Online Appendix for
"The Puzzle of Index Option Returns"

This is the online appendix for "The Puzzle of Index Option Returns" by George Constantinides, Jens Jackwerth, and Alexi Savov. We present a set of tables with alternative specifications for our main results, as well as a set of tests of alternative linear risk factor models.

I.   Robustness

The counterpart of Table OA.I is Table III in the paper. Unlike in the paper, we remove the screening filters when buying into an option portfolio. The screening filters are described in Appendix B of the paper. In Table OA.II, we reinstate the filters, but instead of rebalancing our portfolios daily, we hold the same options until the end of the month without rebalancing, while still adjusting for leverage on the initial date. Tables OA.III and OA.IV represent variations of Table IV in the paper. Table OA.III uses the unfiltered portfolios and Table OA.IV uses the portfolios without rebalancing. In Table OA.V, we present asset pricing results for the OptionMetrics sub-sample, January 1996 to January 2012. In Table OA.VI, we exclude the crash of 1987 and the financial crisis by focusing on the period July 1988 to June 2007. Table OA.VII is a counterpart to Table VI in the paper; the sole difference is that we condition on the lagged level of *Volatility* instead of *Liquidity*.

II.   Alternative Factors

Tables OA.VIII-OA.XII show results for linear factor models employing a range of potential risk factors. The alternative factors are defined as follows.

Market proxies

S&P: monthly return of the S&P 500 index in excess of the return of the one-month T-Bill.
Market: monthly return of the CRSP value-weighted market index in excess of the return of the one-month T-Bill.

Equity-based factors

Size: monthly return on the Fama and French size factor (SMB). Source:

http://mba.tuck.dartmouth.edu/pages/faculty/ken.french

Value: monthly return on the Fama and French value factor (HML). Source:

http://mba.tuck.dartmouth.edu/pages/faculty/ken.french

Momentum: momentum factor, the excess return on a portfolio long stocks with high returns over the period from 12 to two months before portfolio formation and short stocks with low returns over the same period. Source:

http://mba.tuck.dartmouth.edu/pages/faculty/ken.french

Volatility-related factors

Jump: the sum of all daily returns of the S&P 500 that are lower than -4% within each month, zero if there are none; approximately 7% of the months have nonzero jump.

Volatility Jump: the sum of all daily increases in the ATM call portfolio implied volatility that are greater than 4%, zero otherwise; approximately 10% of the months have nonzero *Volatility Jump*.

Volatility: end-of-the-month ATM call portfolio implied volatility minus the beginning-of-the-month ATM call portfolio implied volatility. Using the CBOE-provided shorter time-series VIX does significantly change the results.

RV: annualized realized daily volatility over the month minus the realized volatility over the previous month.

RV-IV: change over last month in the difference between the annualized realized volatility during the month and the annualized monthly ATM implied volatility at the beginning of the month.

Slope: change over last month in the difference between the average of the OTM call and ITM put portfolio implied volatility and the average of the ITM call and OTM put portfolio implied volatility. Using the CBOE-provided shorter time-series SKEW does significantly change the results.

Liquidity-related factors

Liquidity: innovation of market-wide liquidity factor proposed by Pastor and Stambaugh (2003). Source: Wharton Research Data Services.

Volume: percentage change in the monthly option volume.

Open Interest: percentage change in the beginning of the month total option open interest, available only since 1996.

OTM Put Volume: percentage change in the monthly 0.95 OTM put option volume.

Bid-Ask: percentage change in the weighted average percentage bid-ask spread of the ATM call portfolio.

Factors based on sentiment and noise-trader beliefs

Sentiment: sentiment factor proposed by Baker and Wurgler (2006).

SPF Dispersion: measure based on the Survey of Professional Forecasters from the Federal Reserve Bank of Philadelphia. Largely following Shaliastovich (2008), we take the cross-sectional dispersion of one-quarter-ahead nominal GDP growth forecasts and scale by the square-root of the number of forecasts to get a measure of the precision of the forecasts. We then difference the series to obtain an innovation in forecast dispersion. We apply the corresponding quarterly observation to each month in the quarter.

Retail Call Demand: monthly difference in net call demand (in number of contracts) by small and medium size investors, as classified and provided by Market Data Express.

Retail Put Demand: monthly difference in net put demand (in number of contracts) by small and medium size investors, as classified and provided by Market Data Express.

Macro-based and other factors

Default: monthly premium of the BAA bond return over the AAA bond return, differenced over time.

Term: monthly premium of the 10-year bond return over the three-month T-Bill return, differenced over time.

Sharpe: innovation in the market Sharpe ratio as in Brennan, Wang, and Xia (2004).

Riskfree: change in the one-month LIBOR.

Inflation: innovation in inflation as in Brennan, Wang, and Xia (2004).

GDP: return on a portfolio mimicking GDP growth, as in Vassalou (2003).

