Does Risk-Neutral Skewness Predict the Cross-Section of Equity Option Portfolio Returns?

Online Appendix

JOURNAL OF FINANCIAL
AND QUANTITATIVE ANALYSIS
Vol. 48, No. 4, Aug. 2013

Turan G. Bali* Scott Murray†

*Robert S. Parker Chair Professor of Finance, McDonough School of Business, Georgetown University, Washington, D.C. 20057. Phone: (202) 687-5388, Fax: (202) 687-4031, Email: tgb27@georgetown.edu.

†Assistant Professor of Finance, College of Business Administration, University of Nebraska - Lincoln, P.O. Box 880490, Lincoln, NE 68588-0490. Email: smurray6@unl.edu.

I Physical Skew and Future Returns

We examine the ability of physical (historical) skewness to predict the future returns of both stocks and skewness assets. Each month, on the first trading day following the monthly expiration, historical skewness is calculated as the skewness of the daily log returns over the past year. On the second day after the monthly expiration, portfolios of stocks and skewness assets are formed based on deciles of historical skewness. The skewness assets are formed using 1-month options. The portfolios are held until the options in the skewness assets expire approximately one month later. Table I presents the average raw returns, along with the CAPM (CAPM), Fama-French 3-factor (FF3 Alpha) and Fama-French-Carhart 4-factor (FFC4 Alpha) alphas following Fama and French (1993) and Carhart (1997). The 10-1 column represents the raw and risk-adjusted returns for the portfolio that is long skewness assets for decile 10 of $RNSkew$ and short skewness assets for decile 1. The 10-1 t-stat column is the t-statistic testing the null hypothesis that the average 10-1 return, CAPM alpha, FF3 alpha, and FFC4 alpha is equal to 0. The t-statistics are adjusted following Newey and West (1987) with lag of 6 months. None of the 10-1 alphas exhibit a statistically significant difference from 0. Thus, we find no evidence in our sample that physical skewness can predict the future returns of stocks or skewness assets.

II Calculation of Risk Free Rate and Present Value of Dividends

The present value of dividends ($PVDivs$) on date t_0 for an option expiring on date t_1 is calculated to be the sum of the present values of all dividends paid on the underlying stock with ex-dates between date t_0 (exclusive) and t_1 (inclusive). Specifically, let $Div_{e,\tau}$ be a dividend paid on the underlying stock with ex-date e and pay-date τ, where $t_0 \leq e \leq t_1$,

and let r_t be the risk-free rate of return on a deposit made on date t_0 to be withdrawn on date τ, and t_τ be the time, in years, between dates t_0 and τ, then we have.

$$PVDivs = \sum_{t_0 \leq \tau \leq t_1} e^{-r_\tau t_\tau} Div_{e,\tau} \tag{1}$$

OptionMetrics provides zero-rate data for each date t_0 and a series of maturities. r_τ, for any specific value of t_0 and τ, is found by applying a cubic spline to the zero-rate data for date t_0 and find the interpolated zero-rate for matruity t_τ.

III Is There a Risk-Based Explanation?

We begin the risk analysis by examining three commonly used measures of portfolio risk: the standard deviation of monthly returns, value-at-risk, and expected shortfall. In addition to these risk measures, we look at the sensitivities of the skewness asset portfolio returns to the market factor (MKT), Fama and French (1993) size (SMB) and book-to-market (HML) factors, Carhart (1997) momentum (UMD) factor, and the short-term reversal factor ($STRev$).[1] We complete the risk-analysis by augmenting the standard risk models using several additional option and stock market based factors.

III.A Standard Deviation, Value-At-Risk, and Expected ShortFall

The most commonly employed measure of portfolio risk is the standard deviation of portfolio returns. Portfolios with high risk are expected to have a high return standard deviation. In addition to the standard deviation, risk is often measured by analyzing the magnitude of the losses that occur in extreme situations, i.e. the magnitude of the losses in the extreme left side of the distribution of returns. Two risk-metrics designed to measure such losses

[1] Jegadeesh (1990) and Lehmann (1990) were the first to discover the short-term reversal effect in stock returns. The short-term reversal factor returns are calculated by Kenneth French and published in his online data library.

are value-at-risk (VaR) and expected shortfall (ES). VaR is defined as the maximum loss expected on a portfolio of assets over a certain holding period at a given confidence level (probability).[2] The VaR for a portfolio is simply an estimate of a specified percentile of the probability distribution of the portfolio's returns. The specified percentile is usually computed for the lower tail of the distribution of returns. Thus, we calculate the value-at-risk for a given probability p, $VaR(p)$, to be the p^{th} percentile of the monthly returns of the skewness assets.

VaR as a risk measure is criticized for not being sub-additive. Because of this the risk of a portfolio can be larger than the sum of the stand-alone risks of its components when measured by VaR. Hence, managing risk by VaR may fail to stimulate diversification. Moreover, VaR does not take into account the severity of an incurred damage event. To alleviate these deficiencies Artzner, Delbaen, Eber, and Heath (1999) introduced the expected shortfall risk measure, which is defined as the conditional expectation of loss given that the loss is beyond the VaR level. The ES measure is defined as $ES(p) = E[R|R \leq VaR(p)]$, where R represents the return on the portfolio. The expected shortfall considers losses beyond the VaR level. Conceptually, ES can be interpreted as the average loss in the worst $100 \times p$ percent of cases.

Table II presents the standard deviation of monthly returns, along with the 5% VaR and 5% ES for each of the decile portfolios. As the skewness assets contain both long and short positions, and the choice to define the skewness assets in a manner such that they represent a long skewness position was arbitrary, we also calculate the 5% VaR and 5% ES for portfolios of short skewness assets.[3] Remember that when holding short skewness asset

[2]For example, if the given period of time is one month (as it is in the portfolio returns analyzed in this paper) and the given probability is 5%, the VaR measure would be an estimate of the decline in the portfolio value that could occur with a 5% probability over the next month. In other words, if the VaR measure is accurate, losses greater than the 5% VaR measure should occur less than 5% of the time.

