Internet Appendix

Option Factor Momentum

(Not for publication)

Overview

- **Internet Appendix A** provides summary statistics of individual delta-hedged call option returns.
- **Internet Appendix B** provides a detailed list of option characteristics with their respective construction.
- **Internet Appendix C** provides details on the empirical implementation of analyses in the paper.
  - Internet Appendix C.1 provides details on the factor momentum decompositions.
  - Internet Appendix C.2 provides details on constructing principal component momentum strategies.
- **Internet Appendix D** provides details on alternative option return definitions and robustness tables on option factor momentum.
  - Internet Appendix D.1 shows results when we account for interest compounding in the computation of the profit/loss of delta-hedging the option position.
  - Internet Appendix D.2 shows results when using the minimum variance delta following Hull and White (2017) instead of the Black-Scholes (1973) delta.
  - Internet Appendix D.3 shows results using option returns where the delta-hedge is performed only at position initiation instead of daily rebalancing of the hedge position.
- **Internet Appendix E** comprises details, such as tables and figures, on additional analyses and robustness checks in the paper.
  - Internet Appendix E.1 provides subsample analyses for factor momentum strategies.
  - Internet Appendix E.2 depicts rolling means of individual option factor returns.
  - Internet Appendix E.3 presents results for alternative momentum strategies following Gupta and Kelly (2019).
  - Internet Appendix E.4 replicates the main findings with put instead of call options.
  - Internet Appendix E.5 reports the main results when using the underlying's market capitalization value-weights in the factors' construction.
  - Internet Appendix E.6 reports the main results when disregarding illiquid options based on the relative bid-ask spread.

Internet Appendix A Summary Statistics of Individual Delta-Hedged Option Returns

Table A.1: Summary Statistics of Individual Options

This table reports summary statistics of our final sample of monthly call option data used to construct option factors. The sample period is from February 1996 to December 2021. Daily delta-hedged option returns are the monthly returns of a delta-hedged call position that is adjusted daily to be immune to changes in the underlying. Details are outlined in Section II.A. Dollar-open interest is the call contract's open interest times the option's mid price at the beginning of the month. Delta is the option's delta as provided by OptionMetrics. Moneyness is the ratio of the option's strike price (K) to the underlying stock price (S). Time to maturity is the days until the option's expiration. Market capitalization is the market value of the underlying stock's outstanding shares at the beginning of the month.

Variable	Mean	SD	10^{th} pct.	Median	90^{th} pct.
Option return (daily delta-hedged, in %)	-0.12	5.59	-4.61	-0.56	4.51
Dollar open interest	1799.01	9165.33	8.75	154.38	3296
Delta	0.54	0.12	0.39	0.54	0.68
Moneyness (K/S)	1	0.05	0.94	1	1.06
Time to maturity (in days)	49.7	2.07	46	50	52
Market cap.	9.42	38.07	0.33	1.84	17.66

Internet Appendix B List of Option Factor Characteristics

1. Systematic volatility (SYSVOL): The systematic volatility of the underlying stock's returns. Following Aretz et al. (2023), it is estimated as the square root of the annualized variance of the fitted value from a time-series regression of the stock's return on the Fama and French (2016) six-factor model over the past 24 months.
2. Option illiquidity (OPTSPREAD): Option illiquidity is measured as the proportional option bid-ask spread following Christoffersen et al. (2018).
3. Embedded leverage (EMBEDLEV): The embedded leverage of the option contract following Frazzini and Pedersen (2022) which has been also used in Buechner and Kelly (2022) for an option factor model for S&P 500 index options.
4. Delta-hedging costs (HC): Delta hedging costs are calculated according to Tian and Wu (2023). Specifically, delta-hedging costs, $hc_{t,i}$, at time$-t$ on stock i are given as

$$hc_{i,t} = \sigma_{t,i}\sqrt{(1-\rho_{t,i}^2)/DV_{t,i}},$$

   where $\sigma_{t,i}$ denotes the stock's historical return volatility estimator, $\rho_{t,i}$ the return correlation of the stock with the aggregate market portfolio, and $DV_{t,i}$ denotes the average dollar trading volume (in thousands) on the stock.
5. Volatility risk (VR): Volatility risk is calculated according to Tian and Wu (2023). It is the standard deviation of daily changes of the stock i's one-month at-the-money option implied volatility over the past month t.
6. Historical jump risk (JR): (Historical) jump risk follows Tian and Wu (2023) in its construction. It is the product of the stock's excess kurtosis and historical return volatility over the past month.
7. Volatility of implied volatility (VOV): Volatility of implied volatility is calculated following Ruan (2020) as the standard deviation of 30-day at-the-money volatility scaled by the mean of 30-day at-the-money volatility over the previous month.
8. Historical stock volatility (HVOL): The historical volatility of stock returns measured over the past month using daily data as in Hu and Jacobs (2020).
9. The term structure of implied at-the-money volatility (IVTERM): The difference between short and long term at-the-money implied volatility following Vasquez (2017). Following the implementation by Goyal and Saretto (2022), we take the difference between 365 and 30 days to expiration at-the-money implied volatility from the implied volatility surface of OptionMetrics. At-the-money implied volatility is the average of the put and call implied volatility with an absolute delta of 0.5.

10. Stock return autocorrelation (AC): The autocorrelation of daily returns over the last six months requiring at least 100 observations (Jeon et al., 2024).
11. Average of the ten highest past returns (MAX10): As in Byun and Kim (2016), the average of the ten highest daily returns over the last three months following Bali, Cakici, and Whitelaw (2011).
12. Default risk (DEFRISK): Following Vasquez and Xiao (2024), we calculate the default probability of the underlying stock as in Bharath and Shumway (2008).
13. Idiosyncratic skewness (ISKEW): The third moment of the residuals from regressing the stock returns on the market return and its square following Byun and Kim (2016).
14. Total skewness (TSKEW): The third moment of daily stock returns following Byun and Kim (2016).
15. Idiosyncratic volatility (IVOL): The idiosyncratic volatility of the underlying with respect to the Fama and French (1993) three-factor model over the past month as in Cao and Han (2013). The construction follows Goyal and Saretto (2022).
16. Implied volatility minus realized volatility (IVRV): The difference between implied and realized volatility as in Goyal and Saretto (2009).
17. Stock illiquidity (AMIHUD): Following and Zhan et al. (2022) and Kanne et al. (2023), we include the Amihud (2002) illiquidity measure over the past month.
18. Short interest (RSI): The ratio between short interest (taken from Compustat's Supplemental Short Interest File, *shortintadj*) and the total shares outstanding (Ramachandran & Tayal, 2021).
19. One-year new stock issues (ISSUE_1Y): Following Zhan et al. (2022), we include the one-year change in the log of the number of shares outstanding (Pontiff & Woodgate, 2008). The data is taken from Jensen, Kelly, and Pedersen (2023).
20. Five-year new stock issues (ISSUE_5Y): Following Zhan et al. (2022), we calculate the five-year change in the log of the number of shares outstanding (Daniel & Titman, 2006).
21. Altman Z-score (ZSCORE): Following Zhan et al. (2022), we include the Altman Z-score (Dichev, 1998). The data is taken from Jensen et al. (2023).
22. Analyst dispersion (DISP): Following Zhan et al. (2022), we include analyst earnings forecast dispersion computed as the standard deviation of analysts' annual earnings-per-share forecasts over the absolute value of the average forecast (Diether, Malloy, & Scherbina, 2002). The data is constructed using the replication code by Green, Hand, and Zhang (2017).[1]
23. Cash-to-assets ratio (CASH_AT): Following Zhan et al. (2022), we include the corpo-

[1] `https://sites.google.com/site/jeremiahrgreenacctg/home`.

rate cash holdings over total assets (Palazzo, 2012). The data is taken from Jensen et al. (2023).