Table OA.I: Portfolio descriptive statistics, unfiltered data. The portfolios are leverage-adjusted and daily-rebalanced. No filters are applied on the buy-in side. The data covers April 1986 through January 2012. For comparison, the S&P 500 index has a sample average return of 0.65% with a standard error of 0.26; its volatility is 4.56%; it has skewness of -0.79 and excess kurtosis of 2.25; its Jarque-Bera normality test p-value is 0.00.

	Calls						Puts					
K/S	90.0%	95.0%	100.0%	105.0%	110.0%	Hi-Lo	90.0%	95.0%	100.0%	105.0%	110.0%	Hi-Lo
						Average returns						
30 days	0.44	0.36	0.27	0.13	0.68	0.23	2.25	-0.25	0.95	0.76	0.75	-1.50
(s.e.)	(0.25)	(0.24)	(0.24)	(0.25)	(0.22)	(0.19)	(0.44)	(2.01)	(0.31)	(0.28)	(0.27)	(0.27)
90 days	0.47	0.41	0.34	0.26	0.14	-0.33	0.94	0.99	0.81	0.74	0.71	-0.23
(s.e.)	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)	(0.11)	(0.42)	(0.35)	(0.31)	(0.29)	(0.28)	(0.22)
90-30	0.03	0.04	0.07	0.12	-0.54		-1.31	1.24	-0.14	-0.02	-0.04	
(s.e.)	(0.02)	(0.02)	(0.03)	(0.09)	(0.13)		(0.13)	(1.98)	(0.04)	(0.03)	(0.03)	
						Volatility						
30 days	4.34	4.27	4.22	4.33	3.85	3.38	7.72	35.43	5.43	4.96	4.79	4.80
90 days	4.25	4.20	4.22	4.23	4.18	1.94	7.44	6.12	5.49	5.10	4.89	3.92
90-30	0.33	0.36	0.56	1.66	2.33		2.23	34.83	0.66	0.50	0.48	
						Skewness						
30 days	-0.32	-0.23	0.10	1.62	1.09	1.10	-4.75	-16.65	-1.66	-1.19	-0.93	5.47
90 days	-0.28	-0.15	0.00	0.23	0.46	1.14	-4.82	-2.95	-2.03	-1.50	-1.20	7.82
90-30	0.60	1.07	-0.65	-4.86	-0.83		-1.23	17.47	-1.43	-2.43	-0.94	
						Excess kurtosis						
30 days	0.95	0.84	1.17	9.69	3.32	2.56	43.92	284.54	8.86	6.09	4.40	53.86
90 days	0.91	0.82	0.92	1.13	1.61	3.16	47.47	22.83	13.12	8.60	6.53	89.60
90-30	3.14	4.45	2.58	49.89	2.13		16.52	303.72	16.12	19.60	15.96	
						Jarque-Bera normality test p-value						
30 days	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90 days	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90-30	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
						S&P betas						
30 days	0.90	0.87	0.83	0.71	0.49	-0.41	1.24	1.47	1.08	1.02	0.99	-0.25
90 days	0.88	0.86	0.85	0.81	0.74	-0.14	1.27	1.16	1.08	1.03	1.00	-0.27

Table OA.II: Portfolio descriptive statistics, holding period returns with leverage adjustment but no daily rebalancing. At the start of each month, we buy options from our filtered data that expire in the subsequent month or later, and sell them at the end of the month. The sample covers April 1986 through January 2012. For comparison, the S&P 500 index has an average return of 0.65% with a standard error of 0.26; its volatility is 4.56%; it has skewness of -0.79 and excess kurtosis of 2.25; its Jarque-Bera normality test p-value is 0.00.

