Risk-neutral Skewness, Informed Trading, and the Cross-section of Stock Returns

Supplementary Internet Appendices

In this file, we provide additional results and discussions. Internet Appendix A presents additional evidence to corroborate the main findings. Internet Appendix B provides the details of robustness check results in Section 5. Internet Appendix C discusses how and why our results differ from those in Conrad, Dittmar, and Ghysels (2013).

Internet Appendix A

Table IA.1 Various Weekly Portfolio Formation and Holding Approaches

This table reports portfolio sort results with various holding and weighting approaches. On each Tuesday, firms are sorted into decile portfolios based on the average level of risk-neutral skewness from the previous Wednesday to Tuesday. Panel A reports results of value-weighted returns, and skip one day from sorting and holding period. Panel B (C) reports results for equally (value) weighted return and no skip between formation and holding period. Panel D (E) report results of equally (value) weighted returns, based on sorting on single day RNS on Tuesday, and skip one day between formation and holding period. Panel F (G) report results of equally (value) weighted returns, based on sorting on single day RNS on Tuesday, and no skip between formation and holding period. Alphas are estimated using (i) the Fama-French (2015) five factors and the momentum factor (FF5+Mom), (ii) the q-factor model of Hou, Xue, and Zhang (2015) (q-factor), and (iii) the q-factor model plus the momentum factor (q-factor+Mom). Newey-West (1987) t-statistics are reported in parenthesis.

Panel A: Weekly Sort on Average Risk Neutral Skewness, Skip One Day, Equally Weight Return

	Low	2	3	4	5	6	7	8	9	High	High-Low
Raw Return	0.18	0.20	0.22	0.25	0.26	0.25	0.28	0.28	0.33	0.38	0.20
	(2.66)	(2.49)	(2.49)	(2.64)	(2.57)	(2.43)	(2.73)	(2.66)	(3.23)	(4.10)	(4.60)
FF5+Mom	0.17	0.19	0.22	0.25	0.25	0.25	0.28	0.27	0.32	0.37	0.20
	(2.58)	(2.37)	(2.47)	(2.62)	(2.46)	(2.32)	(2.6)	(2.46)	(3.05)	(3.74)	(4.05)
q-factor	0.18	0.21	0.23	0.26	0.27	0.26	0.30	0.29	0.34	0.39	0.21
	(2.73)	(2.58)	(2.68)	(2.81)	(2.67)	(2.5)	(2.78)	(2.67)	(3.2)	(3.87)	(4.09)
q-factor+Mom	0.18	0.21	0.23	0.26	0.27	0.26	0.29	0.29	0.33	0.38	0.20
	(2.72)	(2.54)	(2.66)	(2.8)	(2.63)	(2.47)	(2.74)	(2.61)	(3.17)	(3.85)	(4.06)

Panel B: Weekly Sort on Average Risk Neutral Skewness, No Skip, Equally Weight Return

	Low	2	3	4	5	6	7	8	9	High	High-Low
Raw Return	0.12	0.15	0.16	0.22	0.19	0.22	0.25	0.26	0.34	0.41	0.29
	(1.64)	(1.66)	(1.68)	(2.06)	(1.74)	(1.9)	(2.18)	(2.30)	(3.05)	(4.03)	(5.82)
FF5+Mom	0.11	0.14	0.16	0.21	0.18	0.21	0.24	0.26	0.33	0.40	0.28
	(1.63)	(1.58)	(1.69)	(2.09)	(1.69)	(1.84)	(2.09)	(2.18)	(2.91)	(3.69)	(5.05)
q-factor	0.12	0.16	0.18	0.23	0.21	0.23	0.26	0.28	0.36	0.42	0.30
	(1.73)	(1.81)	(1.93)	(2.31)	(1.93)	(2.06)	(2.29)	(2.39)	(3.08)	(3.82)	(5.15)
q-factor+Mom	0.12	0.15	0.18	0.23	0.21	0.23	0.26	0.28	0.35	0.41	0.29
	(1.74)	(1.79)	(1.93)	(2.31)	(1.9)	(2.03)	(2.26)	(2.36)	(3.08)	(3.84)	(5.16)

Panel C: Weekly Sort on Average Risk Neutral Skewness, No Skip, Value Weight Return											
	Low	2	3	4	5	6	7	8	9	High	High-Low
Raw Return	0.19	0.27	0.30	0.30	0.35	0.34	0.38	0.39	0.45	0.40	0.21
	(2.57)	(3.33)	(3.47)	(3.31)	(3.72)	(3.62)	(4.10)	(4.03)	(4.93)	(4.88)	(4.38)
FF5+Mom	0.19	0.26	0.30	0.30	0.34	0.34	0.37	0.38	0.44	0.39	0.20
	(2.74)	(3.55)	(3.88)	(3.56)	(3.87)	(3.96)	(4.38)	(4.34)	(5.02)	(4.83)	(4.24)
q-factor	0.19	0.27	0.31	0.32	0.36	0.36	0.40	0.41	0.46	0.41	0.22
	(2.78)	(3.79)	(4.10)	(3.80)	(4.13)	(4.14)	(4.58)	(4.53)	(5.20)	(4.96)	(4.37)
q-factor+Mom	0.19	0.27	0.31	0.31	0.35	0.35	0.39	0.39	0.45	0.40	0.21
	(2.85)	(3.79)	(4.09)	(3.78)	(4.10)	(4.10)	(4.56)	(4.53)	(5.23)	(4.99)	(4.28)

Panel D: Weekly Sort on Tuesday Risk Neutral Skewness, Skip One Day, Equal Weight Return											
	Low	2	3	4	5	6	7	8	9	High	High-Low
Raw Return	0.13	0.17	0.17	0.19	0.20	0.21	0.25	0.28	0.30	0.38	0.24
	(1.77)	(1.91)	(1.72)	(1.83)	(1.83)	(1.87)	(2.23)	(2.55)	(2.79)	(3.74)	(5.36)
FF5+Mom	0.12	0.16	0.16	0.19	0.19	0.21	0.24	0.28	0.29	0.37	0.25
	(1.65)	(1.81)	(1.67)	(1.77)	(1.76)	(1.81)	(2.08)	(2.42)	(2.56)	(3.47)	(4.81)
q-factor	0.13	0.18	0.18	0.20	0.21	0.23	0.26	0.30	0.31	0.39	0.26
	(1.80)	(1.99)	(1.86)	(1.94)	(1.96)	(2.01)	(2.28)	(2.59)	(2.71)	(3.59)	(4.83)
q-factor+Mom	0.13	0.18	0.18	0.20	0.21	0.22	0.26	0.29	0.30	0.38	0.25
	(1.76)	(1.97)	(1.85)	(1.92)	(1.94)	(1.98)	(2.24)	(2.55)	(2.66)	(3.57)	(4.84)

Panel E: Weekly Sort on Tuesday Risk Neutral Skewness, Skip One Day, Value Weight Return											
	Low	2	3	4	5	6	7	8	9	High	High-Low
Raw Return	0.17	0.22	0.21	0.29	0.27	0.30	0.36	0.32	0.30	0.34	0.17
	(2.36)	(2.78)	(2.56)	(3.26)	(2.93)	(3.17)	(3.85)	(3.62)	(3.35)	(4.27)	(3.63)
FF5+Mom	0.16	0.21	0.21	0.29	0.26	0.29	0.35	0.32	0.29	0.33	0.16
	(2.37)	(2.91)	(2.68)	(3.43)	(3.00)	(3.32)	(4.00)	(3.75)	(3.30)	(4.15)	(3.45)
q-factor	0.17	0.23	0.22	0.30	0.29	0.31	0.37	0.34	0.31	0.35	0.18
	(2.50)	(3.10)	(2.86)	(3.61)	(3.28)	(3.57)	(4.18)	(3.99)	(3.51)	(4.39)	(3.62)
q-factor+Mom	0.17	0.22	0.22	0.30	0.28	0.31	0.36	0.33	0.30	0.34	0.17
	(2.51)	(3.06)	(2.81)	(3.57)	(3.21)	(3.52)	(4.11)	(3.91)	(3.42)	(4.32)	(3.45)

Panel F: Weekly Sort on Tuesday Risk Neutral Skewness, No Skip, Equally Weight Return											
	Low	2	3	4	5	6	7	8	9	High	High-Low
Raw Return	0.12	0.15	0.16	0.22	0.19	0.22	0.25	0.26	0.34	0.41	0.29
	(1.64)	(1.66)	(1.68)	(2.06)	(1.74)	(1.90)	(2.18)	(2.30)	(3.05)	(4.03)	(5.82)
FF5+Mom	0.11	0.14	0.16	0.21	0.18	0.21	0.24	0.26	0.33	0.40	0.28
	(1.63)	(1.58)	(1.69)	(2.09)	(1.69)	(1.84)	(2.09)	(2.18)	(2.91)	(3.69)	(5.05)
q-factor	0.12	0.16	0.18	0.23	0.21	0.23	0.26	0.28	0.36	0.42	0.30
	(1.73)	(1.81)	(1.93)	(2.31)	(1.93)	(2.06)	(2.29)	(2.39)	(3.08)	(3.82)	(5.15)
q-factor+Mom	0.12	0.15	0.18	0.23	0.21	0.23	0.26	0.28	0.35	0.41	0.29
	(1.74)	(1.79)	(1.93)	(2.31)	(1.90)	(2.03)	(2.26)	(2.36)	(3.08)	(3.84)	(5.16)

Panel G: Weekly Sort on Tuesday Risk Neutral Skewness, No Skip, Value Weight Return											
	Low	2	3	4	5	6	7	8	9	High	High-Low
Raw Return	0.19	0.27	0.30	0.30	0.35	0.34	0.38	0.39	0.45	0.40	0.21
	(2.57)	(3.33)	(3.47)	(3.31)	(3.72)	(3.62)	(4.1)	(4.03)	(4.93)	(4.88)	(4.38)
FF5+Mom	0.19	0.26	0.30	0.30	0.34	0.34	0.37	0.38	0.44	0.39	0.20
	(2.74)	(3.55)	(3.88)	(3.56)	(3.87)	(3.96)	(4.38)	(4.34)	(5.02)	(4.83)	(4.24)
q-factor	0.19	0.27	0.31	0.32	0.36	0.36	0.40	0.41	0.46	0.41	0.22
	(2.78)	(3.79)	(4.10)	(3.80)	(4.13)	(4.14)	(4.58)	(4.53)	(5.20)	(4.96)	(4.37)
q-factor+Mom	0.19	0.27	0.31	0.31	0.35	0.35	0.39	0.39	0.45	0.40	0.21
	(2.85)	(3.79)	(4.09)	(3.78)	(4.10)	(4.10)	(4.56)	(4.53)	(5.23)	(4.99)	(4.28)

Table IA.2: Weekly and Monthly Decile Portfolios Sorted on Risk-Neutral Skewness

This table reports value-weighted returns for RNS portfolios with alternative soring and holding approaches. In Panel A, the sorting signal is weekly average RNS calculated from prior week Wednesday to current Tuesday. The positions are held for four weeks. In this case, there are four running portfolios every week. We thus form calendar time portfolios to avoid the impact on inferences due to the serial correlation caused by overlapping returns. In Panel B, we perform monthly sorting and monthly holding. At the end of each month, firms are sorted into decile portfolios based on the average value of RNS during the month (excludes the last day of the month). The positions are held for one month, and monthly value-weighted returns and risk-adjusted alphas are reported. In Panel C, the sorting signals are based on the average of RNS over the last five days (excludes the last day) of the month. The positions are held for one month, and monthly value-weighted returns and risk-adjusted alphas are reported. Alphas are estimated using (i) the Fama-French (2015) five factors and the momentum factor (FF5+Mom), (ii) the q-factor model of Hou, Xue, and Zhang (2014) (q-factor), and (iii) the q-factor model plus the momentum factor (q-factor+Mom). Newey-West (1987) t-statistics are reported in parenthesis.