24. Cash flow volatility (OCFQ_SALEQ_STD): Following Zhan et al. (2022), we include the standard deviation of quarterly reported operating cash flows over quarterly sales (Huang, 2009). The data is taken from Jensen et al. (2023).
25. Operating profits-to-book equity (OPE_BE): The operating profits-to-book equity ratio as in Fama and French (2015). The data is taken from Jensen et al. (2023).
26. Profit margin (EBIT_SALE): Following Zhan et al. (2022), we include the profit margin defined as EBIT over total sales (Soliman, 2008). The data is taken from Jensen et al. (2023).
27. Net total issuance (NETIS_AT): Net total issuance defined as total share and debt issuance minus cash dividend payments as in Bradshaw, Richardson, and Sloan (2006). The data is taken from Jensen et al. (2023).
28. Stock price (LOG_PRICE): Following Zhan et al. (2022) and Boulatov et al. (2022), we take the log of the underlying stock's close price. The data is taken from CRSP.

Internet Appendix C Technical Details on Empirical Implementations

C.1 Factor Momentum Decompositions

We follow Arnott et al. (2023) in empirically implementing the factor return decompositions outlined in Section IV.A:

1. To compute the autocovariance matrix of factor returns Ω from our full sample of factor returns and computing the terms $\mathrm{Var}[\mu^F]$ and $\frac{\mu^{F\prime}\mu^F}{N}$ by subtracting the other decomposition terms (namely the ones capturing autocorrelation and cross-serial correlation in returns) from the total strategy returns in equations (5) and (7).
2. To estimate standard errors for the decomposition terms, we bootstrap our factor returns and respective formation period by month. We apply block bootstrapping with blocks of length 4 to mimic the autocorrelation-robust Newey-West standard errors. In total, we resample factor returns 2,000 times.
3. To make strategies across different formation periods comparable, we scale the decomposition components and total strategy returns so that the strategy's annualized volatility is 5% for each formation period. 5% is in the general vicinity of the annualized volatility exhibited by our baseline results in Section III.

C.2 Principal Component Momentum

We follow Ehsani and Linnainmaa (2022) in constructing out-of-sample momentum returns on principal components. To do so, we follow three steps for each month t:

1. We calculate eigenvectors from the correlation matrix of monthly factor returns up to month t-1. The first PCA takes 120 months of factor returns as input. The principal component returns up to month t are the product of eigenvectors and raw factor returns.
2. We demean and scale the principal components so that their standard deviation up to month t-1 equals the median factor standard deviation over the same time period.
3. Using the re-scaled and demeaned principal component returns, we construct both time-series and cross-sectional momentum strategies using our standard formation periods following equations (3) and (4). We store the profits of these strategies for month t.

Internet Appendix D Details on Alternative Option Return Definitions

D.1 Delta-Hedging With Compound Interest

We consider here an alternative version of computing delta-hedged call gains. Our alternative version accounts for compound interest in the bank account. Any interest paid during intermediate time steps affects the net cash balance and, thus, future interest gains or losses. As in the main text, we start with a self-financing portfolio consisting of a long call hedged by a position in the underlying. Consider the partition $\Pi = \{t = t_0 < \cdots < t_N = t + \tau\}$ of the interval from t to $t + \tau$. Assume that the long option position is hedged discretely N times at each date $t_n, n = 0, \ldots, N-1$. Contrary to equation (1), we allow for compounded interest in the net cash amount. The discrete delta-hedged call option gain over the period $[t, t+\tau]$ including compound interest, $\Pi^{\text{Compounding}}(t, t+\tau)$, is then given by

$$
\begin{aligned}
\Pi^{\text{Compounding}}(t, t+\tau) = {} & C_{t+\tau} - \Delta_{t_{N-1}} \times S_{t+\tau} \\
& - (C_t - \Delta_t \times S_t) \times \prod_{i=0}^{N-1} (1 + r_{t_i, t_{i+1}}) \\
& + \sum_{j=1}^{N-1} \left[\left(\Delta_{t_j} - \Delta_{t_{j-1}} \right) \times S_{t_j} \times \prod_{k=j}^{N-1} (1 + r_{t_k, t_{k+1}}) \right],
\end{aligned}
\tag{D1}
$$

where C_t denotes the price of the call option at time t, r_{t_i,t_j} is the risk-free rate at t_i with maturity t_j, Δ_t is the observed delta of the call as provided by OptionMetrics at time t and S_t is the price of the underlying at time t. The last two terms in equation (D1) include the interest rate compounding on the initial net cash balance and the changes in the net cash balance due to adjusting the delta-hedge. Table D.1 provides an overview how to derive $\Pi^{\text{Compounding}}(t, t+\tau)$ in equation (D1).

Equation (D1) is quite general because it encompasses two alternative hedging schemes: initial delta-hedging and no delta-hedging. In the case of the former, we have that $\Delta_{t_n} = \Delta_{t_0}, \forall n$. We set $\Delta_{t_n} = 0, \forall n$ in the latter's case.

Table D.2 provides baseline results of our analyses using the alternative return definition from equation (D1).

Table D.1: Daily Delta-Hedging With Compound Interest

This table details the derivation of the profit/loss of daily-delta hedging a call option position, equation (D1). C_t denotes the price of the call option at time t, r_{t_i,t_j} is the risk-free rate at t_i with maturity t_j, Δ_t is the observed delta of the call as provided by OptionMetrics at time t and S_t is the price of the underlying at time t.

Time	Action	Add/Withdraw From Net Cash Amount	Net Cash Amount at End of t_i
$t = t_0$	Buy call and sell Δ_{t_0} shares of underlying	$-C_{t_0} + \Delta_{t_0} \times S_{t_0}$	$-C_{t_0} + \Delta_{t_0} \times S_{t_0} =: I$
t_1	Re-adjust delta-hedge: buy Δ_{t_0} and sell Δ_{t_1} shares of underlying	$(\Delta_{t_1} - \Delta_{t_0}) \times S_{t_1} =: D_{t_1}$	$I \times (1 + r_{t_0,t_1}) + D_{t_1}$
t_2	Re-adjust delta-hedge	$(\Delta_{t_2} - \Delta_{t_1}) \times S_{t_2} =: D_{t_2}$	$[I \times (1 + r_{t_0,t_1}) + D_{t_1}] \times (1 + r_{t_1,t_2}) + D_{t_2}$
...	...	...	...
$t + \tau = t_N$	Sell call and buy $\Delta_{t_{N-1}}$ shares of underlying	$C_{t+\tau} - \Delta_{t_{N-1}} \times S_{t+\tau}$	$C_{t+\tau} - \Delta_{t_{N-1}} \times S_{t+\tau} + I \times \prod_{i=0}^{N-1}(1 + r_{t_i,t_{i+1}})$ $+\sum_{j=1}^{N-1}\left[(\Delta_{t_j} - \Delta_{t_{j-1}}) \times S_{t_j} \times \prod_{k=j}^{N-1}(1 + r_{t_k,t_{k+1}})\right]$

Table D.2: Option Factor Momentum - Returns With Compound Interest

This table follows Table 2, but delta-hedged call returns include compound interest as outlined in Internet Appendix D.1. Panel A reports annualized mean returns and Sharpe ratios of both TSFM and CSFM strategies based on 28 put-based factors from January 1999 to December 2021. Panel B reports the results of regressing both TSFM and CSFM strategies on an equal-weighted portfolio of the 28 option factors with monthly rebalancing (EW_FAC). In Panel C, we use the factor model by Zhan et al. (2022) (ZHCT) consisting of factors based on liquidity (AMIHUD) and the option underlyings' idiosyncratic volatility (IVOL). In Panel D, we use a factor model based on Horenstein et al. (2022) (HVX) which includes the equal-weighted return of 280 decile portfolios from characteristic sorts (EW_RET), the volatility of implied volatility (VOV), and the difference in implied and realized volatility (IVRV). Mean returns (%), alphas (%), Sharpe and information ratios (IR) are annualized. All t-statistics (in parentheses) account for heteroskedasticity and autocorrelation in residuals up to lag four, following Newey and West (1987).