K/S	Calls						Puts					
	90.0%	95.0%	100.0%	105.0%	110.0%	Hi-Lo	90.0%	95.0%	100.0%	105.0%	110.0%	Hi-Lo
Average returns												
30 days	0.36	0.21	0.00	-0.10	0.00	-0.36	2.27	1.91	1.35	0.93	0.79	-1.48
(s.e.)	(0.26)	(0.25)	(0.25)	(0.26)	(0.30)	(0.24)	(0.33)	(0.29)	(0.29)	(0.28)	(0.27)	(0.22)
90 days	0.38	0.26	0.14	0.06	0.09	-0.29	1.83	1.53	1.20	0.93	0.80	-1.03
(s.e.)	(0.25)	(0.25)	(0.25)	(0.26)	(0.29)	(0.19)	(0.32)	(0.29)	(0.28)	(0.27)	(0.26)	(0.15)
90-30	0.02	0.06	0.13	0.16	0.09		-0.44	-0.38	-0.14	0.00	0.01	
(s.e.)	(0.02)	(0.02)	(0.03)	(0.06)	(0.09)		(0.09)	(0.05)	(0.03)	(0.02)	(0.01)	
Volatility												
30 days	4.50	4.48	4.42	4.59	5.29	4.18	5.84	5.18	5.07	4.86	4.67	3.94
90 days	4.38	4.36	4.33	4.55	5.10	3.29	5.56	5.15	4.99	4.80	4.66	2.72
90-30	0.27	0.30	0.46	0.97	1.58		1.63	0.93	0.48	0.32	0.26	
Skewness												
30 days	-0.04	0.25	0.92	2.49	4.73	3.14	-5.85	-2.99	-1.66	-0.91	-0.53	6.58
90 days	-0.01	0.24	0.68	1.87	3.60	3.75	-3.26	-2.14	-1.46	-0.94	-0.63	4.74
90-30	1.32	1.23	-0.43	-2.31	-5.10		5.56	0.65	-0.15	-0.65	-0.95	
Excess kurtosis												
30 days	0.49	0.42	1.56	9.07	29.20	18.80	52.83	14.44	5.31	2.61	1.80	76.43
90 days	0.49	0.50	1.10	6.41	19.95	26.10	18.98	8.84	4.82	2.76	1.92	43.03
90-30	7.81	3.78	2.88	19.12	64.73		71.43	5.57	1.71	3.98	5.51	
Jarque-Bera normality test p-value												
30 days	0.17	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90 days	0.18	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90-30	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
S&P betas												
30 days	0.91	0.89	0.82	0.72	0.65	-0.26	0.94	0.93	0.99	0.99	0.95	0.00
90 days	0.89	0.87	0.83	0.79	0.75	-0.14	1.00	0.97	0.99	0.97	0.95	-0.05

Table OA.III: Asset pricing tests with selected factors using portfolios constructed without filtering the options data. The stock-based (option-based) results estimate factor premia from the 25 Fama-French portfolios (54 option portfolios). We report betas (factor loadings) and pricing errors (alphas) for four representative portfolios (the rest fall in between). We run two-stage OLS with 10,000 bootstrap simulations. We report bootstrapped standard errors, root-mean-squared pricing errors, and a bootstrapped p-value for the joint hypothesis that all pricing errors are zero. April 1986 to January 2012.

					Factor premia					
1st factor	S&P		S&P		S&P		S&P		S&P	
Stock-based	0.63	(0.30)	0.51	(0.28)	0.57	(0.31)	0.53	(0.27)	0.48	(0.30)
Option-based	0.35	(0.29)	0.25	(0.35)	0.28	(0.28)	0.18	(0.29)	0.25	(0.33)
Difference	0.28	(0.18)	0.26	(0.21)	0.30	(0.18)	0.35	(0.14)	0.23	(0.23)
2nd factor			Jump		Volatility Jump		Volatility		Liquidity	
Stock-based			1.27	(0.79)	-3.73	(1.71)	-1.04	(0.85)	5.81	(2.17)
Option-based			1.14	(0.87)	-2.20	(1.96)	-1.14	(0.55)	3.97	(3.89)
Difference			0.13	(1.12)	-1.53	(2.49)	0.10	(0.87)	1.84	(4.43)
					Call portfolios					
					Betas (for 2nd factor)					
30 days, 95%	0.87	(0.03)	-0.18	(0.05)	0.06	(0.02)	0.10	(0.04)	-0.02	(0.02)
30 days, 105%	0.71	(0.07)	-0.35	(0.07)	0.16	(0.04)	0.29	(0.07)	-0.04	(0.04)
90 days, 95%	0.86	(0.03)	-0.18	(0.05)	0.07	(0.02)	0.11	(0.04)	-0.02	(0.02)
90 days, 105%	0.80	(0.05)	-0.28	(0.07)	0.11	(0.03)	0.26	(0.05)	-0.04	(0.03)
					Alphas (using stock-based premia)					
30 days, 95%	-0.52	(0.16)	-0.21	(0.20)	-0.27	(0.21)	-0.35	(0.14)	-0.27	(0.20)
30 days, 105%	-0.63	(0.21)	-0.16	(0.33)	-0.07	(0.36)	-0.35	(0.28)	-0.29	(0.27)
90 days, 95%	-0.46	(0.16)	-0.15	(0.20)	-0.18	(0.22)	-0.30	(0.15)	-0.20	(0.20)
90 days, 105%	-0.57	(0.19)	-0.17	(0.28)	-0.15	(0.29)	-0.30	(0.25)	-0.22	(0.25)
					Alphas (using option-based premia)					
30 days, 95%	-0.27	(0.11)	0.01	(0.10)	-0.09	(0.07)	-0.01	(0.09)	-0.10	(0.14)
30 days, 105%	-0.43	(0.18)	0.01	(0.16)	-0.07	(0.20)	-0.01	(0.14)	-0.20	(0.22)
90 days, 95%	-0.22	(0.11)	0.06	(0.09)	-0.02	(0.08)	0.04	(0.08)	-0.04	(0.14)
90 days, 105%	-0.34	(0.14)	0.03	(0.10)	-0.06	(0.13)	0.07	(0.10)	-0.10	(0.17)
					Put portfolios					
					Betas (for 2nd factor)					
30 days, 95%	1.47	(0.34)	0.21	(0.41)	-0.39	(0.28)	-0.36	(0.33)	-0.39	(0.57)
30 days, 105%	1.02	(0.04)	0.13	(0.08)	-0.04	(0.02)	-0.19	(0.06)	0.03	(0.04)
90 days, 95%	1.17	(0.11)	0.43	(0.19)	-0.14	(0.05)	-0.52	(0.12)	0.12	(0.08)
90 days, 105%	1.04	(0.05)	0.18	(0.10)	-0.07	(0.02)	-0.24	(0.07)	0.04	(0.04)
					Alphas (using stock-based premia)					
30 days, 95%	-1.53	(2.25)	-1.58	(1.94)	-2.71	(2.73)	-1.63	(2.05)	0.90	(1.93)
30 days, 105%	-0.22	(0.15)	-0.23	(0.18)	-0.30	(0.18)	-0.25	(0.18)	-0.21	(0.19)
90 days, 95%	-0.09	(0.22)	-0.41	(0.43)	-0.48	(0.35)	-0.34	(0.43)	-0.58	(0.39)
90 days, 105%	-0.25	(0.16)	-0.32	(0.21)	-0.41	(0.20)	-0.32	(0.21)	-0.34	(0.21)