[3]The standard deviation of monthly returns is the same regardless of whether long or short positions are held.

positions, the relation between $RNSkew$ and portfolio returns becomes positive. All of the risk-metrics for long skewness asset positions indicate more risk in the 10th decile portfolio (low returns) than in the 1st decile portfolio (high returns). This is the opposite of what is expected if cross-sectional differences in risk were driving the results. The 5% VaR for the short PUTCALL and PUT portfolios is lower in decile 10 than in decile 1, indicating less risk in decile, inconsistent with a positive 10-1 return. The 5% ES measures for the short PUTCALL and PUT portfolios show no pattern. In summary, the risk analysis presented in Table II gives no support for a risk-based explanation of the skewness asset returns.

III.B Portfolio Sensitivities to Known Factors

It is possible that there exists a cross-sectional pattern in the factor sensitivities of the skewness asset portfolios to these risk factors. To test this, Table III presents the factor sensitivities of each of the decile portfolios to each of the factors comprising the CAPM (MKT only), Fama-French 3-factor (MKT, SMB, and HML), and Fama-French-Carhart 4-factor (MKT, SMB, HML, and UMD) models. In addition to these risk factors, we also presents factor sensitivities calculated using a model that includes the 4 Fama-French-Carhart factors along with the short-term reversal factor.

The results in Table III present no evidence of strong cross-sectional patterns in factor sensitivities across the decile portfolios. The coefficients on MKT, HML, and UMD are lower for the 1st decile than for the 10th decile portfolio in all models, inconsistent with the hypothesis that decile 1 has higher risk and thus commands a higher return. The SMB coefficients for the 1st decile are higher than for the 10th decile in all models, consistent with a risk-based explanation for the observed return patterns. However, these coefficients, without exception, produce t-statistics less than 2.0 in magnitude. Finally, the $STRev$ factor consistently has lower coefficients in decile 10 than in decile 1. The magnitude of the difference between the decile 10 and decile 1 coefficients (-0.07 for the PUTCALL asset,

-0.01 for the PUT, and -0.13 for the CALL asset) is way too small to be taken as an explanation for the negative cross-sectional relation between $RNSkew$ and skewness asset returns. Furthermore, this difference is largest for the CALL asset, where the relation does not exist.

III.C Aggregate Volatility, Stock and Option Market Factors

The skewness assets are comprised of both stock and option positions, thus the returns on these assets are theoretically determined not only by exposure to stock market factors, but also to option market factors. Goyal and Saretto (2009) demonstrate that a portfolio that is long ATM straddles for stocks with high values of historical realized volatility minus implied volatility ($RV - IV$), and short straddles for stocks where the opposite is true, generates positive abnormal returns. If the returns of this portfolio are due to compensation for exposure to a priced risk factor, then it is imperative that we control for such exposures. To do so, we create a proxy for this factor by taking the returns on a portfolio that is long ATM straddles for stocks in the top third of $RV - IV$ and short ATM straddles for stocks in the bottom third of $RV - IV$.[4] We call this factor $RV - IVStraddle$.

As option portfolio returns are intimately connected to the return on the underlying stocks, we control for the potential that a corresponding stock-based factor exists by calculating the returns on a portfolio that is long (short) stock for stocks in the top (bottom) third of $RV - IV$. We name this factor $RV - IVStock$.

[4]The factor mimicking portfolio is created using the same schedule used for the skewness assets and by Goyal and Saretto (2009). The signal ($RV - IV$) is generated on the first day after each monthly expiration. The portfolios are initiated at the close of the second day following each monthly expiration using 1-month options, and are held until expiration. The ATM strike used to form each straddle is found by choosing the strike of the call option with delta closest to 0.5. We require that the delta of each of the options used to form the straddle is between 0.4 and 0.6. When data for such options are not available, the observation is discarded. RV is calculated as the annualized standard deviation of daily log returns using 12 months of daily data. We require that data be available for each trading day during the past 12 months for entry into the sample. IV is calculated using the average of the call (put) implied volatilities of the 1-month contracts with delta closest to 0.5 (-0.5). We require that the absolute values of the option deltas used to calculate IV are between 0.4 and 0.6.

Bali and Hovakimian (2009) and Cremers and Weinbaum (2010) show that the difference between ATM call implied volatility (CIV) and ATM put implied volatility (PIV) is a strong predictor of future stock performance. We form two additional factors based on the $CIV - PIV$ signal.[5] The first is the returns on a portfolio that is long (short) stocks in the top (bottom) third of $CIV - PIV$. This factor is intended to proxy for a factor associated with the returns generated in Bali and Hovakimian (2009) and Cremers and Weinbaum (2010). We call the returns on this portfolio the $CIV - PIVStock$ factor.

As the $CIV - PIV$ signal is very similar in nature to the calculation of $RNSkew$, it is necessary that we control for the possibility that the returns generated by the skewness assets are simply a reflection of the manifestation of a $CIV-PIV$ based factor in the options market. To do so, we calculate a proxy for such a factor, which we name $CIV-PIVStraddle$, by taking the returns of a portfolio that is long (short) ATM straddles for stocks in the highest (lowest) third of $CIV - PIV$.

In addition to these stock and option market factors, we control for the aggregate volatility (MN) and crash-neutral aggregate volatility ($CNMN$) factors developed by Cremers, Halling, and Weinbaum (2013). These factors are calculated as the returns of a market-neutral straddle portfolio (MN), and a crash-neutral market-neutral straddle portfolio ($CNMN$). Analyses using the MN and $CMNM$ factors end on the December 2007 expiration because data for these factors are not available for later periods.[6] There are therefore only 144 (instead of 177) monthly return periods for models using the MN or $CNMN$ factor.

Finally, we control for the possibility that the long-short portfolio returns are related

[5] CIV and PIV are calculated by taking the implied volatilities of the 1-month contracts with delta closest to 0.5 and -0.5 respectively. We require that the absolute values of the option deltas used to calculate CIV and PIV are between 0.4 and 0.6.

[6] We thank Martijn Cremers, Michael Halling, and David Weinbaum for providing us with the daily factor returns. Factor returns corresponding to the periods during which the skewness asset portfolios are held were constructed from the daily data in the same manner as the returns for the MKT, SMB, HML, UMD, and $STRev$ factors.

index option returns by creating an S&P index straddle factor ($S\&PStraddle$) and an S&P crash factor ($S\&PPut$, see Du and Kapadia (2011)). The $S\&PStraddle$ factor is calculated the as the return of an at-the-money S&P straddle created in exactly the same manner as the single stock straddles used for the $RV-IVStraddle$ and $CIV-PIVStraddle$ factors. The $S\&PPut$ factor is calculated as the return of an out-of-the-money put option with target delta -0.2.