Panel A: Weekly Sort, and Four-Weeks Holding Period, Value Weight Return Reported Weekly											
	Low	2	3	4	5	6	7	8	9	High	High-Low
Raw Return	0.17	0.23	0.26	0.28	0.28	0.28	0.28	0.29	0.32	0.31	0.14
	(2.41)	(2.99)	(3.15)	(3.21)	(3.13)	(3.06)	(3.11)	(3.17)	(3.69)	(4.00)	(3.32)
FF5+Mom	0.17	0.23	0.26	0.28	0.28	0.27	0.27	0.28	0.31	0.30	0.13
	(2.53)	(3.10)	(3.38)	(3.42)	(3.21)	(3.07)	(3.12)	(3.22)	(3.61)	(3.79)	(3.01)
q-factor	0.17	0.24	0.27	0.29	0.29	0.29	0.30	0.30	0.33	0.32	0.14
	(2.62)	(3.30)	(3.57)	(3.65)	(3.47)	(3.33)	(3.36)	(3.45)	(3.82)	(3.98)	(3.12)
q-factor+Mom	0.18	0.23	0.27	0.29	0.29	0.28	0.28	0.29	0.32	0.31	0.13
	(2.64)	(3.25)	(3.53)	(3.60)	(3.43)	(3.27)	(3.28)	(3.35)	(3.74)	(3.88)	(2.92)
Panel B: Monthly Sort on Average RNS over the Month, Monthly Holding, Value Weight Monthly Return											
	Low	2	3	4	5	6	7	8	9	High	High-Low
Raw Return	0.57	0.94	0.82	0.95	1.11	0.73	0.98	0.89	1.02	1.11	0.54

	(2.05)	(3.05)	(2.47)	(2.70)	(2.92)	(1.86)	(2.64)	(2.28)	(2.56)	(3.35)	(2.55)
FF5+Mom	–0.14	0.17	0.00	0.20	0.31	–0.11	0.10	0.01	0.08	0.16	0.29
	(–1.68)	(1.36)	(0.04)	(1.65)	(2.41)	(–0.72)	(0.54)	(0.08)	(0.39)	(1.25)	(2.07)
q-factor	0.01	0.35	0.22	0.41	0.54	0.14	0.29	0.29	0.37	0.38	0.37
	(0.12)	(2.71)	(2.16)	(3.21)	(4.16)	(1.05)	(1.83)	(1.62)	(1.37)	(1.80)	(1.71)
q-factor+Mom	0.01	0.35	0.22	0.41	0.54	0.14	0.29	0.29	0.37	0.38	0.37
	(0.12)	(2.63)	(2.13)	(3.20)	(4.18)	(1.05)	(1.90)	(2.01)	(1.74)	(2.51)	(2.47)

Panel C: Monthly Sort on Average RNS over the Last Five Days of the Month, Monthly Holding, Value Weight Monthly Return

	Low	2	3	4	5	6	7	8	9	High	High-Low
Raw Return	0.59	0.82	0.74	0.99	1.06	0.77	0.96	0.79	1.16	1.17	0.57
	(2.13)	(2.67)	(2.32)	(2.75)	(2.91)	(2.09)	(2.52)	(2.05)	(3.13)	(3.77)	(2.91)
FF5+Mom	–0.10	0.03	–0.04	0.21	0.33	–0.05	0.10	–0.10	0.26	0.22	0.32
	(–0.96)	(0.26)	(–0.48)	(1.92)	(2.71)	(–0.38)	(0.51)	(–0.69)	(2.12)	(2.18)	(2.06)
q-factor	0.03	0.22	0.13	0.41	0.55	0.16	0.34	0.18	0.50	0.46	0.43
	(0.25)	(2.25)	(1.39)	(3.16)	(4.11)	(1.05)	(1.68)	(1.39)	(2.64)	(2.42)	(1.92)
q-factor+Mom	0.03	0.22	0.13	0.41	0.55	0.16	0.34	0.18	0.50	0.46	0.43
	(0.24)	(2.20)	(1.41)	(3.18)	(4.36)	(1.04)	(1.92)	(1.53)	(3.99)	(3.06)	(2.45)

Table IA.3: Fama-MacBeth Cross-Sectional Regressions with Existing Option Based Signals

This table presents the time-series average of the weekly cross-section regression coefficients. Panel A reports results for univariate setting that regresses stock excess return of week t+1 is regressed on the risk-neutral skewness (RNS) in week t, and other alternative option based signals, including RNS (column 1), IV_Skew (column 2), IV_Spread (Column 3), CP_Ratio (column 4) and RV-IV Spread (column 5). In Panel B column 1 to 4, reports bivariate setting that includes RNS and one existing option based signal, column 5 reports multivariate setting that includes all alternative option signals. Newey-West (1987) t-statistics are reported in parenthesis. The average adjusted R^2 is reported for each model specification in the last row. Models (1) and (2) use weekly excess returns as the dependent variable. Models (3) and (4) use risk-adjusted returns (with FF5+Mom, and q-factor+Mom as factor models, respectively) as the dependent variables.

Panel A: Univariate Results					
	1	2	3	4	5
RNS	0.125				
	(3.90)				
IV_Skew		–1.253			
		(6.55)			
IV_Spread			1.441		
			(7.37)		
CP_Ratio				0.001	
				(2.28)	
RV-IV Spread					–0.130
					(1.65)
Intercept	0.275	0.262	0.219	0.192	0.203
	(2.42)	(2.87)	(2.26)	(1.97)	(2.12)
Adjusted R^2 (%)	0.002	0.002	0.002	0.001	0.002
Panel B: Bivariate Results					
	1	2	3	4	5
RNS	0.044	0.075	0.101	0.106	0.043
	(2.45)	(4.61)	(6.23)	(6.02)	(2.33)
IV_Skew	–1.006				–0.330
	(–6.24)				(–1.69)
IV_Spread		1.460			1.771
		(8.05)			(6.33)
CP_Ratio			0.001		0.001
			(1.25)		(0.69)
RV-IV Spread				–0.102	–0.286
				(–1.44)	(–3.68)
Intercept	0.031	0.013	0.000	0.008	0.015
	(1.25)	(0.07)	(0.00)	(0.41)	(0.56)
Adjusted R^2 (%)	0.004	0.004	0.003	0.006	0.013

Table IA.4: Double Sort on Risk-Neutral Skewness and Other Option Signals

This table reports the value-weighted returns for portfolios formed by sorting on (i) RNS and implied volatility skew (IV_Skew) of Xing, Zhang and Zhao (2010) in Panel A, (ii) RNS and implied volatility spread (IV_Spread) of Cremers and Weinbaum (2010) in Panel B, and (iii) RNS and call-put volume ratio (CP_Ratio) of Pan and Poteshman (2006)in Panel C, and (iv) RNS and difference between realized and implied volatility (RV-IV) of Bollerslev, Tauchen, and Zhou (2009). At the end of the trading day on each Tuesday, stocks are independently sorted into quintiles based on RNS, and IV_Skew or IV_Spread or CP_Ratio or RV-IV Spread. Portfolio returns are calculated from Thursday of the sorting week to the following Wednesday. Also reported at the end of each panel are the differential returns and alphas between high and low RNS portfolios (RNS quintile 5 minus RNS quintile 1). Newey-West (1987) t-statistics are reported in parenthesis.

Panel A: RNS and IV_Skew

Portfolio Returns	IV_Skew Quintile 1	2	3	4	IV_Skew Quintile 5
RNS Quintile 1	0.100	0.146	0.138	0.126	0.052
	(1.12)	(2.11)	(1.82)	(1.64)	(0.60)
2	0.168	0.288	0.257	0.199	0.163
	(1.89)	(3.30)	(2.88)	(2.00)	(1.45)
3	0.214	0.285	0.230	0.187	0.115
	(2.20)	(2.98)	(2.27)	(1.72)	(0.95)
4	0.233	0.165	0.114	0.160	0.242
	(2.49)	(1.72)	(1.15)	(1.59)	(1.97)
RNS Quintile 5	0.288	0.268	0.073	0.199	0.318
	(3.19)	(2.77)	(0.72)	(1.75)	(3.28)
RNS Qintile 5-RNS Quintile 1	0.187	0.122	–0.065	0.073	0.266
	(2.36)	(1.71)	(–0.74)	(0.78)	(3.42)
Alpha FF5+Mom	0.219	0.139	–0.059	0.091	0.244
	(2.71)	(1.75)	(–0.77)	(0.92)	(2.95)
Alpha q-Factor+Mom	0.169	0.150	–0.061	0.134	0.248
	(2.01)	(1.87)	(–0.81)	(1.23)	(2.88)

Panel B: RNS and IV_Spread					
Portfolio Returns	IV_Spread Quintile 1	2	3	4	IV_Spread Quintile 5
RNS Quintile 1	0.067	0.105	0.119	0.154	0.054
	(0.72)	(1.35)	(1.56)	(1.97)	(0.58)
2	0.205	0.244	0.205	0.260	0.251
	(1.75)	(2.65)	(2.34)	(2.95)	(2.36)
3	0.108	0.247	0.246	0.281	0.197
	(0.84)	(2.51)	(2.71)	(2.84)	(1.79)
4	0.139	0.154	0.199	0.237	0.288
	(1.10)	(1.58)	(2.32)	(2.63)	(2.59)
RNS Quintile 5	0.190	0.201	0.210	0.280	0.382
	(1.86)	(2.20)	(2.50)	(3.09)	(3.91)
RNS Qintile 5-RNS Quintile 1	0.123	0.096	0.091	0.126	0.329
	(1.76)	(1.44)	(1.51)	(1.75)	(4.20)
Alpha FF5+Mom	0.109	0.092	0.079	0.109	0.325
	(1.68)	(1.33)	(1.30)	(1.52)	(4.73)
Alpha q-Factor+Mom	0.113	0.111	0.121	0.082	0.262
	(1.84)	(1.52)	(1.89)	(1.22)	(3.67)

Panel C: RNS and CP_Ratio					
Portfolio Returns	CP_Ratio Quintile 1	2	3	4	CP_Ratio Quintile 5
RNS Quintile 1	0.153	0.115	0.077	0.094	0.133
	(1.71)	(1.33)	(1.06)	(1.34)	(2.10)
2	0.185	0.237	0.222	0.199	0.207
	(1.85)	(2.48)	(2.41)	(2.38)	(2.59)
3	0.140	0.280	0.161	0.210	0.292
	(1.40)	(2.66)	(1.58)	(2.25)	(3.40)
4	0.184	0.201	0.217	0.182	0.209
	(1.87)	(1.99)	(2.20)	(1.90)	(2.37)
RNS Quintile 5	0.219	0.385	0.255	0.307	0.271
	(2.48)	(3.89)	(2.58)	(3.50)	(3.21)
RNS Qintile 5-RNS Quintile 1	0.066	0.270	0.178	0.214	0.138
	(1.12)	(3.88)	(2.53)	(3.58)	(2.62)
Alpha FF5+Mom	0.055	0.277	0.181	0.221	0.129
	(0.97)	(3.69)	(2.48)	(3.81)	(2.58)
Alpha q-Factor+Mom	0.039	0.302	0.181	0.237	0.127
	(0.67)	(3.79)	(2.67)	(4.02)	(2.85)

Panel D: RNS and RV-IV Spread					
Portfolio Returns	RV-IV Spread Quintile 1	2	3	4	RV-IV Spread Quintile 5
RNS Quintile 1	0.214	0.231	0.132	0.026	0.030
	(2.08)	(2.97)	(1.84)	(0.31)	(0.30)
2	0.335	0.336	0.188	0.191	0.168
	(2.95)	(3.63)	(2.33)	(2.08)	(1.42)
3	0.272	0.234	0.268	0.247	0.135
	(2.31)	(2.48)	(3.05)	(2.53)	(1.06)
4	0.232	0.323	0.178	0.197	0.123
	(2.10)	(3.60)	(2.08)	(2.07)	(0.93)
RNS Quintile 5	0.462	0.254	0.264	0.251	0.193
	(4.32)	(2.97)	(2.98)	(3.05)	(1.74)
RNS Qintile 5-RNS Quintile 1	0.248	0.023	0.132	0.226	0.164
	(2.89)	(0.36)	(2.33)	(4.24)	(2.17)
Alpha FF5+Mom	0.235	0.031	0.120	0.200	0.163
	(2.55)	(0.50)	(1.92)	(4.03)	(2.07)
Alpha q-Factor+Mom	0.247	0.049	0.110	0.217	0.130
	(2.51)	(0.81)	(1.94)	(4.26)	(1.68)

Table IA.5 Corner Portfolios Performance of Double Sort on Risk-Neutral Skewness and Other Option Signals

This table reports the corner portfolio returns formed by sorting on (i) RNS and implied volatility skew (IV_Skew) of Xing, Zhang, and Zhao (2010), (ii) RNS and implied volatility spread (IV_Spread) of Cremers and Weinbaum (2010), (iii) RNS and call-put volume ratio (CP_Ratio) of Pan and Poteshman (2006), and (iv) difference between realized and implied volatility (RV-IV) of Bollerslev, Tauchen, and Zhou (2009). The corner portfolios are implemented with long and short positions based on the direction of return prediction. Specifically, these corner portfolios are based on (i) long RNS quintile five and IV_Skew quintile one, and short RNS quintile one and IV_Skew quintile five, (ii) long RNS quintile five and IV_Spread quintile five, and short RNS quintile one and IV_Spread quintile one, (iii) long RNS quintile five and CP_Ratio quintile five, and short RNS quintile one and CP_Ratio quintile one, and (iv) long RNS quintile five and RV-IV Spread quintile one, and short RNS quintile one and RV-IV Spread quintile five. Alphas are estimated using (i) the Fama-French (2015) five factors and the momentum factor (FF5+Mom), (ii) the q-factor model of Hou, Xue and Zhang (2014) (q-factor), and (iii) the q-factor model plus the momentum factor (q-factor+Mom), and Stambaugh and Yuan (2016) mispricing factors. Newey-West (1987) t-statistics are reported in parenthesis.