	Time-Series Factor Momentum				Cross-Sectional Factor Momentum			
	t-1	t-6	t-2 - t-12	t-13 - t-60	t-1	t-6	t-2 - t-12	t-13 - t-60
Panel A: Performance of Factor Momentum								
Mean Return	10.58	14.16	14.56	12.05	6.52	9.09	9.47	6.96
	(7.72)	(10.76)	(10.76)	(9.06)	(7.21)	(10.71)	(10.18)	(10.65)
Sharpe Ratio	2.05	3.09	3.20	2.65	1.73	2.78	2.92	2.39
	(9.86)	(11.26)	(12.42)	(7.78)	(8.62)	(11.15)	(14.48)	(8.82)
Panel B: Factor Momentum vs. Equal-Weighted Factors								
α	3.72	5.24	4.72	1.14	4.37	6.78	6.38	2.80
	(2.34)	(3.42)	(3.75)	(1.38)	(3.16)	(4.76)	(4.77)	(3.13)
EW_FAC	0.98	1.28	1.41	1.70	0.31	0.33	0.44	0.65
	(5.09)	(6.39)	(10.12)	(15.08)	(2.41)	(2.43)	(3.01)	(4.12)
R^2	0.24	0.51	0.62	0.85	0.04	0.07	0.12	0.30
IR	0.83	1.63	1.69	0.64	1.19	2.15	2.10	1.15
Panel C: Factor Momentum vs. ZHCT Factors								
α	8.07	10.32	10.30	5.65	6.40	9.02	8.84	4.26
	(5.61)	(7.86)	(7.94)	(4.75)	(4.99)	(8.11)	(8.58)	(7.36)
AMIHUD	0.36	0.30	0.30	0.10	0.19	0.17	0.16	0.03
	(4.26)	(4.65)	(4.51)	(1.18)	(2.69)	(3.13)	(2.81)	(0.47)
IVOL	0.06	0.23	0.27	0.59	-0.09	-0.08	-0.02	0.25
	(0.53)	(1.91)	(2.71)	(5.90)	(-0.91)	(-0.89)	(-0.30)	(4.93)
R^2	0.18	0.30	0.36	0.64	0.08	0.08	0.07	0.27
IR	1.72	2.70	2.83	2.06	1.77	2.87	2.83	1.71
Panel D: Factor Momentum vs. HVX Factors								
α	6.52	8.35	6.60	5.73	4.20	4.88	3.86	4.33
	(4.78)	(6.27)	(5.32)	(3.71)	(4.14)	(5.22)	(4.21)	(3.43)
EW_RET	-0.03	-0.13	-0.10	-0.21	0.10	0.09	0.13	-0.05
	(-0.28)	(-1.25)	(-0.79)	(-1.07)	(1.42)	(1.61)	(2.32)	(-0.46)
VOV	0.01	0.23	0.22	0.24	-0.06	0.06	0.05	-0.08
	(0.08)	(1.50)	(1.70)	(1.72)	(-0.79)	(0.87)	(0.83)	(-1.14)
IVRV	0.14	0.16	0.24	0.21	0.10	0.15	0.20	0.12
	(2.94)	(3.97)	(6.22)	(2.22)	(2.75)	(6.21)	(7.88)	(2.28)
R^2	0.05	0.18	0.27	0.24	0.07	0.16	0.30	0.08
IR	1.29	2.01	1.69	1.45	1.16	1.63	1.42	1.55

D.2 Minimum Variance Delta

In the main text, we use the delta obtained from OptionMetrics in computing the delta-hedged option gain, see equation (1). However, this delta does not necessarily minimize the variance of the changes in the hedge portfolio if, e.g., there is a non-zero correlation between changes in volatility and prices (Hull & White, 2017). The minimum variance delta is the position in the underlying that minimizes the variance of the changes in the value of the hedge portfolio. It considers price changes and the expected change in volatility conditional on a price change, unlike the Black-Scholes delta.

We adopt the empirically motivated minimum-variance delta by Hull and White (2017) as other previously proposed minimum-variance deltas are also not exactly model-free (see Alexander & Imeraj, 2023, for an overview on various previously proposed minimum-variance deltas). Let δS denote a small change in the underlying stock price. δC denotes a small change in the option price. The minimum variance delta, Δ_{MV}, is the value that minimizes the variance of $\delta C - \Delta_{MV}\delta S$. Hull and White (2017) propose the following form for Δ_{MV}

$$\Delta_{MV} = \Delta_{BS} + \nu_{BS} \times \frac{(a + b \times \Delta_{BS} + c \times \Delta_{BS}^2)}{S \times \sqrt{T}}, \tag{D2}$$

where ν_{BS} denotes the Black-Scholes vega, S is the stock price, T the time-to-maturity of the option, and a, b and c are parameters to be estimated empirically.

We estimate the parameters a, b, and c using a regression over a rolling window of 12 months and use the estimated parameters out-of-sample to construct the minimum variance delta. Hence, δ_{MV} are only applied out-of-sample. As an example, to compute the delta-hedged gains over the investment period from the end of December 1999 to the end of January 2000, we estimate a, b, and c with daily data from January 1999 to the mid of December 1999 by running the below regression

$$\delta C - \Delta_{BS} \times \delta S = \nu_{BS} \times \delta S \times \frac{(a + b \times \Delta_{BS} + c \times \Delta_{BS}^2)}{S \times \sqrt{T}} + \varepsilon. \tag{D3}$$

Subsequently, we use the estimated parameters to calculate Δ_{MV} and replace the Black-Scholes delta in equation (1) with the minimum variance delta, Δ_{MV}, for the investment period from end of December 1999 to end of January 2000. Then we roll forward one month and repeat the above steps.

When estimating equation (D3), we consider all options written on common stock on a standard monthly expiration cycle. We winsorize the dependent variable in equation (D3) at $0.001 = 0.1\%$ in both tails to mitigate the influence of data errors. Further, we consider the following filters on the day the hedge portfolio is set up. First, we require that options exhibit positive bid-ask spreads and a positive bid price. Second, to mitigate the influence of stale option prices, options must have either positive open interest or positive volume.

Table D.3 provide baseline results of our analyses.

Table D.3: Option Factor Momentum - Minimum Variance Delta

This table follows Table 2, but the return definition of delta-hedged calls utilizes the minimum-variance delta introduced by Hull and White (2017) and outlined in Internet Appendix D.2. Panel A reports annualized mean returns and Sharpe ratios of both TSFM and CSFM strategies based on 28 factors from January 2000 to December 2021. Panel B reports the results of regressing both TSFM and CSFM strategies on an equal-weighted portfolio of the 28 option factors with monthly rebalancing (EW_FAC). In Panel C, we use the factor model by Zhan et al. (2022) (ZHCT) consisting of factors based on liquidity (AMIHUD) and the option underlyings' idiosyncratic volatility (IVOL). In Panel D, we use a factor model based on Horenstein et al. (2022) (HVX) which includes the equal-weighted return of 280 decile portfolios from characteristic sorts (EW_RET), the volatility of implied volatility (VOV), and the difference in implied and realized volatility (IVRV). Mean returns (%), alphas (%), Sharpe and information ratios (IR) are annualized. All t-statistics (in parentheses) account for heteroskedasticity and autocorrelation in residuals up to lag four, following Newey and West (1987).