In Table IV, we present the alphas and factor sensitivities for the returns of the decile 10 minus decile 1 portfolio of the skewness assets using several different risk models. The results demonstrate that the cross-sectional return pattern observed in the PUTCALL and PUT assets cannot be explained by any of the factor models, as the t-statistics associated with the alpha coefficient for each of these models are larger than 2.0, with one exception.[7] With two exceptions, the alphas for the 10-1 CALL asset portfolios remain, in almost all models, insignificant. In summary, the main results of the paper hold after controlling for a wide array of stock and option market factors.

[7]The only exception is model (9) for the PUT asset, which produces a t-statistic of -1.81, and thus is significant at the 10%, but not the 5% level.

References

Artzner, P., Delbaen, F., Eber, J.-M., and Heath, D. 1999. Coherent measures of risk. Mathematical Finance, 9(3), 203.

Bali, T. G. and Hovakimian, A. 2009. Volatility spreads and expected stock returns. Management Science, 55(11), 1797–1812.

Carhart, M. M. 1997. On persistence in mutual fund performance. Journal of Finance, 52(1), 57–82.

Cremers, M., Halling, M., and Weinbaum, D. 2013. Aggregate jump and volatility risk in the cross-section of stock returns. Journal of Finance, forthcoming.

Cremers, M. and Weinbaum, D. 2010. Deviations from put-call parity and stock return predictability. Journal of Financial Quantitative Analysis, 45(2), 335–367.

Du, J. and Kapadia, N. 2011. The tail in the volatility index. Working paper University of Massachusetts-Amherst.

Fama, E. F. and French, K. R. 1993. Common risk factors in the returns on stocks and bonds. Journal of Financial Economics, 33(1), 3–56.

Goyal, A. and Saretto, A. 2009. Cross-section of option returns and volatility. Journal of Financial Economics, 94(2), 310 – 326.

Jegadeesh, N. 1990. Evidence of predictable behavior of security returns. Journal of Finance, 45(3), 881–898.

Lehmann, B. N. 1990. Fads, martingales, and market efficiency. Quarterly Journal of Economics, 105(1), 1–28.

Newey, W. K. and West, K. D. 1987. A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. Econometrica, 55(3), 703–708.

Table I: Relation between Physical Skewness and Future Returns

This table shows the average monthly returns for portfolios of stocks and skewness assets formed on deciles of historical skewness. Historical skewness is calculated for each stock on the first trading day after each monthly expiration using daily data from the past 1 year. The skewness asset and stock portfolios are formed on the second day after each monthly expiration using options that expire in the next month, and are held until expiration. The table shows raw excess returns (Excess Return), along with CAPM (CAPM Alpha), Fama-French 3-factor (FF3 Alpha), and Fama-French-Carhart 4-factor alphas (FFC4 Alpha). The 10-1 column represents the difference between the returns for decile 10 and decile 1. The 10-1 t-stat column is the t-statistic testing the null hypothesis that the average 10-1 excess return, CAPM alpha, FF3 alpha, or FFC4 alpha is equal to zero. The t-statistics are adjusted using Newey and West (1987) with lag of 6 months. The sample covers the period January 1996 through October 2010.

PUTCALL Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**10-1**	**10-1 t-stat**
Excess Return	-0.92	-0.82	-0.82	-0.66	-0.93	-0.87	-1.25	-0.45	-0.63	-0.30	0.62	1.36
CAPM Alpha	-0.83	-0.82	-0.82	-0.59	-0.91	-0.79	-1.18	-0.41	-0.56	-0.25	0.58	1.35
FF3 Alpha	-0.89	-0.89	-0.91	-0.66	-0.95	-0.87	-1.19	-0.45	-0.59	-0.30	0.59	1.34
FFC4 Alpha	-0.98	-0.91	-0.95	-0.67	-0.98	-0.92	-1.24	-0.51	-0.58	-0.32	0.67	1.53

PUT Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**10-1**	**10-1 t-stat**
Excess Return	-0.09	0.02	-0.20	0.29	0.02	0.04	-0.24	-0.22	-0.10	0.23	0.31	0.85
CAPM Alpha	-0.00	-0.01	-0.22	0.37	0.03	0.12	-0.20	-0.16	-0.03	0.30	0.30	0.76
FF3 Alpha	-0.01	-0.05	-0.31	0.34	0.02	0.09	-0.18	-0.16	-0.02	0.32	0.33	0.83
FFC4 Alpha	-0.08	-0.09	-0.36	0.29	-0.02	0.03	-0.24	-0.20	-0.00	0.35	0.43	1.08

CALL Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**10-1**	**10-1 t-stat**
Excess Return	-1.34	-0.93	-0.83	-0.92	-0.95	-1.20	-1.65	0.21	-0.21	-0.46	0.88	1.04
CAPM Alpha	-1.27	-0.92	-0.80	-0.89	-0.92	-1.12	-1.53	0.24	-0.13	-0.44	0.83	1.06
FF3 Alpha	-1.35	-1.03	-0.86	-0.95	-1.00	-1.25	-1.60	0.14	-0.24	-0.57	0.78	0.97
FFC4 Alpha	-1.49	-1.05	-0.90	-0.89	-1.04	-1.33	-1.68	0.05	-0.25	-0.61	0.88	1.09

Stock Return	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**10-1**	**10-1 t-stat**
Excess Return	0.53	0.65	0.99	0.54	0.65	0.74	0.71	0.97	0.70	1.16	0.64	1.23
CAPM Alpha	-0.14	-0.02	0.31	-0.13	-0.04	0.05	0.02	0.25	0.04	0.48	0.62	1.26
FF3 Alpha	-0.24	-0.12	0.23	-0.17	-0.08	0.02	-0.04	0.23	-0.01	0.41	0.66	1.33
FFC4 Alpha	-0.07	-0.11	0.22	-0.23	-0.03	0.05	-0.01	0.23	0.03	0.34	0.41	0.94

Table II: Is There a Risk Based Explanation of Returns?
The table below presents the standard deviation (σ) of monthly returns, along with the 5% value-at-risk (VaR) and 5% expected shortfall (ES) for each of the decile portfolios. All values are calculated based on the 177 monthly returns for each decile portfolio, and are shown in percent.