	Raw	Alpha FF5+Mom	Alpha Q-Factors+Mom	Alpha Mispricing Factors
RNS and IV_Skew	0.24	0.23	0.23	0.20
	(3.49)	(3.41)	(3.44)	(2.90)
RNS and IV_Spread	0.32	0.31	0.32	0.34
	(4.94)	(4.91)	(5.26)	(5.35)
RNS and CP_Ratio	0.12	0.10	0.10	0.07
	(2.36)	(2.58)	(2.65)	(2.07)
RNS and RV-IV Spread	0.43	0.41	0.43	0.35
	(4.65)	(4.48)	(4.61)	(3.57)

Table IA.6: Risk-neutral Skewness Return Predictability and News Release-Controlling for Existing Option Signals

This table presents coefficient estimates from weekly Fama-MacBeth cross-sectional regressions. Using the RavenPack news database, we use a news dummy (ND) variable to capture the arrival of news releases. ND for a firm equals one if there is at least one news release for that firm with RavenPack both relevance and novelty scores of 100 during week t+1. The stock return of week t+1 is regressed on the NewDummy in week t+1, RNS in week t, and an interaction term of RNS and ND, after controlling for all firm characteristics as in Table 3. To ascertain incremental RNS return predictability, we also include IV_Skew, IV_Spread, CP_Ratio, and RV-IV Spread and interaction terms with ND. All control variables from Table 3 are included. The average adjusted R^2 is the time-series average of the cross-sectional adjusted R^2. Newey-West (1987) t-statistics are reported in parenthesis.

Panel A: All news releases	Excess Return Univariate	Excess Return	FF5+Mom	Q-factor+Mom
ND	0.156	0.174	0.167	0.162
	(4.00)	(4.81)	(4.78)	(4.56)
RNS	0.002	0.035	0.028	0.037
	(0.06)	(1.44)	(1.21)	(1.58)
RNS*ND	**0.115**	**0.105**	**0.106**	**0.104**
	(3.30)	**(3.12)**	**(3.10)**	**(3.03)**
IV_Skew	–0.507	–0.383	–0.293	–0.422
	(–1.49)	(–1.37)	(–1.11)	(–1.58)
IV_Skew*ND	–0.040	0.116	0.097	0.079
	(–0.10)	(0.30)	(0.26)	(0.21)
IV_Spread	1.027	0.273	0.392	0.326
	(2.30)	(0.62)	(0.87)	(0.73)
IV_Spread*ND	0.643	0.957	0.848	0.859
	(1.02)	(1.55)	(1.34)	(1.37)
CP_Ratio	0.000	–0.003	–0.002	–0.002
	(0.09)	(–1.00)	(–0.64)	(–0.68)
CP_Ratio*ND	–0.003	0.000	–0.001	0.000
	(–0.88)	(0.02)	(–0.39)	(–0.05)
RV-IV Spread	–0.192	–0.190	–0.169	–0.217
	(–1.53)	(–1.52)	(–1.41)	(–1.85)
(RV-IV Spread)*ND	0.062	0.170	0.195	0.183
	(0.40)	(1.01)	(1.17)	(1.08)
Adjusted R^2 (%)	1.8%	8.1%	4.2%	4.6%

Internet Appendix B: Robustness

In this appendix, we discuss the robustness results in detail. The robustness tests include:

1. The impact of trading frictions and/or limits-to-arbitrage on the RNS-return relation.
2. The impact of non-linearities in illiquidity, co-skewness, reversals, and risk neutral volatility on the return-RNS relation.
3. The impact of short selling.
4. The RNS-return relation across the various formation and holding periods.

1.1 Trading frictions

We have documented a significant positive relation between RNS and subsequent stock returns in the cross-section. Without market frictions, this relation creates profitable trading opportunities. Moreover, Shleifer and Vishny (1997) argue that arbitrage is both risky and costly and thus likely to be limited. The positive RNS-return relation may reflect the fact that stock price adjustments are slow due to trading frictions or limits-to-arbitrage. In this subsection, we investigate whether trading frictions and limits-to-arbitrage impact the results.

To capture trading frictions, we use idiosyncratic volatility (Ivol) as a proxy for arbitrage risk, and the Amihud (2002) illiquidity measure (ILLIQ) proxies for illiquidity. We split the overall sample into sub-groups based on Ivol and ILLIQ, and then compare the RNS-return relation across these sub-groups. If trading frictions and limits-to-arbitrage drive the positive RNS-return relation, we expect that the relation exists mainly for stocks with high Ivol and high ILLIQ.

Panel A of Table IB.1 reports results for different Ivol portfolios. Every week, we split the overall sample based on the prior month Ivol into low and high Ivol subgroups. Within each Ivol subgroup, we then sort stocks into quintile RNS portfolios and track the subsequent week returns for each quintile portfolio. The return difference between the High and Low RNS portfolios is 17 bps for the stocks with high Ivol, compared with 14 bps for stocks with low Ivol. The alphas, when adjusting with the FF5+Mom (q-factor+Mom) factors are 17 (18) bps with a t-statistic of 2.28 (2.41) for the high Ivol portfolios and 12 (13) bps with at t-statistic of 3.42 (3.67) for the low Ivol portfolios.

Likewise, Panel B of Table IB.1 reports results for different ILLIQ portfolios. For the high ILLIQ portfolio, the alpha differential between the high and low RNS portfolios using FF5+Mom (q-factor+Mom) is 22 (23) bps, while for the low ILLIQ portfolio the corresponding alphas are 13 (14) bps per week. Even though the alphas are 30% to 40% lower in the low Ivol/ILLIQ portfolios than the high Ivol/ILLIQ portfolios, the coefficients are statistically significant for all sets of portfolios.

Panels A and B of Table IB.2 present Fama-MacBeth regression coefficients on RNS for the different Ivol and ILLIQ subgroups, respectively. The overall sample is partitioned into high, median, and low subgroups based on the 30^{th} and the 70^{th} percentiles of Ivol or ILLIQ. The RNS coefficient estimates are significant for both the high and the low Ivol/ILLIQ stocks in both panels. This result is robust across different model specifications. With FF5+Mom for risk-adjusted returns in Panel A, the RNS coefficients are 0.06 (t-statistic = 6.07), 0.11 (t-statistic = 7.12), and 0.15 (t-statistic = 5.52) for the low, median, and high Ivol groups, respectively. The difference in RNS coefficients between the high and low Ivol groups is 0.09 (t-statistic = 3.35). The results for ILLIQ in Panel B are qualitatively similar, with the high ILLIQ group having a significantly higher RNS coefficient.

Overall, the results indicate that the positive RNS-return relation is more pronounced for stocks with higher idiosyncratic volatility and higher illiquidity. However, the RNS-return relation remains significant for stocks with low limits-to-arbitrage and low illiquidity as well, indicating that the limits-to-arbitrage and illiquidity, while an important driver in the return-RNS relation, cannot fully account for it.

1.2 Potential non-linearities

We have controlled for a set of cross-sectional return predictors in Fama-MacBeth cross-sectional regression that imposes a linear relation between returns and explanatory variables. In this section, we control for potential non-linearities, and show that the positive RNS-return relation is not driven by the well-known correlations between stock returns and (i) illiquidity (ILLIQ), (ii) coskewness (CoSkew), (iii) return reversal (Ret1), and (iv) risk neutral volatility (RNV).

We double sort stocks into portfolios by RNS and either ILLIQ, CoSkew, Ret1, or RNV. While all these variables are included in the Fama-MacBeth regressions as controls, double sorts allow for non-linear relations between these variables and returns. At the end of the trading day on each Tuesday, stocks are independently sorted into quintiles based on RNS and either ILLIQ, CoSkew, Ret1, or RNV. Returns of these 25 portfolios are then calculated from Thursday of the sorting week to the following Wednesday.

Panels A, B, C, and D of Table IB.3 report the raw returns (and t-statistics) of the 25 portfolios double sorted on RNS and ILLIQ, RNS and CoSkew, RNS and Ret1, and RNS and RNV, respectively. The returns on the quintile portfolios formed on ILLIQ, CoSkew, Ret1, and RNV increase with RNS such that the returns on the high RNS portfolio exceed that of the low RNS portfolio in each of the 20 cases. For each quintile portfolio sorted on RNS, we then average across the five portfolios formed on ILLIQ, CoSkew, Ret1, and RNV, resulting in RNS portfolios that control for each of the four characteristics. For example, the average raw and FF5+Mom adjusted returns on the ILLIQ-controlled long-short RNS portfolio amounts to 20 bps per week. The q-factor+Mom (mispricing factors) adjusted long-short RNS portfolio alphas amount to 21 (23) bps per week. We obtain similar returns for long-short RNS portfolios upon controlling for CoSkew, Ret1, and RNV. The results indicate that the positive RNS-return relation is not driven by non-linearities in illiquidity, co-skewness, return reversals, and risk-neutral volatility.

1.3 Short-selling

Next, we address a potential concern that the positive RNS-return relation is driven by informed short selling rather than informed options trading. Informed traders can reveal their negative private information by either buying put options or short selling. Informed put buying will lead put options market makers to quickly short sell in the equity market to hedge their written put positions.[1] In either case, the positive relation between RNS and future returns may exist. Hence, we examine whether the positive RNS-return relation holds among portfolios with different levels of short interest to verify our proposed informed options trading channel.[2]

Specifically, we independently double sort stocks into 25 portfolios based on RNS and either the short interest ratio (SHORT) or the change in the short interest ratio (ΔSHORT). SHORT is the percentage of short interest relative to the total number of common shares outstanding. The short interest data from Compustat refers to positions held short as of settlement date on the 15th business day of each month. Thus, on each short interest settlement day *t*, we sort stocks into quintiles based on SHORT, and the average RNS over five days from

[1] Hu (2014) shows that option market makers hedging activities induce stock order imbalance which predicts subsequent stock returns.

[2] Note that Panel A of Table 2 shows that the low RNS decile portfolio yields a positive but insignificant risk-adjusted return. Figure 3 also shows that low RNS decile stocks are perceived as undervalued rather than overvalued, compared with high RNS decile stocks. These results have indicated that the low RNS stocks are less likely to attract short sellers.

t−4 to t. We then skip one day and calculate returns during the following week (Panels A and C of Table IB.4) or the following month (Panels B and D) for each of 25 intersecting portfolios.

The positive RNS-return relation obtains in each of the 25 portfolios formed by sorting on SHORT or ΔSHORT. As before, for each quintile portfolio sorted on RNS, we average across the five SHORT or ΔSHORT portfolios, resulting in RNS portfolios controlling for SHORT or ΔSHORT. In all Panels, the differential returns and alphas between the high and the low RNS portfolio remain economically large and statistically significant. For example, the risk-adjusted alphas with FF5+Mom are 13 bps per week (Panel A) and 65 bps per month (Panel B), respectively.

1.4 Various formation and holding periods

Our main findings have shown a strong and positive cross-sectional relation between RNS and the subsequent week's stock return. We now investigate longer-term return predictability by experimenting with different permutations of the formation and holding periods. The formation and the holding periods are both extended from one week to two, …, to thirteen weeks. We estimate 169 different strategies with m-week formation periods and n-week holding periods ([*m*, *n*]). This set of analysis allows us to address the conflicting results in the literature that adopt different frequencies of analysis. Essentially, the strategy [1, 1] is our main analysis of the weekly formation and weekly holding periods. The [4, 4] strategy represents the monthly formation and monthly holdings of Stilger, Kostakis, and Poon (2017). The [13, 13] strategy is the quarterly formation and quarterly holdings as in Conrad, Dittmar, and Ghysels (2013). For holding periods longer than one week, we form calendar time portfolios to avoid the impact on inferences due to the serial correlation caused by overlapping returns.