	Time-Series Factor Momentum				Cross-Sectional Factor Momentum			
	t-1	t-6	t-2 - t-12	t-13 - t-60	t-1	t-6	t-2 - t-12	t-13 - t-60
Panel A: Performance of Factor Momentum								
Mean Return	10.12	14.56	15.28	13.01	5.97	8.91	9.56	7.33
	(7.04)	(10.89)	(11.04)	(9.07)	(6.31)	(10.60)	(10.57)	(10.89)
Sharpe Ratio	1.90	3.14	3.22	2.70	1.53	2.63	2.96	2.68
	(8.47)	(11.40)	(12.96)	(6.96)	(7.43)	(9.00)	(15.55)	(8.41)
Panel B: Factor Momentum vs. Equal-Weighted Factors								
α	2.90	5.76	5.24	0.96	4.12	7.01	6.45	2.93
	(1.91)	(3.23)	(2.99)	(1.03)	(3.05)	(4.74)	(4.11)	(3.27)
EW_FAC	1.01	1.23	1.40	1.74	0.26	0.27	0.43	0.64
	(5.47)	(5.52)	(7.49)	(14.60)	(2.19)	(1.87)	(2.62)	(4.87)
R^2	0.24	0.47	0.59	0.87	0.03	0.04	0.12	0.36
IR	0.63	1.71	1.72	0.55	1.07	2.11	2.13	1.33
Panel C: Factor Momentum vs. ZHCT Factors								
α	7.90	11.37	11.48	4.07	6.39	9.51	9.08	4.24
	(5.43)	(8.02)	(7.57)	(4.17)	(4.92)	(8.18)	(7.77)	(5.91)
AMIHUD	0.32	0.31	0.27	0.00	0.18	0.15	0.13	-0.02
	(3.86)	(4.58)	(3.58)	(-0.04)	(2.73)	(2.99)	(2.34)	(-0.35)
IVOL	0.09	0.18	0.25	0.75	-0.11	-0.12	-0.01	0.26
	(0.81)	(1.43)	(2.25)	(10.35)	(-1.30)	(-1.28)	(-0.10)	(4.67)
R^2	0.15	0.28	0.30	0.68	0.07	0.08	0.05	0.24
IR	1.61	2.88	2.90	1.49	1.71	2.93	2.89	1.78
Panel D: Factor Momentum vs. HVX Factors								
α	6.17	8.78	7.22	5.42	3.55	5.03	4.28	3.19
	(3.99)	(6.79)	(5.33)	(3.58)	(3.00)	(5.00)	(4.53)	(2.96)
EW_RET	-0.02	-0.12	-0.07	-0.17	0.10	0.12	0.12	0.00
	(-0.22)	(-1.24)	(-0.49)	(-0.79)	(1.44)	(1.93)	(2.01)	(0.03)
VOV	0.05	0.23	0.21	0.27	-0.08	0.05	0.01	0.01
	(0.34)	(1.62)	(1.63)	(2.06)	(-1.23)	(0.81)	(0.22)	(0.13)
IVRV	0.14	0.17	0.26	0.27	0.11	0.14	0.20	0.18
	(2.79)	(4.14)	(5.58)	(2.65)	(2.75)	(5.52)	(7.58)	(4.33)
R^2	0.05	0.19	0.27	0.29	0.07	0.14	0.25	0.16
IR	1.19	2.11	1.78	1.34	0.94	1.60	1.53	1.27

D.3 Initially Delta-Hedged Returns

In our main analysis, we use the gains of a daily delta-hedged option strategy to define option returns. The main advantage of adjusting the hedge daily versus only initially is to reduce hedging errors (Tian & Wu, 2023). Another perspective is that the difference between the two strategies is due to a stock strategy that profits from short-term reversal (Heston et al., 2023). Daily delta-hedging means buying low (decreasing short stock position after a negative stock return) and selling high (increasing short stock position after a positive stock return). If the gains of that strategy are asymmetric and persistent across long and short factor legs, this stock reversal strategy could potentially drive factor momentum. To rule this mechanism out, we calculate gains from an option strategy with only an initial delta hedge.

We define initial delta-hedged call returns over the holding period t to $t+\tau$ as

$$r_{t,t+\tau} = \frac{C_{t+\tau} - C_t - \Delta_t(S_{t+\tau} - S_t)}{\Delta_t S_t - C_t} - r_f, \tag{D4}$$

where r_f is the monthly risk-free rate. Option factor momentum strategies are then constructed following the main text. Table D.4 provides baseline results using initial delta-hedged call returns.

Table D.4: Performance of Option Factor Momentum - Initially Delta-Hedged Returns

This table follows Table 2, but delta-hedged call returns utilize an initial delta hedge instead of a daily rebalancing schedule (see equation (D4)). Panel A reports annualized mean returns and Sharpe ratios of both TSFM and CSFM strategies based on 28 factors from January 1999 to December 2021. Panel B reports the results of regressing both TSFM and CSFM strategies on an equal-weighted portfolio of the 28 option factors with monthly rebalancing (EW_FAC). In Panel C, we use the factor model by Zhan et al. (2022) (ZHCT) consisting of factors based on liquidity (AMIHUD) and the option underlyings' idiosyncratic volatility (IVOL). In Panel D, we use a factor model based on Horenstein et al. (2022) (HVX) which includes the equal-weighted return of 280 decile portfolios from characteristic sorts (EW_RET), the volatility of implied volatility (VOV), and the difference in implied and realized volatility (IVRV). Mean returns (%), alphas (%), Sharpe and information ratios (IR) are annualized. All t-statistics (in parentheses) account for heteroskedasticity and autocorrelation in residuals up to lag four, following Newey and West (1987).

	Time-Series Factor Momentum				Cross-Sectional Factor Momentum			
	t-1	t-6	t-2 - t-12	t-13 - t-60	t-1	t-6	t-2 - t-12	t-13 - t-60
Panel A: Performance of Factor Momentum								
Mean Return	7.49	10.35	12.45	9.59	5.02	7.04	9.33	4.99
	(4.59)	(7.70)	(9.42)	(7.15)	(3.64)	(5.20)	(7.58)	(4.26)
Sharpe Ratio	0.86	1.50	1.73	1.66	0.65	1.02	1.27	0.85
	(4.45)	(5.74)	(7.42)	(6.52)	(3.62)	(4.96)	(5.39)	(3.59)
Panel B: Factor Momentum vs. Equal-Weighted Factors								
α	3.97	5.36	5.03	1.56	4.38	6.44	6.55	0.60
	(1.65)	(2.84)	(3.17)	(1.32)	(1.95)	(2.62)	(3.44)	(0.49)
EW_FAC	0.66	0.94	1.40	1.57	0.12	0.11	0.52	0.86
	(1.86)	(4.10)	(6.24)	(6.86)	(0.40)	(0.38)	(2.20)	(4.62)
R^2	0.04	0.14	0.28	0.51	0.00	0.00	0.04	0.15
IR	0.47	0.84	0.82	0.39	0.57	0.94	0.91	0.11
Panel C: Factor Momentum vs. ZHCT Factors								
α	6.73	10.82	12.95	5.81	4.95	8.81	11.56	1.09
	(3.24)	(6.24)	(6.32)	(5.88)	(2.61)	(4.55)	(6.22)	(0.96)
AMIHUD	0.11	0.20	0.10	-0.14	0.08	0.17	0.08	-0.13
	(0.72)	(1.50)	(0.55)	(-1.45)	(0.60)	(1.49)	(0.49)	(-1.22)
IVOL	0.08	-0.06	-0.06	0.35	0.00	-0.20	-0.24	0.36
	(0.73)	(-0.53)	(-0.37)	(7.17)	(0.05)	(-1.74)	(-1.60)	(5.41)
R^2	0.02	0.05	0.02	0.30	0.01	0.12	0.13	0.31
IR	0.78	1.61	1.81	1.21	0.65	1.36	1.69	0.22
Panel D: Factor Momentum vs. HVX Factors								
α	10.67	7.30	6.66	7.19	7.31	5.34	3.33	4.42
	(3.74)	(3.85)	(3.27)	(3.23)	(2.89)	(2.91)	(1.85)	(1.68)
EW_RET	0.08	0.00	0.07	-0.05	0.08	0.10	0.16	-0.09
	(0.55)	(-0.04)	(0.62)	(-0.38)	(0.75)	(1.16)	(1.90)	(-0.64)
VOV	0.10	-0.10	-0.19	0.14	0.10	-0.17	-0.26	0.10
	(0.66)	(-0.71)	(-1.10)	(1.13)	(0.70)	(-1.14)	(-1.37)	(0.57)
IVRV	-0.11	0.12	0.26	0.06	-0.08	0.12	0.30	-0.02
	(-1.46)	(2.41)	(3.82)	(0.74)	(-1.01)	(2.04)	(4.77)	(-0.18)
R^2	0.02	0.04	0.18	0.05	0.02	0.09	0.30	0.03
IR	1.24	1.08	1.02	1.28	0.96	0.81	0.54	0.76