				Alphas (using option-based premia)					
30 days, 95%	-1.11	(1.98)	-1.19	(1.47)	-1.77	(1.75)	-1.23	(1.55)	0.56	(0.50)
30 days, 105%	0.07	(0.09)	0.04	(0.10)	0.06	(0.10)	0.05	(0.08)	0.07	(0.08)
90 days, 95%	0.24	(0.15)	-0.09	(0.08)	0.05	(0.21)	-0.09	(0.08)	-0.10	(0.16)
90 days, 105%	0.04	(0.09)	-0.04	(0.08)	-0.02	(0.12)	-0.03	(0.07)	-0.03	(0.07)
			Stock portfolio test statistics (using stock-based premia)						
R.m.s. (p)	0.25	(0.00)	0.24	(0.00)	0.23	(0.00)	0.25	(0.00)	0.21	(0.01)
			Option portfolio test statistics (using stock-based premia)						
R.m.s. (p)	0.49	(0.37)	0.36	(0.47)	0.50	(0.60)	0.39	(0.38)	0.38	(0.59)
			Option portfolio test statistics (using option-based premia)						
R.m.s. (p)	0.41	(0.37)	0.24	(0.46)	0.33	(0.44)	0.25	(0.39)	0.20	(0.24)

Table OA.IV: Asset pricing tests with selected factors using holding period option portfolio returns. At the start of each month, we buy options that expire in the subsequent month or later while adjusting for leverage. We sell these options at the end of the month without rebalancing. The stock-based (option-based) results estimate factor premia from the 25 Fama-French portfolios (54 option portfolios). We report betas (factor loadings) and pricing errors (alphas) for four representative portfolios (the rest fall in between). We run two-stage OLS with 10,000 bootstrap simulations. We report bootstrapped standard errors, root-mean-squared pricing errors, and a bootstrapped p-value for the joint hypothesis that all pricing errors are zero. April 1986 to January 2012.