PUTCALL Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
σ	3.19	3.59	4.13	4.00	4.23	4.39	4.27	4.64	4.17	4.05
VaR(5%)	5.48	6.67	6.12	8.14	6.63	7.32	6.36	7.60	7.13	7.29
ES(5%)	6.90	8.72	8.76	11.44	9.78	10.64	11.14	12.15	11.48	12.29
VaR(5%) Short	5.03	5.12	5.55	4.48	5.89	6.30	5.21	5.15	4.45	4.01
ES(5%) Short	5.77	7.07	9.50	6.64	8.54	9.22	6.82	7.28	5.56	6.45

PUT Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
σ	3.74	4.73	3.87	4.16	4.06	3.97	4.25	4.60	4.47	4.01
VaR(5%)	3.97	5.07	4.74	6.92	5.60	4.83	5.72	5.70	5.71	5.87
ES(5%)	7.37	10.84	7.93	10.71	9.25	8.59	10.73	11.32	11.76	8.66
VaR(5%) Short	6.89	8.26	7.21	6.93	6.56	6.11	6.11	6.20	5.79	6.17
ES(5%) Short	8.88	10.93	9.09	8.74	8.44	8.52	8.49	8.30	7.36	8.50

CALL Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
σ	4.87	4.88	5.82	5.75	5.82	6.01	5.22	6.16	5.54	6.80
VaR(5%)	10.19	9.36	7.27	11.81	10.32	10.79	10.68	9.56	11.81	11.90
ES(5%)	12.24	12.10	12.04	17.01	13.80	14.80	13.53	14.89	14.93	19.33
VaR(5%) Short	5.72	5.58	5.57	6.25	7.42	8.50	6.97	7.03	7.59	5.88
ES(5%) Short	8.12	9.22	13.73	8.49	12.19	14.61	9.22	13.64	9.43	12.60

Table III: Factor Sensitivities

The tables below present factor sensitivities (t-statistics in parentheses) for portfolios of skewness assets formed on deciles of *RNSkew* for the CAPM (Panel A), FF3 (Panel B), FFC4 (Panel C), and FFC4 + Short Term Reversal (STRev, Panel D) risk factor models. Returns and alphas are in percent. Newey and West (1987) t-statistics are reported in parentheses.

Panel A. CAPM Factor Sensitivities

PUTCALL Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alpha	-0.02	-0.18	-0.25	-0.72	-0.54	-0.57	-1.03	-0.96	-1.34	-1.56
t-stat	(-0.07)	(-0.73)	(-0.82)	(-2.14)	(-1.57)	(-1.93)	(-3.25)	(-2.60)	(-4.31)	(-5.08)
MKT	-0.23	-0.19	-0.11	-0.17	-0.07	-0.02	-0.04	-0.02	-0.02	-0.07
t-stat	(-2.85)	(-2.49)	(-0.87)	(-1.37)	(-0.48)	(-0.17)	(-0.28)	(-0.09)	(-0.10)	(-0.53)
PUT Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alpha	1.00	0.50	0.49	-0.13	0.04	-0.04	-0.42	-0.32	-0.74	-0.21
t-stat	(3.29)	(1.50)	(1.84)	(-0.40)	(0.14)	(-0.15)	(-1.19)	(-0.82)	(-2.31)	(-0.73)
MKT	-0.24	-0.19	-0.14	-0.18	-0.08	-0.00	-0.06	-0.01	0.08	-0.02
t-stat	(-3.55)	(-2.43)	(-1.47)	(-1.76)	(-0.71)	(-0.02)	(-0.42)	(-0.04)	(0.58)	(-0.12)
CALL Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alpha	-1.23	-0.63	-0.50	-0.80	-0.54	-0.34	-0.74	-0.41	-0.78	-1.76
t-stat	(-3.29)	(-1.69)	(-1.14)	(-1.95)	(-1.09)	(-0.74)	(-2.39)	(-0.87)	(-1.92)	(-3.32)
MKT	-0.16	-0.09	-0.02	-0.21	-0.03	-0.11	-0.07	-0.01	-0.16	-0.15
t-stat	(-1.31)	(-0.97)	(-0.14)	(-1.37)	(-0.18)	(-0.81)	(-0.61)	(-0.07)	(-0.99)	(-0.83)