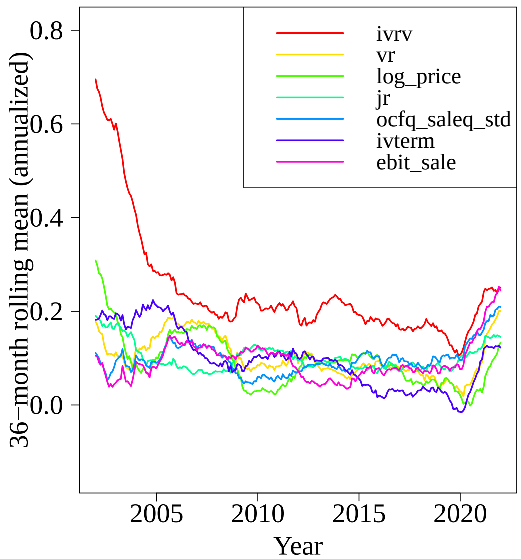
Internet Appendix E Details on Additional Analyses and Robustness Tests

E.1 Subsample Analyses

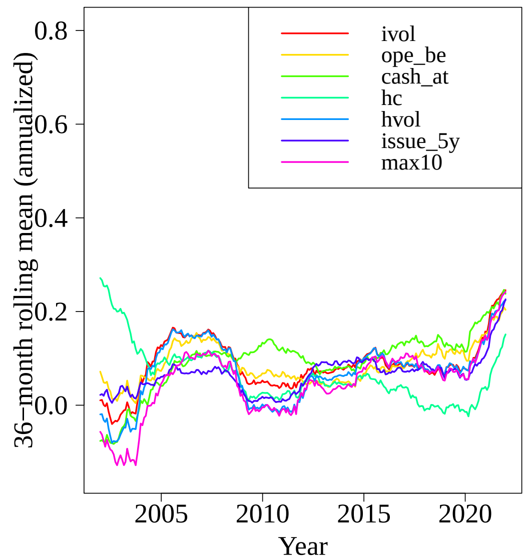
Table E.1: Option Factor Momentum Alphas for Different Subperiods.
This table reports alphas after risk-adjusting option factor momentum returns using the model proposed by Horenstein et al. (2022). Panel A reports alphas for two sample halves (1999/01-2010/06 versus 2010/07-2021/12). Panel B splits the sample according to NBER expansion and recession months. In Panel C, we split the sample into high and low sentiment periods using the median of the Baker and Wurgler (2006) sentiment index from 1999 to 2021. Panel D also employs a sample split based on the median of the intermediary capital ratio proposed by He et al. (2017). Alphas are annualized and given in percent. *t*-statistics (in parentheses) account for heteroskedasticity and autocorrelation in residuals, following Newey and West (1987). The total sample period is from January 1999 to December 2021.

		Time-Series Factor Momentum				Cross-Sectional Factor Momentum			
	# Months	t-1	t-6	t-2 - t-12	t-13 - t-60	t-1	t-6	t-2 - t-12	t-13 - t-60
Panel A: Sample Split Into 2 Halves									
1999/01-2010/06	138	8.78	10.50	6.04	5.22	5.64	5.23	2.65	3.08
		(4.13)	(5.46)	(3.16)	(3.08)	(3.05)	(3.04)	(1.62)	(1.64)
2010/07-2021/12	138	4.02	4.74	4.88	4.65	2.38	4.05	4.08	4.68
		(2.28)	(2.80)	(2.94)	(2.73)	(2.27)	(3.69)	(4.05)	(4.48)
Panel B: NBER Business Cycles									
Expansion	248	5.66	6.87	4.89	5.03	3.56	4.52	2.84	3.78
		(4.25)	(5.07)	(4.02)	(4.99)	(3.74)	(4.64)	(3.10)	(4.69)
Recession	28	-0.34	7.68	4.03	-3.17	2.52	3.92	4.22	2.78
		(-0.05)	(2.44)	(1.07)	(-0.41)	(0.41)	(1.09)	(1.27)	(0.41)
Panel C: Sentiment									
High	138	9.41	10.14	8.15	8.16	6.25	5.39	4.31	5.84
		(4.01)	(5.75)	(5.68)	(4.22)	(3.51)	(3.83)	(3.70)	(3.60)
Low	138	4.53	7.75	5.89	4.26	2.37	4.91	3.85	2.72
		(2.93)	(4.37)	(4.10)	(2.42)	(2.22)	(3.87)	(3.21)	(2.14)
Panel D: Intermediary capital									
High	138	8.05	9.60	6.93	8.09	5.55	5.40	3.33	5.28
		(3.86)	(6.03)	(5.44)	(5.01)	(3.16)	(3.84)	(2.81)	(3.35)
Low	138	5.24	6.18	4.35	3.25	2.82	4.17	3.53	2.70
		(2.54)	(2.64)	(2.12)	(1.62)	(2.31)	(2.98)	(2.71)	(2.17)

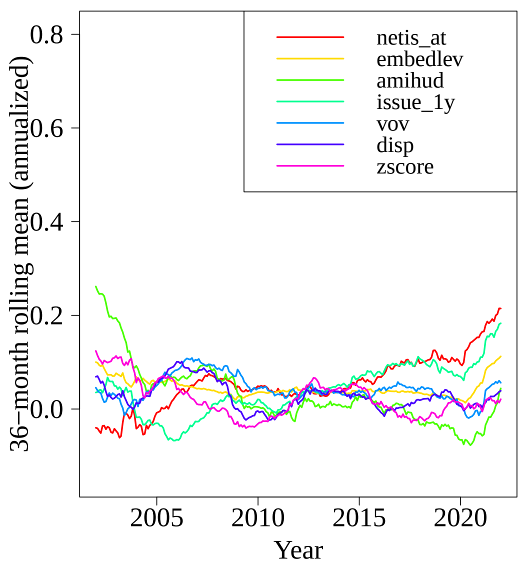
E.2 Rolling Mean Factor Returns



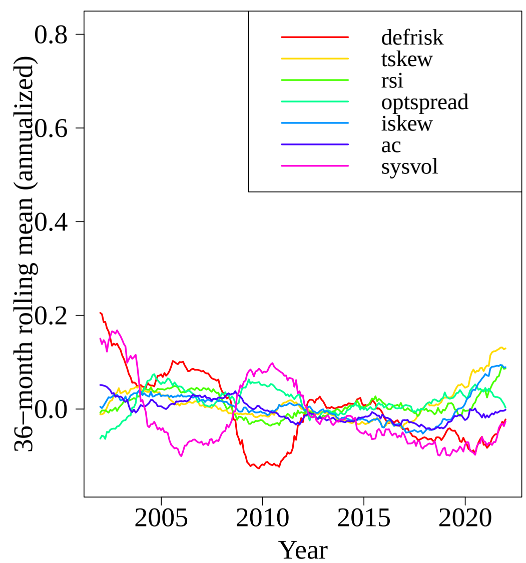
(a) Factors 1-7



(b) Factors 8-14



(c) Factors 15-21



(d) Factors 22-28

Fig. E.1. 36-Month Rolling Mean Factor Returns.