	Factor premia									
1st factor	S&P		S&P		S&P		S&P		S&P	
Stock-based	0.63	(0.30)	0.51	(0.28)	0.57	(0.30)	0.53	(0.27)	0.48	(0.30)
Option-based	0.52	(0.27)	0.59	(0.43)	0.68	(0.45)	0.37	(0.29)	0.64	(0.50)
Difference	0.12	(0.16)	-0.09	(0.33)	-0.10	(0.38)	0.16	(0.16)	-0.16	(0.48)
2nd factor			\multicolumn{2}{c}{Jump}		\multicolumn{2}{c}{Volatility Jump}		\multicolumn{2}{c}{Volatility}	\multicolumn{2}{c}{Liquidity}
Stock-based			1.27	(0.79)	-3.73	(1.68)	-1.04	(0.84)	5.81	(2.17)
Option-based			3.43	(3.72)	-12.59	(10.28)	-2.15	(0.54)	14.56	(14.47)
Difference			-2.16	(3.77)	8.86	(10.32)	1.12	(0.84)	-8.76	(14.55)
Call portfolios										
Betas (for 2nd factor)										
30 days, 95%	0.90	(0.05)	-0.17	(0.10)	0.04	(0.03)	0.16	(0.07)	-0.03	(0.04)
30 days, 105%	0.73	(0.08)	-0.21	(0.10)	0.07	(0.03)	0.36	(0.09)	-0.04	(0.04)
90 days, 95%	0.88	(0.05)	-0.17	(0.09)	0.04	(0.02)	0.16	(0.06)	-0.03	(0.04)
90 days, 105%	0.80	(0.07)	-0.22	(0.10)	0.08	(0.03)	0.35	(0.09)	-0.04	(0.04)
Alphas (using stock-based premia)										
30 days, 95%	-0.69	(0.18)	-0.39	(0.24)	-0.50	(0.23)	-0.48	(0.19)	-0.38	(0.26)
30 days, 105%	-0.88	(0.21)	-0.57	(0.28)	-0.60	(0.28)	-0.54	(0.33)	-0.53	(0.30)
90 days, 95%	-0.62	(0.18)	-0.32	(0.23)	-0.42	(0.22)	-0.41	(0.18)	-0.33	(0.24)
90 days, 105%	-0.77	(0.20)	-0.43	(0.27)	-0.47	(0.27)	-0.43	(0.31)	-0.42	(0.28)
Alphas (using option-based premia)										
30 days, 95%	-0.59	(0.09)	-0.10	(0.18)	-0.22	(0.23)	-0.15	(0.08)	-0.26	(0.21)
30 days, 105%	-0.80	(0.16)	-0.19	(0.19)	-0.04	(0.23)	0.01	(0.10)	-0.28	(0.29)
90 days, 95%	-0.52	(0.09)	-0.03	(0.13)	-0.12	(0.20)	-0.07	(0.08)	-0.23	(0.20)
90 days, 105%	-0.68	(0.14)	-0.04	(0.16)	0.13	(0.22)	0.12	(0.08)	-0.19	(0.23)
Put portfolios										
Betas (for 2nd factor)										
30 days, 95%	0.93	(0.09)	0.26	(0.14)	-0.06	(0.06)	-0.50	(0.05)	0.05	(0.05)
30 days, 105%	0.98	(0.03)	-0.03	(0.08)	0.01	(0.03)	-0.18	(0.07)	-0.02	(0.03)
90 days, 95%	0.98	(0.07)	0.17	(0.11)	-0.04	(0.05)	-0.44	(0.05)	0.02	(0.04)
90 days, 105%	0.97	(0.04)	-0.02	(0.08)	0.01	(0.03)	-0.19	(0.08)	-0.02	(0.03)
Alphas (using stock-based premia)										
30 days, 95%	0.99	(0.21)	0.82	(0.32)	0.86	(0.27)	0.72	(0.41)	0.87	(0.26)
30 days, 105%	-0.02	(0.16)	0.13	(0.17)	0.07	(0.18)	-0.06	(0.20)	0.23	(0.22)

90 days, 95%	0.58	(0.19)	0.52	(0.24)	0.52	(0.23)	0.36	(0.37)	0.60	(0.22)
90 days, 105%	-0.02	(0.16)	0.13	(0.17)	0.06	(0.18)	-0.06	(0.21)	0.22	(0.22)

<div align="center">Alphas (using option-based premia)</div>

30 days, 95%	1.10	(0.17)	0.18	(0.19)	0.26	(0.28)	0.25	(0.08)	0.32	(0.32)
30 days, 105%	0.09	(0.06)	0.11	(0.19)	0.05	(0.19)	-0.13	(0.09)	0.23	(0.24)
90 days, 95%	0.69	(0.13)	0.08	(0.16)	0.10	(0.28)	-0.03	(0.07)	0.25	(0.21)
90 days, 105%	0.09	(0.06)	0.09	(0.17)	0.00	(0.16)	-0.15	(0.10)	0.21	(0.20)

<div align="center">Stock portfolio test statistics (using stock-based premia)</div>

R.m.s. (p)	0.25	(0.00)	0.24	(0.00)	0.23	(0.00)	0.25	(0.00)	0.21	(0.01)

<div align="center">Option portfolio test statistics (using stock-based premia)</div>

R.m.s. (p)	0.68	(0.00)	0.46	(0.26)	0.50	(0.19)	0.44	(0.09)	0.47	(0.37)

<div align="center">Option portfolio test statistics (using option-based premia)</div>

R.m.s. (p)	0.67	(0.00)	0.14	(0.41)	0.15	(0.72)	0.16	(0.38)	0.27	(0.51)

Table OA.V: Asset pricing tests with selected factors using leverage-adjusted portfolios with daily rebalancing, OptionMetrics subsample. The stock-based (option-based) results estimate factor premia from the 25 Fama-French portfolios (54 option portfolios). We report betas (factor loadings) and pricing errors (alphas) for four representative portfolios (the rest fall in between). We run two-stage OLS with 10,000 bootstrap simulations. We report bootstrapped standard errors, root-mean-squared pricing errors, and a bootstrapped p-value for the joint hypothesis that all pricing errors are zero. January 1996 to January 2012.