Panel B. FF3 Factor Sensitivities

PUTCALL Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alpha	-0.05	-0.20	-0.27	-0.77	-0.57	-0.63	-1.12	-1.04	-1.43	-1.60
t-stat	(-0.18)	(-0.76)	(-0.87)	(-2.17)	(-1.52)	(-1.92)	(-3.49)	(-2.55)	(-4.19)	(-4.62)
MKT	-0.24	-0.21	-0.11	-0.15	-0.07	-0.01	-0.02	0.00	-0.01	-0.05
t-stat	(-3.02)	(-2.85)	(-0.97)	(-1.30)	(-0.52)	(-0.06)	(-0.14)	(0.01)	(-0.08)	(-0.38)
HML	0.04	-0.01	0.05	0.17	0.06	0.17	0.27	0.22	0.23	0.17
t-stat	(0.37)	(-0.08)	(0.37)	(1.64)	(0.42)	(1.49)	(2.11)	(1.16)	(1.62)	(1.22)
SMB	0.11	0.10	0.05	-0.03	0.07	0.02	0.04	0.03	0.13	-0.05
t-stat	(1.12)	(0.88)	(0.41)	(-0.38)	(0.86)	(0.24)	(0.41)	(0.27)	(1.40)	(-0.73)
PUT Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alpha	1.02	0.50	0.52	-0.13	0.05	-0.05	-0.48	-0.37	-0.79	-0.23
t-stat	(3.27)	(1.51)	(1.86)	(-0.40)	(0.17)	(-0.20)	(-1.36)	(-0.87)	(-2.39)	(-0.78)
MKT	-0.25	-0.21	-0.13	-0.16	-0.07	0.00	-0.03	-0.00	0.08	0.00
t-stat	(-3.93)	(-2.67)	(-1.35)	(-1.49)	(-0.64)	(0.02)	(-0.21)	(-0.02)	(0.67)	(0.04)
HML	-0.06	-0.06	-0.04	0.06	-0.01	0.04	0.21	0.12	0.12	0.12
t-stat	(-0.89)	(-0.75)	(-0.41)	(0.67)	(-0.07)	(0.49)	(2.27)	(0.77)	(1.10)	(0.90)
SMB	0.01	0.10	-0.10	-0.08	-0.04	0.00	-0.06	0.06	0.06	-0.06
t-stat	(0.10)	(0.84)	(-1.05)	(-1.15)	(-0.57)	(0.04)	(-0.57)	(0.50)	(0.75)	(-0.66)
CALL Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alpha	-1.35	-0.70	-0.57	-0.94	-0.59	-0.44	-0.86	-0.50	-0.91	-1.81
t-stat	(-3.29)	(-1.73)	(-1.26)	(-2.06)	(-1.12)	(-0.89)	(-2.68)	(-0.95)	(-1.95)	(-3.00)
MKT	-0.17	-0.09	-0.05	-0.19	-0.05	-0.08	-0.06	0.00	-0.14	-0.09
t-stat	(-1.64)	(-1.14)	(-0.34)	(-1.53)	(-0.39)	(-0.77)	(-0.59)	(0.02)	(-1.08)	(-0.56)
HML	0.23	0.16	0.09	0.38	0.04	0.32	0.31	0.24	0.34	0.26
t-stat	(1.25)	(1.02)	(0.40)	(2.49)	(0.20)	(2.12)	(1.82)	(1.07)	(1.82)	(1.14)
SMB	0.28	0.12	0.24	0.12	0.21	0.02	0.12	0.08	0.11	-0.20
t-stat	(1.96)	(0.68)	(1.31)	(0.83)	(1.64)	(0.21)	(1.02)	(0.47)	(0.78)	(-1.38)

Panel C. FFC4 Factor Sensitivities

PUTCALL Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alpha	-0.04	-0.24	-0.31	-0.80	-0.66	-0.61	-1.14	-1.09	-1.47	-1.69
t-stat	(-0.13)	(-0.88)	(-1.00)	(-2.14)	(-1.79)	(-1.75)	(-3.34)	(-2.60)	(-4.11)	(-4.58)
MKT	-0.25	-0.18	-0.09	-0.13	-0.02	-0.02	-0.01	0.03	0.01	0.00
t-stat	(-3.07)	(-2.25)	(-0.63)	(-1.05)	(-0.12)	(-0.17)	(-0.05)	(0.18)	(0.08)	(0.03)
HML	0.03	0.02	0.08	0.19	0.12	0.16	0.29	0.25	0.26	0.23
t-stat	(0.29)	(0.21)	(0.58)	(1.68)	(0.95)	(1.27)	(2.13)	(1.34)	(1.74)	(1.63)
SMB	0.11	0.10	0.05	-0.03	0.07	0.02	0.04	0.03	0.13	-0.05
t-stat	(1.12)	(0.92)	(0.42)	(-0.38)	(0.81)	(0.24)	(0.41)	(0.27)	(1.40)	(-0.69)
UMD	-0.02	0.07	0.06	0.04	0.14	-0.04	0.03	0.08	0.05	0.13
t-stat	(-0.49)	(1.41)	(0.63)	(0.75)	(1.92)	(-0.50)	(0.55)	(1.16)	(0.86)	(1.61)

PUT Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alpha	1.03	0.47	0.46	-0.12	-0.05	-0.04	-0.49	-0.41	-0.86	-0.30
t-stat	(3.34)	(1.41)	(1.63)	(-0.36)	(-0.16)	(-0.14)	(-1.31)	(-0.93)	(-2.53)	(-0.97)
MKT	-0.26	-0.19	-0.10	-0.17	-0.02	-0.00	-0.02	0.02	0.13	0.05
t-stat	(-3.91)	(-2.21)	(-0.84)	(-1.36)	(-0.13)	(-0.03)	(-0.15)	(0.09)	(0.94)	(0.35)
HML	-0.07	-0.03	0.00	0.05	0.06	0.03	0.22	0.15	0.17	0.16
t-stat	(-0.97)	(-0.36)	(0.02)	(0.53)	(0.60)	(0.37)	(2.03)	(0.86)	(1.43)	(1.25)
SMB	0.01	0.10	-0.10	-0.08	-0.04	0.00	-0.06	0.06	0.06	-0.06
t-stat	(0.10)	(0.87)	(-1.09)	(-1.14)	(-0.58)	(0.04)	(-0.56)	(0.49)	(0.71)	(-0.66)
UMD	-0.02	0.06	0.09	-0.01	0.15	-0.02	0.01	0.06	0.11	0.10
t-stat	(-0.56)	(0.91)	(1.64)	(-0.23)	(2.81)	(-0.24)	(0.21)	(0.92)	(1.94)	(1.75)

Panel C. FFC4 Factor Sensitivities - Continued

CALL Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alpha	-1.30	-0.77	-0.60	-1.00	-0.69	-0.39	-0.88	-0.64	-0.92	-1.98
t-stat	(-3.32)	(-1.72)	(-1.41)	(-2.05)	(-1.35)	(-0.76)	(-2.64)	(-1.19)	(-1.93)	(-3.17)
MKT	-0.20	-0.05	-0.03	-0.16	0.00	-0.11	-0.05	0.08	-0.13	0.01
t-stat	(-1.94)	(-0.56)	(-0.16)	(-1.12)	(0.03)	(-0.91)	(-0.45)	(0.52)	(-0.96)	(0.05)
HML	0.19	0.21	0.11	0.42	0.10	0.28	0.32	0.33	0.35	0.37
t-stat	(1.14)	(1.26)	(0.55)	(2.58)	(0.66)	(1.84)	(2.07)	(1.59)	(1.87)	(1.72)
SMB	0.27	0.12	0.25	0.12	0.21	0.02	0.12	0.08	0.11	-0.20
t-stat	(1.98)	(0.72)	(1.34)	(0.84)	(1.60)	(0.21)	(1.03)	(0.52)	(0.78)	(-1.32)
UMD	-0.07	0.10	0.05	0.09	0.15	-0.08	0.02	0.20	0.01	0.25
t-stat	(-0.92)	(1.16)	(0.36)	(1.00)	(1.49)	(-0.71)	(0.28)	(1.75)	(0.08)	(1.55)