Notes: This figure plots the annualized 36-month rolling mean returns of our 28 factors from January 1999 to December 2021. Factors are separated into four groups by sorting from the highest to the lowest mean factor return (see Table 1).

E.3 Alternative Momentum Strategies Following Gupta and Kelly (2019)

Table E.2: Option Factor Momentum - Alternative Strategies

This table follows Table 2, but TSFM and CSFM strategies are constructed as outlined in Section VI.C. Panel A reports annualized mean returns and Sharpe ratios of both TSFM and CSFM strategies based on 28 factors from January 1999 to December 2021. Panel B reports results of regressing TSFM and CSFM on a factor model based on Horenstein et al. (2022) (HVX) which includes the equal-weighted return of 280 option portfolios from the decile sorts on our 28 characteristics (EW_RET), the long-short factor based on the volatility of implied volatility (VOV), and the long-short factor based on the difference in implied and realized volatility (IVRV). Regression intercepts (α) are annualized and given in percent. Information ratios (IR) are the ratio of α and the standard deviation of regression residuals and also annualized. t-statistics (in parentheses) account for heteroskedasticity and autocorrelation in residuals up to lag four, following Newey and West (1987).

	Time-Series Factor Momentum				Cross-Sectional Factor Momentum			
	t-1	t-6	t-2 - t-12	t-13 - t-60	t-1	t-6	t-2 - t-12	t-13 - t-60
Panel A: Performance of Factor Momentum								
Mean Return	9.88	13.38	13.58	8.76	9.91	14.39	14.84	11.04
	(7.96)	(11.54)	(10.47)	(4.43)	(7.84)	(11.99)	(11.18)	(10.68)
Sharpe Ratio	1.92	2.72	2.78	1.41	2.00	3.34	3.45	3.07
	(10.18)	(12.32)	(13.96)	(2.73)	(10.28)	(12.90)	(16.35)	(8.47)
Panel B: Factor Momentum vs. HVX Factors								
α	6.39	8.18	4.44	1.73	5.42	6.85	4.35	4.50
	(4.65)	(5.38)	(3.07)	(0.65)	(4.03)	(5.65)	(3.78)	(3.96)
EW_RET	0.08	0.10	0.12	-0.11	0.13	0.10	0.13	0.06
	(0.84)	(1.22)	(1.87)	(-0.45)	(1.47)	(1.49)	(2.44)	(0.45)
VOV	-0.04	0.09	0.05	0.09	-0.09	0.05	0.02	-0.01
	(-0.38)	(0.85)	(0.60)	(0.54)	(-0.97)	(0.63)	(0.34)	(-0.06)
IVRV	0.14	0.18	0.33	0.33	0.19	0.27	0.39	0.33
	(2.90)	(3.82)	(7.73)	(2.31)	(3.87)	(8.65)	(11.71)	(4.87)
R^2	0.05	0.10	0.29	0.12	0.10	0.26	0.49	0.28
IR	1.28	1.76	1.08	0.30	1.16	1.84	1.42	1.48

Table E.3: Option momentum - Alternative Strategies

This table follows Table 5 and Table 6, but option factor momentum (FM) and option momentum strategies (OM) are constructed as outlined in Section VI.C. For each underlying company, we require option return observations for at least two-thirds of the months of the formation period. Panel A reports results of regressing time-series option momentum and cross-sectional momentum on factors based on the model by Horenstein et al. (2022) (HVX): the equal-weighted return of 280 portfolios from the decile sorts on our 28 characteristics (EW_RET), the long-short factor based on the volatility of implied volatility (VOV), and the long-short factor based on the difference in implied and realized volatility (IVRV). Panel B augments this model by factor momentum returns. Panel C switches option momentum and factor momentum. Alphas are annualized and given in percent. t-statistics (in parentheses) account for heteroskedasticity and autocorrelation in residuals up to lag four, following Newey and West (1987). The sample period is from January 1999 to December 2021.

	Panel A: Time-Series Momentum				Panel B: Cross-Sectional Momentum			
	t-1	t-6	t-2 - t-12	t-13 - t-60	t-1	t-6	t-2 - t-12	t-13 - t-60
Panel A: Regression $R_t^{OM} = \alpha + \beta_1\,\text{EW\_RET}_t + \beta_2\,\text{VOV}_t + \beta_3\,\text{IVRV}_t + \varepsilon_t$								
α	-1.20	1.17	0.76	1.88	0.72	2.10	2.06	2.23
	(-1.17)	(1.12)	(0.70)	(1.78)	(0.81)	(2.22)	(2.19)	(2.54)
R^2	0.18	0.17	0.28	0.04	0.09	0.13	0.26	0.08
Panel B: Regression $R_t^{OM} = \alpha + \beta_1\,R_t^{FM} + \beta_2\,\text{EW\_RET}_t + \beta_3\,\text{VOV}_t + \beta_4\,\text{IVRV}_t + \varepsilon_t$								
α	-2.32	-0.34	-0.19	1.74	-0.44	0.10	0.77	1.74
	(-2.42)	(-0.35)	(-0.20)	(1.81)	(-0.51)	(0.12)	(1.01)	(1.97)
R^2	0.24	0.24	0.34	0.09	0.23	0.27	0.36	0.11
Panel C: Regression $R_t^{FM} = \alpha + \beta_1\,R_t^{OM} + \beta_2\,\text{EW\_RET}_t + \beta_3\,\text{VOV}_t + \beta_4\,\text{IVRV}_t + \varepsilon_t$								
α	6.93	7.67	4.12	0.55	4.90	5.64	3.46	3.86
	(5.09)	(5.33)	(3.09)	(0.20)	(4.06)	(5.23)	(3.61)	(3.37)
R^2	0.12	0.18	0.35	0.17	0.24	0.38	0.56	0.30

E.4 Factor Momentum With Puts

Table E.4: Option Factor Momentum - Puts

This table follows Table 2, but all factors are constructed by sorting delta-hedged put options instead of call options. Panel A reports annualized mean returns and Sharpe ratios of both TSFM and CSFM strategies based on 28 put-based factors from January 1999 to December 2021. Panel B reports results of regressing TSFM and CSFM on a factor model based on Horenstein et al. (2022) (HVX) which includes the equal-weighted return of 280 put option portfolios from the decile sorts on our 28 characteristics (EW_RET), the long-short factor based on the volatility of implied volatility (VOV), and the long-short factor based on the difference in implied and realized volatility (IVRV). Regression intercepts (α) are annualized and given in percent. Information ratios (IR) are the ratio of α and the standard deviation of regression residuals and are also annualized. t-statistics (in parentheses) account for heteroskedasticity and autocorrelation in residuals up to lag four, following Newey and West (1987).