	Factor premia									
1st factor	S&P		S&P		S&P		S&P		S&P	
Stock-based	0.63	(0.45)	0.74	(0.42)	0.72	(0.44)	0.73	(0.41)	0.68	(0.42)
Option-based	0.95	(0.40)	1.44	(0.66)	1.59	(0.49)	1.09	(0.44)	1.25	(0.50)
Difference	-0.32	(0.26)	-0.70	(0.72)	-0.88	(0.48)	-0.36	(0.36)	-0.57	(0.53)
2nd factor			Jump		Volatility Jump		Volatility		Liquidity	
Stock-based			-0.34	(0.66)	2.42	(1.95)	0.19	(0.92)	-0.47	(1.28)
Option-based			3.57	(1.27)	-12.35	(4.64)	-3.52	(0.83)	5.61	(2.34)
Difference			-3.92	(1.55)	14.77	(5.46)	3.71	(1.23)	-6.08	(2.59)
Call portfolios										
Betas (for 2nd factor)										
30 days, 95%	0.84	(0.08)	-0.25	(0.21)	0.04	(0.12)	0.16	(0.07)	-0.11	(0.07)
30 days, 105%	0.71	(0.11)	-0.35	(0.24)	0.06	(0.12)	0.28	(0.07)	-0.20	(0.07)
90 days, 95%	0.83	(0.08)	-0.27	(0.17)	0.06	(0.10)	0.17	(0.07)	-0.13	(0.06)
90 days, 105%	0.81	(0.10)	-0.34	(0.22)	0.09	(0.11)	0.24	(0.09)	-0.19	(0.07)
Alphas (using stock-based premia)										
30 days, 95%	-0.09	(0.24)	-0.33	(0.19)	-0.26	(0.18)	-0.24	(0.17)	-0.21	(0.18)
30 days, 105%	-0.57	(0.29)	-0.86	(0.25)	-0.80	(0.23)	-0.79	(0.26)	-0.77	(0.28)
90 days, 95%	-0.05	(0.24)	-0.31	(0.18)	-0.28	(0.17)	-0.23	(0.17)	-0.19	(0.19)
90 days, 105%	-0.28	(0.29)	-0.58	(0.25)	-0.62	(0.23)	-0.48	(0.26)	-0.47	(0.27)
Alphas (using option-based premia)										
30 days, 95%	-0.35	(0.09)	-0.01	(0.16)	-0.47	(0.13)	0.01	(0.06)	-0.04	(0.12)
30 days, 105%	-0.80	(0.19)	-0.10	(0.22)	-0.60	(0.19)	-0.05	(0.08)	0.02	(0.17)
90 days, 95%	-0.32	(0.10)	0.09	(0.16)	-0.21	(0.11)	0.06	(0.05)	0.08	(0.11)
90 days, 105%	-0.54	(0.16)	0.08	(0.17)	-0.01	(0.22)	0.08	(0.08)	0.18	(0.14)
Put portfolios										
Betas (for 2nd factor)										
30 days, 95%	0.81	(0.09)	0.17	(0.51)	0.02	(0.22)	-0.24	(0.13)	0.11	(0.07)
30 days, 105%	0.86	(0.06)	-0.15	(0.24)	0.09	(0.12)	-0.02	(0.10)	-0.04	(0.06)
90 days, 95%	0.90	(0.06)	0.09	(0.37)	0.04	(0.21)	-0.19	(0.12)	0.10	(0.07)
90 days, 105%	0.86	(0.05)	-0.12	(0.22)	0.06	(0.12)	-0.02	(0.10)	-0.02	(0.06)
Alphas (using stock-based premia)										
30 days, 95%	1.50	(0.27)	1.52	(0.36)	1.38	(0.32)	1.58	(0.37)	1.55	(0.32)
30 days, 105%	0.42	(0.21)	0.24	(0.17)	0.10	(0.19)	0.35	(0.18)	0.35	(0.16)
90 days, 95%	0.76	(0.23)	0.72	(0.26)	0.55	(0.25)	0.78	(0.30)	0.80	(0.27)
90 days, 105%	0.43	(0.21)	0.26	(0.17)	0.19	(0.17)	0.37	(0.17)	0.37	(0.16)