Panel D. FFC4 and Short-Term Reversal (STRev) Factor Sensitivities

PUTCALL Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alpha	0.02	-0.17	-0.03	-0.68	-0.59	-0.39	-0.99	-0.93	-1.26	-1.53
t-stat	(0.06)	(-0.63)	(-0.09)	(-1.98)	(-1.60)	(-1.15)	(-2.95)	(-2.22)	(-3.74)	(-4.19)
MKT	-0.24	-0.17	-0.03	-0.11	-0.00	0.02	0.02	0.07	0.05	0.04
t-stat	(-2.87)	(-1.96)	(-0.20)	(-0.82)	(-0.03)	(0.18)	(0.14)	(0.34)	(0.37)	(0.27)
HML	0.03	0.01	0.05	0.18	0.12	0.14	0.27	0.24	0.24	0.21
t-stat	(0.25)	(0.15)	(0.37)	(1.56)	(0.90)	(1.09)	(2.01)	(1.21)	(1.56)	(1.49)
SMB	0.11	0.10	0.05	-0.03	0.07	0.02	0.04	0.03	0.13	-0.05
t-stat	(1.13)	(0.90)	(0.41)	(-0.36)	(0.80)	(0.25)	(0.41)	(0.27)	(1.39)	(-0.66)
UMD	-0.03	0.06	0.02	0.03	0.13	-0.06	0.01	0.06	0.03	0.11
t-stat	(-0.66)	(1.29)	(0.34)	(0.58)	(1.94)	(-0.86)	(0.24)	(0.94)	(0.49)	(1.46)
STRev	-0.04	-0.05	-0.20	-0.09	-0.05	-0.16	-0.11	-0.12	-0.16	-0.11
t-stat	(-0.88)	(-1.14)	(-2.21)	(-1.64)	(-0.69)	(-2.40)	(-1.79)	(-2.15)	(-2.40)	(-2.14)

PUT Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alpha	1.22	0.49	0.67	-0.01	-0.05	0.11	-0.37	-0.24	-0.64	-0.10
t-stat	(4.36)	(1.49)	(2.34)	(-0.04)	(-0.19)	(0.38)	(-1.03)	(-0.58)	(-2.01)	(-0.29)
MKT	-0.22	-0.19	-0.05	-0.14	-0.02	0.03	0.00	0.05	0.17	0.09
t-stat	(-2.85)	(-1.93)	(-0.42)	(-1.07)	(-0.12)	(0.19)	(0.01)	(0.25)	(1.13)	(0.66)
HML	-0.09	-0.04	-0.02	0.04	0.06	0.02	0.21	0.13	0.15	0.14
t-stat	(-1.06)	(-0.38)	(-0.15)	(0.42)	(0.61)	(0.22)	(1.94)	(0.74)	(1.21)	(1.06)
SMB	0.01	0.10	-0.10	-0.08	-0.04	0.00	-0.05	0.06	0.06	-0.06
t-stat	(0.12)	(0.87)	(-1.03)	(-1.12)	(-0.58)	(0.05)	(-0.56)	(0.48)	(0.70)	(-0.61)
UMD	-0.05	0.05	0.07	-0.03	0.15	-0.03	-0.00	0.04	0.09	0.08
t-stat	(-1.18)	(0.90)	(1.55)	(-0.52)	(2.82)	(-0.52)	(-0.01)	(0.65)	(1.55)	(1.22)
STRev	-0.14	-0.02	-0.16	-0.08	0.00	-0.11	-0.09	-0.12	-0.16	-0.15
t-stat	(-2.91)	(-0.28)	(-2.33)	(-1.38)	(0.02)	(-1.53)	(-1.28)	(-2.67)	(-2.73)	(-2.68)

Panel D. FFC4 and Short-Term Reversal (STRev) Factor Sensitivities - Continued

CALL Asset	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alpha	-1.30	-0.72	-0.27	-0.85	-0.55	-0.12	-0.73	-0.48	-0.72	-1.79
t-stat	(-3.43)	(-1.69)	(-0.50)	(-1.96)	(-1.00)	(-0.25)	(-2.10)	(-0.86)	(-1.56)	(-2.85)
MKT	-0.20	-0.04	0.04	-0.12	0.03	-0.05	-0.02	0.11	-0.09	0.05
t-stat	(-1.92)	(-0.45)	(0.20)	(-0.93)	(0.20)	(-0.44)	(-0.16)	(0.70)	(-0.66)	(0.24)
HML	0.19	0.20	0.08	0.41	0.09	0.26	0.31	0.32	0.33	0.36
t-stat	(1.17)	(1.24)	(0.38)	(2.54)	(0.58)	(1.78)	(2.03)	(1.50)	(1.76)	(1.62)
SMB	0.27	0.12	0.25	0.12	0.21	0.02	0.12	0.08	0.11	-0.19
t-stat	(1.99)	(0.72)	(1.35)	(0.83)	(1.61)	(0.21)	(1.01)	(0.51)	(0.77)	(-1.31)
UMD	-0.07	0.10	0.01	0.07	0.13	-0.11	0.01	0.18	-0.01	0.23
t-stat	(-0.94)	(1.14)	(0.10)	(0.84)	(1.49)	(-1.07)	(0.06)	(1.75)	(-0.14)	(1.56)
STRev	-0.01	-0.04	-0.25	-0.11	-0.10	-0.20	-0.11	-0.11	-0.15	-0.14
t-stat	(-0.05)	(-0.62)	(-1.60)	(-1.30)	(-0.92)	(-2.41)	(-1.10)	(-0.94)	(-1.30)	(-1.15)

Table IV: Volatility, Stock, and Option Market Factors

Panels A, B, and C below present the risk-adjusted alphas and factor sensitivities (Newey and West (1987) t-statistics in parentheses) for the returns on the decile 10 - decile 1 portfolios of PUTCALL, PUT, and CALL assets respectively, where the portfolios are formed on deciles of $RNSkew$. The RV-IV Straddle (Stock) factors are formed by taking the returns of a portfolio that is long ATM straddles (stocks) for stocks in the highest third of RV-IV, and short straddles (stocks) for stocks in the lowest third of RV-IV, where RV is the 1 year realized stock volatility, and IV is the average of the 1 month ATM call and ATM put implied volatilities. The CIV-PIV Straddle (Stock) factor returns are calculated analogously, using ATM call implied volatility (CIV) minus ATM put implied volatility (PIV) as the signal. The MN and CNMN factors are the aggregate volatility and crash-neutral aggregate volatility factors developed by Cremers, Halling, and Weinbaum (2013). The S&P Straddle and S&P Put factors are calculated as the returns on an ATM S&P Index straddle and OTM S&P Index put contract respectively.