	Time-Series Factor Momentum				Cross-Sectional Factor Momentum			
	t-1	t-6	t-2 - t-12	t-13 - t-60	t-1	t-6	t-2 - t-12	t-13 - t-60
Panel A: Performance of Factor Momentum								
Mean Return	9.14	13.19	12.83	12.03	4.44	6.56	6.85	5.27
	(8.15)	(14.35)	(13.40)	(12.50)	(6.34)	(12.06)	(11.98)	(10.49)
Sharpe Ratio	2.29	3.93	3.67	3.32	1.54	2.83	3.00	2.36
	(8.30)	(14.26)	(13.32)	(8.80)	(6.33)	(9.98)	(11.55)	(7.98)
Panel B: Factor Momentum vs. HVX Factors								
α	7.49	11.24	9.22	7.75	3.14	5.40	4.48	3.02
	(5.56)	(9.70)	(7.70)	(5.60)	(3.23)	(6.93)	(6.43)	(3.14)
EW_RET	-0.07	-0.07	-0.09	-0.18	0.03	0.08	0.09	-0.03
	(-0.63)	(-0.74)	(-0.75)	(-1.20)	(0.38)	(1.66)	(1.86)	(-0.36)
VOV	-0.01	0.08	0.09	0.10	-0.11	-0.01	0.00	-0.11
	(-0.11)	(0.66)	(0.68)	(0.66)	(-1.60)	(-0.22)	(-0.03)	(-1.60)
IVRV	0.07	0.07	0.14	0.19	0.09	0.07	0.12	0.14
	(1.14)	(1.83)	(3.98)	(2.82)	(1.81)	(2.05)	(4.38)	(3.63)
R^2	0.02	0.04	0.10	0.18	0.04	0.05	0.13	0.13
IR	1.89	3.42	2.78	2.36	1.11	2.39	2.11	1.45

Table E.5: Option Momentum - Puts

This table follows Table 5 and Table 6, but both factors for option factor momentum (FM) and option momentum strategies (OM) are based on delta-hedged put options instead of call options. For each underlying company, we require option return observations for at least two-thirds of the months of the formation period. Panel A reports results of regressing time-series option momentum and cross-sectional option momentum on factors based on the model by Horenstein et al. (2022) (HVX): the equal-weighted return of 280 portfolios from the decile sorts on our 28 characteristics (EW_RET), the long-short factor based on the volatility of implied volatility (VOV), and the long-short factor based on the difference in implied and realized volatility (IVRV). Panel B augments this model by factor momentum returns. Panel C switches option momentum and factor momentum. Alphas are annualized and given in percent. *t*-statistics (in parentheses) account for heteroskedasticity and autocorrelation in residuals up to lag four, following Newey and West (1987). The sample period is from January 1999 to December 2021.

	Panel A: Time-Series Momentum				Panel B: Cross-Sectional Momentum			
	t-1	t-6	t-2 - t-12	t-13 - t-60	t-1	t-6	t-2 - t-12	t-13 - t-60
Panel A: Regression $R_t^{OM} = \alpha + \beta_1\,\text{EW\_RET}_t + \beta_2\,\text{VOV}_t + \beta_3\,\text{IVRV}_t + \varepsilon_t$								
α	4.61	4.51	2.43	-1.61	1.43	2.14	1.97	0.06
	(2.71)	(3.14)	(1.34)	(-0.88)	(2.49)	(3.64)	(3.32)	(0.12)
R^2	0.12	0.01	0.06	0.17	0.07	0.18	0.19	0.07
Panel B: Regression $R_t^{OM} = \alpha + \beta_1\,R_t^{FM} + \beta_2\,\text{EW\_RET}_t + \beta_3\,\text{VOV}_t + \beta_4\,\text{IVRV}_t + \varepsilon_t$								
α	-0.14	0.02	2.49	-4.05	0.57	0.49	0.75	-0.05
	(-0.12)	(0.01)	(1.38)	(-1.90)	(1.03)	(0.75)	(1.17)	(-0.08)
R^2	0.32	0.13	0.06	0.22	0.27	0.32	0.28	0.07
Panel C: Regression $R_t^{FM} = \alpha + \beta_1\,R_t^{OM} + \beta_2\,\text{EW\_RET}_t + \beta_3\,\text{VOV}_t + \beta_4\,\text{IVRV}_t + \varepsilon_t$								
α	5.80	9.80	9.23	8.04	2.00	4.15	3.70	3.02
	(5.51)	(8.18)	(6.72)	(6.25)	(2.15)	(5.69)	(5.40)	(3.16)
R^2	0.25	0.16	0.10	0.22	0.25	0.22	0.23	0.13

E.5 Constructing Options Factors Using Market Capitalization Weighting

Table E.6: Option Factor Momentum - Market Capitalization Weighting

This table follows Table 2, but decile portfolio returns used for constructing factors are calculated by weighting each call option by its underlying stock's market capitalization. Following Jensen et al. (2023), we winsorize market capitalization at the 80th percentile each month. Panel A reports annualized mean returns and Sharpe ratios of both TSFM and CSFM strategies based on 28 factors from January 1999 to December 2021. Panel B reports results of regressing TSFM and CSFM on a factor model based on Horenstein et al. (2022) (HVX) which includes the equal-weighted return of 280 option portfolios from the decile sorts on our 28 characteristics (EW_RET), the long-short factor based on the volatility of implied volatility (VOV), and the long-short factor based on the difference in implied and realized volatility (IVRV). Regression intercepts (α) are annualized and given in percent. Information ratios (IR) are the ratio of α and the standard deviation of regression residuals and are also annualized. t-statistics (in parentheses) account for heteroskedasticity and autocorrelation in residuals up to lag four, following Newey and West (1987).

	Time-Series Factor Momentum				Cross-Sectional Factor Momentum			
	t-1	t-6	t-2 - t-12	t-13 - t-60	t-1	t-6	t-2 - t-12	t-13 - t-60
Panel A: Performance of Factor Momentum								
Mean Return	6.62	9.99	9.77	6.04	4.84	7.19	7.51	2.85
	(5.50)	(9.09)	(7.79)	(4.92)	(4.26)	(6.66)	(5.94)	(3.33)
Sharpe Ratio	1.32	2.32	2.27	1.36	1.05	1.73	1.68	0.84
	(5.90)	(11.18)	(9.61)	(3.49)	(5.11)	(11.38)	(9.62)	(2.36)
Panel B: Factor Momentum vs. HVX Factors								
α	6.40	7.66	5.07	1.54	4.43	5.10	3.41	0.02
	(4.40)	(5.39)	(3.93)	(0.87)	(3.32)	(3.87)	(2.92)	(0.01)
EW_RET	0.01	0.03	0.11	-0.15	0.06	0.09	0.22	-0.14
	(0.08)	(0.34)	(1.44)	(-0.78)	(0.65)	(0.87)	(2.94)	(-1.11)
VOV	-0.23	0.07	0.03	0.19	-0.18	-0.03	-0.08	0.00
	(-1.91)	(0.55)	(0.27)	(1.09)	(-1.78)	(-0.24)	(-0.73)	(0.01)
IVRV	0.05	0.11	0.24	0.24	0.05	0.12	0.23	0.17
	(0.91)	(2.56)	(5.77)	(3.01)	(0.96)	(2.49)	(5.17)	(2.98)
R^2	0.03	0.04	0.20	0.19	0.04	0.06	0.24	0.15
IR	1.30	1.81	1.32	0.38	0.98	1.27	0.88	0.01

Table E.7: Option Momentum - Market Capitalization Weighting

This table follows Table 5 and Table 6, but decile portfolio returns used for constructing factors are calculated by weighting each call option by its underlying stock's market capitalization. Options are weighted accordingly for the option momentum strategies (OM). Following Jensen et al. (2023), we winsorize market capitalization at the 80th percentile each month. For each underlying company, we require option return observations for at least two-thirds of the months of the formation period. Panel A reports results of regressing time-series option momentum and cross-sectional option momentum on factors based on the model by Horenstein et al. (2022) (HVX): the equal-weighted return of 280 portfolios from the decile sorts on our 28 characteristics (EW_RET), the long-short factor based on the volatility of implied volatility (VOV), and the long-short factor based on the difference in implied and realized volatility (IVRV). Panel B augments this model by factor momentum (FM) returns. Panel C switches option momentum and factor momentum. Alphas are annualized and given in percent. t-statistics (in parentheses) account for heteroskedasticity and autocorrelation in residuals up to lag four, following Newey and West (1987). The sample period is from January 1999 to December 2021.

