.34	0.53	0.83	0.19	0.36	0.67	0.21	0.77	0.37	0.62	0.41	0.40	0.68	0.67	0.25	-0.01
Q3	3.78	3.53	3.55	3.46	3.51	2.36	3.69	3.81	3.36	3.55	3.75	3.49	3.66	3.57	3.56	3.70	2.89	0.93
Max	25.50	24.37	20.45	20.14	25.63	14.95	27.11	24.08	24.48	24.21	20.87	20.16	21.71	21.02	23.91	28.81	23.60	11.71
α	-1.88	-1.04	-0.73	1.51	1.89	3.77	-3.31	-0.65	-1.90	0.32	-0.46	-0.12	1.56	2.29	4.24	1.93	5.25	1.47
	(-1.1)	(-0.7)	(-0.5)	(1.1)	(1.3)	(1.5)	(-1.7)	(-0.4)	(-1.2)	(0.2)	(-0.3)	(-0.1)	(1.0)	(1.5)	(2.7)	(1.0)	(1.7)	(1.1)
Mkt_RF	1.09	1.00	1.03	1.01	0.97	-0.12	1.10	1.07	1.02	0.99	1.05	1.02	1.01	0.98	0.97	0.98	-0.13	-0.01
	(42.0)	(44.3)	(48.8)	(48.8)	(42.7)	(-2.9)	(36.4)	(41.6)	(41.5)	(39.4)	(46.2)	(41.3)	(43.2)	(42.2)	(39.3)	(32.5)	(-2.6)	(-0.5)
R^2	83.82	85.21	87.49	87.49	84.29	2.34	79.55	83.56	83.52	82.00	86.26	83.38	84.59	83.95	81.99	75.66	1.97	0.08
α	-2.45	-1.90	-1.54	0.87	1.88	4.33	-3.83	-1.39	-2.69	-0.80	-1.57	-1.04	1.04	1.48	3.81	2.11	5.94	1.61
	(-1.7)	(-1.6)	(-1.4)	(0.7)	(1.4)	(1.7)	(-2.2)	(-1.0)	(-2.0)	(-0.6)	(-1.4)	(-0.9)	(0.8)	(1.2)	(2.7)	(1.2)	(1.9)	(1.2)
Mkt_RF	1.07	1.00	1.02	1.00	0.95	-0.12	1.09	1.06	1.01	0.98	1.05	1.00	1.00	0.97	0.95	0.94	-0.14	-0.02
	(45.8)	(51.5)	(58.7)	(54.2)	(43.8)	(-2.9)	(39.0)	(47.7)	(48.6)	(49.3)	(57.8)	(52.1)	(47.2)	(48.0)	(42.3)	(33.8)	(-2.9)	(-1.0)
SMB	0.38	0.37	0.38	0.30	0.25	-0.13	0.43	0.43	0.43	0.47	0.41	0.49	0.34	0.36	0.35	0.39	-0.05	0.08
	(9.6)	(11.2)	(12.7)	(9.6)	(6.8)	(-1.9)	(9.1)	(11.5)	(12.1)	(13.8)	(13.1)	(14.9)	(9.5)	(10.4)	(9.1)	(8.1)	(-0.5)	(2.3)
HML	0.10	0.19	0.17	0.13	-0.03	-0.14	0.08	0.15	0.16	0.25	0.25	0.19	0.10	0.17	0.07	-0.10	-0.19	-0.05
	(2.4)	(5.3)	(5.3)	(3.9)	(-0.8)	(-1.8)	(1.6)	(3.6)	(4.1)	(6.7)	(7.5)	(5.2)	(2.4)	(4.7)	(1.7)	(-2.0)	(-2.0)	(-1.2)
R^2	87.37	89.69	91.87	90.43	86.24	4.13	83.59	88.38	88.79	89.19	91.63	90.29	87.94	88.29	85.60	79.88	3.22	2.13

Table A17. *Continued.* Portfolio momentum in Europe, Japan, and Asia Pacific ex Japan: 5×5 size and book-to-market and 2×4×4 size, operating profitability. and investment portfolios.

Panel D. 4 and 8 momentum portfolios, respectively, from Japanese 2×4×4 size, operating profitability, and investment portfolios

	1	2	3	4	WML_4	1	2	3	4	5	6	7	8	WML_8	$W_8–W_4$
Mean	3.01	2.89	4.92	6.30	3.29	4.34	2.28	4.07	2.13	6.87	3.69	7.68	6.07	1.73	-1.56
St Dev	22.15	20.25	18.65	19.37	13.05	23.46	21.78	20.26	20.58	19.14	19.11	19.87	20.31	16.33	6.97
Sharpe	0.02	0.02	0.13	0.20	0.25	0.08	-0.01	0.08	-0.02	0.23	0.06	0.26	0.18	0.11	-0.22
Skew	0.46	0.23	0.14	0.43	0.17	0.50	0.39	0.23	0.18	0.31	0.06	0.46	0.45	0.09	0.28
Kurt	2.37	1.48	0.45	1.66	5.30	2.57	2.11	1.25	1.31	0.69	0.26	1.47	1.82	5.58	2.57
Min	-19.67	-19.49	-16.11	-18.32	-20.02	-21.60	-18.48	-16.80	-20.24	-15.30	-16.74	-15.91	-18.89	-25.85	-7.84
Q1	-3.57	-2.79	-3.19	-2.68	-1.48	-3.33	-3.31	-3.15	-3.05	-3.18	-3.41	-2.95	-3.02	-2.12	-1.26
Med	0.36	0.15	0.53	0.59	0.13	0.35	0.41	0.38	0.17	0.66	0.47	0.74	0.69	0.03	-0.13
Q3	3.39	3.68	3.55	3.37	1.69	3.63	3.66	3.53	3.30	3.78	3.66	3.78	3.30	2.08	0.80
Max	28.10	23.57	16.57	25.13	16.32	32.09	26.94	24.56	22.40	18.93	15.44	24.02	26.71	20.61	8.48
α	-1.29	-1.28	0.87	2.21	3.50	-0.01	-1.97	-0.05	-2.04	2.83	-0.37	3.55	1.98	1.99	-1.51
	(-0.8)	(-1.0)	(0.8)	(1.8)	(1.5)	(-0.0)	(-1.2)	(-0.0)	(-1.5)	(2.1)	(-0.3)	(2.8)	(1.2)	(0.7)	(-1.2)
Mkt_RF	1.11	1.03	0.96	0.98	-0.12	1.14	1.08	1.00	1.03	0.96	0.96	1.01	0.99	-0.15	-0.03
	(45.9)	(52.1)	(58.9)	(52.0)	(-3.3)	(38.3)	(43.6)	(42.5)	(47.2)	(45.5)	(48.2)	(51.1)	(38.3)	(-3.3)	(-1.5)
R^2	86.11	88.87	91.08	88.84	3.10	81.22	84.85	84.18	86.78	85.87	87.23	88.47	81.15	3.05	0.63
α	-2.11	-2.12	0.03	2.40	4.51	-0.89	-3.05	-0.84	-2.96	1.85	-1.28	3.05	2.59	3.48	-1.03
	(-1.4)	(-1.8)	(0.0)	(2.0)	(1.9)	(-0.5)	(-2.1)	(-0.6)	(-2.4)	(1.5)	(-1.1)	(2.5)	(1.6)	(1.2)	(-0.8)
Mkt_RF	1.11	1.03	0.97	0.97	-0.14	1.14	1.09	1.01	1.03	0.96	0.97	1.01	0.96	-0.18	-0.04
	(47.9)	(56.6)	(65.0)	(51.3)	(-3.8)	(40.1)	(46.7)	(44.1)	(52.7)	(50.6)	(51.8)	(52.6)	(38.1)	(-3.8)	(-1.9)
SMB	0.21	0.22	0.15	0.10	-0.11	0.31	0.21	0.18	0.30	0.26	0.16	0.18	0.14	-0.17	-0.06
	(5.3)	(7.1)	(6.1)	(3.0)	(-1.8)	(6.4)	(5.2)	(4.6)	(8.9)	(8.0)	(5.1)	(5.6)	(3.3)	(-2.1)	(-1.6)
HML	0.15	0.15	0.17	-0.09	-0.24	0.13	0.22	0.15	0.14	0.17	0.19	0.07	-0.22	-0.35	-0.11
	(3.5)	(4.4)	(6.3)	(-2.5)	(-3.4)	(2.4)	(5.1)	(3.5)	(3.9)	(4.9)	(5.5)	(1.9)	(-4.8)	(-4.1)	(-3.0)
R^2	87.69	90.89	92.84	89.30	7.42	83.63	87.05	85.73	89.83	88.97	89.17	89.60	82.75	9.09	4.12

Table A17. *Continued.* Portfolio momentum in Europe, Japan, and Asia Pacific ex Japan: 5×5 size and book-to-market and 2×4×4 size, operating profitability. and investment portfolios.

Panel E. 5 and 10 momentum portfolios, respectively, from Asia Pacific ex Japan 5×5 size and book-to-market portfolios

	1	2	3	4	5	WML_5	1	2	3	4	5	6	7	8	9	10	WML_{10}	$W_{10}–W_5$
Mean	9.37	10.15	9.71	11.07	13.41	4.04	8.33	9.41	8.56	10.01	10.29	9.63	10.51	11.06	14.09	12.48	4.14	0.11
St Dev	23.42	22.18	21.55	21.21	21.46	13.75	23.45	23.72	22.58	21.86	22.24	21.95	22.16	21.24	22.13	21.60	14.80	7.92
Sharpe	0.30	0.35	0.34	0.41	0.51	0.29	0.25	0.29	0.27	0.35	0.35	0.33	0.36	0.40	0.53	0.46	0.28	0.01
Skew	0.33	-0.37	-0.26	-0.45	-0.66	-0.80	0.29	0.36	-0.41	-0.52	-0.11	-0.41	-0.16	-0.75	-0.64	-0.79	-0.78	0.10
Kurt	6.21	3.82	2.88	3.38	2.15	6.92	4.84	7.22	3.84	3.65	3.81	2.45	3.85	2.71	2.38	2.64	7.64	3.14
Min	-33.71	-32.58	-26.01	-29.71	-24.28	-23.20	-32.59	-34.79	-33.98	-31.46	-30.54	-26.93	-28.25	-30.74	-26.78	-28.47	-23.69	-10.57
Q1	-2.32	-1.93	-2.19	-2.41	-1.79	-1.68	-2.36	-2.33	-2.21	-1.78	-2.06	-2.50	-2.37	-2.22	-1.65	-1.76	-1.69	-1.04
Med	0.82	0.96	1.20	1.22	1.32	0.34	0.76	0.92	0.71	1.31	1.01	1.56	1.32	1.02	1.46	1.15	0.71	-0.04
Q3	3.94	3.57	4.05	4.19	4.87	2.52	3.93	3.61	3.87	3.95	3.75	4.24	3.96	4.34	4.87	4.91	2.66	0.97
Max	39.45	26.00	26.61	28.44	17.96	17.90	34.95	42.37	24.80	26.79	30.33	24.61	32.47	18.20	18.65	17.72	24.01	8.92
α	-2.13	-1.13	-1.44	0.05	2.66	4.79	-3.05	-2.11	-2.77	-0.95	-0.86	-1.60	-0.73	0.21	3.13	1.89	4.94	0.15
	(-1.2)	(-0.8)	(-1.3)	(0.0)	(1.7)	(1.9)	(-1.6)	(-1.1)	(-1.9)	(-0.6)	(-0.6)	(-1.3)	(-0.5)	(0.2)	(1.9)	(1.0)	(1.8)	(0.1)
Mkt_RF	1.08	1.05	1.04	1.02	0.99	-0.09	1.06	1.08	1.06	1.01	1.04	1.05	1.05	1.00	1.01	0.97	-0.10	-0.01
	(43.7)	(55.1)	(64.9)	(65.0)	(43.7)	(-2.4)	(39.8)	(40.8)	(49.5)	(45.6)	(47.6)	(57.6)	(53.5)	(51.9)	(42.2)	(37.4)	(-2.4)	(-0.2)
R^2	84.88	89.94	92.53	92.56	84.86	1.71	82.35	83.01	87.82	85.94	86.95	90.70	89.40	88.78	83.95	80.44	1.66	0.02
α	-2.75	-0.34	-1.11	0.28	2.53	5.28	-2.54	-2.94	-1.83	0.42	-0.62	-0.82	-0.30	0.65	2.96	2.00	4.54	-0.74
	(-1.7)	(-0.3)	(-1.1)	(0.3)	(1.7)	(2.0)	(-1.4)	(-1.7)	(-1.3)	(0.3)	(-0.5)	(-0.7)	(-0.2)	(0.5)	(1.9)	(1.2)	(1.6)	(-0.5)
Mkt_RF	1.07	1.06	1.03	1.02	0.98	-0.09	1.06	1.06	1.06	1.02	1.03	1.05	1.05	1.00	1.00	0.96	-0.10	-0.01
	(46.2)	(56.9)	(69.6)	(67.4)	(47.4)	(-2.3)	(42.5)	(43.6)	(52.1)	(50.2)	(53.3)	(62.9)	(56.3)	(56.3)	(45.2)	(41.4)	(-2.5)	(-0.7)
SMB	0.27	0.19	0.22	0.17	0.32	0.05	0.37	0.30	0.26	0.34	0.36	0.28	0.24	0.29	0.32	0.41	0.04	0.00
	(6.1)	(5.2)	(7.7)	(5.7)	(7.9)	(0.6)	(7.5)	(6.3)	(6.4)	(8.7)	(9.6)	(8.6)	(6.6)	(8.4)	(7.3)	(9.0)	(0.6)	(-0.1)
HML	0.22	-0.03	0.06	0.05	0.17	-0.05	0.10	0.27	-0.02	-0.04	0.14	0.01	0.05	0.07	0.18	0.18	0.08	0.13
	(5.0)	(-0.8)	(2.0)	(1.6)	(4.3)	(-0.7)	(2.0)	(5.7)	(-0.5)	(-1.1)	(3.6)	(0.5)	(1.4)	(2.1)	(4.1)	(4.0)	(1.1)	(3.2)
R^2	87.12	90.72	93.67	93.25	87.70	2.00	84.96	85.89	89.17	88.56	89.96	92.37	90.65	90.76	86.59	84.68	2.05	3.06

Table A17. *Continued.* Portfolio momentum in Europe, Japan, and Asia Pacific ex Japan: 5×5 size and book-to-market and 2×4×4 size, operating profitability. and investment portfolios.

Panel F. 4 and 8 momentum portfolios, respectively, from Asia Pacific ex Japan 2×4×4 size, operating profitability, and investment portfolios

	1	2	3	4	WML_4	1	2	3	4	5	6	7	8	WML_8	$W_8–W_4$
Mean	6.54	10.11	13.23	10.35	3.81	3.29	7.99	10.34	10.72	14.35	11.53	11.95	9.40	6.11	2.30
St Dev	24.22	21.65	21.64	20.42	14.34	24.43	24.70	23.77	21.70	22.00	22.31	20.95	21.11	16.53	9.45
Sharpe	0.17	0.35	0.50	0.39	0.27	0.03	0.22	0.33	0.38	0.54	0.41	0.45	0.33	0.37	0.24
Skew	-0.14	-0.39	-0.08	-0.41	-0.61	-0.13	0.06	-0.33	-0.33	-0.01	-0.17	-0.23	-0.71	-0.74	0.52
Kurt	3.26	3.20	2.85	2.51	5.91	2.67	4.20	3.81	2.72	1.73	4.06	2.39	2.78	5.81	4.00
Min	-27.95	-26.90	-26.32	-24.84	-21.59	-25.98	-29.68	-33.73	-25.65	-24.18	-27.26	-24.32	-25.15	-26.87	-9.91
Q1	-2.78	-1.95	-2.19	-1.80	-1.49	-3.20	-3.12	-2.30	-2.00	-2.22	-2.07	-1.80	-1.81	-1.81	-1.34
Med	0.97	1.15	1.36	1.22	0.36	0.54	0.81	1.43	1.23	1.30	1.22	1.17	1.14	0.71	0.16
Q3	3.80	3.82	4.70	4.06	2.25	3.75	4.02	4.22	4.06	4.66	4.43	4.32	4.21	3.00	1.70
Max	28.61	25.17	30.07	26.42	21.13	29.75	31.66	28.57	23.14	23.42	35.10	27.94	22.85	22.04	16.44
α	-5.33	-1.07	2.05	-0.09	5.24	-8.33	-3.93	-1.44	-0.31	3.26	0.43	1.46	-0.93	7.39	2.15
	(-3.1)	(-0.9)	(1.8)	(-0.1)	(2.0)	(-4.0)	(-2.1)	(-0.9)	(-0.2)	(2.2)	(0.3)	(0.9)	(-0.5)	(2.4)	(1.2)
Mkt_RF	1.12	1.04	1.04	0.95	-0.17	1.09	1.13	1.11	1.02	1.03	1.03	0.96	0.94	-0.15	0.02
	(45.5)	(63.4)	(64.6)	(47.3)	(-4.5)	(36.8)	(41.4)	(48.6)	(51.5)	(48.8)	(44.4)	(41.8)	(35.9)	(-3.5)	(0.7)
R^2	85.91	92.19	92.47	86.79	5.69	79.97	83.43	87.42	88.63	87.52	85.27	83.70	79.15	3.44	0.14
α	-5.30	-0.60	1.47	-0.06	5.24	-8.09	-3.92	-1.00	-0.04	2.81	-0.19	1.07	-0.74	7.35	2.11
	(-3.1)	(-0.5)	(1.3)	(-0.0)	(2.0)	(-4.0)	(-2.1)	(-0.6)	(-0.0)	(1.9)	(-0.1)	(0.7)	(-0.4)	(2.4)	(1.2)
Mkt_RF	1.12	1.04	1.03	0.95	-0.17	1.09	1.13	1.11	1.02	1.02	1.02	0.95	0.94	-0.15	0.02
	(45.7)	(63.4)	(65.0)	(47.3)	(-4.5)	(37.8)	(41.6)	(49.8)	(51.2)	(48.5)	(46.3)	(42.2)	(36.2)	(-3.4)	(0.7)
SMB	0.16	0.06	0.06	0.11	-0.04	0.28	0.19	0.21	0.05	0.06	0.24	0.16	0.18	-0.10	-0.06
	(3.2)	(1.7)	(2.0)	(2.9)	(-0.6)	(4.9)	(3.5)	(4.8)	(1.4)	(1.4)	(5.4)	(3.5)	(3.6)	(-1.1)	(-1.1)
HML	0.03	-0.06	0.10	0.02	-0.01	0.03	0.04	-0.02	-0.03	0.08	0.15	0.09	0.01	-0.02	-0.01
	(0.7)	(-1.8)	(3.3)	(0.6)	(-0.1)	(0.5)	(0.8)	(-0.4)	(-0.7)	(2.0)	(3.4)	(2.1)	(0.2)	(-0.2)	(-0.1)
R^2	86.37	92.33	92.81	87.13	5.79	81.37	84.06	88.22	88.70	87.76	86.97	84.53	79.93	3.83	0.52

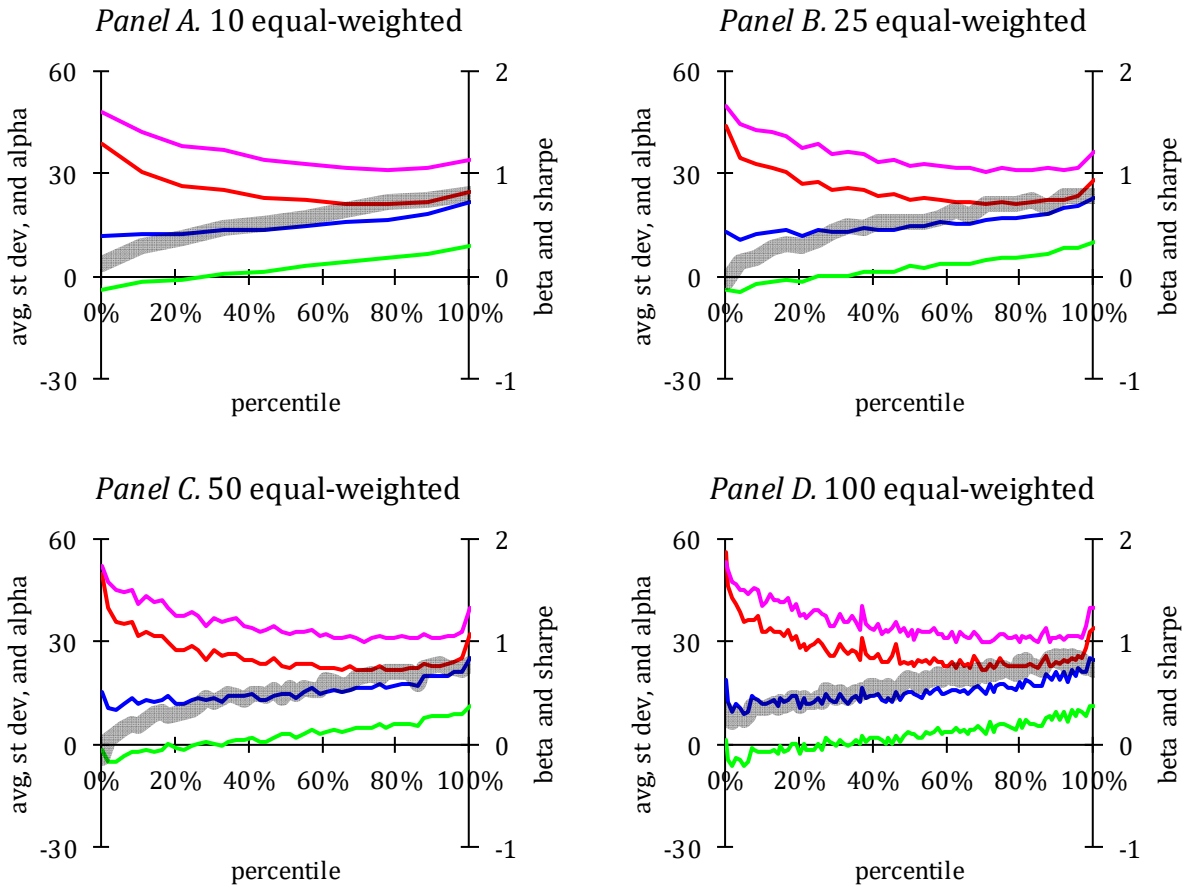

Figure A1. Average returns, standard deviations, Sharpe ratios, alphas, and betas of equal-weighted momentum portfolios.