Table IB.5 presents the long-short returns for the High-Low RNS portfolios. Panel A reports the results for the full sample from January 1996 to June 2015. Panels B and C report the subsample results for the periods from January 1996 to December 2005 and from January 2006 to June 2015, respectively. The first subsample corresponds to that in Conrad, Dittmar, and Ghysels (2013).

In Panel A, for every holding period, the RNS return predictability persists beyond the one-week horizon and stays economically and statistically significant until thirteen weeks. For the [1, 13] strategy with a one-week formation period and a holding period of 13 weeks, the High-Low RNS portfolio return is 14 basis points per week or 7.28 per year. The RNS return predictability decreases almost monotonically with the holding period. For the shorter holding periods, the return predictability decreases with the formation period as well. For instance, the High-Low RNS portfolio return reduces from 27 bps per week for the [1, 1] portfolio to 15 bps for the [13, 1] portfolio. The [4, 4] strategy which corresponds to a monthly formation and holding period has a High-Low RNS portfolio return of 16 bps per week. The return for the [13, 13] strategy, which corresponds to the quarterly holding and formation period, has a return of 13 bps per week.

Panel B of Table IB.5 shows that the long-short portfolio returns are statistically significant at the 5% level for the short formation. Once the formation period is extended, the significant results only exist for shorter holding periods. For instance, the [7, 1] strategy has a significant return of 16 bps per week but the [7, 7] strategy does not provide a statistically significant return. Similarly, the [13, 1] strategy has a significant return of 16 bps per week, but the [13, 4] strategy is no longer significant. However, the returns in the second subsample in Panel C are statistically and economically significant for all formation and holding periods. The returns are higher during the earlier subsample in Panel B for the shorter formation and holding periods. For instance, the return for the [1, 1] strategy is 22 bps per week for the earlier subsample, but for the [13, 13] strategy the return is an insignificant 10 bps per week for the earlier subsample. The pattern is less prominent in Panel C for the later subsample.

Tables IB.6, IB.7, and IB.8 report the alphas obtained from a time-series regression of the long-short RNS portfolios returns on the Fama-French (2015) factors plus the momentum factor (FF5+Mom), Hou, Xue, and Zhang (2015) factors plus the momentum factor (q-factor+Mom), and the mispricing factors of Stambaugh and Yuan (2016), respectively. Regardless of the choice of the factor model, the results are similar to those reported in Table IB.5.[3]

In sum, there is a strong and robust positive relation between RNS and the cross-section of stock returns at the weekly frequency. For the overall sample, the return predictability is present for all formation and holding periods up to 13 weeks. However, for the longer formation and holding periods, the RNS-return relation is not robust during the early subsample, from

[3] Over the full sample, the risk-adjusted alphas using the FF5+Mom factors amount to 28 bps (t-statistic = 6.12), 24 bps (t-stattistic = 5.52), 23 bps (t-statistic = 5.27) and 20 bps (t-statistic = 4.81), per week for weekly formation and holding portfolio for one-week, two-weeks, three-weeks, and four-weeks, respectively. With the q-factor+Mom factors, the corresponding numbers are 30 bps (t-statistic = 6.63), 26 bps (t-statistic = 6.08), 24 bps (t-statistic = 5.8), and 22 bps (t-statistic = 5.31), respectively. With the Stambaugh and Yuan (2017) mispricing factors, these numbers are 29 bps (t-statistic = 8.21), 25 bps (t-statistic = 7.71), 23 bps (t-statistic = 7.38), and 21 bps (t-statistic = 6.77), respectively.

January 1996 to June 2005. In particular, in unreported results, we form non-overlapping portfolios and find that the return to the [13, 13] strategy is an insignificant 10 bps per week in the first half of the sample. Further, the return to the [13, 13] strategy is negative, albeit insignificantly so, over the sample period 1996-1999 as in Conrad, Dittmar, and Ghysels (2013).

Table IB.1: The Impact of Trading frictions on RNS-Return Relation

Each Tuesday, the overall sample is first split into low and high groups based on idiosyncratic volatility (Ivol) in Panel A, or the Amihud (2002) illiquidity measure (ILLIQ) in Panel B, calculated over the past month. Then, stocks are sorted into quintile portfolios based on the average level of RNS from the previous Wednesday to Tuesday. Quintile 1 contains stocks with the lowest RNS stocks, and quintile 5 contains stocks with the highest RNS. Equally-weighted portfolios are formed and held from Thursday to Wednesday of the following week. The table reports the average portfolio Ivol or ILLIQ, the average RNS, average weekly return, alphas with respect to the Fama-French (2015) factors plus the momentum factor (FF5+Mom), and alphas with respect to the Hou, Xue, and Zhang (2015) factors plus the momentum factor (q-factor+Mom). Newey-West (1987) t-statistics (in parenthesis) for the alphas are reported for each decile portfolio as well as for the long-short portfolio (High-Low).

Panel A: Quintile Portfolio Sort by RNS on Subsample split by Ivol

	Low Ivol Subsample						High Ivol Subsample					
	Low	2	3	4	High	High-Low	Low	2	3	4	High	High-Low
Mean Ivol	0.013	0.015	0.015	0.015	0.015		0.033	0.035	0.037	0.038	0.037	
Mean RNS	–1.384	–0.835	–0.597	–0.324	1.22		–0.984	–0.605	–0.398	–0.155	0.606	
Mean Ret	0.108	0.204	0.225	0.244	0.245	0.138	0.089	0.248	0.190	0.168	0.259	0.170
	(1.53)	(2.70)	(2.91)	(3.29)	(3.45)	(3.71)	(0.77)	(1.91)	(1.41)	(1.24)	(2.16)	(2.21)
FF5+Mom	0.128	0.222	0.233	0.254	0.250	0.123	0.131	0.308	0.255	0.225	0.301	0.171
	(1.93)	(3.12)	(3.15)	(3.60)	(3.62)	(3.42)	(1.19)	(2.66)	(2.08)	(1.70)	(2.49)	(2.28)
q-factor+Mom	0.146	0.242	0.251	0.274	0.273	0.128	0.155	0.328	0.282	0.262	0.337	0.182
	(2.34)	(3.57)	(3.55)	(4.11)	(4.17)	(3.67)	(1.49)	(3.01)	(2.47)	(2.12)	(2.87)	(2.41)

Panel B: Quintile Portfolio Sort by RNS on Subsample split by Amihud Illiquidity

	Low ILLIQ Subsample						High ILLIQ Subsample					
	Low	2	3	4	High	High-Low	Low	2	3	4	High	High-Low
Mean ILLIQ	0.008	0.009	0.01	0.011	0.013		0.336	0.309	0.399	0.488	0.765	
Mean RNS	–1.336	–0.825	–0.624	–0.416	0.929		–1.035	–0.569	–0.332	–0.057	0.81	
Mean Ret	0.107	0.216	0.221	0.206	0.239	0.132	0.098	0.151	0.169	0.232	0.311	0.213
	(1.46)	(2.54)	(2.45)	(2.33)	(3.10)	(3.20)	(1.10)	(1.42)	(1.48)	(2.00)	(3.01)	(5.47)
FF5+Mom	0.130	0.245	0.248	0.230	0.257	0.128	0.116	0.179	0.208	0.266	0.333	0.217
	(1.89)	(3.13)	(2.98)	(2.73)	(3.40)	(3.05)	(1.33)	(1.81)	(1.93)	(2.35)	(3.18)	(4.94)
q-factor+Mom	0.148	0.264	0.268	0.258	0.284	0.136	0.137	0.200	0.232	0.298	0.367	0.230
	(2.29)	(3.57)	(3.43)	(3.27)	(3.92)	(3.34)	(1.65)	(2.12)	(2.26)	(2.74)	(3.61)	(5.17)

Table IB.2: Fama-MacBeth Regressions in Trading Frictions Subsamples

Firms are classified into low, median, and high trading frictions groups based on the 30th and 70th percentile idiosyncratic volatility (Ivol) in Panel A, or the Amihud illiquidity measure (ILLIQ) in Panel B, calculated over the past month. This table reports the coefficient estimates on RNS from weekly Fama-MacBeth regressions for each Ivol and ILLIQ subsample as well as the difference in the coefficient estimates between high and low Ivol or ILLIQ groups. Newey-West (1987) adjusted t-statistics are in parenthesis. All the controls as in Table 3 have been included in the regressions

Panel A: Fama-MacBeth coefficient estimates on RNS -- Ivol Subsample			
	Excess Returns	FF5+Mom	q-factor+Mom
Low Ivol	0.056	0.058	0.059
	(5.69)	(6.07)	(6.15)
Median Ivol	0.106	0.114	0.110
	(7.16)	(7.12)	(7.10)
High Ivol	0.159	0.152	0.157
	(5.40)	(5.52)	(5.63)
High-Low	0.102	0.093	0.098
	(3.55)	(3.35)	(3.55)
Panel B: Fama-MacBeth coefficient estimates on RNS -- ILLIQ Subsample			
	Excess Returns	FF5+Mom	q-factor+Mom
Low ILLIQ	0.093	0.076	0.087
	(5.39)	(4.46)	(5.48)
Median ILLIQ	0.107	0.117	0.116
	(6.76)	(6.97)	(7.02)
High ILLIQ	0.137	0.136	0.137
	(7.63)	(8.20)	(8.21)
High- ILLIQ	0.045	0.060	0.049
	(1.96)	(2.74)	(2.29)

Table IB.3: Robustness Check – Potential Non-Linearities

This table reports the portfolio returns formed by sorting on (i) RNS and ILLIQ in Panel A, (ii) RNS and CoSkew in Panel B, and (iii) RNS and Ret1 in Panel C. At the end of the trading day on each Tuesday, stocks are independently sorted into quintiles based on RNS, and ILLIQ or CoSkew or Ret1. Portfolio returns are calculated from Thursday of the sorting week to the following Wednesday. Also reported at the end of each panel are the differential returns and alphas between high and low RNS portfolios (RNS quintile 5 minus RNS quintile 1). The RNS quintile 5 and quintile 1 returns are calculated as average returns across the five intersecting portfolios formed by sorting on the variables ILLIQ, CoSkew, and Ret1. Newey-West (1987) t-statistics are reported in parenthesis.

Panel A: RNS and ILLIQ

Portfolio Returns	ILLIQ Quintile 1	2	3	4	ILLIQ Quintile 5
RNS Quintile 1	0.10	0.14	0.12	0.04	0.02
	(1.42)	(1.74)	(1.38)	(0.43)	(0.20)
2	0.22	0.21	0.18	0.14	0.09
	(2.60)	(2.12)	(1.78)	(1.23)	(0.76)
3	0.22	0.21	0.21	0.18	0.10
	(2.53)	(2.03)	(1.91)	(1.55)	(0.79)
4	0.23	0.23	0.25	0.23	0.19
	(2.54)	(2.34)	(2.41)	(1.94)	(1.49)
RNS Quintile 5	0.24	0.27	0.35	0.28	0.29
	(2.87)	(3.26)	(3.94)	(2.58)	(2.53)

	Raw	Alpha FF5+Mom	Alpha q-Factor+Mom	Alpha Mispricing Factors
High RNS-Low RNS	0.20	0.20	0.21	0.23
	(6.81)	(6.18)	(6.49)	(6.75)

Panel B: RNS and COSKEW

Portfolio Returns	CoSkew Quintile 1	2	3	4	CoSkew Quintile 5
RNS Quintile 1	0.05	0.00	0.11	0.14	0.14
	(0.57)	(0.04)	(1.68)	(1.64)	(1.31)
2	0.14	0.19	0.17	0.22	0.23
	(1.43)	(2.37)	(2.32)	(2.22)	(1.89)
3	0.18	0.20	0.18	0.25	0.23
	(1.65)	(2.38)	(2.27)	(2.48)	(1.67)
4	0.13	0.24	0.26	0.23	0.20
	(1.22)	(3.01)	(3.26)	(2.20)	(1.46)
RNS Quintile 5	0.20	0.23	0.29	0.26	0.34
	(2.15)	(3.15)	(3.67)	(2.81)	(2.71)

	Raw	Alpha FF5+Mom	Alpha q-Factor+Mom	Alpha Mispricing Factors
High RNS-Low RNS	0.18	0.18	0.19	0.18
	(4.56)	(4.46)	(4.68)	(5.03)