	Alphas (using option-based premia)								
30 days, 95%	1.24	(0.25)	0.34	(0.36)	0.91	(0.26)	0.45	(0.12)	0.43	(0.20)
30 days, 105%	0.15	(0.06)	0.17	(0.22)	0.59	(0.20)	-0.01	(0.09)	0.12	(0.13)
90 days, 95%	0.47	(0.17)	-0.24	(0.23)	0.39	(0.21)	-0.22	(0.07)	-0.31	(0.16)
90 days, 105%	0.15	(0.06)	0.10	(0.16)	0.23	(0.08)	-0.03	(0.06)	0.02	(0.09)
	Stock portfolio test statistics (using stock-based premia)								
R.m.s. (p)	0.28	(0.00)	0.27	(0.00)	0.26	(0.00)	0.29	(0.00)	0.28	(0.00)
	Option portfolio test statistics (using stock-based premia)								
R.m.s. (p)	0.68	(0.30)	0.75	(0.33)	0.67	(0.47)	0.75	(0.41)	0.74	(0.31)
	Option portfolio test statistics (using option-based premia)								
R.m.s. (p)	0.62	(0.34)	0.22	(0.59)	0.54	(0.59)	0.19	(0.55)	0.20	(0.67)

Table OA.VI: Asset pricing tests with selected factors using leverage-adjusted portfolios with daily rebalancing, subsample without the 1987 crash and the financial crisis of 2008. The sample beings in July 1988 and ends in June 2007. The stock-based (option-based) results estimate factor premia from the 25 Fama-French portfolios (54 option portfolios). We report betas (factor loadings) and pricing errors (alphas) for four representative portfolios (the rest fall in between). We run two-stage OLS with 10,000 bootstrap simulations. We report bootstrapped standard errors, root-mean-squared pricing errors, and a bootstrapped p-value for the joint hypothesis that all pricing errors are zero.

					Factor premia					
1st factor	S&P		S&P		S&P		S&P		S&P	
Stock-based	0.84	(0.33)	0.77	(0.29)	0.96	(0.32)	0.62	(0.29)	0.64	(0.33)
Option-based	0.51	(0.27)	0.39	(0.31)	0.47	(0.31)	0.49	(0.28)	-0.31	(0.59)
Difference	0.33	(0.19)	0.37	(0.21)	0.49	(0.26)	0.13	(0.15)	0.95	(0.59)
2nd factor			Jump		Volatility Jump		Volatility		Liquidity	
Stock-based			0.22	(0.26)	-2.32	(1.07)	-1.42	(0.82)	6.99	(2.60)
Option-based			0.94	(0.37)	-3.79	(2.24)	-1.62	(0.38)	22.92	(14.75)
Difference			-0.72	(0.44)	1.47	(2.54)	0.19	(0.77)	-15.93	(14.74)
					Call portfolios					
					Betas (for 2nd factor)					
30 days, 95%	0.92	(0.03)	-0.25	(0.11)	0.05	(0.04)	0.17	(0.04)	0.02	(0.02)
30 days, 105%	0.81	(0.06)	-0.42	(0.11)	0.17	(0.07)	0.41	(0.06)	0.00	(0.03)
90 days, 95%	0.91	(0.03)	-0.24	(0.09)	0.05	(0.04)	0.18	(0.04)	0.02	(0.02)
90 days, 105%	0.88	(0.05)	-0.47	(0.13)	0.13	(0.07)	0.40	(0.05)	0.02	(0.02)
					Alphas (using stock-based premia)					
30 days, 95%	-0.61	(0.20)	-0.50	(0.16)	-0.61	(0.20)	-0.22	(0.20)	-0.54	(0.22)
30 days, 105%	-0.83	(0.24)	-0.71	(0.20)	-0.57	(0.28)	-0.19	(0.34)	-0.67	(0.25)
90 days, 95%	-0.59	(0.20)	-0.49	(0.15)	-0.59	(0.20)	-0.19	(0.20)	-0.53	(0.21)
90 days, 105%	-0.65	(0.23)	-0.52	(0.21)	-0.49	(0.26)	-0.02	(0.34)	-0.60	(0.24)
					Alphas (using option-based premia)					
30 days, 95%	-0.30	(0.06)	0.03	(0.07)	-0.07	(0.07)	-0.05	(0.04)	0.06	(0.14)
30 days, 105%	-0.57	(0.14)	-0.09	(0.12)	0.09	(0.10)	0.02	(0.08)	0.10	(0.28)
90 days, 95%	-0.29	(0.06)	0.03	(0.04)	-0.07	(0.05)	-0.02	(0.03)	0.05	(0.14)
90 days, 105%	-0.37	(0.11)	0.16	(0.07)	0.15	(0.06)	0.20	(0.04)	-0.04	(0.18)
					Put portfolios					
					Betas (for 2nd factor)					
30 days, 95%	0.95	(0.06)	1.06	(0.28)	-0.18	(0.08)	-0.52	(0.08)	0.07	(0.04)
30 days, 105%	0.96	(0.03)	0.13	(0.14)	-0.05	(0.04)	-0.06	(0.05)	0.04	(0.02)
90 days, 95%	0.98	(0.05)	0.73	(0.22)	-0.14	(0.07)	-0.38	(0.07)	0.06	(0.03)
90 days, 105%	0.96	(0.03)	0.24	(0.13)	-0.07	(0.04)	-0.13	(0.05)	0.04	(0.02)
					Alphas (using stock-based premia)					
30 days, 95%	0.68	(0.22)	0.58	(0.35)	0.19	(0.34)	0.30	(0.44)	0.37	(0.31)
30 days, 105%	-0.31	(0.18)	-0.26	(0.15)	-0.53	(0.20)	-0.16	(0.15)	-0.39	(0.22)
90 days, 95%	0.03	(0.19)	-0.01	(0.26)	-0.37	(0.28)	-0.18	(0.33)	-0.19	(0.26)