The figure shows the annualized monthly average returns, standard deviations, Sharpe ratios, CAPM alphas, and market betas of 10 (Panel A), 25 (Panel B), 50 (Panel C), and 100 (Panel D) equal-weighted momentum portfolios. The x-axis shows the percentile—the most loser and the most winner portfolio are at 0% and 100%, respectively. Blue, red, green, and magenta lines are the average returns, standard deviations, alphas, and betas of the momentum portfolios, respectively. Black shades are the Sharpe ratios. The data are based on the Center for Research in Security Prices (CRSP) and span December 1926 to December 2019.

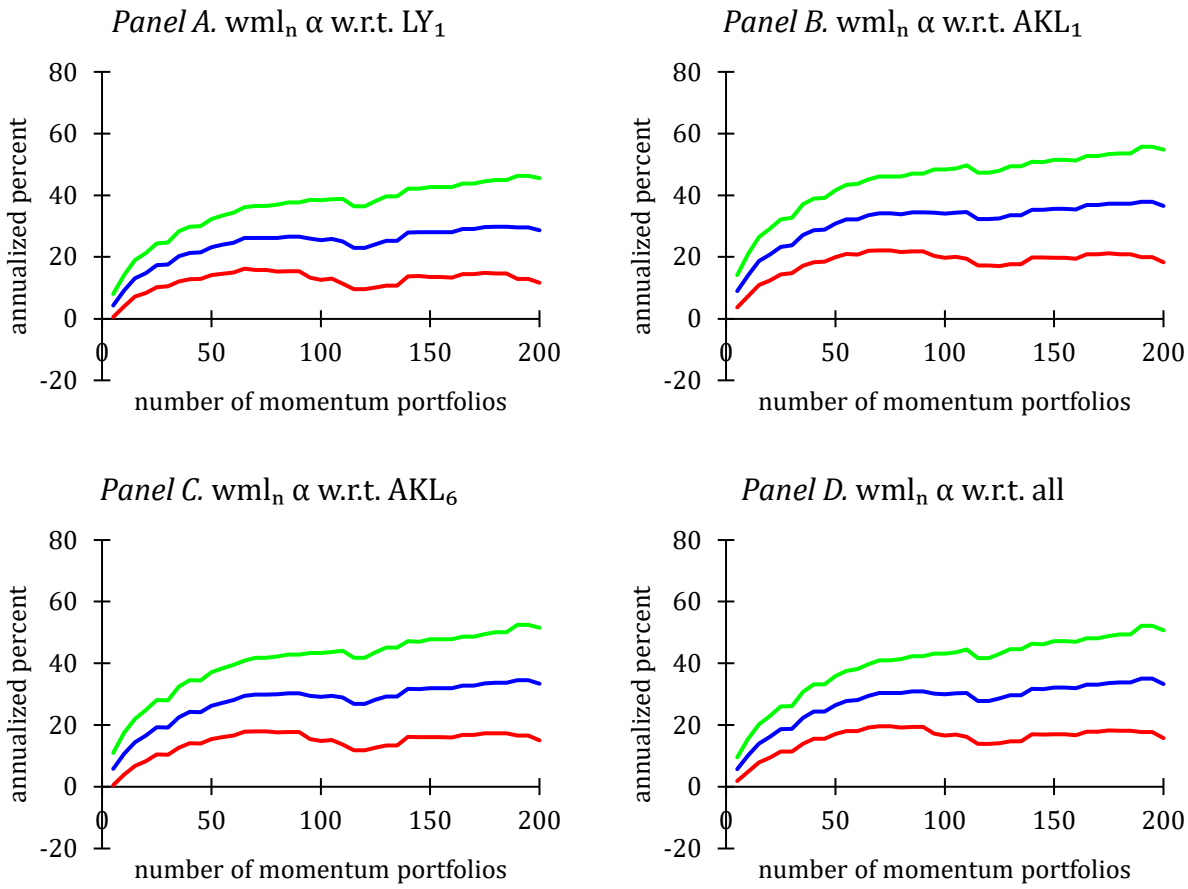

Figure A2. Number of momentum portfolios and WML alpha against factor momentum.
This figure shows the spanning alphas of the n-portfolio winner-minus-loser factors (WML_n) with respect to three different types of factor momentum—the Leippold–Yang (2021) one-month (LY_1) factor momentum and the Arnott–Kalesnik–Linnainmaa (2023) one- (AKL_1) and six-month (AKL_6) factor momentum—based on 210 US equity factors, as functions of $n \in \{5,10,\cdots,200\}$, the number of portfolios. The 210 factors are from Professor Leippold's website (https://osf.io/6sxc8). Panels A, B, C, and D regress WML_n on LY_1, AKL_1, AKL_6, and all three types of factor momentum, respectively. Blue, green, and red are the statistics and their two standard error bands. The data span July 1966 to December 2018.

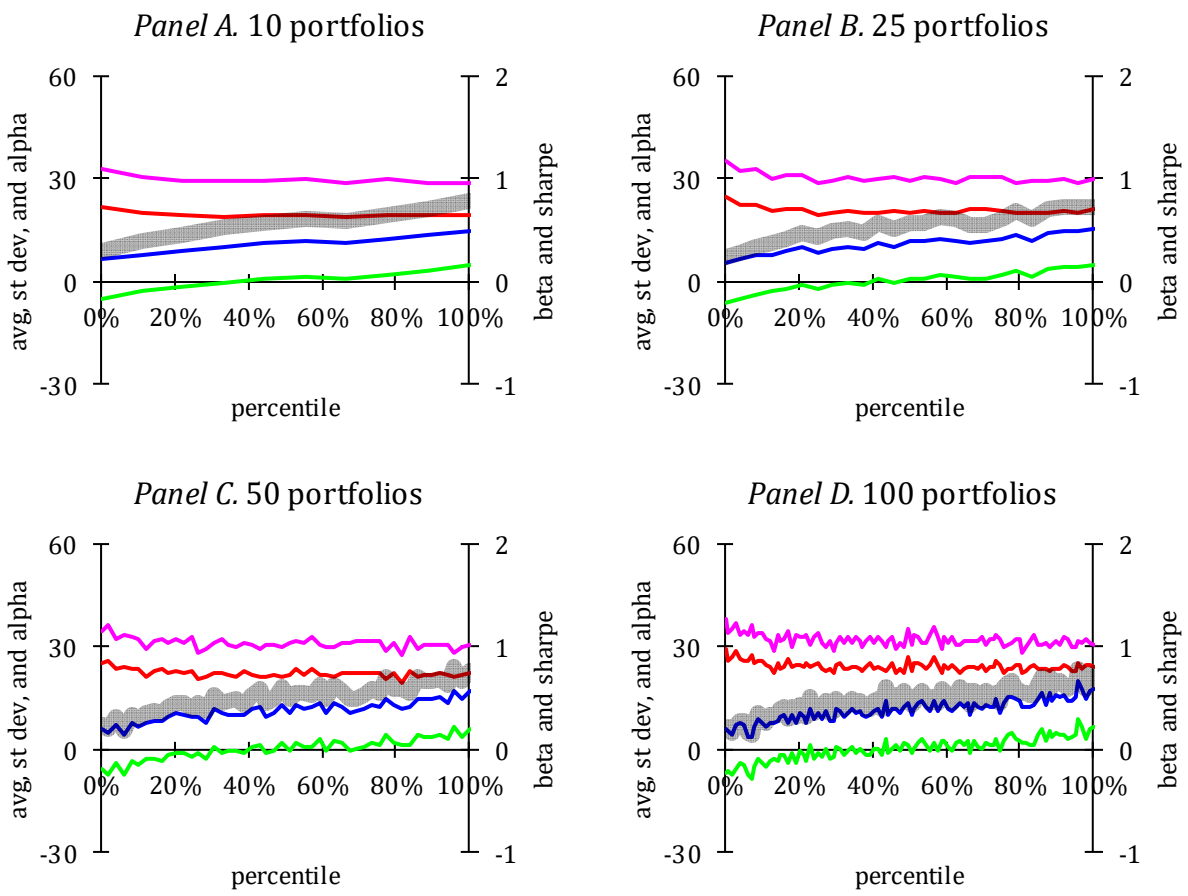

Figure A3. Average returns, standard deviations, Sharpe ratios, alphas, and betas of value-weighted residual momentum portfolios.

The figure shows the annualized monthly average returns, standard deviations, Sharpe ratios, CAPM alphas, and market betas of 10 (Panel A), 25 (Panel B), 50 (Panel C), and 100 (Panel D) value-weighted residual momentum portfolios (Blitz, Huij, and Martens, 2011). The x-axis shows the percentile—the most loser and the most winner portfolio are at 0% and 100%, respectively. Blue, red, green, and magenta lines are the average returns, standard deviations, alphas, and betas of the momentum portfolios, respectively. Black shades are the Sharpe ratios. The data are based on CRSP and span December 1926 to December 2019.

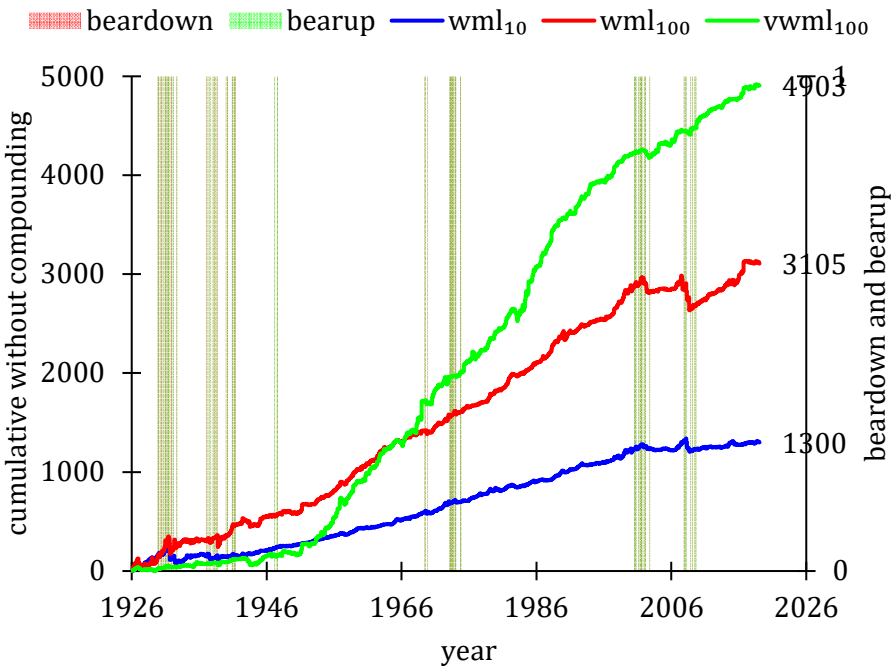

Figure A4. Cumulative WML and vWML returns in bear markets.
Blue, red, and green lines are cumulative, non-compounding, returns to simple decile WML, simple percentile WML, and volatility-managed (Moreira and Muir, 2017) percentile WML positions from value-weighted momentum portfolios, respectively. Red and green shades are bear-down and bear-up markets, respectively. Following Daniel and Moskowitz (2016), the bear-market indicator equals 1 if the trailing two-year cumulative market return is negative, and the up-market indicator equals 1 if the contemporaneous excess market return is positive. The data span January 1927 to December 2019.

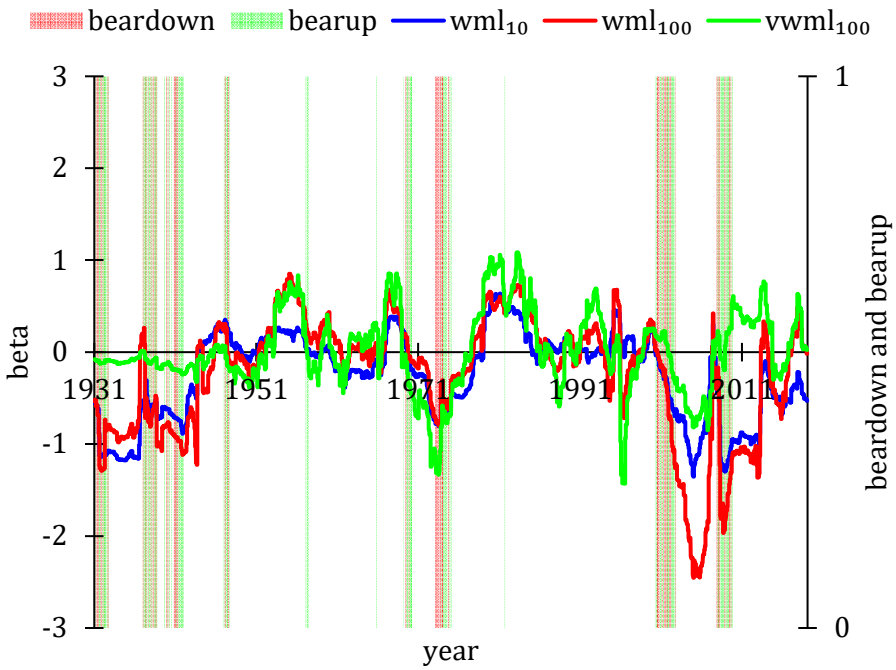

Figure A5. 60-month market betas of WML and vWML returns.
Blue, red, and green lines are trailing 60-month market betas of simple decile WML, simple percentile WML, and volatility-managed percentile WML positions from value-weighted momentum portfolios, respectively. Red and green shades are bear-down and bear-up markets, respectively. Following Daniel and Moskowitz (2016), the bear-market indicator equals 1 if the trailing two-year cumulative market return is negative, and the up-market indicator equals 1 if the contemporaneous excess market return is positive. The data span December 1931 to December 2019.

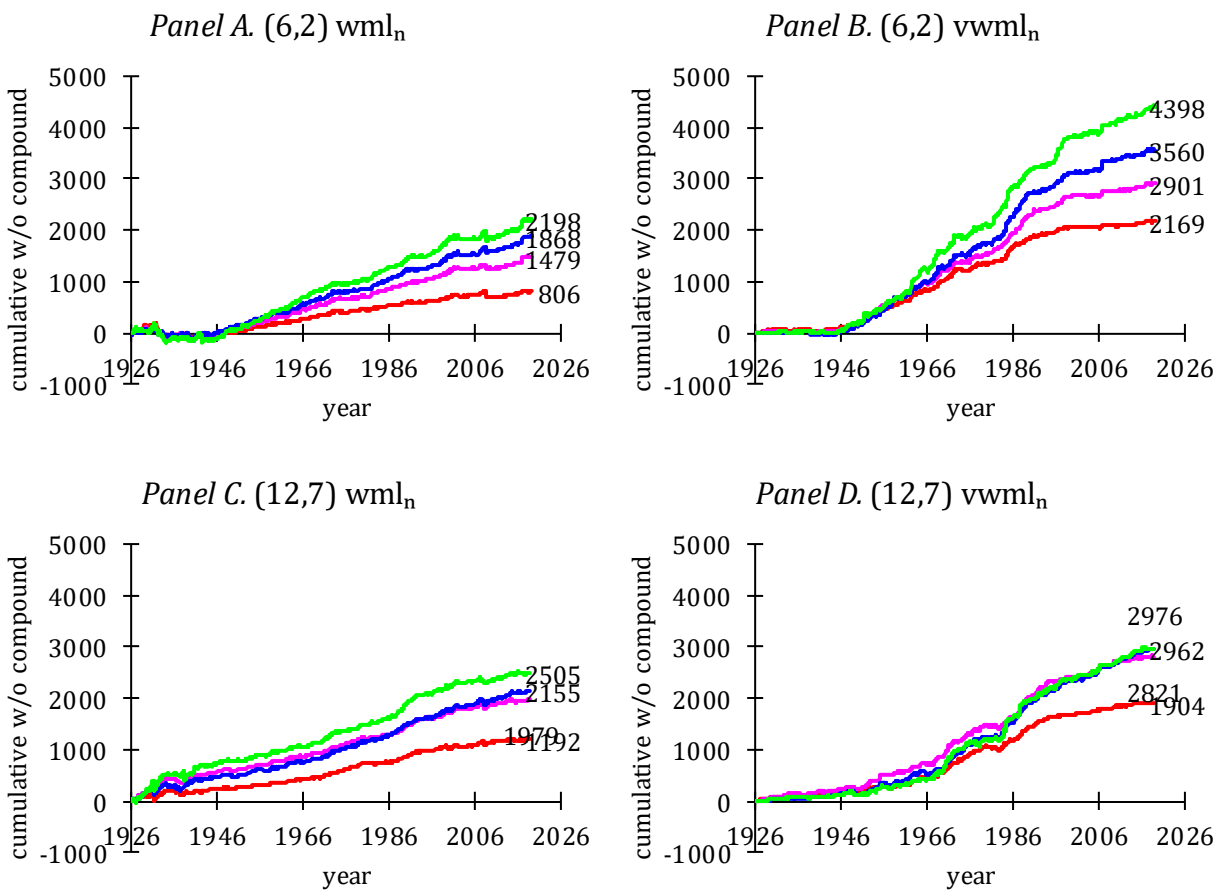

Figure A6. Term structure of momentum: cumulative WML_ns and $vWML_n$s.
The figure shows cumulative, non-compounding, returns to recent (top) and intermediate horizon (bottom) past performance WML_ns (left) and $vWML_n$s (right) (Novy-Marx, 2012; Goyal and Wahal, 2015; Moreira and Muir, 2017). Red, magenta, blue, and green lines are the WML positions from 10, 25, 50, and 100 momentum portfolios, respectively. The data are based on CRSP and are from July 1926 (Panel A), August 1926 (Panel B), January 1927 (Panel C), and February 1927 (Panel D) to December 2019, respectively.

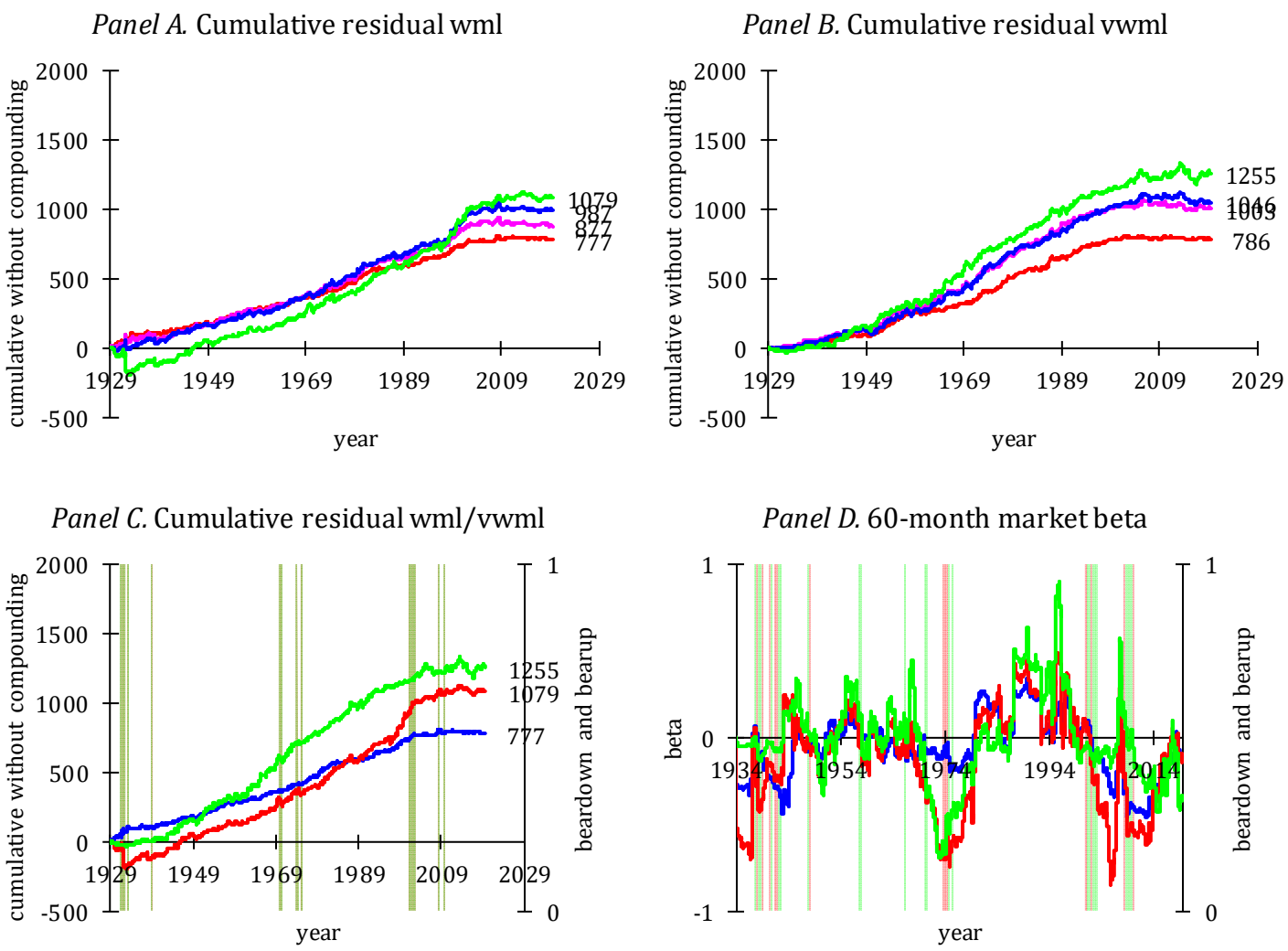

Figure A7. Cumulative returns and 60-month betas of simple and volatility-managed residual momentum portfolios. The figure shows the cumulative simple (Panel A) and volatility-managed (Panel B) residual momentum returns, the cumulative returns in bear markets (Panel C), and the trailing 60-month market betas (Panel D). Panels A, B, C, and D correspond to Figures 4, 5, 6, and 7, respectively. In Panels A and B, red, magenta, blue, and green are the WML positions from 10, 25, 50, and 100 residual momentum portfolios, respectively. In Panels C and D, red, blue, and green are WML_{10}, WML_{100}, and $vWML_{100}$, respectively. The data span July 1929 (Panels A, B, and C) or June 1934 (Panel D) to December 2019, respectively.