Panel C: RNS and Ret1

Portfolio Returns	Ret1 Quintile 1	2	3	4	Ret5 Quintile 5
RNS Quintile 1	0.24	0.16	0.14	0.07	0.00
	(2.02)	(1.78)	(1.73)	(0.90)	(0.02)
2	0.35	0.28	0.24	0.14	0.05
	(2.76)	(2.91)	(2.79)	(1.63)	(0.49)
3	0.38	0.36	0.25	0.14	–0.01
	(2.84)	(3.75)	(2.73)	(1.55)	(–0.08)
4	0.36	0.24	0.23	0.20	0.05
	(2.67)	(2.52)	(2.57)	(2.19)	(0.39)
RNS Quintile 5	0.42	0.32	0.25	0.13	0.09
	(3.43)	(3.54)	(2.98)	(1.51)	(0.80)

	Raw	Alpha FF5+Mom	Alpha q-Factor+Mom	Alpha Mispricing Factors
High RNS-Low RNS	0.12	0.12	0.13	0.11
	(3.02)	(2.91)	(3.16)	(2.93)

Panel D: RNS and RNV

Portfolio Returns	RNV Quintile 1	2	3	4	RNV Quintile 5
RNS Quintile 1	0.09	0.15	0.16	0.15	–0.19
	(1.46)	(1.60)	(1.40)	(1.01)	(–1.04)
2	0.17	0.27	0.21	0.32	0.14
	(2.67)	(2.88)	(1.75)	(2.08)	(0.71)
3	0.24	0.19	0.31	0.18	0.09
	(3.66)	(2.10)	(2.59)	(1.19)	(0.44)
4	0.23	0.20	0.28	0.16	0.17
	(3.65)	(2.31)	(2.48)	(1.08)	(0.84)
RNS Quintile 5	0.24	0.29	0.26	0.29	0.18
	(3.85)	(3.52)	(2.69)	(2.11)	(1.02)

	Raw	Alpha FF5+Mom	Alpha q-Factor+Mom	Alpha Mispricing Factors
High RNS-Low RNS	0.18	0.16	0.17	0.17
	(3.48)	(3.16)	(3.25)	(3.24)

Table IB.4: RNS-Return Relation and Short Interest

This table reports the portfolio returns formed by sorting on (i) RNS and the relative short interest (SHORT) in Panels A and B and (ii) RNS and the change of SHORT (ΔSHORT) in Panels C and D. SHORT is defined as the percentage of short interest relative to total number of common shares outstanding. The short interest data from Compustat refers to positions held short as of settlement date on the 15th business day of each month. On each short interest settlement day *t*, we independently sort stocks into quintiles based on SHORT or ΔSHORT, and the average RNS over five days from *t–4 to t*. Then we skip one day and calculate returns during the following week (Panels A and C), or the following month (Panels B and D) for each of 25 portfolios. Also reported at the end of each panel are the differential returns and alphas between high and low RNS portfolios (RNS quintile 5 minus RNS quintile 1). The RNS quintile 5 and quintile 1 returns are calculated as average returns across the five intersecting portfolios formed by sorting on SHORT or ΔSHORT. Newey-West (1987) t-statistics are reported in parenthesis.

Panel A: Double sort on RNS and SHORT, one-week holding period returns

Portfolio Returns	SHORT Quintile 1	2	3	4	SHORT Quintile 5
RNS Quintile 1	–0.02	0.06	0.07	0.03	0.01
	(–0.13)	(0.47)	(0.51)	(0.22)	(0.06)
2	0.11	0.11	0.15	0.03	0.07
	(0.68)	(0.83)	(0.94)	(0.22)	(0.42)
3	0.16	0.17	0.04	0.15	–0.03
	(0.71)	(1.18)	(0.27)	(0.91)	(–0.15)
4	0.03	0.12	0.04	0.08	0.11
	(0.15)	(0.90)	(0.26)	(0.50)	(0.59)
RNS Quintile 5	0.21	0.06	0.12	0.13	0.16
	(1.25)	(0.47)	(0.82)	(0.87)	(0.90)

	Raw	Alpha FF5+Mom	Alpha q-Factor+Mom	Alpha Mispricing Factors
High RNS-Low RNS	0.11	0.13	0.14	0.15
	(2.76)	(2.34)	(2.23)	(2.12)

Panel B: Double sort on RNS and SHORT, one-month holding period returns					
Portfolio Returns	SHORT Quintile 1	2	3	4	SHORT Quintile 5
RNS Quintile 1	–0.02	0.12	0.34	0.07	0.14
	(–0.09)	(0.59)	(1.54)	(0.28)	(0.52)
2	0.25	0.48	0.53	0.41	0.28
	(0.88)	(2.31)	(2.16)	(1.56)	(0.91)
3	0.73	0.66	0.53	0.55	0.21
	(2.43)	(2.96)	(2.04)	(2.07)	(0.68)
4	0.79	0.50	0.52	0.43	0.38
	(2.18)	(1.97)	(1.91)	(1.54)	(1.18)
RNS Quintile 5	0.64	0.66	0.53	0.64	0.61
	(2.24)	(3.08)	(2.07)	(2.48)	(1.84)
	Raw	Alpha FF5+Mom	Alpha q-Factor+Mom	Alpha Mispricing Factors	
High RNS-Low RNS	0.48	0.65	0.61	0.53	
	(4.13)	(3.73)	(3.57)	(3.10)	

Panel C: Double sort on RNS and change of ΔSHORT, one-week holding period returns					
Portfolio Returns	SHORT Quintile 1	2	3	4	SHORT Quintile 5
RNS Quintile 1	–0.03	–0.06	–0.02	–0.05	–0.11
	(–0.21)	(0.45)	(0.14)	(–0.34)	(0.65)
2	0.02	0.04	0.10	0.02	0.11
	(0.74)	(1.01)	(0.65)	(0.82)	(0.70)
3	0.07	0.05	0.12	0.22	0.07
	(0.43)	(0.31)	(0.77)	(1.10)	(0.39)
4	0.04	0.17	0.11	–0.03	–0.02
	(0.24)	(1.04)	(0.65)	(–0.19)	(–0.10)
RNS Quintile 5	0.10	0.17	0.13	0.09	0.03
	(0.72)	(1.23)	(0.92)	(0.64)	(0.18)
	Raw	Alpha FF5+Mom	Alpha q-Factor+Mom	Alpha Mispricing Factors	
High RNS-Low RNS	0.15	0.13	0.16	0.18	
	(2.16)	(2.05)	(2.32)	(2.14)	

Panel D: Double sort on RNS and change of ΔSHORT, one-month holding period returns

Portfolio Returns	ΔSHORT Quintile 1	2	3	4	ΔSHORT Quintile 5
RNS Quintile 1	–0.12	0.18	0.11	0.08	0.15
	(–0.45)	(0.79)	(0.54)	(0.33)	(0.65)
2	0.39	0.63	0.28	0.33	0.26
	(1.47)	(2.73)	(1.19)	(1.32)	(0.99)
3	0.51	0.65	0.63	0.57	0.25
	(1.88)	(2.49)	(2.38)	(2.23)	(0.95)
4	0.40	0.61	0.94	0.53	0.17
	(1.36)	(1.89)	(3.10)	(1.97)	(0.56)
RNS Quintile 5	0.57	0.81	0.41	0.61	0.34
	(2.25)	(3.27)	(1.58)	(2.54)	(1.17)

	Raw	Alpha FF5+Mom	Alpha q-Factors+Mom	Alpha Mispricing Factors
High RNS-Low RNS	0.47	0.63	0.58	0.47
	(3.71)	(3.51)	(3.30)	(2.76)

Table IB.5: Predictability of Risk-neutral Skewness Portfolios with Various Formation and Holding Periods

This table reports the average percentage weekly return differential between the decile 10 (the highest RNS) and decile 1 (the lowest RNS) portfolios with various formation and holding periods. Consider the one-week formation period and a one-week holding period, the [1,1] portfolio. Every Tuesday, the sample stocks are sorted into decile portfolios based on average RNS during the formation period (Wednesday to Tuesday). We then hold the portfolio from Thursday to the subsequent Wednesday. The [m,n] portfolio is formed similarly with stocks sorted based on average RNS over m weeks ending on a Tuesday and held over n weeks starting on Thursday following the formation period. We always skip one day between the formation and holding periods. Calendar time portfolio returns are computed for overlapping portfolios when holding periods are longer than a week. Panel A reports results for the overall sample from January 1996 to June 2015. Panel B reports results for the first half of the sample period from January 1996 to December 2005. Panel C reports results for the second half of the sample period from January 2006 to June 2015. Bold numbers denote significance at the 5% level using Newey-West (1987) standard errors.

Panel A: Full Sample from January 1996 to June 2015

	Holding Period												
Formation Period	1-week	2-weeks	3-weeks	4-weeks	5-weeks	6-weeks	7-weeks	8-weeks	9-weeks	10-weeks	11-weeks	12-weeks	13-weeks
1-week	**0.17**	**0.15**	**0.14**	**0.14**	**0.14**	**0.14**	**0.15**	**0.15**	**0.15**	**0.14**	**0.14**	**0.14**	**0.14**
2-weeks	**0.12**	**0.12**	**0.12**	**0.13**	**0.13**	**0.13**	**0.14**	**0.14**	**0.14**	**0.13**	**0.13**	**0.13**	**0.13**
3-weeks	**0.15**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.15**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**
4-weeks	**0.13**	**0.13**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.13**	**0.13**	**0.13**	**0.13**
5-weeks	**0.12**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.13**	**0.13**	**0.13**	**0.13**
6-weeks	**0.14**	**0.15**	**0.15**	**0.15**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.13**
7-weeks	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**
8-weeks	**0.16**	**0.15**	**0.15**	**0.15**	**0.14**	**0.14**	**0.14**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**
9-weeks	**0.15**	**0.15**	**0.15**	**0.14**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**
10-weeks	**0.13**	**0.14**	**0.14**	**0.13**	**0.13**	**0.13**	**0.13**	**0.12**	**0.12**	**0.12**	**0.12**	**0.13**	**0.13**
11-weeks	**0.14**	**0.14**	**0.14**	**0.13**	**0.13**	**0.13**	**0.13**	**0.12**	**0.12**	**0.13**	**0.13**	**0.13**	**0.13**
12-weeks	**0.15**	**0.15**	**0.14**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**
13-weeks	**0.15**	**0.14**	**0.14**	**0.14**	**0.14**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**

Panel B: January 1996 to December 2005

Formation Period	Holding Period												
	1-week	2-weeks	3-weeks	4-weeks	5-weeks	6-weeks	7-weeks	8-weeks	9-weeks	10-weeks	11-weeks	12-weeks	13-weeks
1-week	**0.22**	**0.19**	**0.18**	**0.18**	**0.18**	**0.17**	**0.18**	**0.18**	**0.17**	**0.16**	**0.15**	**0.14**	**0.14**
2-weeks	**0.16**	**0.15**	**0.16**	**0.17**	**0.16**	**0.17**	**0.16**	**0.15**	**0.14**	**0.14**	**0.13**	**0.13**	**0.13**
3-weeks	**0.18**	**0.17**	**0.18**	**0.18**	**0.18**	**0.17**	**0.17**	**0.15**	**0.15**	**0.14**	**0.14**	**0.14**	**0.13**
4-weeks	**0.17**	**0.17**	**0.17**	**0.17**	**0.16**	**0.15**	**0.15**	**0.14**	**0.14**	**0.13**	**0.13**	**0.13**	**0.13**
5-weeks	**0.17**	**0.17**	**0.17**	**0.17**	**0.16**	**0.15**	**0.14**	**0.14**	**0.13**	**0.13**	**0.13**	0.13	0.13
6-weeks	**0.18**	**0.18**	**0.17**	**0.16**	**0.15**	**0.15**	**0.14**	**0.14**	**0.14**	**0.13**	0.13	0.13	0.13
7-weeks	**0.16**	**0.15**	**0.15**	**0.15**	**0.14**	**0.14**	0.14	0.13	0.13	0.13	0.13	0.12	0.12
8-weeks	**0.18**	**0.17**	**0.16**	**0.16**	**0.15**	**0.15**	0.14	0.13	0.13	0.13	0.13	0.13	0.12
9-weeks	**0.18**	**0.16**	**0.16**	**0.16**	**0.15**	0.15	0.14	0.13	0.13	0.12	0.12	0.12	0.12
10-weeks	**0.15**	**0.15**	**0.16**	**0.15**	**0.15**	0.15	0.14	0.13	0.13	0.12	0.12	0.12	0.11
11-weeks	**0.16**	**0.16**	**0.16**	0.15	0.15	0.14	0.13	0.13	0.12	0.12	0.12	0.12	0.11
12-weeks	**0.17**	**0.16**	**0.16**	0.15	0.15	0.14	0.13	0.13	0.12	0.12	0.12	0.11	0.11
13-weeks	**0.16**	**0.15**	**0.16**	0.16	0.15	0.14	0.14	0.13	0.12	0.12	0.12	0.11	0.10