Tables begin on next page.

Panel A. PUTCALL Asset 10-1 Risk-Adjusted Alphas and Factor Sensitivities

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**
Alpha	-1.54	-1.55	-1.65	-1.55	-1.53	-1.64	-1.64	-1.64	-1.42	-1.82	-1.82	-1.73	-1.90	-1.641	-1.669	-1.669	-1.409	-1.83
	(-5.31)	(-5.22)	(-5.52)	(-5.04)	(-4.49)	(-5.65)	(-5.46)	(-5.42)	(-3.62)	(-5.95)	(-6.04)	(-6.29)	(-4.49)	(-5.22)	(-5.23)	(-5.22)	(-3.54)	(-4.24)
MKT	0.159	0.197	0.256	0.277	0.252	0.243	0.251	0.255	0.246	0.240	0.229	0.310	0.280	0.260	0.238	0.213	0.215	0.286
	(1.83)	(2.55)	(3.25)	(3.33)	(3.14)	(3.06)	(3.18)	(3.07)	(2.83)	(2.67)	(2.65)	(3.42)	(2.69)	(3.17)	(2.57)	(2.43)	(2.18)	(2.57)
HML		-0.164	-0.162	-0.162	-0.163	-0.134	-0.157	-0.165	-0.136	-0.220	-0.239	-0.233	-0.204	0.198	0.188	0.188	0.203	0.324
		(-1.85)	(-1.78)	(-1.75)	(-1.76)	(-1.62)	(-1.74)	(-1.72)	(-1.55)	(-2.21)	(-2.33)	(-2.38)	(-2.29)	(1.99)	(1.81)	(1.83)	(1.95)	(3.64)
SMB		0.129	0.195	0.186	0.190	0.226	0.196	0.191	0.207	0.231	0.217	0.258	0.311	-0.158	-0.163	-0.150	-0.124	-0.194
		(1.30)	(2.01)	(1.92)	(1.94)	(2.40)	(2.04)	(2.00)	(2.09)	(2.53)	(2.39)	(2.91)	(3.96)	(-1.83)	(-1.80)	(-1.74)	(-1.50)	(-2.19)
UMD			0.151	0.139	0.152	0.148	0.149	0.153	0.144	0.243	0.240	0.261	0.272	0.149	0.149	0.142	0.138	0.267
			(1.96)	(1.78)	(1.99)	(1.95)	(1.96)	(1.98)	(1.85)	(2.91)	(2.87)	(3.25)	(3.60)	(1.99)	(1.91)	(1.80)	(1.73)	(3.63)
STRev				-0.075					-0.046				0.045				-0.039	0.048
				(-1.26)					(-0.77)				(0.71)				(-0.66)	(0.79)
RV-IV					-0.011				-0.012				0.011				-0.014	0.007
Straddle					(-0.46)				(-0.57)				(0.46)				(-0.72)	(0.31)
RV-IV						0.139			0.122				0.154				0.119	0.166
Stock						(1.37)			(1.17)				(1.40)				(1.14)	(1.51)
CIV-PIV							0.012		0.011				0.007				0.013	0.006
Straddle							(0.40)		(0.37)				(0.23)				(0.42)	(0.18)
CIV-PIV								-0.031	-0.036				-0.029				-0.049	-0.029
Stock								(-0.16)	(-0.18)				(-0.13)				(-0.24)	(-0.13)
MN										0.001		0.118	0.122					0.118
										(0.11)		(3.04)	(3.00)					(2.91)
CNMN											-0.006	-0.131	-0.135					-0.134
											(-0.58)	(-3.02)	(-2.95)					(-2.96)
S&P														0.001		0.005	0.005	0.003
Straddle														(0.25)		(0.82)	(0.83)	(0.49)
S&P															-0.001	-0.002	-0.002	0.000
Put															(-0.36)	(-0.96)	(-0.75)	(0.18)
n	177	177	177	177	177	177	177	177	177	144	144	144	144	177	177	177	177	144