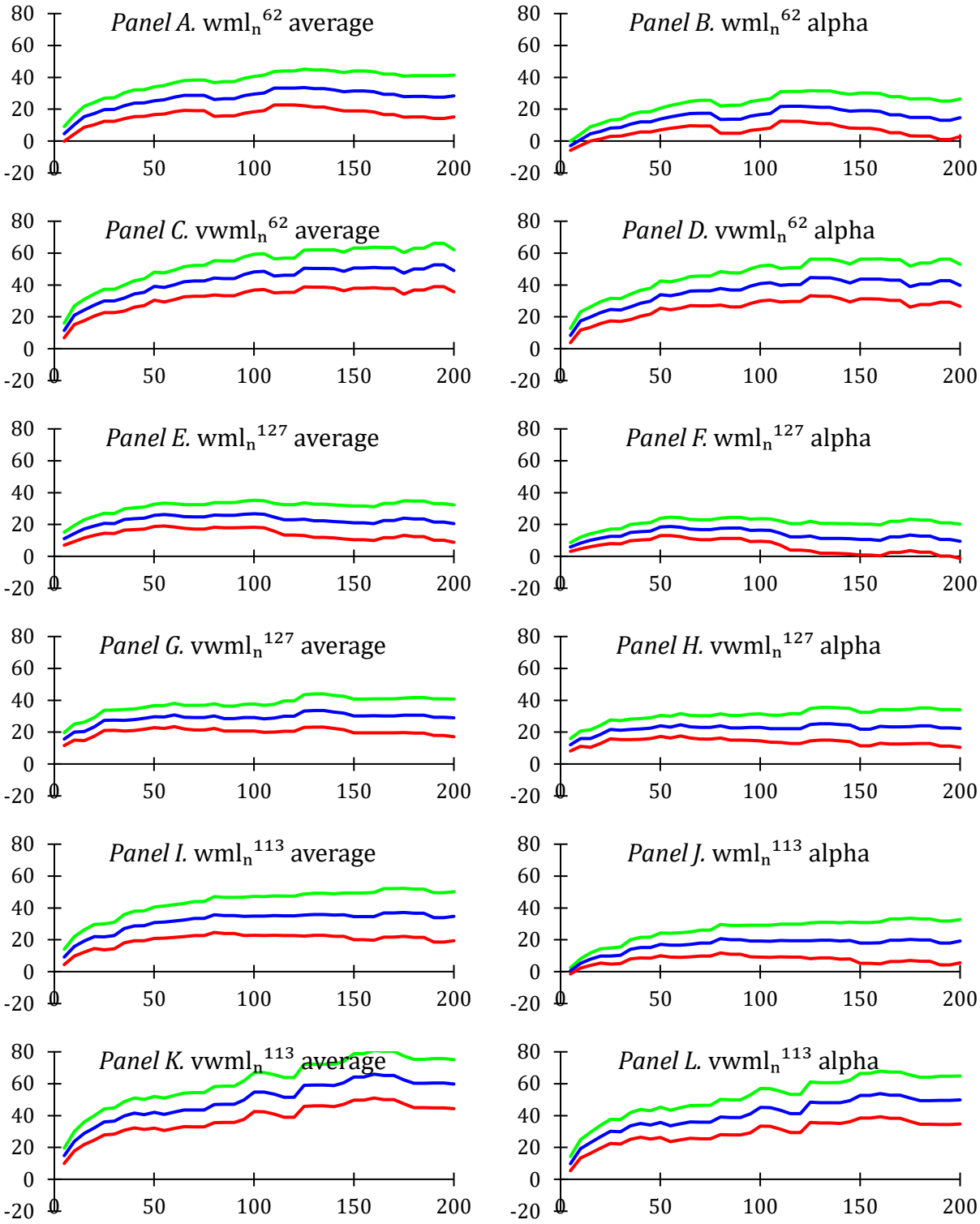

Figure A8. Number of recent/intermediate horizon momentum portfolios and WML performance. The figure shows the average return and alpha (Fama and French, 2018) of the recent past performance WML (Panels A, B) and vWML (Panels C, D), respectively, those of the intermediate horizon past performance WML (Panels E, F) and vWML (Panels G, H), respectively, and those of the (t−11,t−3) WML (Panels I, J) and vWML (Panels K, L) (Gong, Liu, and Liu, 2015), respectively, as functions of n=5,10,⋯,200, the number of momentum portfolios. Blue, green, and red are the statistics and their two standard error bands. Average returns and alphas are annualized. The data are based on CRSP and span July 1963 to December 2019.

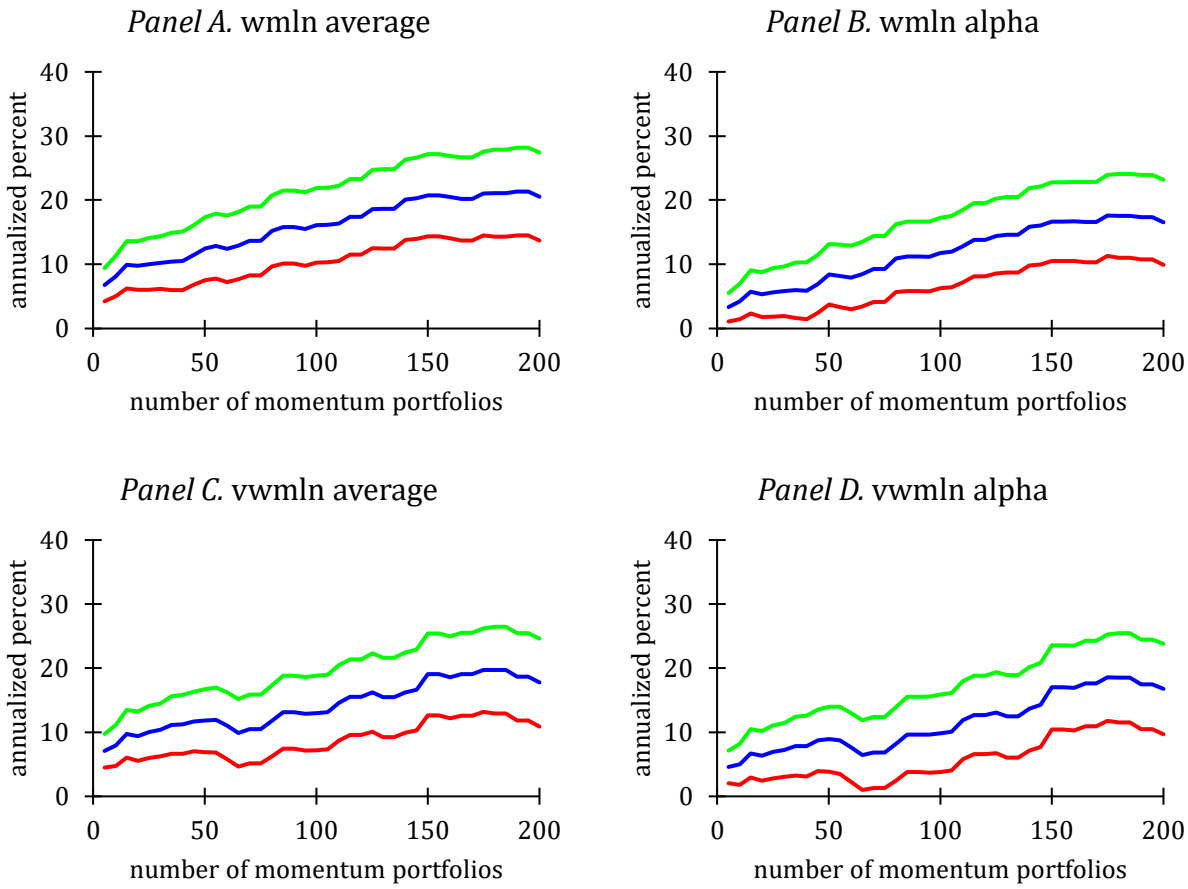

Figure A9. Number of residual momentum portfolios and WML performance.
The figure shows the average return (Panel A) and alpha (Fama and French, 2018) (Panel B) of the simple residual (Blitz, Huij, and Martens, 2011) WML and the average return (Panel C) and alpha (Panel D) of the volatility-managed (Moreira and Muir, 2017) residual WML as functions of n=5,10,⋯,200, the number of momentum portfolios—for example, WML_5 and WML_{200} are on the left and right. Blue, green, and red are the statistics and their two standard error bands. Average returns and alphas are annualized. The data are based on CRSP and span July 1963 to December 2019.

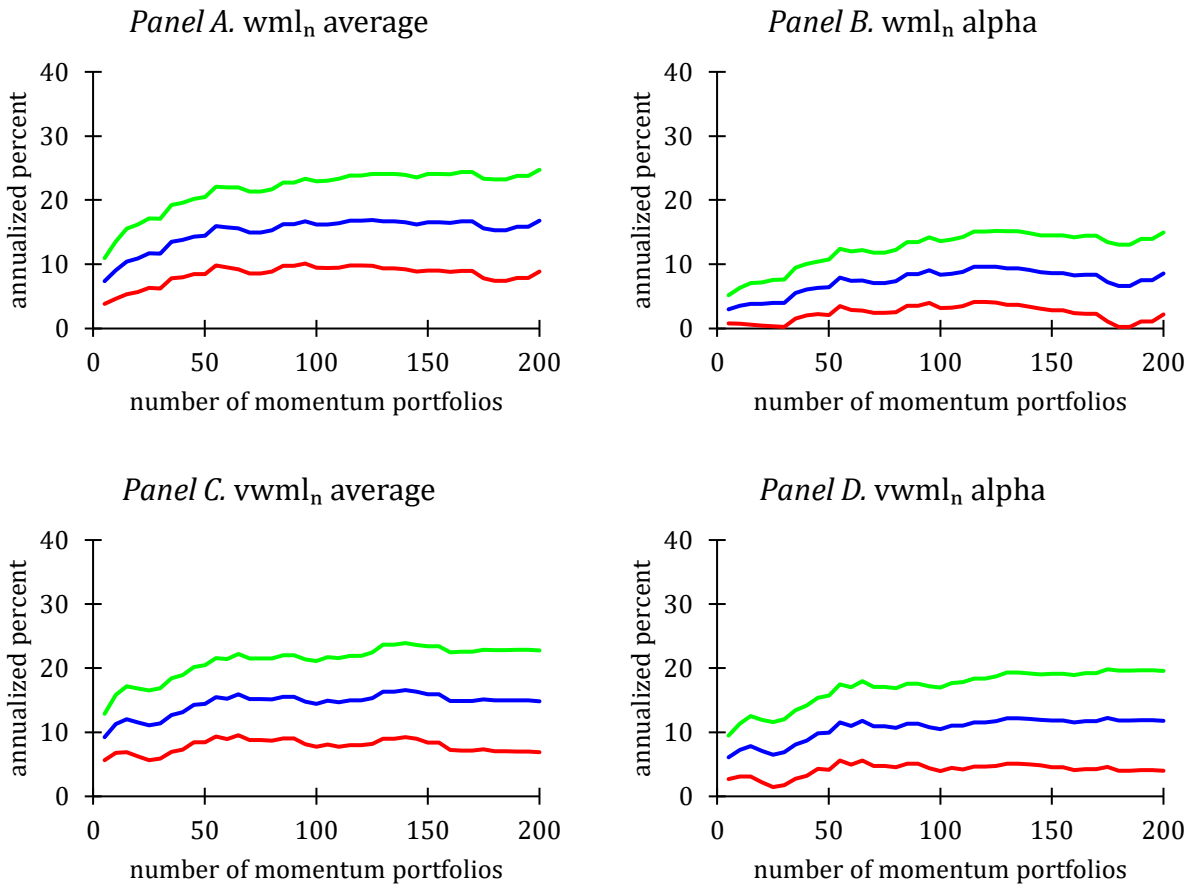

Figure A10. Number of alpha momentum portfolios and WML performance.
The figure shows the average return (Panel A) and alpha (Fama and French, 2018) (Panel B) of the simple alpha (Hühn and Scholz, 2018; Zaremba, Umutlu, and Karathanasopoulos, 2019) WML and the average return (Panel C) and alpha (Panel D) of the volatility-managed (Moreira and Muir, 2017) alpha WML as functions of n=5,10,⋯,200, the number of momentum portfolios—for example, WML_5 and WML_{200} are on the left and right. Blue, green, and red are the statistics and their two standard error bands. Average returns and alphas are annualized. The data are based on CRSP and span July 1963 to December 2019.

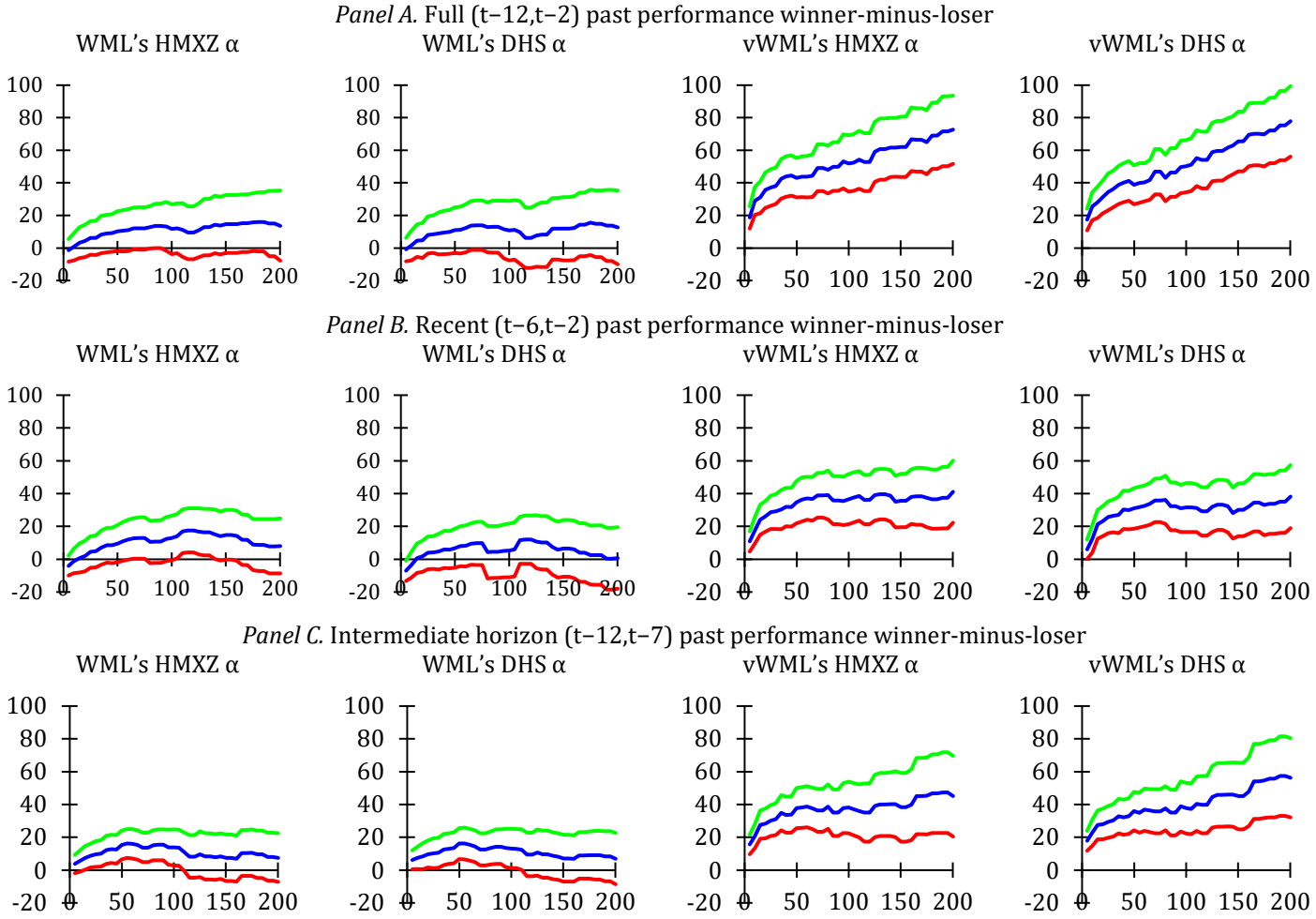

Figure A11. Number of momentum portfolios and other winner-minus-loser alphas.
The figure shows Hou–Mo–Xue–Zhang (2020) five-factor alphas and Daniel–Hirshleifer–Sun (2020) three-factor alphas of the simple and the volatility-managed (Moreira and Muir, 2017) WML position based on full (t−12,t−2; Panel A), recent (t−6,t−2; B), and intermediate horizon (t−12,t−7; C) past performance (Novy-Marx, 2012), respectively, as functions of n=5,10,⋯,200, the number of momentum portfolios—for example, WML_5 and WML_{200} are on the left and right. Blue, green, and red are the statistics and their two standard error bands. Average returns and alphas are annualized. The data are based on CRSP and span January 1967 to December 2019 for HMXZ and span July 1972 to December 2018 for DHS.

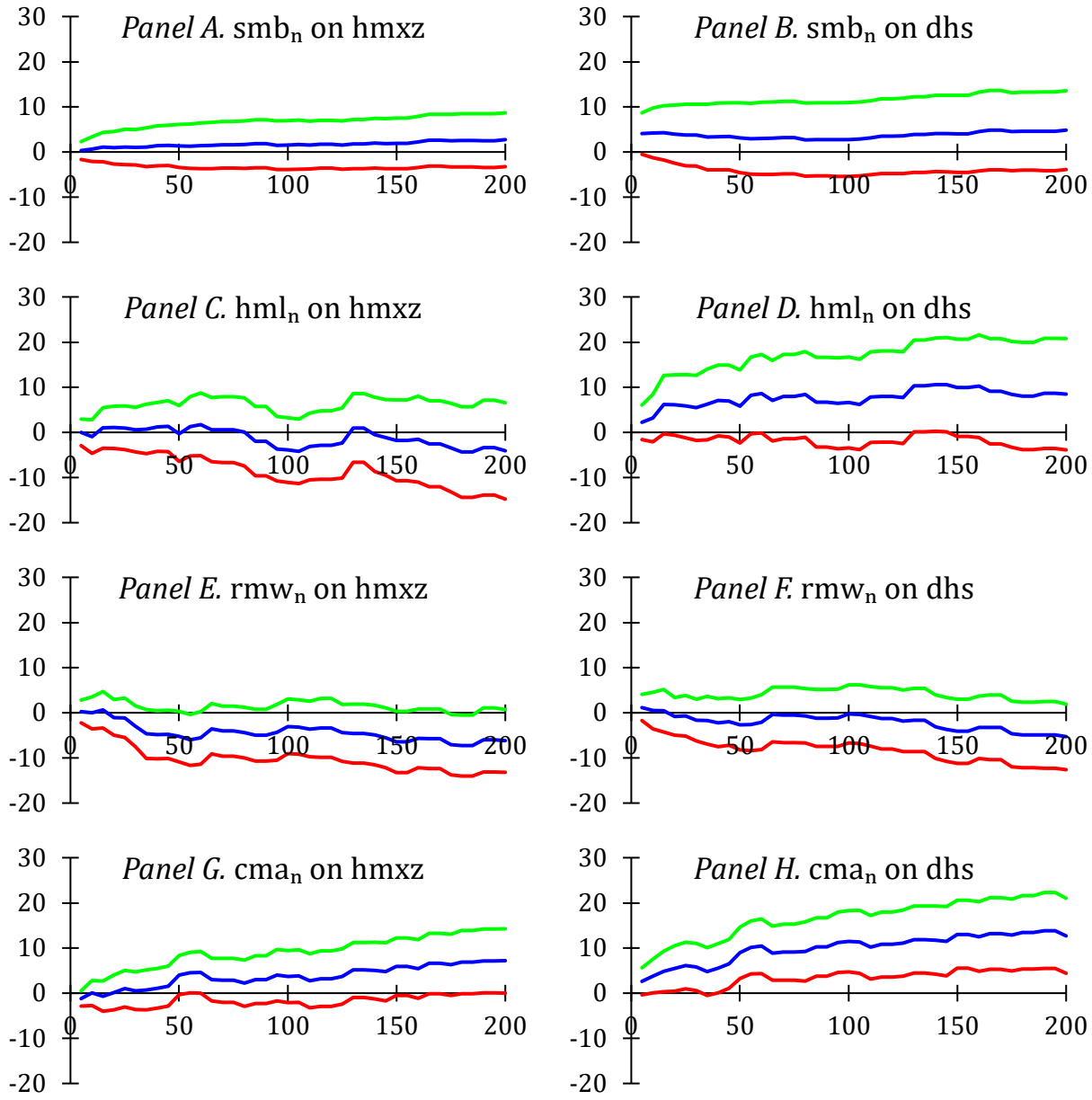

Figure A12. Number of portfolios and other long-short alphas.
The figure shows Hou–Mo–Xue–Zhang (2020) five-factor alphas (left) and Daniel–Hirshleifer–Sun (2020) three-factor alphas (right) of the size (first; small-minus-big), the book-to-market (second; high-minus-low), the operating profitability (third; robust-minus-weak), and the investment (fourth; conservative-minus-aggressive) long-short positions, respectively, as functions of n∈{5,10,⋯,200}. Blue, green, and red are the statistics and their two standard error bands. The data span July 1963 to December 2019.