Panel C: Subsample Period from January 2006 to June 2015													
	Holding Period												
Formation Period	1-week	2-weeks	3-weeks	4-weeks	5-weeks	6-weeks	7-weeks	8-weeks	9-weeks	10-weeks	11-weeks	12-weeks	13-weeks
1-week	**0.11**	**0.11**	**0.11**	**0.09**	**0.09**	**0.10**	**0.11**	**0.12**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**
2-weeks	**0.09**	**0.09**	**0.09**	**0.09**	**0.09**	**0.10**	**0.11**	**0.12**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**
3-weeks	**0.13**	**0.10**	**0.09**	**0.09**	**0.10**	**0.11**	**0.13**	**0.13**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**
4-weeks	**0.09**	**0.09**	**0.11**	**0.11**	**0.11**	**0.12**	**0.13**	**0.13**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**
5-weeks	**0.08**	**0.10**	**0.11**	**0.11**	**0.12**	**0.13**	**0.13**	**0.13**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**
6-weeks	**0.10**	**0.11**	**0.13**	**0.13**	**0.13**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**
7-weeks	**0.11**	**0.13**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.15**
8-weeks	**0.14**	**0.13**	**0.14**	**0.14**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.14**	**0.14**
9-weeks	**0.12**	**0.13**	**0.13**	**0.12**	**0.11**	**0.12**	**0.12**	**0.12**	**0.12**	**0.13**	**0.13**	**0.14**	**0.14**
10-weeks	**0.11**	**0.12**	**0.12**	**0.11**	**0.11**	**0.11**	**0.11**	**0.12**	**0.12**	**0.13**	**0.13**	**0.14**	**0.14**
11-weeks	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.11**	**0.12**	**0.12**	**0.13**	**0.13**	**0.14**	**0.14**	**0.15**
12-weeks	**0.13**	**0.13**	**0.12**	**0.12**	**0.11**	**0.12**	**0.12**	**0.13**	**0.13**	**0.14**	**0.15**	**0.15**	**0.15**
13-weeks	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.14**	**0.14**	**0.15**	**0.15**	**0.16**	**0.16**

Table IB.6: Alphas with respect to the Fama-French (2015) Factors plus the Momentum Factor

This table reports, for various formation and holding periods, alphas obtained from regressing the weekly return differential between the decile 10 (the highest RNS) and decile 1 (the lowest RNS) portfolios on the Fama-French (2015) factors plus the momentum factor. Consider the one-week formation period and a one-week holding period, the [1,1] portfolio. Every Tuesday, the sample stocks are sorted into decile portfolios based on average RNS during the formation period (Wednesday to Tuesday). We then hold the portfolio from Thursday to the subsequent Wednesday. The [m,n] portfolio is formed similarly with stocks sorted based on average RNS over m weeks ending on a Tuesday and held over n weeks starting on Thursday following the formation period. We always skip one day between the formation and holding periods. Calendar time portfolio returns are computed for overlapping portfolios when holding periods are longer than a week. Panel A reports results for the overall sample from January 1996 to June 2015. Panel B reports results for the first half of the sample period from January 1996 to December 2005. Panel C reports results for the second half of the sample period from January 2006 to June 2015. Bold numbers denote significance at the 5% level using Newey-West (1987) standard errors.

Panel A: Full Sample from January 1996 to June 2015

	Holding Period												
Formation Period	1-week	2-weeks	3-weeks	4-weeks	5-weeks	6-weeks	7-weeks	8-weeks	9-weeks	10-weeks	11-weeks	12-weeks	13-weeks
1-week	**0.16**	**0.13**	**0.13**	**0.12**	**0.12**	**0.12**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.12**	**0.12**
2-weeks	**0.11**	**0.10**	**0.11**	**0.11**	**0.11**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.11**
3-weeks	**0.14**	**0.12**	**0.12**	**0.12**	**0.12**	**0.13**	**0.13**	**0.13**	**0.13**	**0.12**	**0.12**	**0.12**	**0.12**
4-weeks	**0.11**	**0.11**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**
5-weeks	**0.10**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**
6-weeks	**0.12**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**
7-weeks	**0.12**	**0.12**	**0.13**	**0.13**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**
8-weeks	**0.14**	**0.13**	**0.13**	**0.13**	**0.12**	**0.12**	**0.12**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**
9-weeks	**0.13**	**0.13**	**0.13**	**0.12**	**0.12**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**
10-weeks	**0.11**	**0.12**	**0.12**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**
11-weeks	**0.12**	**0.12**	**0.12**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**
12-weeks	**0.13**	**0.13**	**0.12**	**0.12**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**
13-weeks	**0.13**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.11**	**0.11**	**0.12**	**0.12**	**0.12**	**0.11**

Panel B: January 1996 to December 2005

	Holding Period												
Formation Period	1-week	2-weeks	3-weeks	4-weeks	5-weeks	6-weeks	7-weeks	8-weeks	9-weeks	10-weeks	11-weeks	12-weeks	13-weeks
1-week	**0.20**	**0.16**	**0.15**	**0.16**	**0.15**	**0.15**	**0.15**	**0.15**	**0.14**	**0.13**	**0.12**	0.12	0.11
2-weeks	**0.14**	**0.12**	**0.13**	**0.14**	**0.13**	**0.14**	**0.14**	**0.12**	0.12	0.11	0.11	0.10	0.10
3-weeks	**0.15**	**0.14**	**0.15**	**0.15**	**0.14**	**0.14**	**0.14**	**0.13**	0.12	0.12	0.11	0.11	0.10
4-weeks	**0.13**	**0.14**	**0.14**	**0.14**	**0.13**	0.12	0.12	0.11	0.11	0.10	0.10	0.10	0.10
5-weeks	**0.13**	0.13	0.13	0.13	0.12	0.12	0.11	0.11	0.10	0.10	0.10	0.09	0.09
6-weeks	**0.15**	0.14	0.13	0.13	0.12	0.11	0.11	0.10	0.10	0.10	0.09	0.09	0.09
7-weeks	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.09	0.09
8-weeks	0.15	0.13	0.13	0.13	0.12	0.12	0.11	0.10	0.10	0.10	0.09	0.09	0.09
9-weeks	0.14	0.13	0.13	0.13	0.12	0.11	0.11	0.10	0.10	0.09	0.09	0.09	0.08
10-weeks	0.12	0.12	0.13	0.12	0.12	0.11	0.11	0.10	0.09	0.09	0.08	0.08	0.08
11-weeks	0.13	0.13	0.13	0.12	0.11	0.11	0.10	0.09	0.09	0.08	0.08	0.08	0.07
12-weeks	0.14	0.13	0.12	0.12	0.11	0.10	0.09	0.09	0.08	0.08	0.08	0.08	0.07
13-weeks	0.13	0.12	0.12	0.12	0.11	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.07

Panel C: Subsample Period January 2006 to June 2015													
	Holding Period												
Formation Period	1-week	2-weeks	3-weeks	4-weeks	5-weeks	6-weeks	7-weeks	8-weeks	9-weeks	10-weeks	11-weeks	12-weeks	13-weeks
1-week	**0.14**	**0.13**	**0.13**	**0.11**	**0.11**	**0.12**	**0.13**	**0.14**	**0.14**	**0.15**	**0.15**	**0.15**	**0.15**
2-weeks	**0.10**	**0.10**	**0.11**	**0.10**	**0.11**	**0.12**	**0.13**	**0.14**	**0.15**	**0.14**	**0.15**	**0.15**	**0.15**
3-weeks	**0.15**	**0.12**	**0.12**	**0.12**	**0.12**	**0.13**	**0.15**	**0.15**	**0.15**	**0.15**	**0.15**	**0.16**	**0.16**
4-weeks	**0.11**	**0.11**	**0.13**	**0.13**	**0.13**	**0.14**	**0.15**	**0.15**	**0.15**	**0.15**	**0.15**	**0.15**	**0.16**
5-weeks	0.10	**0.13**	**0.14**	**0.14**	**0.14**	**0.15**	**0.15**	**0.15**	**0.16**	**0.16**	**0.16**	**0.16**	**0.16**
6-weeks	**0.12**	**0.14**	**0.15**	**0.16**	**0.16**	**0.16**	**0.16**	**0.16**	**0.16**	**0.16**	**0.16**	**0.16**	**0.17**
7-weeks	**0.14**	**0.15**	**0.16**	**0.16**	**0.16**	**0.16**	**0.16**	**0.16**	**0.16**	**0.16**	**0.16**	**0.17**	**0.17**
8-weeks	**0.17**	**0.16**	**0.16**	**0.16**	**0.15**	**0.15**	**0.15**	**0.15**	**0.15**	**0.15**	**0.16**	**0.16**	**0.17**
9-weeks	**0.14**	**0.15**	**0.15**	**0.14**	**0.13**	**0.14**	**0.14**	**0.14**	**0.15**	**0.15**	**0.16**	**0.16**	**0.17**
10-weeks	**0.14**	**0.15**	**0.15**	**0.13**	**0.13**	**0.13**	**0.13**	**0.14**	**0.14**	**0.15**	**0.16**	**0.16**	**0.17**
11-weeks	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.15**	**0.16**	**0.16**	**0.17**	**0.17**
12-weeks	**0.16**	**0.15**	**0.14**	**0.14**	**0.14**	**0.14**	**0.15**	**0.15**	**0.16**	**0.17**	**0.17**	**0.18**	**0.18**
13-weeks	**0.15**	**0.16**	**0.15**	**0.15**	**0.15**	**0.16**	**0.16**	**0.17**	**0.17**	**0.18**	**0.18**	**0.19**	**0.19**

Table IB.7: Alphas with respect to the Hou, Xue, and Zhang (2015) Factors plus the Momentum Factor

This table reports, for various formation and holding periods, alphas obtained from regressing the weekly return differential between the decile 10 (the highest RNS) and decile 1 (the lowest RNS) portfolios on the Hou, Xue, and Zhang (2015) factors plus the momentum factor. Consider the one-week formation period and a one-week holding period, the [1,1] portfolio. Every Tuesday, the sample stocks are sorted into decile portfolios based on average RNS during the formation period (Wednesday to Tuesday). We then hold the portfolio from Thursday to the subsequent Wednesday. The [m,n] portfolio is formed similarly with stocks sorted based on average RNS over m weeks ending on a Tuesday and held over n weeks starting on Thursday following the formation period. We always skip one day between the formation and holding periods. Calendar time portfolio returns are computed for overlapping portfolios when holding periods are longer than a week. Panel A reports results for the overall sample from January 1996 to June 2015. Panel B reports results for the first half of the sample period from January 1996 to December 2005. Panel C reports results for the second half of the sample period from January 2006 to June 2015. Bold numbers denote significance at the 5% level using Newey-West (1987) standard errors.