Panel B. PUT Asset 10-1 Risk-Adjusted Alphas and Factor Sensitivities

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**
Alpha	-1.207	-1.251	-1.337	-1.318	-0.973	-1.347	-1.308	-1.308	-0.837	-1.458	-1.446	-1.315	-1.443	-1.417	-1.394	-1.393	-1.033	-1.50
	(-2.95)	(-3.09)	(-3.38)	(-3.37)	(-2.36)	(-3.36)	(-3.32)	(-3.17)	(-1.81)	(-3.28)	(-3.35)	(-3.53)	(-3.36)	(-3.51)	(-3.30)	(-3.35)	(-2.45)	(-3.38)
MKT	0.225	0.255	0.305	0.309	0.294	0.315	0.280	0.299	0.268	0.260	0.251	0.368	0.343	0.276	0.248	0.315	0.261	0.471
	(1.75)	(2.31)	(2.90)	(2.86)	(3.04)	(3.07)	(2.57)	(2.78)	(2.34)	(2.59)	(2.58)	(4.32)	(3.17)	(2.81)	(2.46)	(3.10)	(2.11)	(4.95)
HML		-0.069	-0.068	-0.068	-0.069	-0.088	-0.044	-0.077	-0.077	-0.145	-0.174	-0.164	-0.159	0.204	0.212	0.213	0.143	0.299
		(-0.52)	(-0.53)	(-0.53)	(-0.53)	(-0.74)	(-0.37)	(-0.57)	(-0.61)	(-0.90)	(-1.03)	(-1.04)	(-1.09)	(1.57)	(1.56)	(1.55)	(1.06)	(2.21)
SMB		0.177	0.234	0.232	0.220	0.211	0.239	0.216	0.168	0.258	0.240	0.300	0.269	-0.101	-0.071	-0.108	-0.113	-0.199
		(1.37)	(1.85)	(1.81)	(1.70)	(1.77)	(1.91)	(1.62)	(1.35)	(2.00)	(1.81)	(2.31)	(1.98)	(-0.78)	(-0.56)	(-0.85)	(-0.91)	(-1.33)
UMD			0.129	0.127	0.134	0.131	0.120	0.137	0.135	0.217	0.213	0.243	0.233	0.140	0.125	0.147	0.141	0.247
			(1.65)	(1.49)	(1.72)	(1.69)	(1.52)	(1.70)	(1.57)	(2.09)	(2.03)	(2.43)	(2.21)	(1.80)	(1.47)	(1.81)	(1.62)	(2.50)
STRev				-0.014					-0.023				0.050				-0.042	0.035
				(-0.20)					(-0.31)				(0.46)				(-0.54)	(0.33)
RV-IV					-0.032				-0.035				0.009				-0.022	0.019
Straddle					(-1.12)				(-1.14)				(0.43)				(-0.87)	(0.93)
RV-IV						-0.099			-0.115				-0.172				-0.136	-0.176
Stock						(-0.71)			(-0.78)				(-1.12)				(-0.93)	(-1.16)
CIV-PIV							0.058		0.074				0.093				0.078	0.089
Straddle							(1.59)		(1.70)				(1.90)				(1.73)	(1.84)
CIV-PIV								-0.122	-0.205				-0.246				-0.183	-0.218
Stock								(-0.61)	(-0.86)				(-0.93)				(-0.76)	(-0.83)
MN										-0.007		0.171	0.193					0.217
										(-0.59)		(2.36)	(2.68)					(3.05)
CNMN											-0.019	-0.200	-0.223					-0.244
											(-1.14)	(-2.40)	(-2.64)					(-2.98)
S&P														-0.011		-0.014	-0.012	-0.016
Straddle														(-1.70)		(-2.48)	(-1.98)	(-2.94)
S&P															-0.002	0.002	0.001	0.005
Put															(-0.72)	(0.57)	(0.20)	(2.05)
n	177	177	177	177	177	177	177	177	177	144	144	144	144	177	177	177	177	144

Panel C. CALL Asset 10-1 Risk-Adjusted Alphas and Factor Sensitivities

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**
Alpha	-0.527	-0.455	-0.673	-0.492	-1.176	-0.632	-0.696	-0.704	-1.135	-0.792	-0.819	-0.748	-1.489	-0.543	-0.642	-0.643	-0.906	-1.33
	(-1.13)	(-0.94)	(-1.40)	(-1.03)	(-2.23)	(-1.35)	(-1.44)	(-1.55)	(-2.10)	(-1.49)	(-1.54)	(-1.46)	(-2.43)	(-1.06)	(-1.26)	(-1.29)	(-1.59)	(-2.28)
MKT	0.011	0.085	0.212	0.249	0.227	0.174	0.232	0.218	0.255	0.247	0.217	0.280	0.290	0.260	0.243	0.095	0.167	0.132
	(0.09)	(0.70)	(1.56)	(1.66)	(1.66)	(1.49)	(1.79)	(1.53)	(2.00)	(1.43)	(1.31)	(1.56)	(1.59)	(1.76)	(1.38)	(0.62)	(1.14)	(0.62)
HML		-0.473	-0.471	-0.470	-0.469	-0.392	-0.490	-0.460	-0.407	-0.468	-0.479	-0.474	-0.416	0.228	0.192	0.190	0.311	0.430
		(-3.11)	(-3.01)	(-3.01)	(-3.11)	(-3.44)	(-3.20)	(-3.02)	(-3.75)	(-2.48)	(-2.58)	(-2.49)	(-3.51)	(1.49)	(1.19)	(1.27)	(2.19)	(1.90)
SMB		0.037	0.180	0.165	0.199	0.267	0.176	0.199	0.298	0.228	0.209	0.241	0.454	-0.417	-0.469	-0.386	-0.334	-0.355
		(0.19)	(1.11)	(1.05)	(1.35)	(1.70)	(1.09)	(1.37)	(2.12)	(1.03)	(0.96)	(1.07)	(2.33)	(-2.94)	(-3.03)	(-2.72)	(-3.25)	(-2.88)
UMD			0.325	0.304	0.318	0.318	0.332	0.317	0.297	0.468	0.459	0.476	0.510	0.307	0.327	0.280	0.272	0.486
			(2.44)	(2.39)	(2.43)	(2.52)	(2.52)	(2.38)	(2.29)	(2.98)	(2.91)	(3.04)	(3.99)	(2.40)	(2.45)	(2.15)	(2.12)	(3.93)
STRev				-0.132					-0.071				0.058				-0.030	0.081
				(-1.05)					(-0.62)				(0.46)				(-0.26)	(0.62)
RV-IV					0.044				0.044				0.048				0.026	0.031
Straddle					(0.96)				(1.10)				(0.93)				(0.68)	(0.64)
RV-IV						0.386			0.364				0.506				0.376	0.525
Stock						(2.15)			(2.17)				(2.27)				(2.27)	(2.37)
CIV-PIV							-0.047		-0.073				-0.108				-0.071	-0.104
Straddle							(-0.89)		(-1.58)				(-2.26)				(-1.37)	(-2.01)
CIV-PIV								0.132	0.229				0.343				0.169	0.306
Stock								(0.39)	(0.70)				(0.86)				(0.56)	(0.81)
MN										0.036		0.092	0.091					0.057
										(1.91)		(1.26)	(1.38)					(0.80)
CNMN											0.035	-0.062	-0.061					-0.032
											(1.77)	(-0.83)	(-0.88)					(-0.44)
S&P														0.017		0.031	0.027	0.024
Straddle														(2.20)		(3.02)	(2.67)	(2.31)
S&P															0.001	-0.008	-0.005	-0.006
Put															(0.58)	(-3.50)	(-2.11)	(-1.95)
n	177	177	177	177	177	177	177	177	177	144	144	144	144	177	177	177	177	144