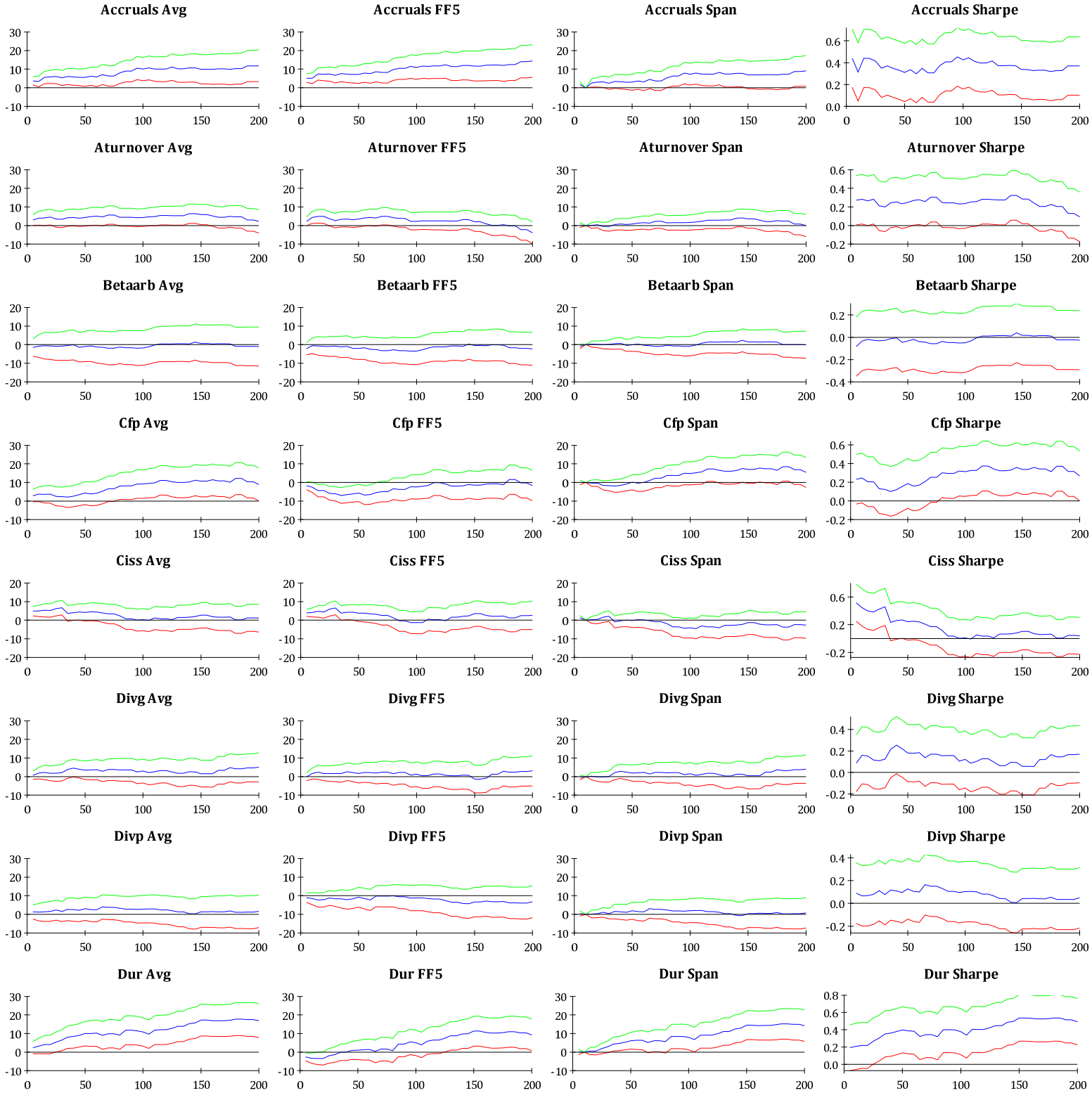

Figure A13. Number of anomaly portfolios and long-short performance: Kozak's (2020) 49 anomalies.
The figure shows the average return (first column), Fama–French (2018) five-factor alpha (second), decile-portfolio long-short spanning alpha (third), and Sharpe ratio (last) of each long-short portfolio based on Kozak's (2020) 49 anomaly characteristics as functions of n=5,10,⋯,200, the number of portfolios—for example, a long-short portfolio formed on five (200) portfolios is on the left (right) of each panel. Each row corresponds to each anomaly. Blue, green, and red are the statistics and their two standard error bands. Shaded are conventional one-year momentum (Mom12). Average returns, alphas, and Sharpe ratios are annualized. The data are based on Professor Serhiy Kozak's website (https://www.serhiykozak.com/data) and CRSP and span July 1963 to December 2019 (at most). From the 54 anomalies of the original data, I exclude 5 anomalies that do not show enough cross-sectional variation (*i.e.*, the number of unique values less than the number of formed portfolios).

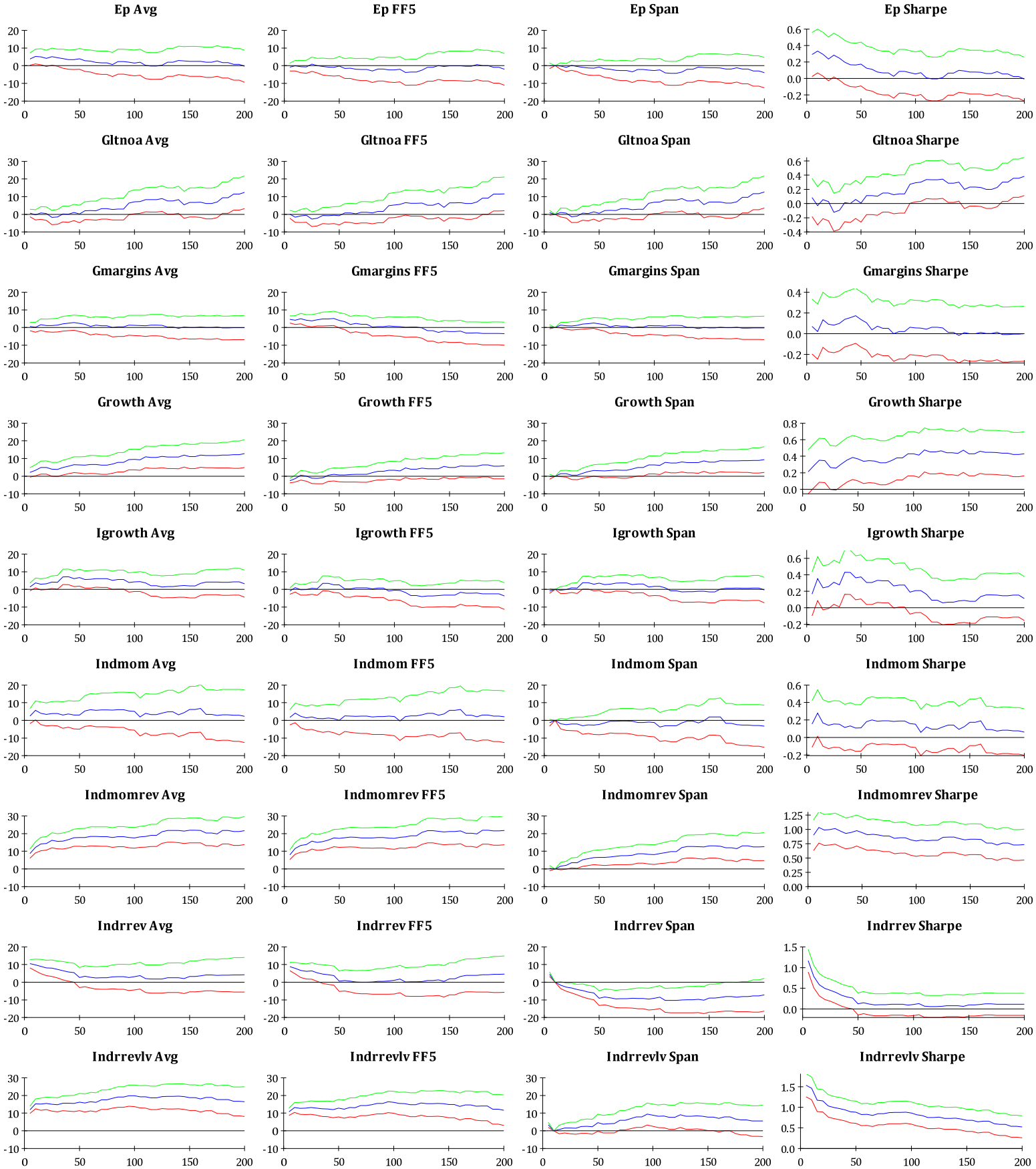

Figure A13. *Continued.* Number of anomaly portfolios and long-short performance: Kozak's (2020) 49 anomalies.

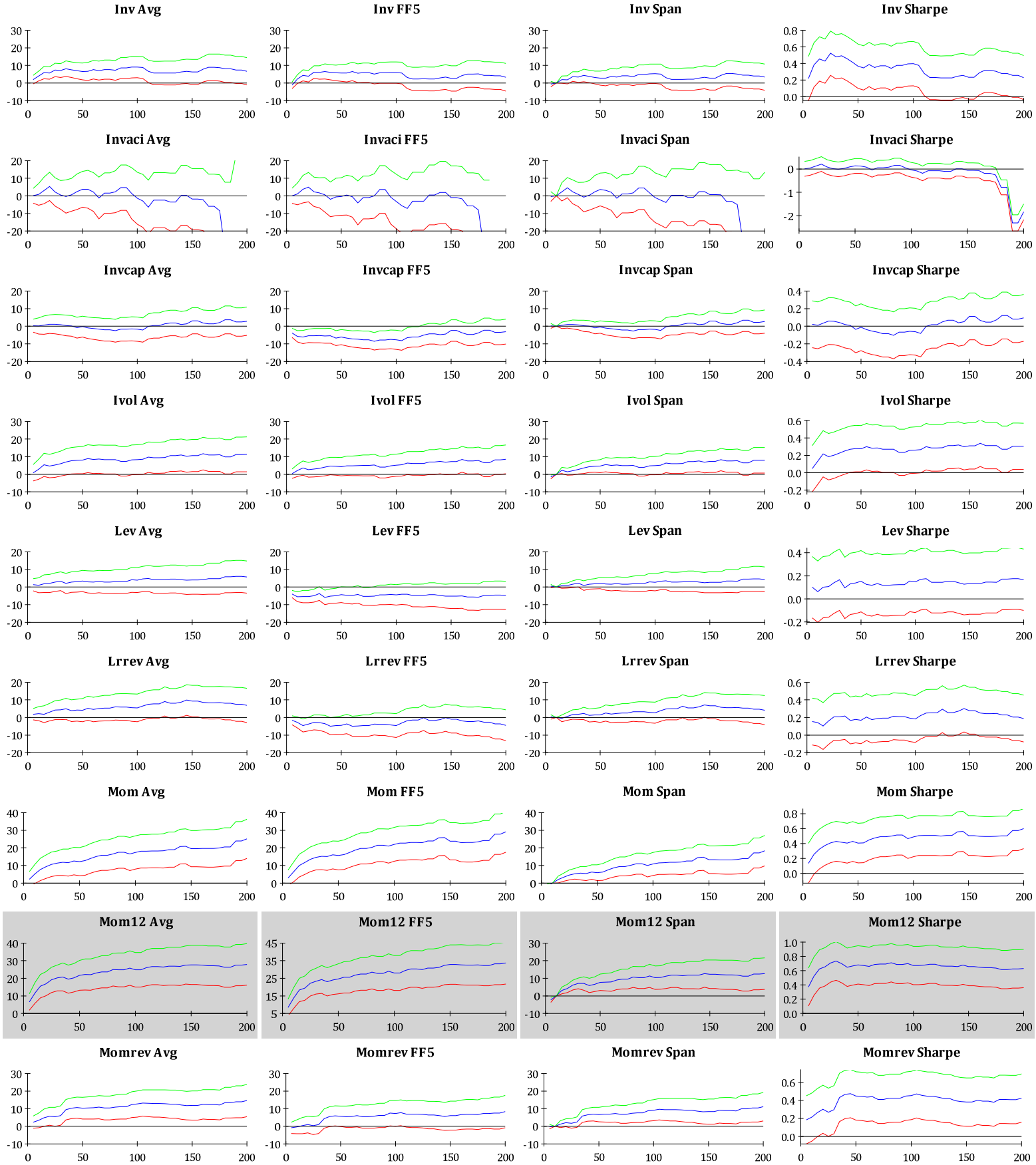

Figure A13. *Continued.* Number of anomaly portfolios and long-short performance: Kozak's (2020) 49 anomalies.

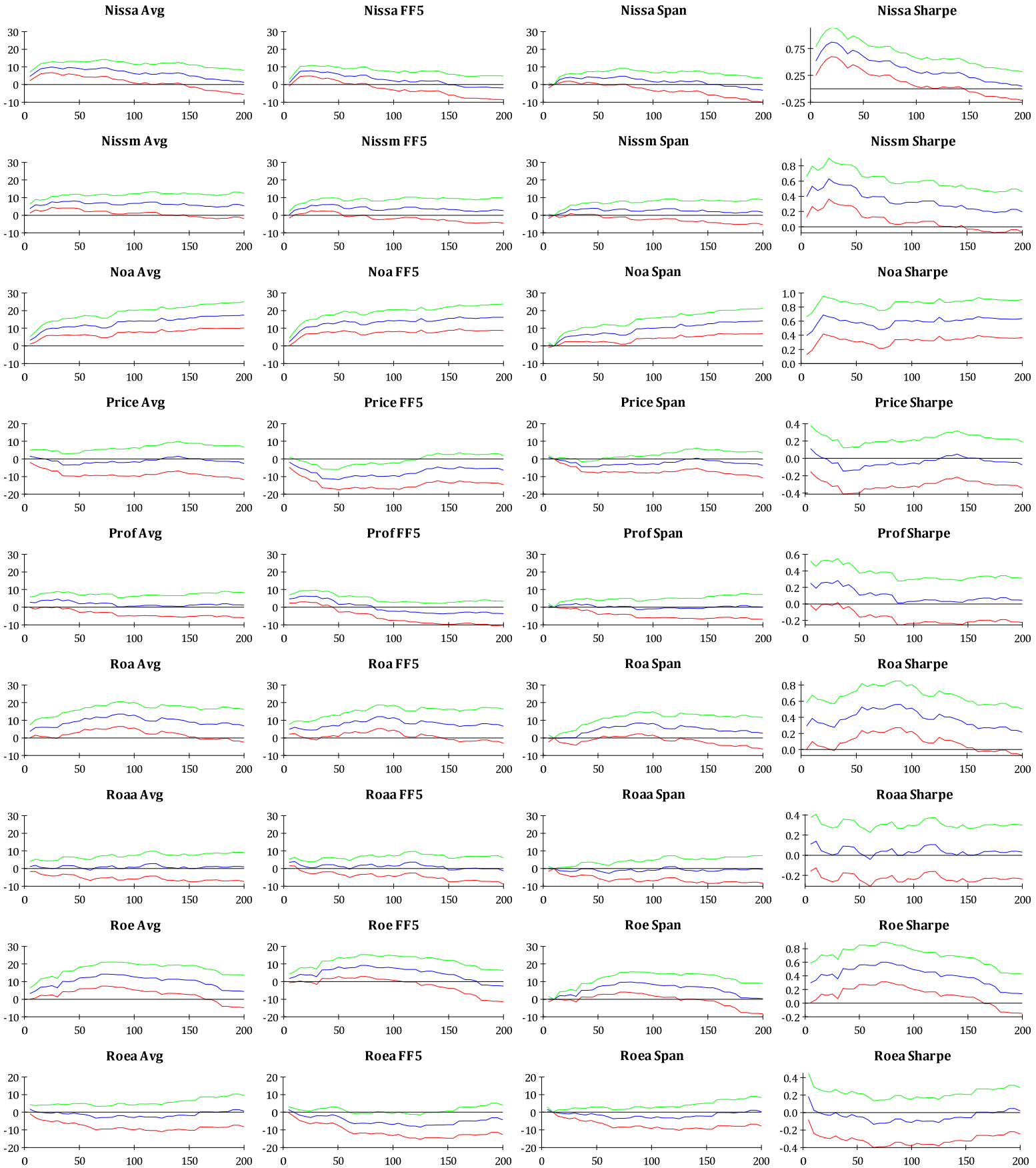

Figure A13. *Continued.* Number of anomaly portfolios and long-short performance: Kozak's (2020) 49 anomalies.

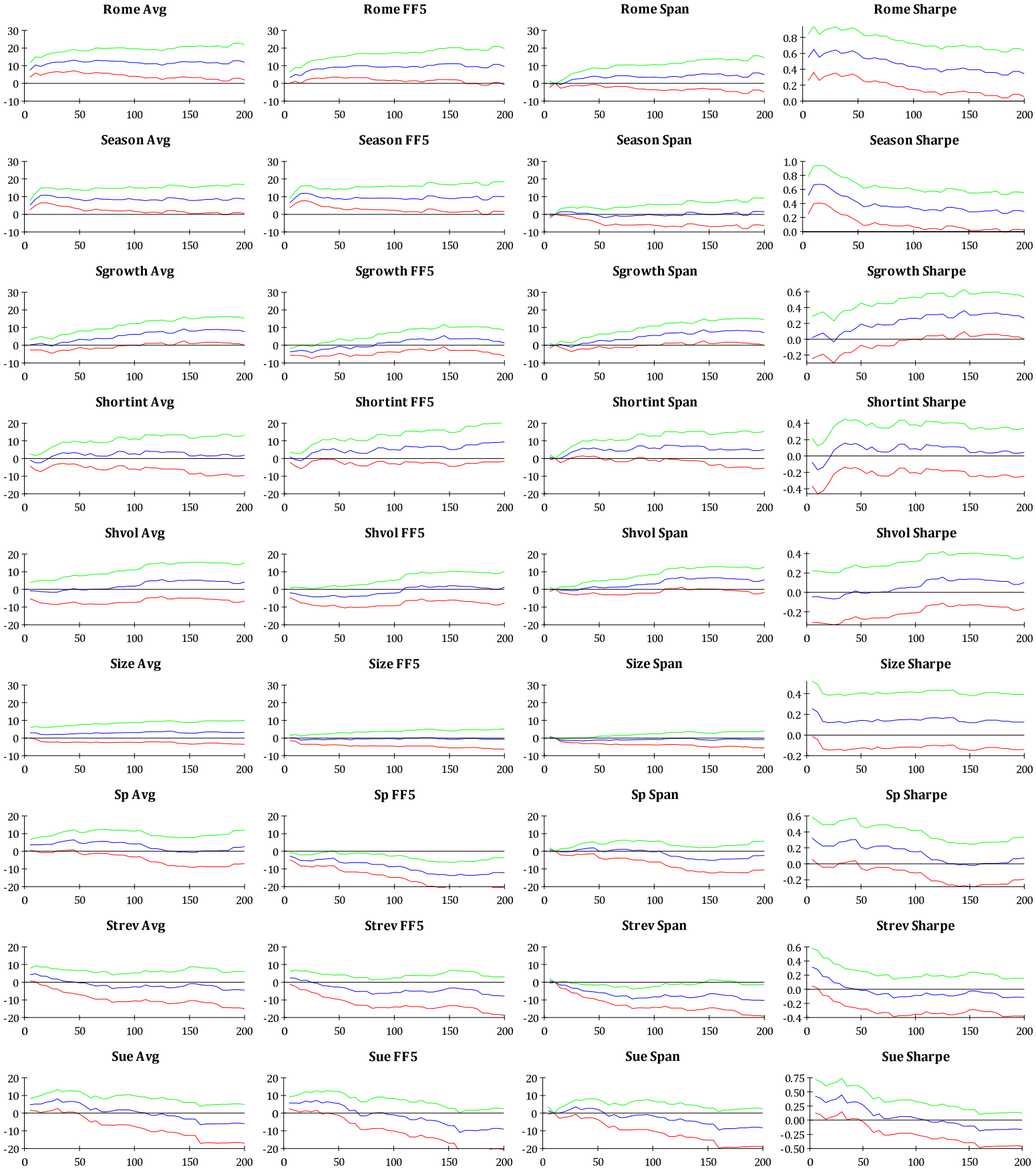

Figure A13. *Continued.* Number of anomaly portfolios and long-short performance: Kozak's (2020) 49 anomalies.