Panel A: Full Sample from January 1996 to June 2015

	Holding Period												
Formation Period	1-week	2-weeks	3-weeks	4-weeks	5-weeks	6-weeks	7-weeks	8-weeks	9-weeks	10-weeks	11-weeks	12-weeks	13-weeks
1-week	**0.17**	**0.15**	**0.15**	**0.13**	**0.13**	**0.13**	**0.14**	**0.15**	**0.15**	**0.16**	**0.16**	**0.16**	**0.17**
2-weeks	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.13**	**0.14**	**0.15**	**0.16**	**0.16**	**0.17**	**0.17**	**0.17**
3-weeks	**0.16**	**0.15**	**0.14**	**0.14**	**0.14**	**0.15**	**0.16**	**0.17**	**0.18**	**0.18**	**0.18**	**0.19**	**0.19**
4-weeks	**0.13**	**0.14**	**0.15**	**0.15**	**0.15**	**0.16**	**0.17**	**0.17**	**0.18**	**0.18**	**0.18**	**0.18**	**0.18**
5-weeks	**0.12**	**0.15**	**0.15**	**0.15**	**0.15**	**0.16**	**0.17**	**0.17**	**0.18**	**0.18**	**0.18**	**0.19**	**0.19**
6-weeks	**0.17**	**0.17**	**0.17**	**0.17**	**0.18**	**0.18**	**0.18**	**0.18**	**0.18**	**0.18**	**0.19**	**0.19**	**0.19**
7-weeks	**0.15**	**0.16**	**0.16**	**0.17**	**0.17**	**0.18**	**0.18**	**0.18**	**0.18**	**0.18**	**0.19**	**0.19**	**0.19**
8-weeks	**0.17**	**0.16**	**0.17**	**0.17**	**0.16**	**0.17**	**0.17**	**0.17**	**0.17**	**0.18**	**0.18**	**0.19**	**0.19**
9-weeks	**0.15**	**0.16**	**0.16**	**0.16**	**0.16**	**0.16**	**0.16**	**0.17**	**0.17**	**0.18**	**0.19**	**0.19**	**0.20**
10-weeks	**0.15**	**0.16**	**0.16**	**0.15**	**0.15**	**0.16**	**0.16**	**0.17**	**0.17**	**0.18**	**0.19**	**0.19**	**0.19**
11-weeks	**0.17**	**0.17**	**0.17**	**0.17**	**0.17**	**0.17**	**0.17**	**0.17**	**0.18**	**0.19**	**0.20**	**0.20**	**0.20**
12-weeks	**0.18**	**0.18**	**0.18**	**0.17**	**0.17**	**0.18**	**0.18**	**0.18**	**0.19**	**0.20**	**0.21**	**0.21**	**0.21**
13-weeks	**0.19**	**0.20**	**0.19**	**0.19**	**0.18**	**0.19**	**0.19**	**0.19**	**0.20**	**0.21**	**0.21**	**0.22**	**0.22**

Panel B: January 1996 to December 2005													
	Holding Period												
Formation Period	1-week	2-weeks	3-weeks	4-weeks	5-weeks	6-weeks	7-weeks	8-weeks	9-weeks	10-weeks	11-weeks	12-weeks	13-weeks
1-week	**0.34**	**0.24**	**0.21**	0.21	0.19	0.18	0.17	0.17	0.17	0.17	0.17	0.17	0.18
2-weeks	**0.27**	**0.23**	**0.21**	0.21	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.19	0.19
3-weeks	**0.22**	**0.24**	**0.23**	0.22	0.21	0.20	0.21	0.21	0.20	0.20	0.20	0.21	0.21
4-weeks	**0.20**	**0.22**	**0.22**	0.22	0.21	0.21	0.21	0.20	0.19	0.19	0.20	0.20	0.20
5-weeks	**0.20**	**0.24**	0.22	0.21	0.21	0.21	0.21	0.20	0.19	0.20	0.20	0.20	0.20
6-weeks	**0.30**	0.27	0.25	0.25	0.24	0.23	0.22	0.21	0.21	0.22	0.22	0.22	0.22
7-weeks	0.21	0.21	0.22	0.23	0.22	0.22	0.22	0.21	0.21	0.22	0.22	0.22	0.22
8-weeks	0.23	0.20	0.21	0.21	0.21	0.22	0.21	0.21	0.21	0.22	0.22	0.22	0.22
9-weeks	0.19	0.20	0.20	0.21	0.22	0.22	0.21	0.21	0.22	0.22	0.22	0.23	0.23
10-weeks	0.18	0.20	0.21	0.21	0.22	0.21	0.21	0.21	0.21	0.22	0.22	0.22	0.22
11-weeks	0.25	0.25	0.25	0.24	0.23	0.23	0.22	0.22	0.22	0.22	0.23	0.23	0.23
12-weeks	0.27	0.27	0.27	0.24	0.24	0.24	0.23	0.22	0.22	0.22	0.23	0.23	0.23
13-weeks	0.28	0.27	0.25	0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.22	0.23	0.22

Panel C: Subsample Period January 2006 to June 2015													
	Holding Period												
Formation Period	1-week	2-weeks	3-weeks	4-weeks	5-weeks	6-weeks	7-weeks	8-weeks	9-weeks	10-weeks	11-weeks	12-weeks	13-weeks
1-week	**0.16**	**0.15**	**0.16**	**0.14**	**0.14**	**0.15**	**0.16**	**0.17**	**0.18**	**0.19**	**0.19**	**0.20**	**0.20**
2-weeks	**0.12**	**0.13**	**0.14**	**0.13**	**0.14**	**0.15**	**0.16**	**0.18**	**0.19**	**0.19**	**0.19**	**0.20**	**0.20**
3-weeks	**0.17**	**0.15**	**0.15**	**0.15**	**0.16**	**0.17**	**0.18**	**0.20**	**0.20**	**0.21**	**0.21**	**0.21**	**0.22**
4-weeks	**0.14**	**0.15**	**0.17**	**0.17**	**0.17**	**0.18**	**0.19**	**0.20**	**0.20**	**0.21**	**0.21**	**0.21**	**0.22**
5-weeks	**0.14**	**0.16**	**0.17**	**0.17**	**0.17**	**0.19**	**0.19**	**0.20**	**0.21**	**0.21**	**0.21**	**0.22**	**0.22**
6-weeks	**0.17**	**0.18**	**0.19**	**0.19**	**0.20**	**0.21**	**0.21**	**0.21**	**0.21**	**0.21**	**0.22**	**0.22**	**0.23**
7-weeks	**0.17**	**0.19**	**0.19**	**0.20**	**0.20**	**0.20**	**0.21**	**0.21**	**0.21**	**0.21**	**0.22**	**0.23**	**0.23**
8-weeks	**0.20**	**0.19**	**0.20**	**0.20**	**0.19**	**0.19**	**0.20**	**0.20**	**0.20**	**0.21**	**0.22**	**0.22**	**0.23**
9-weeks	**0.18**	**0.19**	**0.19**	**0.18**	**0.18**	**0.19**	**0.19**	**0.20**	**0.20**	**0.21**	**0.22**	**0.23**	**0.23**
10-weeks	**0.18**	**0.19**	**0.19**	**0.18**	**0.18**	**0.18**	**0.19**	**0.20**	**0.20**	**0.21**	**0.22**	**0.23**	**0.23**
11-weeks	**0.19**	**0.19**	**0.19**	**0.20**	**0.19**	**0.19**	**0.20**	**0.20**	**0.21**	**0.22**	**0.23**	**0.24**	**0.24**
12-weeks	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.21**	**0.22**	**0.22**	**0.23**	**0.24**	**0.25**	**0.25**
13-weeks	**0.21**	**0.22**	**0.22**	**0.22**	**0.22**	**0.22**	**0.23**	**0.23**	**0.24**	**0.25**	**0.25**	**0.26**	**0.26**

Table IB.8: Alphas with respect to the Stambaugh and Yuan (2016) Mispricing Factors

This table reports, for various formation and holding periods, alphas obtained from regressing the weekly return differential between the decile 10 (the highest RNS) and decile 1 (the lowest RNS) portfolios on the Stambaugh and Yuan (2016) mispricing factors. Consider the one-week formation period and a one-week holding period, the [1,1] portfolio. Every Tuesday, the sample stocks are sorted into decile portfolios based on average RNS during the formation period (Wednesday to Tuesday). We then hold the portfolio from Thursday to the subsequent Wednesday. The [m,n] portfolio is formed similarly with stocks sorted based on average RNS over m weeks ending on a Tuesday and held over n weeks starting on Thursday following the formation period. We always skip one day between the formation and holding periods. Calendar time portfolio returns are computed for overlapping portfolios when holding periods are longer than a week. The sample period is from January 1996 to June 2015. Bold numbers denote significance at the 5% level using Newey-West (1987) standard errors.

Panel A: Full Sample from January 1996 to June 2015

	Holding Period												
Formation Period	1-week	2-weeks	3-weeks	4-weeks	5-weeks	6-weeks	7-weeks	8-weeks	9-weeks	10-weeks	11-weeks	12-weeks	13-weeks
1-week	**0.15**	**0.13**	**0.12**	**0.12**	**0.11**	**0.11**	**0.12**	**0.12**	**0.12**	**0.12**	**0.11**	**0.11**	**0.11**
2-weeks	**0.10**	**0.09**	**0.10**	**0.10**	**0.10**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.10**	**0.10**	**0.10**
3-weeks	**0.13**	**0.11**	**0.11**	**0.11**	**0.12**	**0.12**	**0.12**	**0.12**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**
4-weeks	**0.10**	**0.10**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.10**	**0.10**	**0.10**	**0.10**
5-weeks	**0.09**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**
6-weeks	**0.11**	**0.12**	**0.12**	**0.12**	**0.12**	**0.11**	**0.11**	**0.11**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**
7-weeks	**0.11**	**0.12**	**0.12**	**0.12**	**0.11**	**0.11**	**0.11**	**0.11**	**0.10**	**0.10**	**0.10**	**0.10**	**0.09**
8-weeks	**0.14**	**0.13**	**0.13**	**0.12**	**0.12**	**0.11**	**0.11**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.09**
9-weeks	**0.12**	**0.12**	**0.12**	**0.11**	**0.10**	**0.10**	**0.10**	**0.09**	**0.09**	**0.09**	**0.09**	**0.09**	**0.09**
10-weeks	**0.10**	**0.11**	**0.11**	**0.10**	**0.10**	**0.10**	**0.09**	**0.09**	**0.09**	**0.09**	**0.09**	**0.09**	**0.09**
11-weeks	**0.11**	**0.11**	**0.11**	**0.10**	**0.10**	**0.10**	**0.09**	**0.09**	**0.09**	**0.09**	**0.09**	**0.09**	**0.09**
12-weeks	**0.13**	**0.12**	**0.11**	**0.10**	**0.10**	**0.10**	**0.09**	**0.09**	**0.09**	**0.09**	**0.09**	**0.09**	**0.09**
13-weeks	**0.12**	**0.12**	**0.11**	**0.11**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.09**	**0.09**	**0.09**

Panel B: January 1996 to December 2005

	Holding Period												
Formation Period	1-week	2-weeks	3-weeks	4-weeks	5-weeks	6-weeks	7-weeks	8-weeks	9-weeks	10-weeks	11-weeks	12-weeks	13-weeks
1-week	**0.34**	**0.24**	0.21	0.21	0.19	0.18	0.17	0.17	0.17	0.17	0.17	0.17	0.18
2-weeks	**0.27**	**0.23**	0.21	0.21	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.19	0.19
3-weeks	**0.22**	**0.24**	0.23	0.22	0.21	0.20	0.21	0.21	0.20	0.20	0.20	0.21	0.21
4-weeks	**0.20**	0.22	0.22	0.22	0.21	0.21	0.21	0.20	0.19	0.19	0.20	0.20	0.20
5-weeks	**0.20**	0.24	0.22	0.21	0.21	0.21	0.21	0.20	0.19	0.20	0.20	0.20	0.20
6-weeks	**0.30**	0.27	0.25	0.25	0.24	0.23	0.22	0.21	0.21	0.22	0.22	0.22	0.22
7-weeks	0.21	0.21	0.22	0.23	0.22	0.22	0.22	0.21	0.21	0.22	0.22	0.22	0.22
8-weeks	0.23	0.20	0.21	0.21	0.21	0.22	0.21	0.21	0.21	0.22	0.22	0.22	0.22
9-weeks	0.19	0.20	0.20	0.21	0.22	0.22	0.21	0.21	0.22	0.22	0.22	0.23	0.23
10-weeks	0.18	0.20	0.21	0.21	0.22	0.21	0.21	0.21	0.21	0.22	0.22	0.22	0.22
11-weeks	0.25	0.25	0.25	0.24	0.23	0.23	0.22	0.22	0.22	0.22	0.23	0.23	0.23
12-weeks	0.27	0.27	0.27	0.24	0.24	0.24	0.23	0.22	0.22	0.22	0.23	0.23	0.23
13-weeks	0.28	0.27	0.25	0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.22	0.23	0.22