	Panel A: Time-Series Momentum				Panel B: Cross-Sectional Momentum			
	t-1	t-6	t-2 - t-12	t-13 - t-60	t-1	t-6	t-2 - t-12	t-13 - t-60
Panel A: Regression $R_t^{OM} = \alpha + \beta_1\,\text{EW\_RET}_t + \beta_2\,\text{VOV}_t + \beta_3\,\text{IVRV}_t + \varepsilon_t$								
α	5.33	4.01	2.65	-2.07	1.07	1.35	1.33	0.48
	(2.84)	(2.50)	(1.54)	(-1.40)	(2.02)	(2.00)	(2.39)	(1.38)
R^2	0.21	0.02	0.02	0.05	0.13	0.14	0.22	0.06
Panel B: Regression $R_t^{OM} = \alpha + \beta_1\,R_t^{FM} + \beta_2\,\text{EW\_RET}_t + \beta_3\,\text{VOV}_t + \beta_4\,\text{IVRV}_t + \varepsilon_t$								
α	1.73	-0.28	0.09	-3.08	0.10	-0.01	0.55	0.26
	(1.04)	(-0.23)	(0.06)	(-2.47)	(0.16)	(-0.02)	(1.16)	(0.81)
R^2	0.39	0.30	0.18	0.17	0.39	0.46	0.41	0.17
Panel C: Regression $R_t^{FM} = \alpha + \beta_1\,R_t^{OM} + \beta_2\,\text{EW\_RET}_t + \beta_3\,\text{VOV}_t + \beta_4\,\text{IVRV}_t + \varepsilon_t$								
α	4.26	5.56	4.25	2.37	2.97	3.23	1.99	-0.14
	(3.53)	(5.26)	(3.25)	(1.60)	(2.14)	(3.52)	(2.12)	(-0.10)
R^2	0.25	0.32	0.32	0.29	0.32	0.41	0.43	0.21

E.6 Liquidity Filter

Table E.8: Option Factor Momentum - Most Liquid Options

This table follows Table 2, but we only use call options for which the proportional bid-ask-spread is below the median in each month when constructing factors. Panel A reports annualized mean returns and Sharpe ratios of both TSFM and CSFM strategies based on 28 factors from January 1999 to December 2021. Panel B reports results of regressing TSFM and CSFM on a factor model based on Horenstein et al. (2022) (HVX) which includes the equal-weighted return of 280 portfolios from the decile sorts on our 28 characteristics (EW_RET), the long-short factor based on the volatility of implied volatility (VOV), and the long-short factor based on the difference in implied and realized volatility (IVRV). Regression intercepts (α) are annualized and given in percent. Information ratios (IR) are the ratio of α and the standard deviation of regression residuals and are also annualized. t-statistics (in parentheses) account for heteroskedasticity and autocorrelation in residuals up to lag four, following Newey and West (1987).

	Time-Series Factor Momentum				Cross-Sectional Factor Momentum			
	t-1	t-6	t-2 - t-12	t-13 - t-60	t-1	t-6	t-2 - t-12	t-13 - t-60
Panel A: Performance of Factor Momentum								
Mean Return	7.20	9.65	10.18	8.46	4.10	6.07	6.65	3.70
	(5.44)	(6.81)	(6.84)	(7.24)	(4.06)	(7.88)	(7.56)	(6.77)
Sharpe Ratio	1.34	1.94	1.98	1.86	1.00	1.83	2.11	1.48
	(5.76)	(8.55)	(8.85)	(5.99)	(5.34)	(9.71)	(10.69)	(4.65)
Panel B: Factor Momentum vs. HVX Factors								
α	6.03	4.86	4.16	3.72	3.03	3.71	3.24	2.04
	(4.72)	(3.82)	(3.18)	(2.89)	(3.45)	(4.32)	(4.47)	(2.47)
EW_RET	-0.01	-0.14	-0.13	-0.25	0.09	0.11	0.12	-0.10
	(-0.17)	(-1.66)	(-1.14)	(-1.59)	(1.03)	(1.94)	(2.35)	(-1.45)
VOV	-0.13	0.32	0.31	0.25	-0.08	0.10	0.09	-0.02
	(-1.31)	(2.49)	(2.51)	(3.29)	(-1.21)	(1.36)	(2.04)	(-0.44)
IVRV	0.12	0.15	0.23	0.21	0.10	0.11	0.18	0.13
	(2.31)	(3.75)	(5.59)	(3.72)	(2.46)	(3.50)	(5.85)	(4.48)
R^2	0.04	0.25	0.33	0.36	0.07	0.15	0.32	0.19
IR	1.14	1.13	0.99	1.02	0.77	1.22	1.24	0.91

Table E.9: Option Momentum - Most Liquid Options

This table follows Table 5 and Table 6, but we only use call options for which the proportional bid-ask-spread is below the median in each month when constructing factors and for the option momentum (OM) strategies. For each underlying company, we require option return observations for at least two-thirds of the months of the formation period. Panel A reports results of regressing TSM and CSM on factors based on the model by Horenstein et al. (2022) (HVX): the equal-weighted return of 280 portfolios from the decile sorts on our 28 characteristics (EW_RET), the long-short factor based on the volatility of implied volatility (VOV), and the long-short factor based on the difference in implied and realized volatility (IVRV). Panel B augments this model by factor momentum returns. Panel C switches option momentum and factor momentum. Alphas are annualized and given in percent. t-statistics (in parentheses) account for heteroskedasticity and autocorrelation in residuals up to lag four, following Newey and West (1987). The sample period is from January 1999 to December 2021.

	Panel A: Time-Series Momentum				Panel B: Cross-Sectional Momentum			
	t-1	t-6	t-2 - t-12	t-13 - t-60	t-1	t-6	t-2 - t-12	t-13 - t-60
Panel A: Regression $R_t^{OM} = \alpha + \beta_1\,\text{EW\_RET}_t + \beta_2\,\text{VOV}_t + \beta_3\,\text{IVRV}_t + \varepsilon_t$								
α	6.41	4.06	2.77	-1.07	1.88	1.49	1.39	1.50
	(3.77)	(2.90)	(1.89)	(-0.74)	(2.94)	(2.26)	(2.67)	(2.86)
R^2	0.17	0.03	0.05	0.01	0.16	0.16	0.21	0.07
Panel B: Regression $R_t^{OM} = \alpha + \beta_1\,R_t^{FM} + \beta_2\,\text{EW\_RET}_t + \beta_3\,\text{VOV}_t + \beta_4\,\text{IVRV}_t + \varepsilon_t$								
α	3.24	1.04	1.33	-1.74	1.08	0.07	0.11	1.08
	(1.90)	(0.92)	(0.96)	(-1.18)	(1.55)	(0.11)	(0.22)	(1.92)
R^2	0.33	0.32	0.12	0.03	0.32	0.34	0.39	0.10
Panel C: Regression $R_t^{FM} = \alpha + \beta_1\,R_t^{OM} + \beta_2\,\text{EW\_RET}_t + \beta_3\,\text{VOV}_t + \beta_4\,\text{IVRV}_t + \varepsilon_t$								
α	3.56	2.92	3.56	3.81	1.63	2.86	2.47	1.76
	(3.86)	(2.77)	(2.67)	(3.05)	(2.10)	(3.88)	(4.19)	(2.11)
R^2	0.23	0.48	0.38	0.37	0.25	0.34	0.47	0.22

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