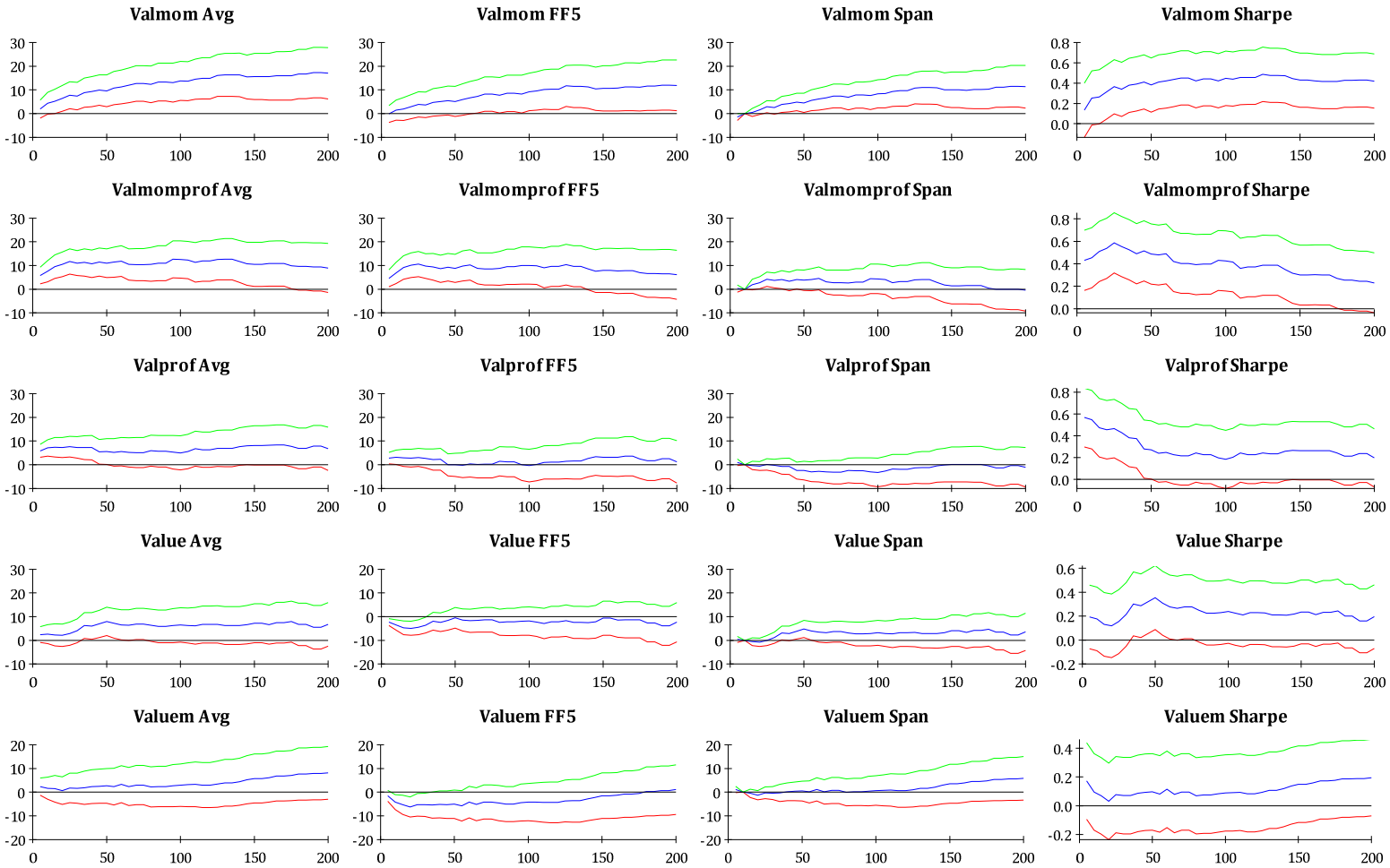

Figure A13. *Continued.* Number of anomaly portfolios and long-short performance: Kozak's (2020) 49 anomalies.

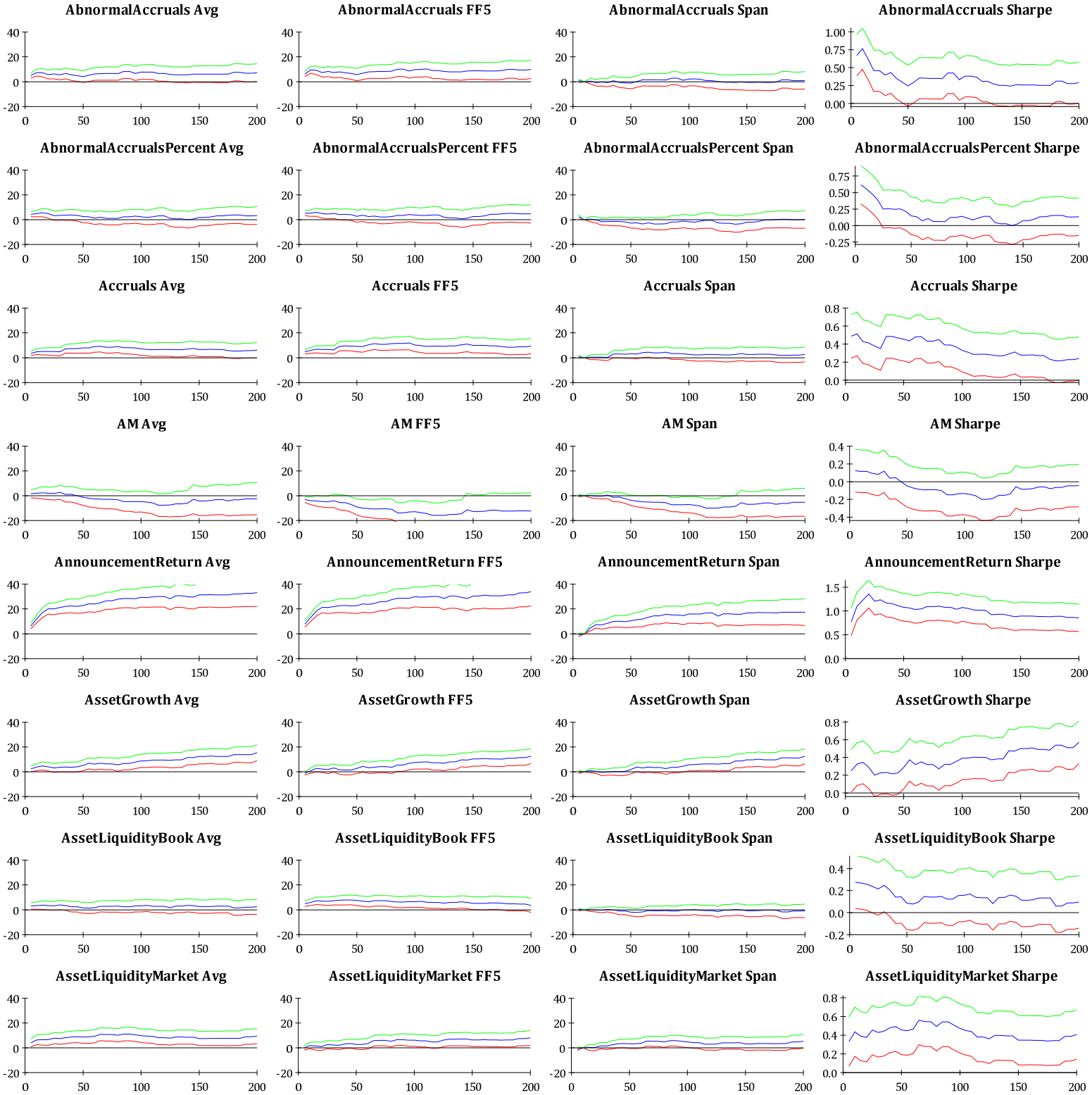

Figure A14. Number of anomaly portfolios and long-short performance: Chen–Zimmermann (2022) 128 anomalies. The figure shows the average return (first column), Fama–French (2018) five-factor alpha (second), decile-portfolio long-short spanning alpha (third), and Sharpe ratio (last) of each long-short portfolio based on Chen and Zimmermann's (2022) 128 anomaly characteristics as functions of n=5,10,⋯,200, the number of portfolios—for example, a long-short portfolio formed on five (200) portfolios is on the left (right) of each panel. Each row corresponds to each anomaly. Blue, green, and red are the statistics and their two standard error bands. Shaded are conventional one-year momentum (Mom12m). Average returns, alphas, and Sharpe ratios are annualized. The data are based on Professors Andrew Y. Chen and Tom Zimmermann's website (https://www.openassetpricing.com/data) and CRSP and span July 1926 to December 2020 (at most). From the 315 anomalies of the original data, I exclude 187 anomalies that do not show enough cross-sectional variation (*i.e.*, the number of unique values less than the number of formed portfolios) or predictability (*i.e.*, a univariate Fama–MacBeth estimate whose absolute *t*-statistic is less than 2).

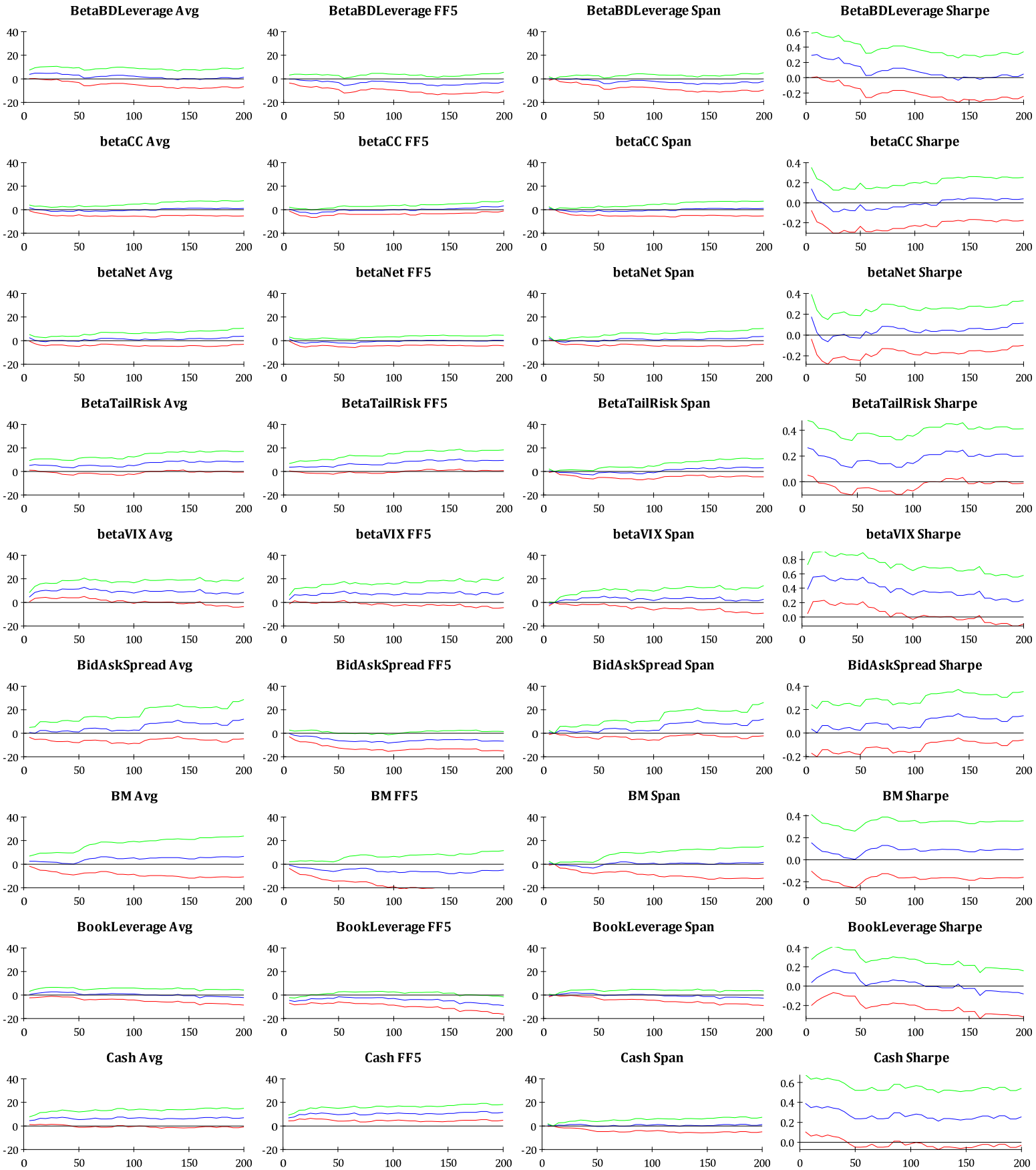

Figure A14. *Continued.* Number of anomaly portfolios and long-short performance: Chen–Zimmermann (2022) 128 anomalies.

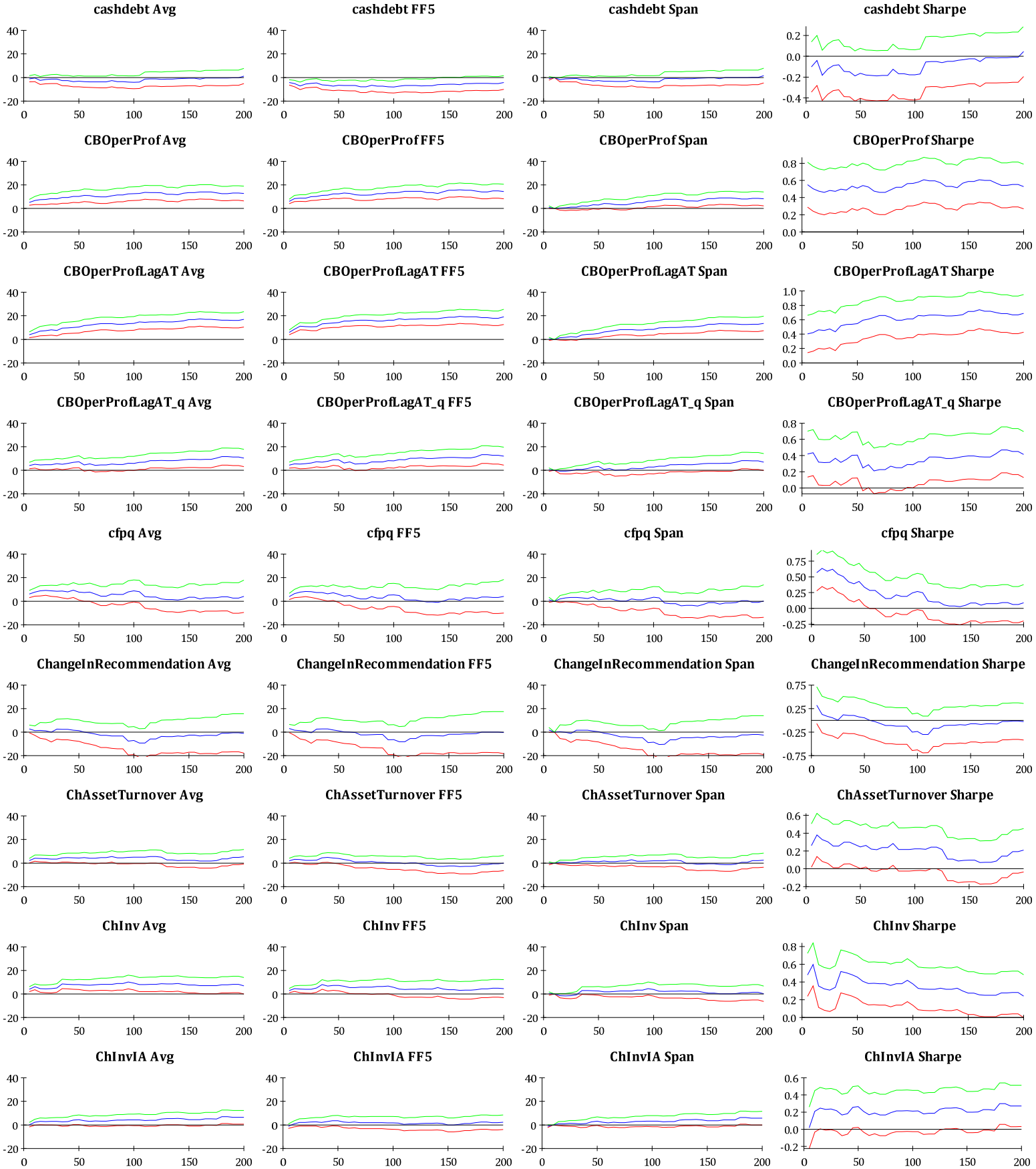

Figure A14. *Continued.* Number of anomaly portfolios and long-short performance: Chen–Zimmermann (2022) 128 anomalies.

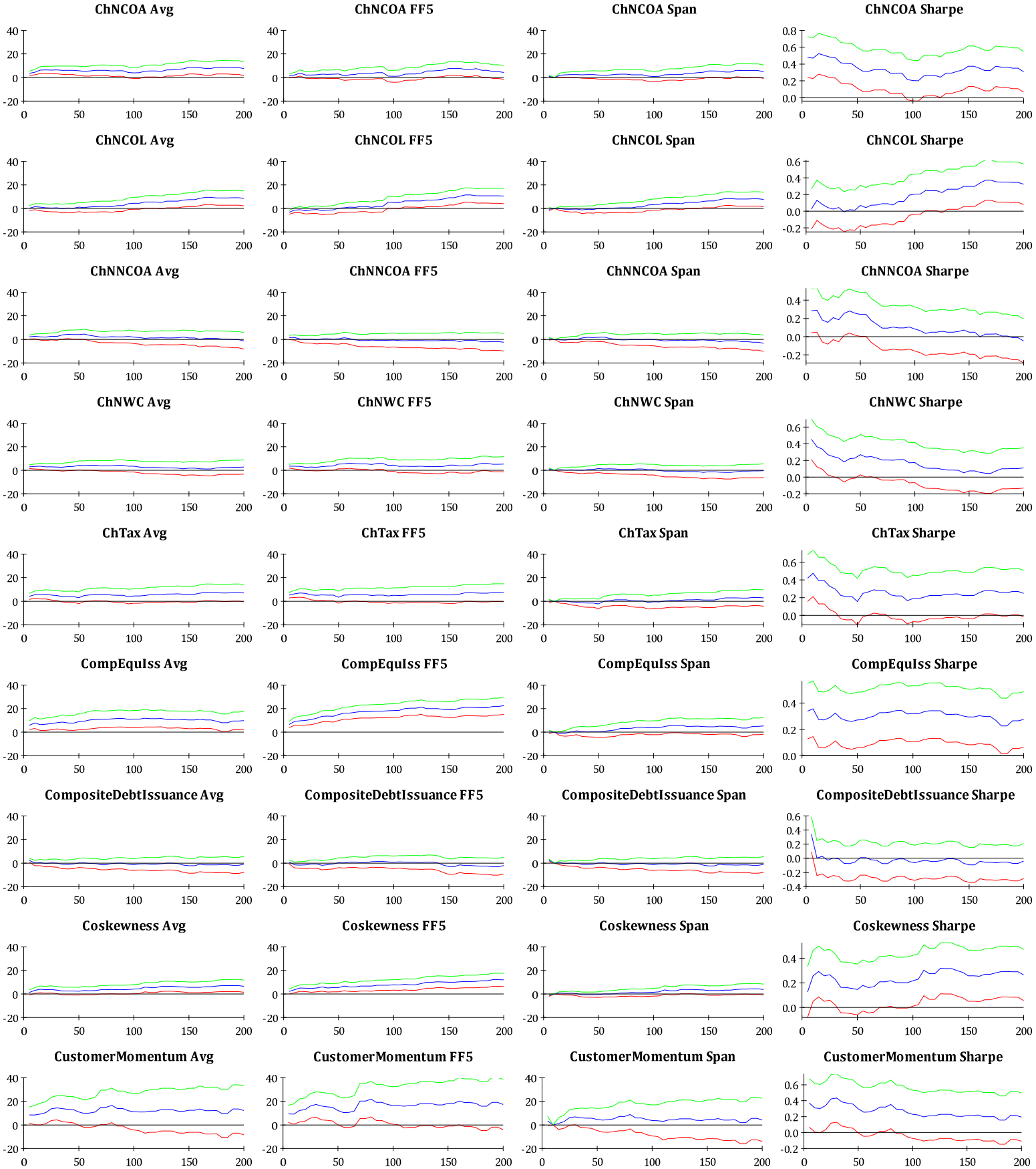

Figure A14. *Continued.* Number of anomaly portfolios and long-short performance: Chen–Zimmermann (2022) 128 anomalies.

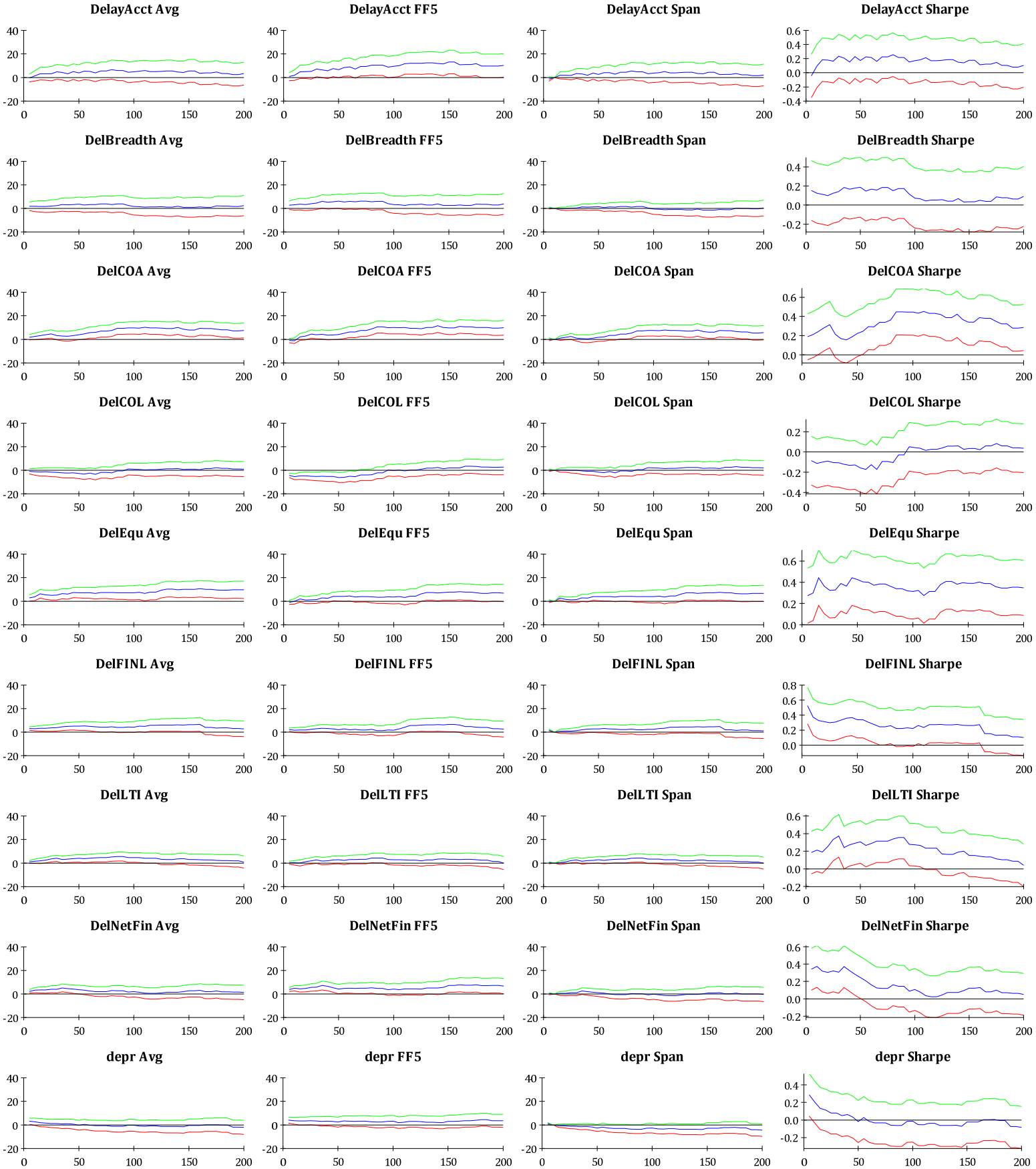

Figure A14. *Continued.* Number of anomaly portfolios and long-short performance: Chen–Zimmermann (2022) 128 anomalies.