Panel C: Subsample Period January 2006 to June 2015													
	Holding Period												
Formation Period	1-week	2-weeks	3-weeks	4-weeks	5-weeks	6-weeks	7-weeks	8-weeks	9-weeks	10-weeks	11-weeks	12-weeks	13-weeks
1-week	**0.10**	**0.10**	**0.09**	**0.08**	**0.07**	**0.08**	**0.09**	**0.10**	**0.10**	**0.11**	**0.11**	**0.11**	**0.11**
2-weeks	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**	**0.08**	**0.10**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**
3-weeks	**0.11**	**0.09**	**0.08**	**0.08**	**0.09**	**0.10**	**0.11**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**
4-weeks	**0.08**	**0.08**	**0.09**	**0.10**	**0.10**	**0.11**	**0.11**	**0.12**	**0.12**	**0.11**	**0.11**	**0.11**	**0.11**
5-weeks	**0.06**	**0.09**	**0.09**	**0.10**	**0.10**	**0.11**	**0.11**	**0.11**	**0.12**	**0.11**	**0.11**	**0.11**	**0.12**
6-weeks	**0.08**	**0.10**	**0.11**	**0.11**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.11**	**0.11**	**0.11**	**0.12**
7-weeks	**0.09**	**0.11**	**0.12**	**0.12**	**0.12**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**	**0.11**
8-weeks	**0.12**	**0.11**	**0.12**	**0.11**	**0.11**	**0.10**	**0.10**	**0.11**	**0.10**	**0.10**	**0.10**	**0.11**	**0.11**
9-weeks	0.09	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.10	**0.10**	**0.10**	**0.11**	**0.11**
10-weeks	0.08	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.09	**0.09**	**0.10**	**0.10**	**0.11**
11-weeks	0.09	0.09	0.09	0.09	0.09	0.08	0.09	0.09	0.10	0.10	**0.11**	**0.11**	**0.11**
12-weeks	0.11	0.10	0.09	0.09	0.08	0.09	0.10	0.10	**0.10**	**0.11**	**0.11**	**0.12**	**0.12**
13-weeks	0.10	0.10	0.10	0.10	0.10	0.10	**0.11**	**0.11**	**0.11**	**0.12**	**0.12**	**0.12**	**0.13**

Internet Appendix C

In this paper, we use the Bakshi, Kapadia, and Madan (2003) methodology to compute the ex-ante skewness (RNS) and document a positive cross-sectional relation between RNS and stock returns. Specifically, we follow Bakshi and Madan (2000) and Bakshi, Kapadia, and Madan (2003) to extract risk-neutral moments from options prices, including risk-neutral variance (RNV), risk-neutral skewness (RNS), and risk-neutral kurtosis (RNK). Bakshi and Madan (2000) demonstrate that payoff function to an underlying security can be replicated and priced with a series of options contracts with different strike prices. Bakshi et al. (2003) show that the risk-neutral moments can be expressed by a combination of τ-maturity time t prices of quadratic (V_t^τ), cubic (W_t^τ), and fourth powers (X_t^τ) contracts. These contracts are defined as:

$$V_t^\tau = \int_{K=S_t}^{\infty} \frac{2\left(1-\ln\left[\frac{K_i}{S_t}\right]\right)}{K_i^2} C_{i,t}^\tau(K_i)dK_i + \int_{K=0}^{S_t} \frac{2\left(1+\ln\left[\frac{S_t}{K_i}\right]\right)}{K_i^2} P_{i,t}^\tau(K_i)dK_i \quad \text{(IC.1)}$$

$$W_t^\tau = \int_{K=S_t}^{\infty} \frac{6\ln\left[\frac{K_i}{S_t}\right]-3\left(\ln\left[\frac{K_i}{S_t}\right]\right)^2}{K_i^2} C_{i,t}^\tau(K_i)\, dK_i - \int_{K=0}^{S_t} \frac{6\ln\left[\frac{S_t}{K_i}\right]+3\left(\ln\left[\frac{S_t}{K_i}\right]\right)^2}{K_i^2} P_{i,t}^\tau(K_i)dK_i \quad \text{(IC.2)}$$

$$X_t^\tau = \int_{K=S_t}^{\infty} \frac{12\left(\ln\left[\frac{K_i}{S_t}\right]\right)^2-4\left(\ln\left[\frac{K_i}{S_t}\right]\right)^3}{K_i^2} C_{i,t}^\tau(K_i)dK_i + \int_{K=0}^{S_t} \frac{12\left(\ln\left[\frac{S_t}{K_i}\right]\right)^2+3\left(\ln\left[\frac{S_t}{K_i}\right]\right)^3}{K_i^2} P_{i,t}^\tau(K_i)dK_i \quad \text{(IC.3)}$$

Where $C_{i,t}^\tau$ ($P_{i,t}^\tau$) denotes for day t call (put) option premium with τ-maturity and strike price K_i. S_t is the underlying stock price at day t. Following Bakshi and Madan (2000) and Bakshi, Kapadia, and Madan (2003), the risk-neutral moments are calculated as:

$$RNV_t^\tau = \frac{e^{r\tau}V_t^\tau - {\mu_t}^2}{\tau} \quad \text{(IC.4)}$$

$$RNS_t^\tau = \frac{e^{r\tau}W_t^\tau - 3\mu_t e^{r\tau} + 2{\mu_t}^3}{[e^{r\tau}V - {\mu_t}^2]^{3/2}} \quad \text{(IC.5)}$$

$$RNK_t^\tau = \frac{e^{r\tau}X_t^\tau - 4\mu_t e^{r\tau}W_t^\tau + 6e^{r\tau}{\mu_t}^2 V_t^\tau - 3{\mu_t}^4}{[e^{r\tau}V - {\mu_t}^2]^2} \quad \text{(IC.6)}$$

Where r is risk-free rate, and $\mu_t = e^{r\tau} - 1 - e^{r\tau}V_t^\tau/2 - e^{r\tau}W_t^\tau/6 - e^{r\tau}X_t^\tau/24$.

We use equations (IC.1) to (IC.6) to extract the RNS (and other higher moments) and use this measure of RNS to document the positive cross-sectional relation between RNS and stock returns. However, this result is not consistent with Conrad, Dittmar, and Ghysels (2013. CDG) who find a negative relation. In this appendix, we provide a discussion that reconciles the opposite findings. We proceed as follows:

- First, we follow the description in CDG and adopt their approach to extract RNS^{CDG} from daily closing option prices.
- Second, we perform the same portfolio sorts as described in CDG (their Table II on page 93). Specifically, we sort stocks into terciles based on the average RNS^{CDG} estimated over the entire past quarter.[4] We then track the subsequent monthly returns in the following quarter.[5]
- Third, we separate the data into two sub-periods. The first sub-period is identical to that of CDG from January 1996 to December 2005 (Table R1). The other one is the updated sample from January 2006 to June 2015 (Table R2).
- We also calculate the monthly return spreads by sorting the average RNS (our measure using the volatility surface data) in the past quarter based on our sample (Panel B) and the CDG sample (Panel C) which has far fewer firms. This should help identify the reasons for the differences between our results and those in CDG.

Table IC.1 presents the results for the same sample period as in CDG from January 1996 to December 2005. Panel A reports monthly returns (with 3-months holding period) based on the quarterly sort on RNS^{CDG}, similar to that reported in Table II of CDG. The return spread between the high and the low RNS^{CDG} terciles is –0.21% per month, though insignificant with a t-statistic of –0.43.[6] Panel B shows that using our RNS sample with our measure of RNS, the return spread between the high and low terciles is 0.08% per month with a t-statistic of 0.18. In Panel C, we use our RNS estimate as the sorting variable, but we only use the

[4] CDG calculate their average RNS^{CGD} based on option maturities of 1-month, 3-months, 6-months, and 12-months. They present results for only the 3-month and the 12-month maturity. As our RNS is extracted from the 30-day volatility surface data, we construct the 1-month RNS^{CDG} as an average *RNS* from options with maturities ranging from 7 to 60 days.

[5] In our main results, we sort stocks into deciles based on the average daily RNS from the prior Wednesday to Tuesday and track the returns over the following week.

[6] We have not been able to exactly replicate the results in CDG as we do not know the exact option contracts used in the CDG analysis. Our replication result can be corroborated by Rehman and Vilkov (2012).

sample stocks contained in Panel A (the sample size is much smaller). Panel C shows that the return spread is positive but insignificant 0.14% (t-statistic = 0.27). These results are consistent with those in Rehman and Vilkov (2012).

The above findings suggest that the opposite results (in our paper vis-à-vis CDG) are driven by the difference in the estimation methodology between RNS^{CGD} and our RNS estimates. As explained in the main text (page 6, and Appendix 1), our RNS estimation is based on pairs of OTM put and call contracts that have identical moneyness. This allows us to avoid biases induced by asymmetric strike-to-spot price distance for OTM put and call options when working with daily closing option prices (Dennis and Mayhew, 2002). It is also worth noting that our RNS sample extracted from the volatility surface data has a much larger cross-sectional coverage than CDG.[7] Also, note that by using the volatility surface data we are not subject to the illiquidity issues with transaction prices.

Table IC.2 presents the results for the sample period from January 2006 to June 2015. As in Table IC.1, sorting on RNS^{CGD} (Panel A) yields a negative but insignificant return spread between the third and first terciles (–0.04% per month with a t-statistic of –0.16). In contrast, Panels B and C report positive and significant return spreads between the third and the first RNS terciles using our measure of RNS over our whole sample and over the CDG sample, respectively. These results together with those in Table IC.1 imply that the negative RNS-return relation is largely driven by the construction methodology of RNS^{CGD}. Table IC.2 also suggests that the impact of the differences in the RNS construction methodology is stronger in more recent years.

[7] CDG present results for the 3-month and the 12-month option maturity. Their average sample size is 307 firms for both samples. They do not report the sample size for the 1-month option maturity sample.

Table IC.1: Quarterly sort on RNS or RNS^{CGD}, sample period 1996 to 2005

This table reports portfolio results as prescribed by CGD. The stocks are sorted into Terciles based on average RNS^{CDG} (or RNS) during each quarter, and monthly return is calculated. Panel A reports result based on RNS^{CDG} sample. Panel B report result based on RNS sample. Panel C reports result based on sort on RNS on RNS^{CDG} sample firms. The sample period is the same as CDG from January 1996 to December 2005. Newey-West (1987) t-statistics are reported in parenthesis.

Panel A: sort on RNS^{CDG} based on the replicated sample

	Tercile 1	Tercile 2	Tercile 3	Tercile 3-1
Returns	0.84%	0.75%	0.63%	–0.21%
	0.91	0.95	0.97	–0.43
Mean RNS	–2.765	0.913	1.945	4.710
	–5.18	5.69	3.94	3.96
Average number of firms	96	128	96	

Panel B: sort on RNS based on the full sample

	Tercile 1	Tercile 2	Tercile 3	Tercile 3-1
Returns	0.90%	0.89%	0.98%	0.08%
	1.86	1.28	1.25	0.18
Mean RNS	–0.846	–0.407	0.564	1.411
	–32.52	–18.20	1.35	3.41
Average number of firms	598	797	598	

Panel C: sort on RNS based on the replicated sample

	Tercile 1	Tercile 2	Tercile 3	Tercile 3-1
Returns	0.65%	0.62%	0.78%	0.14%
	1.04	0.73	0.89	0.27
Mean RNS	–0.884	–0.537	3.146	4.029
	–23.71	–17.07	0.95	1.22
Average number of firms	96	128	96	

Table IC.2: Quarterly sort on RNS or RNS^{CGD}, sample period 2006 to 2015

This table reports portfolio results as prescribed by CGD. The stocks are sorted into Terciles based on average RNS^{CDG} (or RNS) during each quarter, and monthly return is calculated. Panel A reports result based on RNS^{CDG} sample. Panel B report result based on RNS sample. Panel C reports results based on sorting on RNS on RNS^{CDG} sample firms. The sample period is the post-CDG period from January 2006 to June 2015. Newey-West (1987) t-statistics are reported in parenthesis.

Panel A: sort on RNS^{CDG} based on the replicated sample

	Tercile	Tercile 2	Tercile 3	Tercile 3-1
Returns	0.73%	0.59%	0.69%	–0.04%
	1.08	1.00	1.27	–0.16
Mean RNS	–1.330	1.072	1.988	3.318
	–4.76	5.73	5.76	5.79
Average number of firms	144	193	144	

Panel B: sort on RNS based on the full sample

	Tercile	Tercile 2	Tercile 3	Tercile 3–1
Returns	0.47%	0.82%	0.95%	0.48%
	0.95	1.38	1.45	2.03
Mean RNS	–0.986	–0.514	0.225	1.211
	–61.93	–28.31	5.55	28.14
Average number of firms	701	935	701	

Panel C: sort on RNS based on the replicated sample

	Tercile	Tercile 2	Tercile 3	Tercile 3–1
Returns	0.20%	0.67%	0.79%	0.59%
	0.36	1.14	1.18	2.09
Mean RNS	–1.067	–0.696	–0.314	0.752
	–39.57	–28.93	–11.86	33.40
Average number of firms	144	193	144	

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