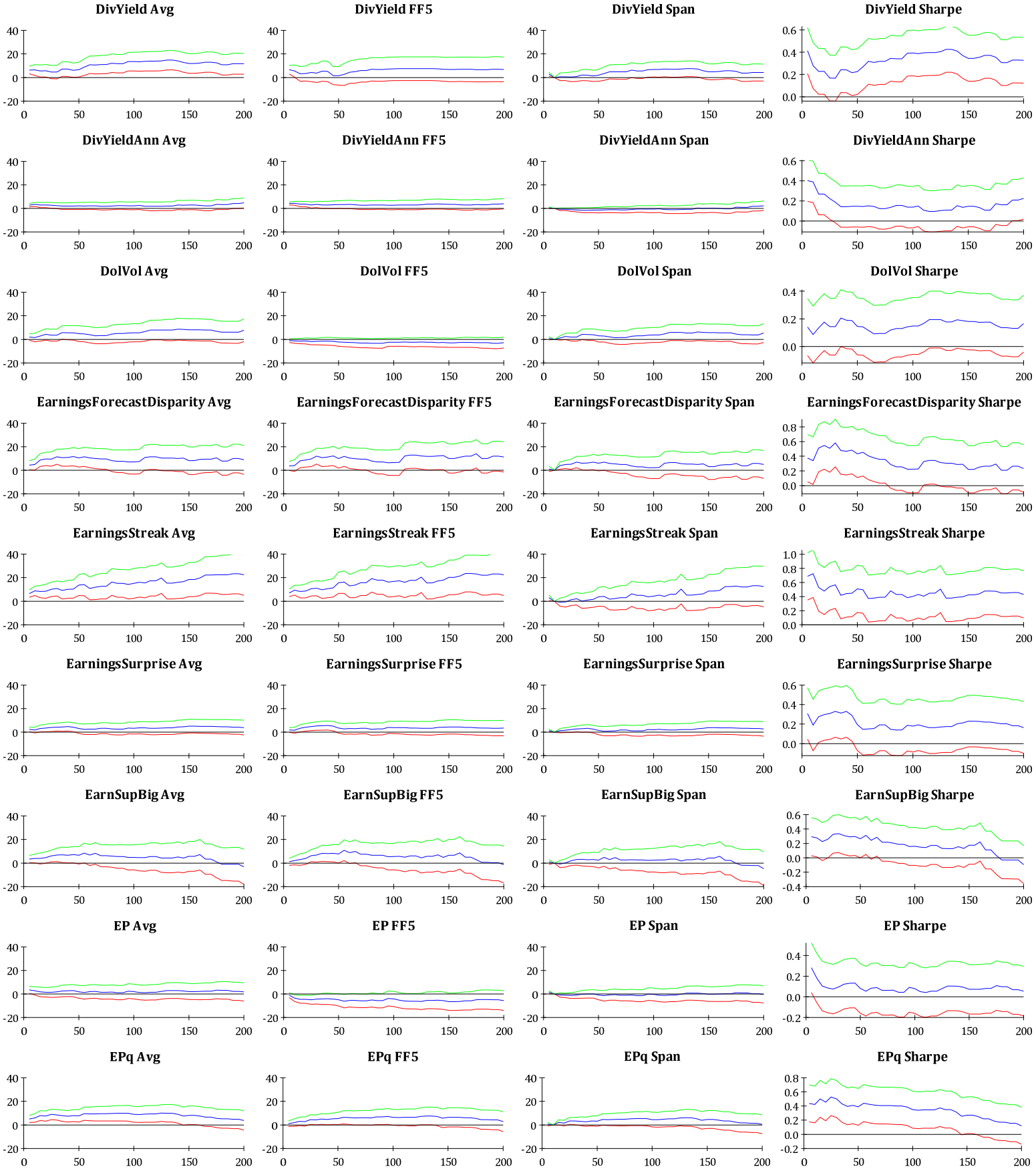

Figure A14. *Continued.* Number of anomaly portfolios and long-short performance: Chen–Zimmermann (2022) 128 anomalies.

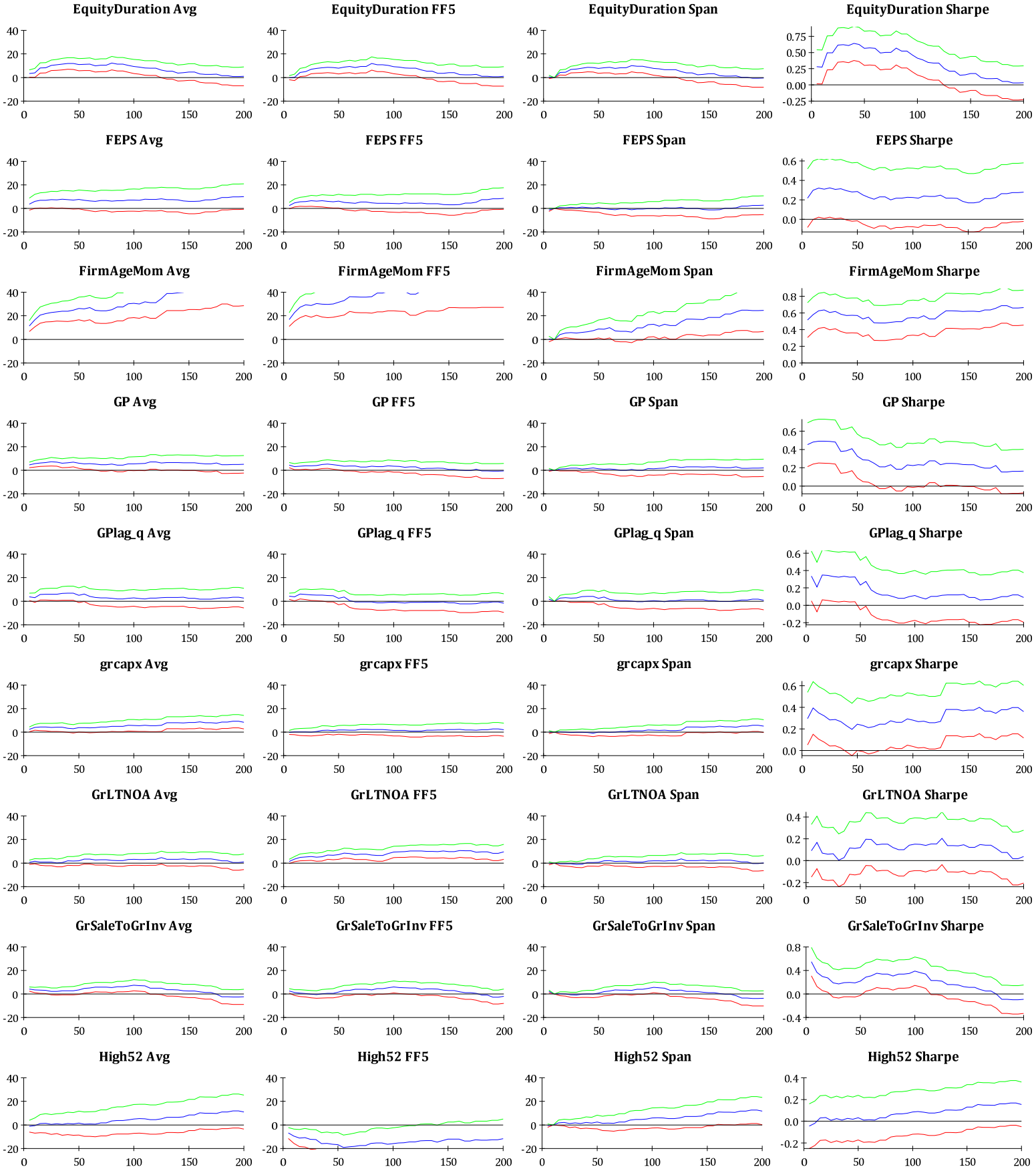

Figure A14. *Continued.* Number of anomaly portfolios and long-short performance: Chen–Zimmermann (2022) 128 anomalies.

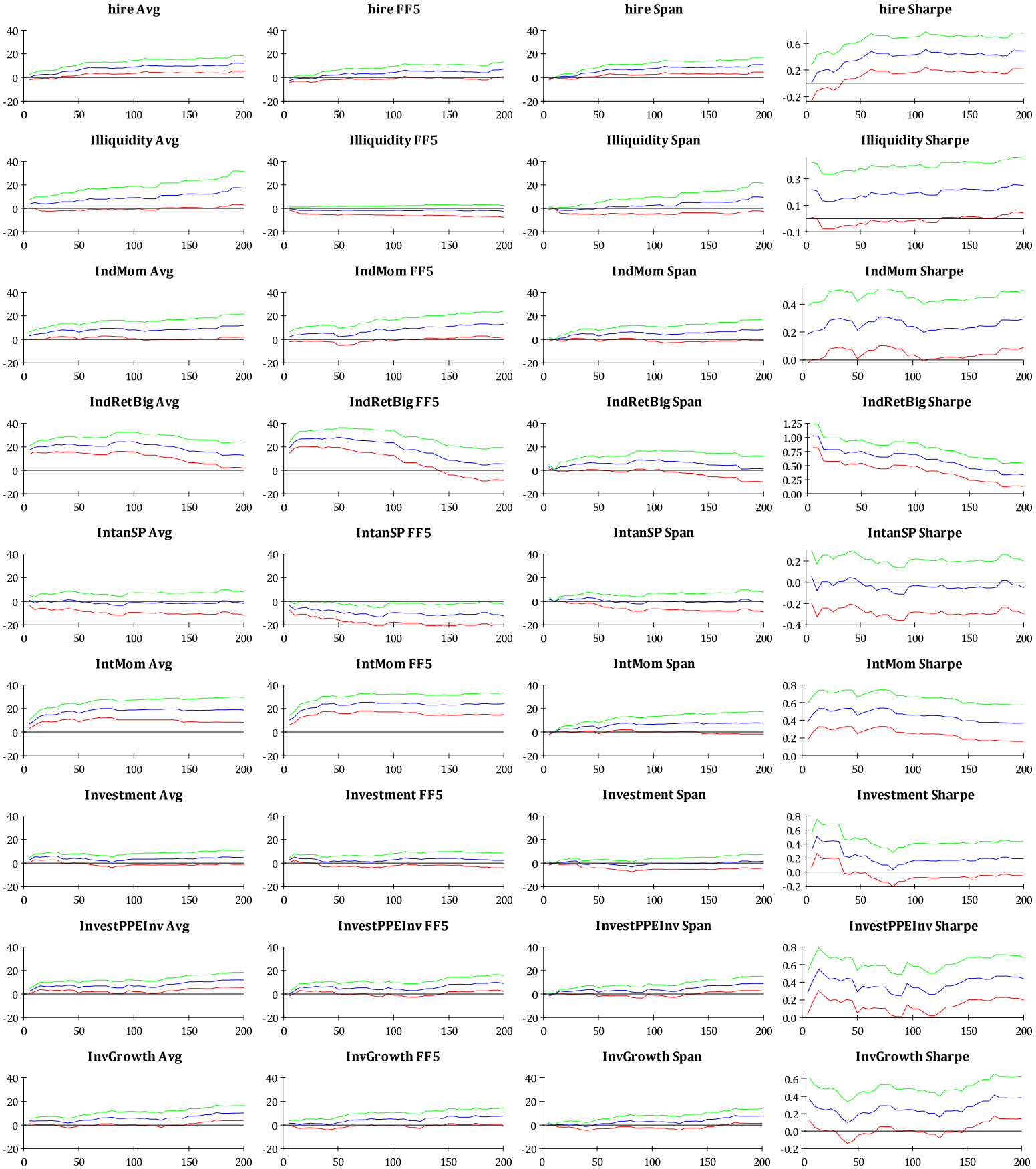

Figure A14. *Continued.* Number of anomaly portfolios and long-short performance: Chen–Zimmermann (2022) 128 anomalies.

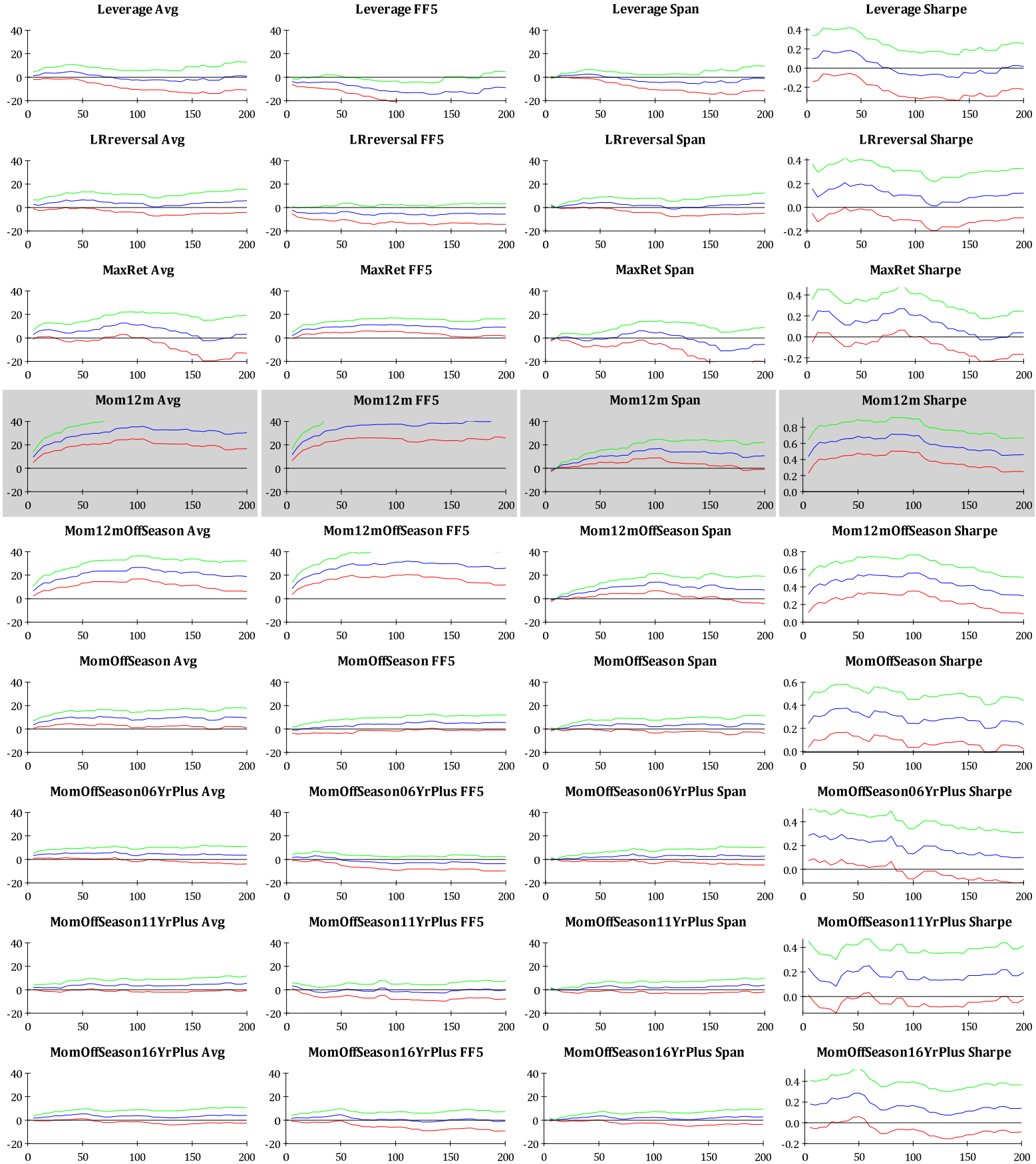

Figure A14. *Continued.* Number of anomaly portfolios and long-short performance: Chen–Zimmermann (2022) 128 anomalies.

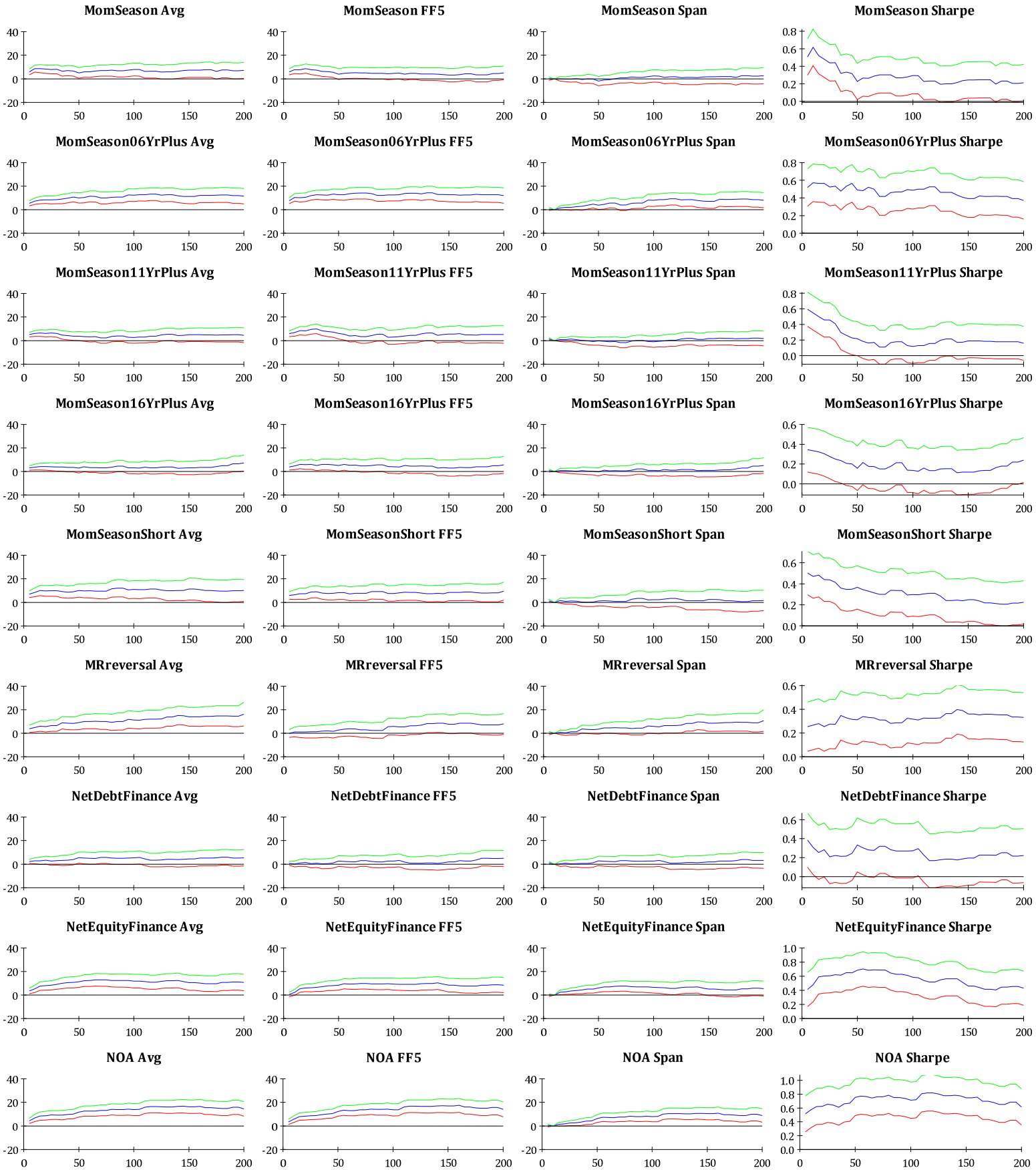

Figure A14. *Continued.* Number of anomaly portfolios and long-short performance: Chen–Zimmermann (2022) 128 anomalies.

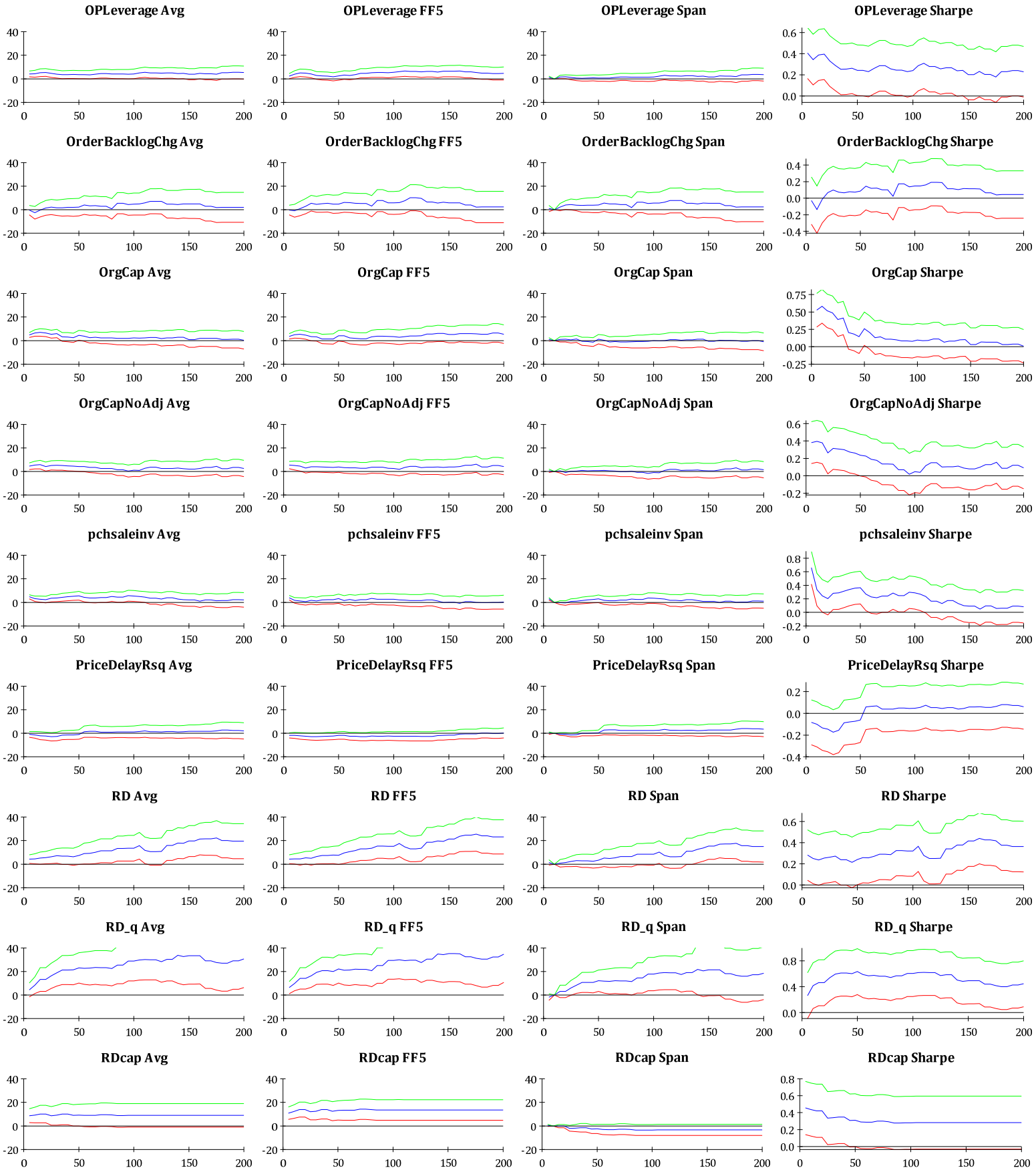

Figure A14. *Continued.* Number of anomaly portfolios and long-short performance: Chen–Zimmermann (2022) 128 anomalies.

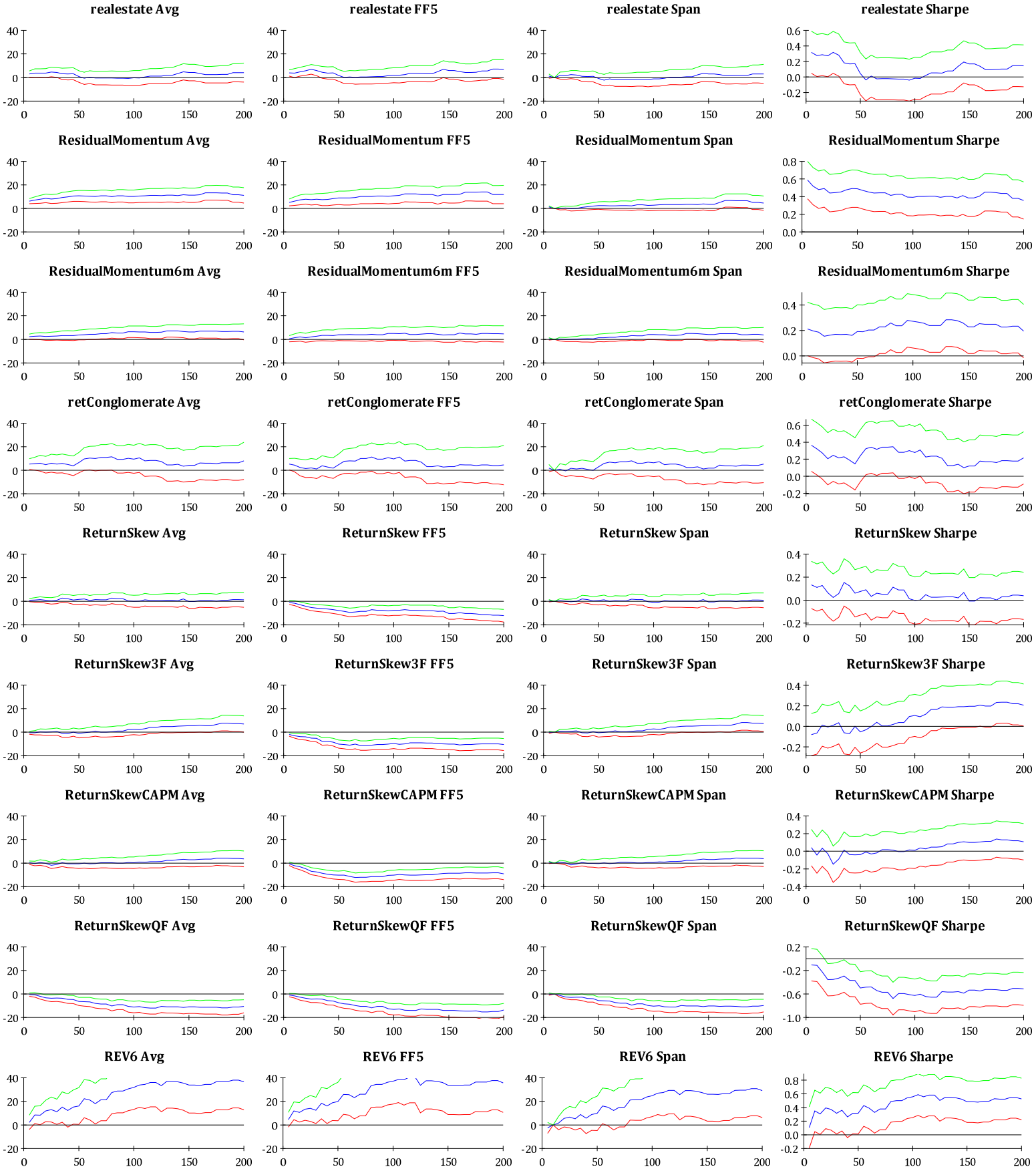

Figure A14. *Continued.* Number of anomaly portfolios and long-short performance: Chen–Zimmermann (2022) 128 anomalies.

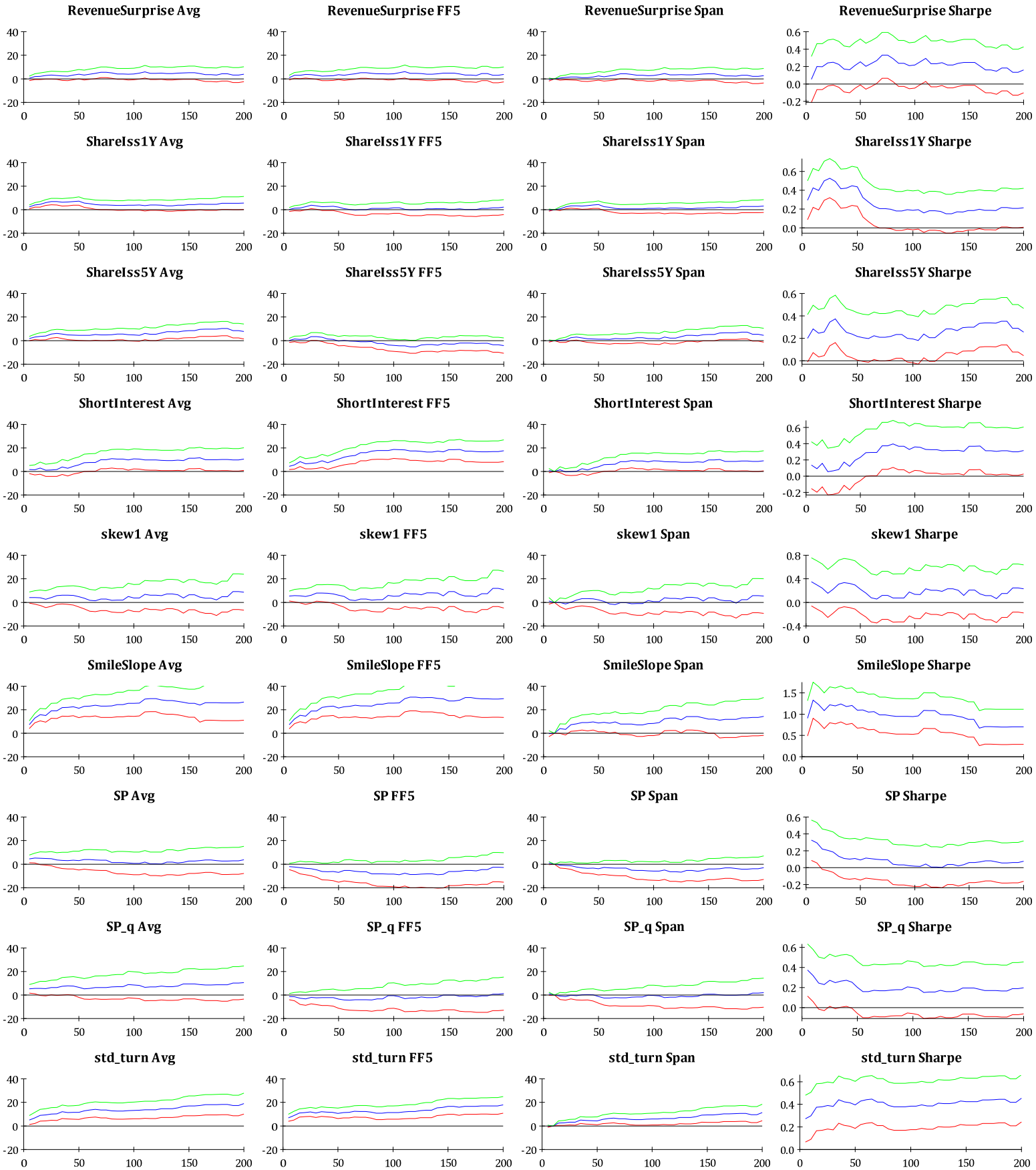

Figure A14. *Continued.* Number of anomaly portfolios and long-short performance: Chen–Zimmermann (2022) 128 anomalies.

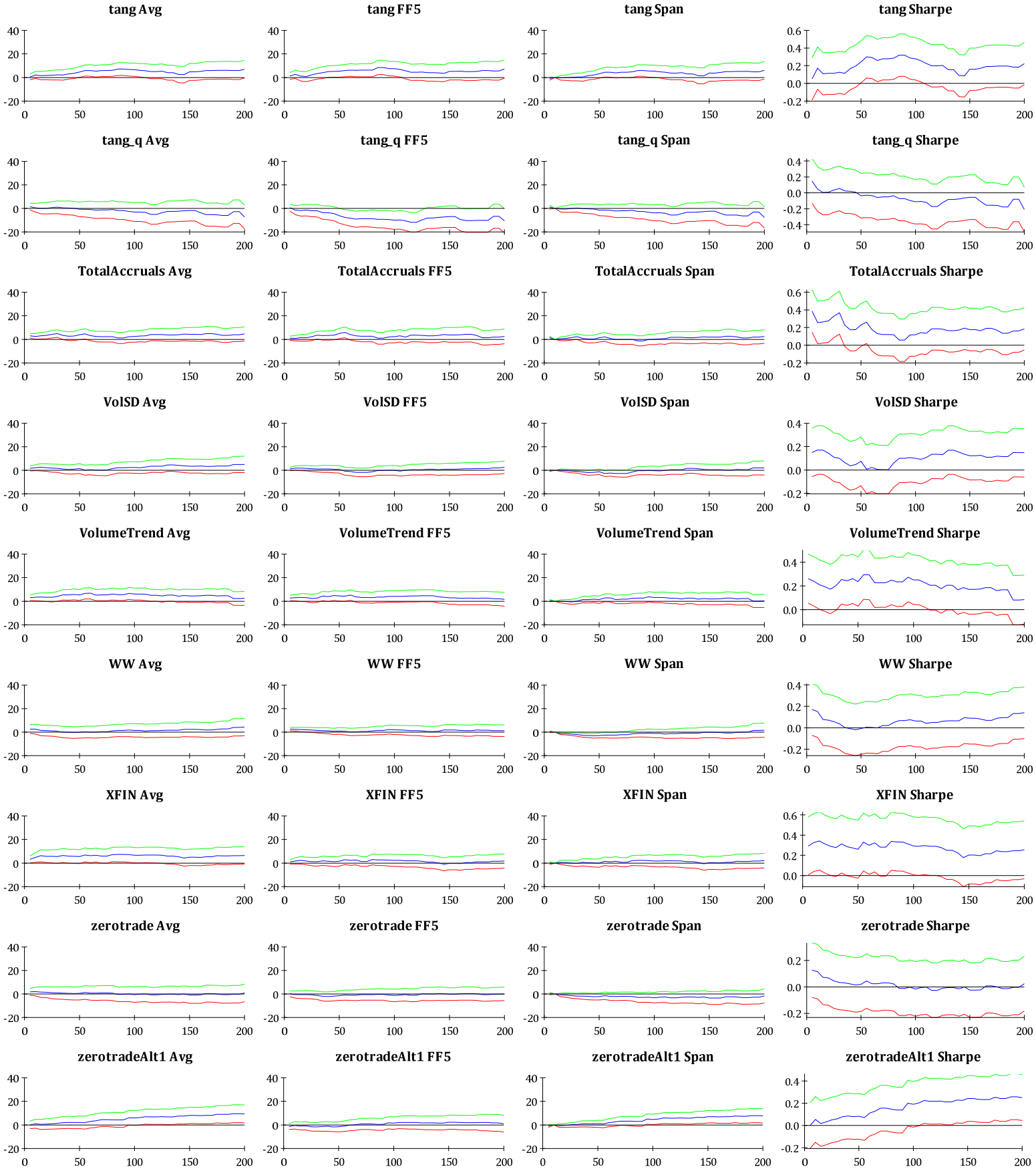

Figure A14. *Continued.* Number of anomaly portfolios and long-short performance: Chen–Zimmermann (2022) 128 anomalies.

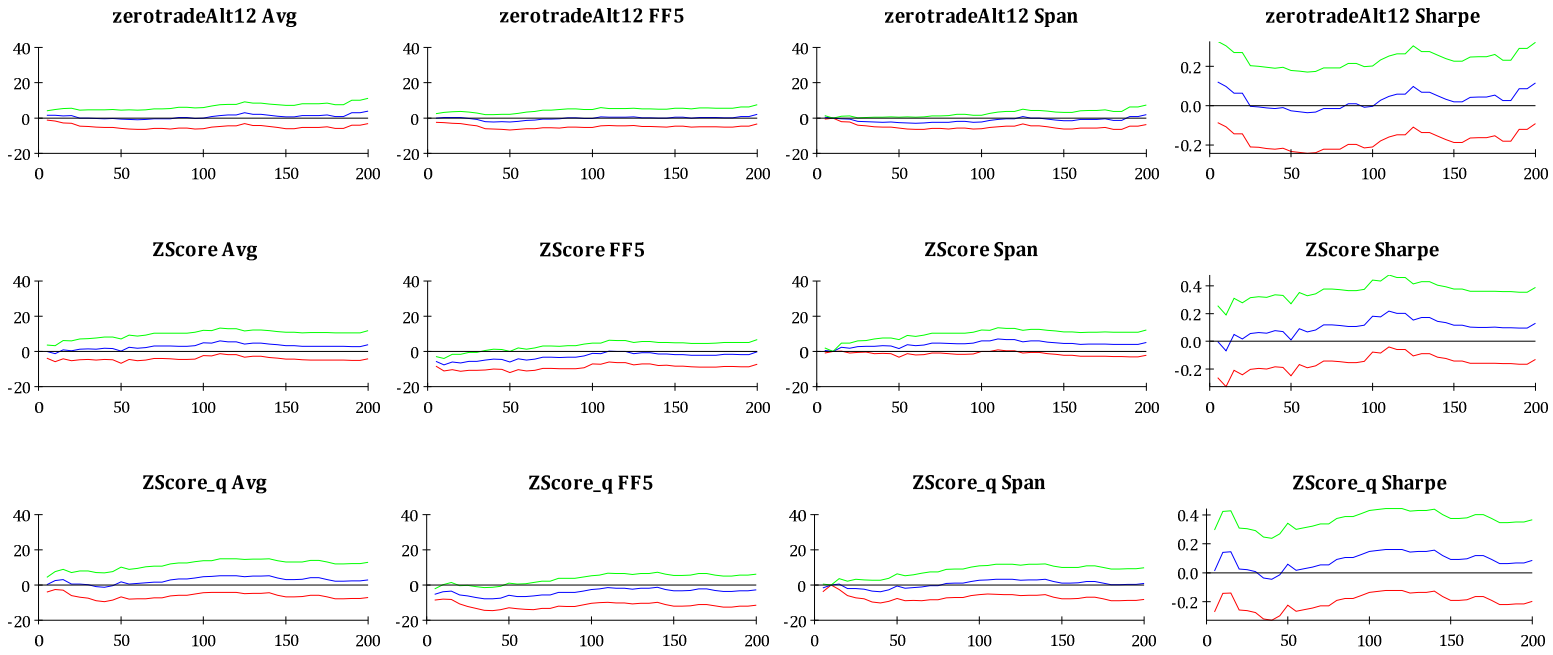

Figure A14. *Continued.* Number of anomaly portfolios and long-short performance: Chen–Zimmermann (2022) 128 anomalies.

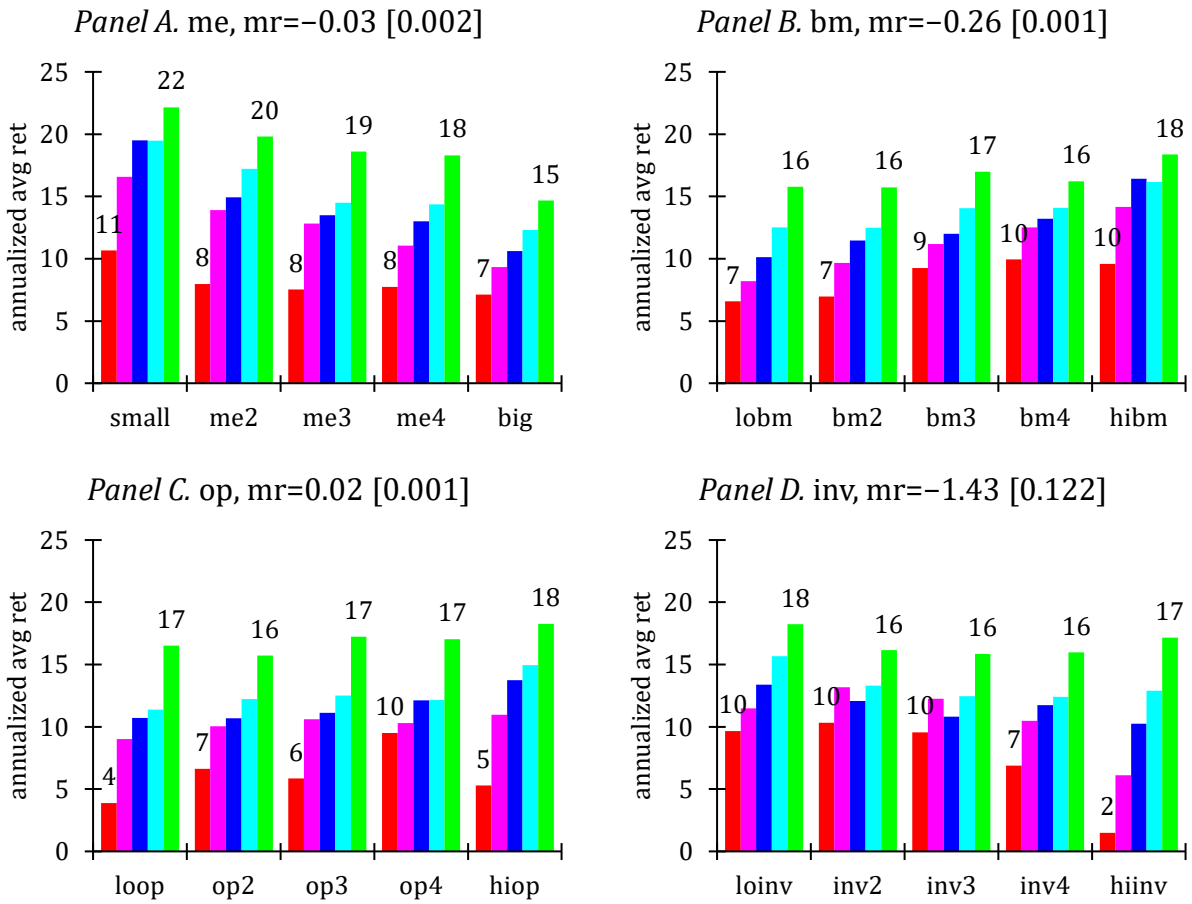

Figure A15. Average returns and monotonicity-relation statistics of two-way momentum portfolios. The figure shows the annualized monthly average returns of 5×5 portfolios formed on size/momentum (Panel A), book-to-market/momentum (Panel B), operating profitability/momentum (Panel C), and investment/momentum (Panel D), respectively, and their Patton–Timmermann (2010) monotonicity test results. Red (left), magenta, blue, cyan, and green (right) bars are the most loser, three intermediate, and the most winner portfolio, respectively. Average returns and monotonicity-relation (MR) statistics are annualized. Bootstrap *p*-values are in brackets. The data are from Professor Kenneth R. French's website (Panel A) or based on CRSP (Panels B, C, and D). The data of Panels A, B, C, and D start in January 1927, January 1927, July 1951, and July 1952, respectively, and end in December 2019.

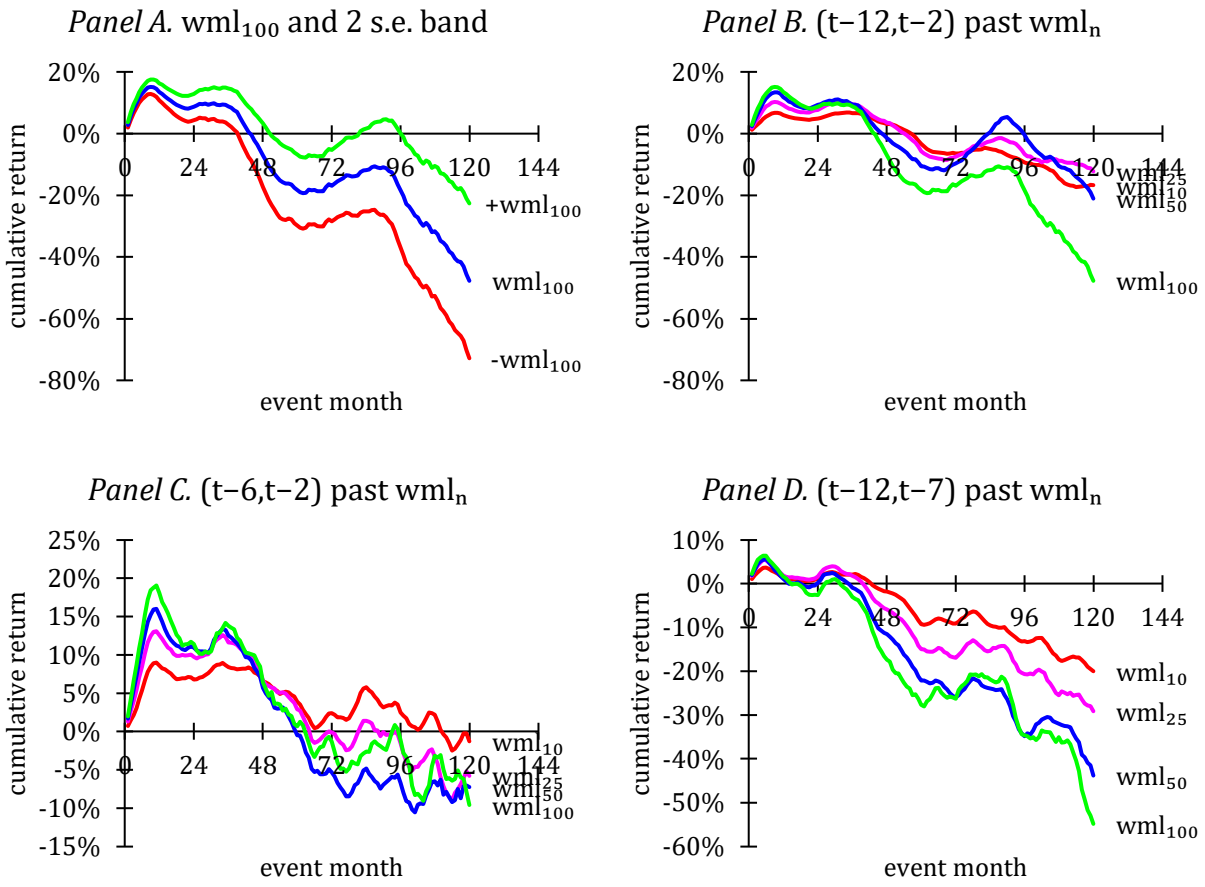

Figure A16. Postholding period winner-minus-loser performance.
The figure shows cumulative WML performance over 10 years after formation (Jegadeesh and Titman, 2001). Panel A shows WML_{100}'s performance (blue) and its two standard error bands (green and red). Panels B, C, and D shows the performance of WML_{10} (red), WML_{25} (magenta), WML_{50} (blue), and WML_{100} (green) based on full (t−12,t−2), recent (t−6,t−2), and intermediate horizon (t−12,t−7) past performance (Novy-Marx, 2012), respectively. Cumulative returns are not annualized. The data span January 1927 to December 2019.

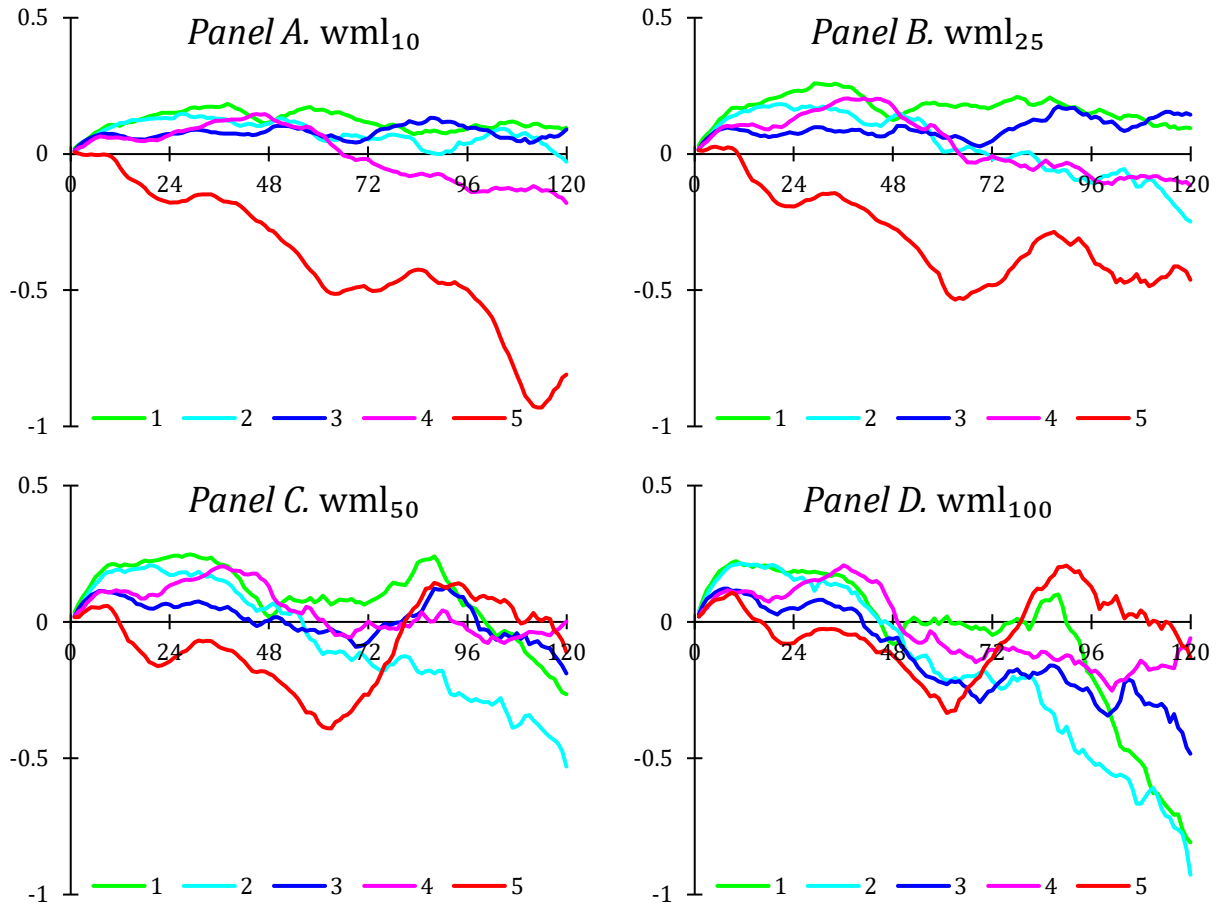

Figure A17. Postholding period winner-minus-loser performance by past momentum performance. The figure shows the cumulative performance of WML_{10} (Panel A), WML_{25} (Panel B), WML_{50} (Panel C), and WML_{100} (Panel D) over 10 years after formation by past momentum performance (PMP) quintiles (Ali, Daniel, and Hirshleifer, 2017), where PMP in month t is WML_{10}'s average monthly return from t−24 to t−1. The monthly PMPs from December 1928 to December 2019 are ranked to quintiles, so the data span December 1928 to December 2019. Green, cyan, blue, magenta, and red are from the first to the last PMP quintile, respectively. Cumulative returns are not annualized.

Panel A. Full (t−12,t−2) past performance winner-minus-loser

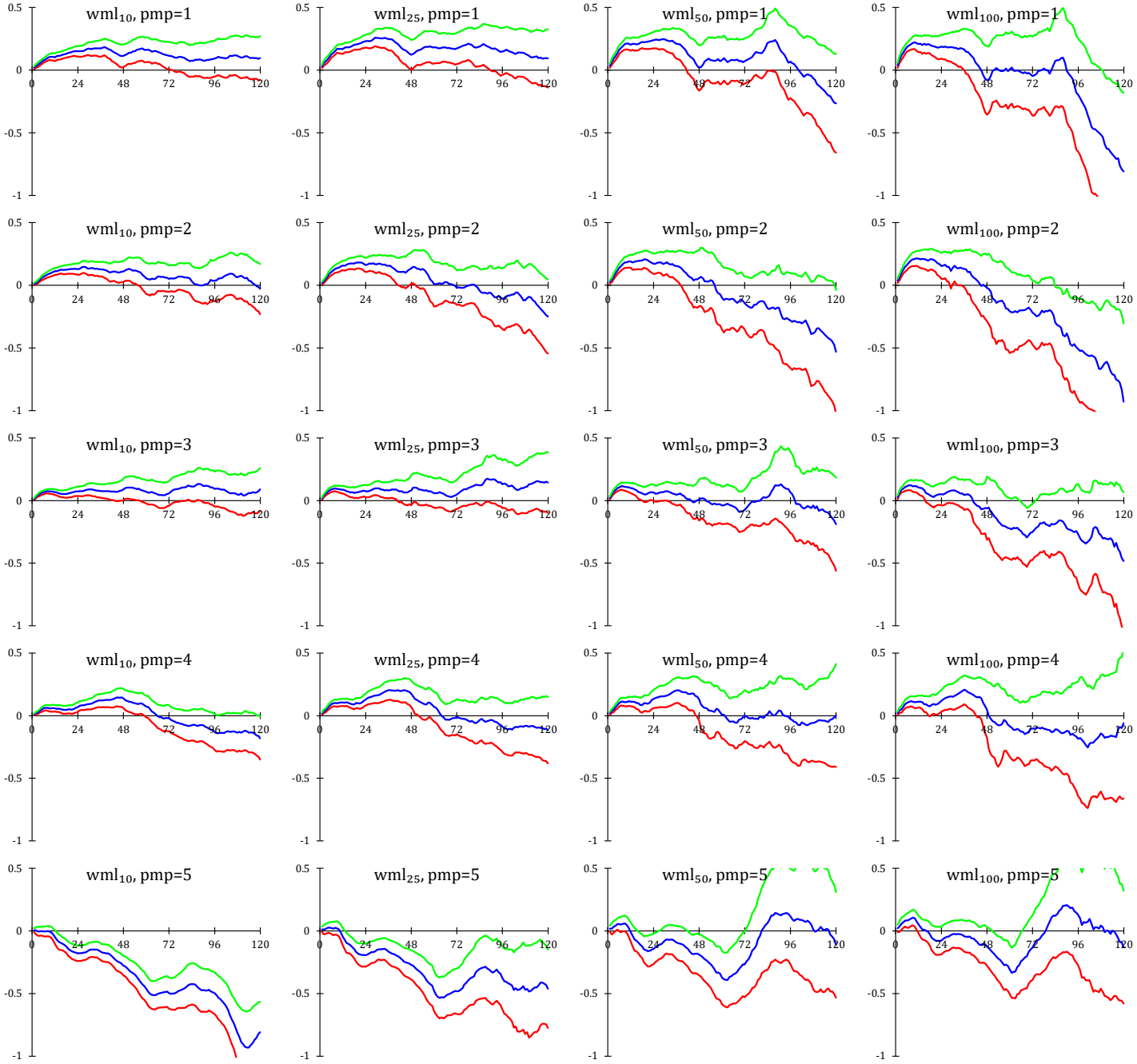

Figure A18. Postholding period winner-minus-loser performance by past momentum performance.
The figure shows the cumulative performance of WML_{10} (first column), WML_{25} (second), WML_{50} (third), and WML_{100} (last) over 10 years after formation by past momentum performance (PMP) quintiles (Ali, Daniel, and Hirshleifer, 2017), where PMP in month t is WML_{10}'s average monthly return from t−24 to t−1. The monthly PMPs from December 1928 to December 2019 are ranked to quintiles, so the data span December 1928 to December 2019. The first, second, third, fourth, and last rows are from the first to the last PMP quintile, respectively. Blue, green, and red are the statistics and their two standard error bands. Cumulative returns are not annualized. Panels A, B, and C use the (t−12,t−2), (t−6,t−2), and (t−12,t−7) horizons, respectively.

Panel B. Recent (t−6,t−2) past performance winner-minus-loser

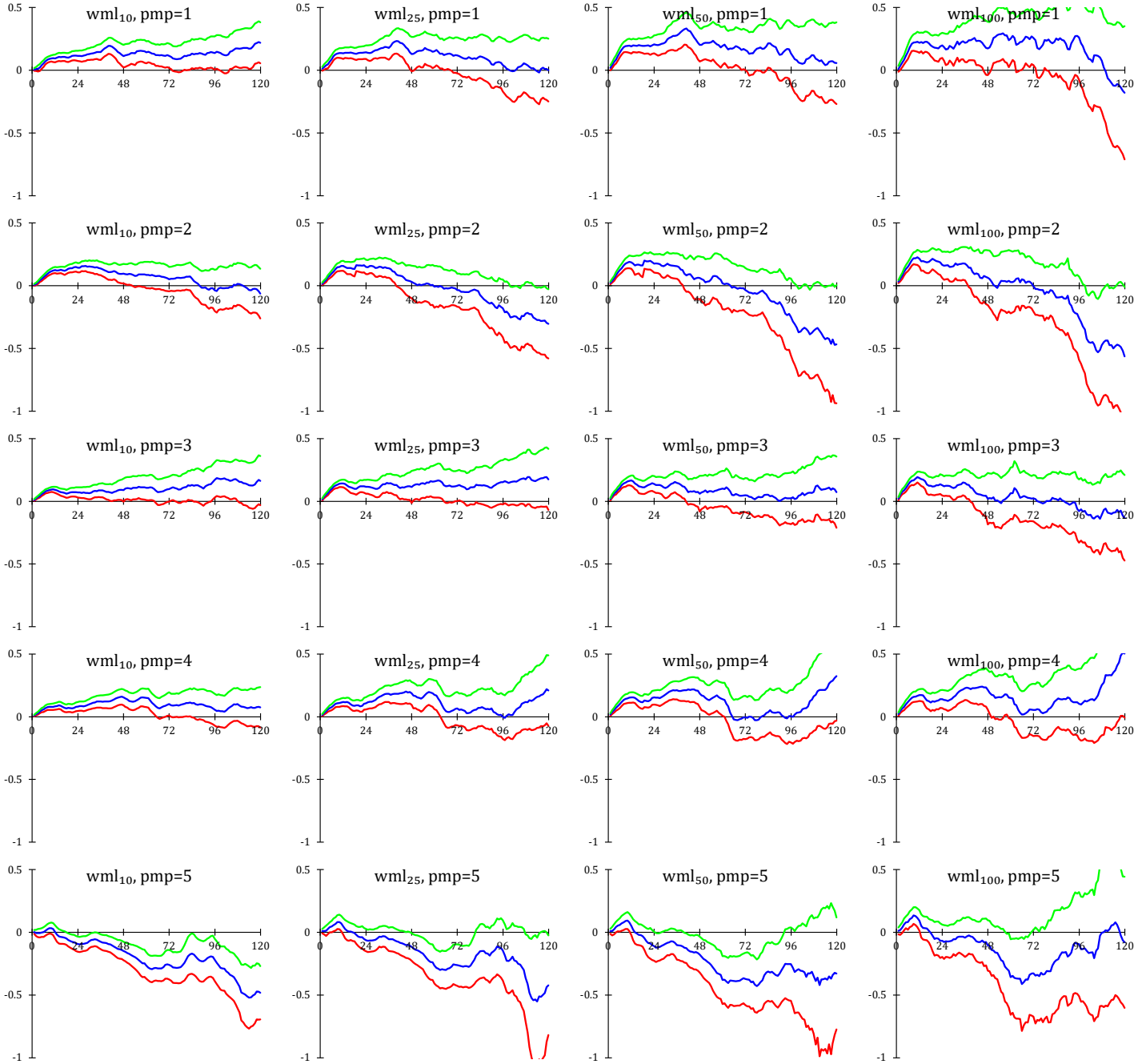

Figure A18. *Continued.* Postholding period winner-minus-loser performance by past momentum performance.

Panel C. Intermediate horizon (t−12,t−7) past performance winner-minus-loser

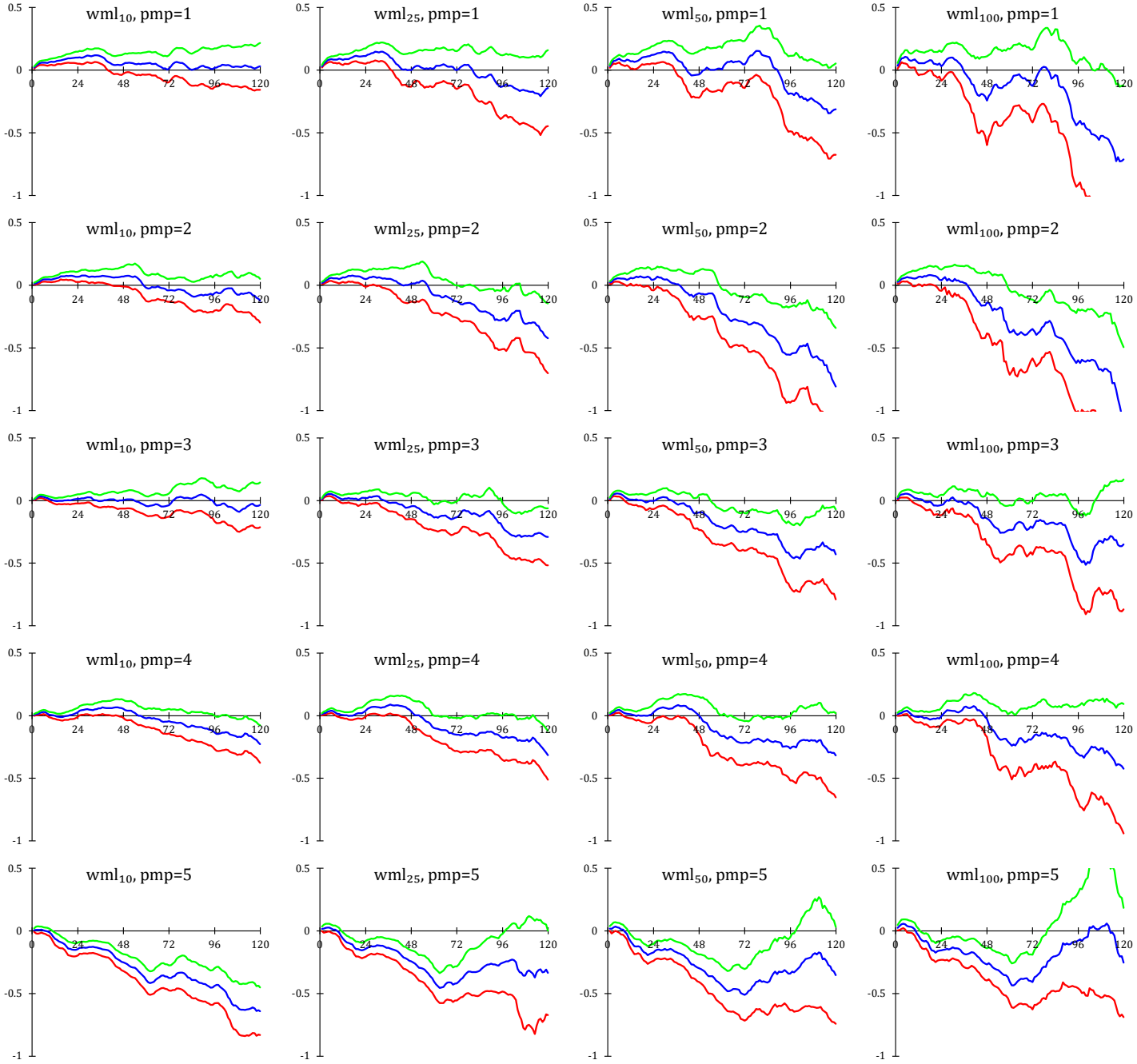

Figure A18. *Continued.* Postholding period winner-minus-loser performance by past momentum performance.