90 days, 105%	-0.31	(0.18)	-0.28	(0.15)	-0.58	(0.21)	-0.25	(0.17)	-0.38	(0.22)

Alphas (using option-based premia)

30 days, 95%	0.99	(0.15)	0.14	(0.10)	0.37	(0.09)	0.29	(0.07)	0.09	(0.32)
30 days, 105%	0.01	(0.03)	0.00	(0.08)	-0.13	(0.07)	-0.05	(0.04)	-0.11	(0.09)
90 days, 95%	0.35	(0.10)	-0.19	(0.10)	-0.11	(0.06)	-0.15	(0.05)	-0.23	(0.22)
90 days, 105%	0.00	(0.05)	-0.10	(0.06)	-0.22	(0.07)	-0.16	(0.04)	-0.08	(0.11)

Stock portfolio test statistics (using stock-based premia)

R.m.s. (p)	0.35	(0.00)	0.35	(0.00)	0.33	(0.00)	0.33	(0.00)	0.27	(0.03)

Option portfolio test statistics (using stock-based premia)

R.m.s. (p)	0.57	(0.00)	0.48	(0.04)	0.52	(0.16)	0.22	(0.16)	0.51	(0.11)

Option portfolio test statistics (using option-based premia)

R.m.s. (p)	0.49	(0.00)	0.13	(0.55)	0.22	(0.43)	0.17	(0.20)	0.22	(0.78)

Table OA.VII: Conditional asset pricing tests with selected factors described in Appendix C. The conditioning variable is the implied volatility of our ATM call portfolio. The stock-based (option-based) results estimate factor premia from the 25 Fama-French portfolios (54 option portfolios). We report betas (factor loadings) and pricing errors (alphas) for four representative portfolios (the rest fall in between). We run two-stage OLS with 10,000 bootstrap simulations. We report bootstrapped standard errors, root-mean-squared pricing errors, and a bootstrapped p-value for the joint hypothesis that all pricing errors are zero. April 1986 to January 2012.

					Factor premia					
1st factor, intercept	S&P		S&P		S&P		S&P		S&P	
Stock-based	0.51	(0.29)	0.51	(0.27)	0.47	(0.28)	0.52	(0.27)	0.52	(0.27)
Option-based	0.24	(0.37)	0.57	(0.35)	0.41	(0.29)	0.46	(0.29)	0.45	(0.35)
Difference	0.26	(0.30)	-0.06	(0.30)	0.07	(0.21)	0.05	(0.18)	0.07	(0.32)
1st factor, slope	S&P		S&P		S&P		S&P		S&P	
Stock-based	0.45	(0.17)	0.50	(0.17)	0.30	(0.17)	0.41	(0.17)	0.35	(0.17)
Option-based	0.77	(0.54)	-0.01	(0.14)	-0.05	(0.13)	-0.01	(0.11)	0.00	(0.16)
Difference	-0.32	(0.54)	0.51	(0.21)	0.35	(0.20)	0.41	(0.18)	0.35	(0.22)
2nd factor, intercept			Jump		Volatility Jump		Volatility		Liquidity	
Stock-based			0.56	(0.86)	-2.09	(1.69)	-0.79	(0.92)	3.23	(1.97)
Option-based			1.25	(1.41)	-1.15	(1.88)	-2.09	(0.53)	9.43	(4.11)
Difference			-0.69	(1.65)	-0.93	(2.57)	1.31	(0.97)	-6.20	(4.46)
2nd factor, slope			Jump		Volatility Jump		Volatility		Liquidity	
Stock-based			0.28	(0.30)	-0.50	(0.75)	-0.65	(0.28)	0.93	(0.45)
Option-based			0.01	(0.63)	0.57	(0.86)	-0.46	(0.16)	1.78	(0.89)
Difference			0.27	(0.71)	-1.07	(1.17)	-0.19	(0.29)	-0.84	(0.99)
					Call portfolios					
					Betas, intercept (for 2nd factor)					
30 days, 95%	0.91	(0.00)	-0.36	(0.00)	0.14	(0.00)	0.28	(0.00)	-0.05	(0.00)
30 days, 105%	0.72	(0.00)	-0.58	(0.00)	0.29	(0.00)	0.58	(0.00)	-0.11	(0.00)
90 days, 95%	0.91	(0.00)	-0.36	(0.00)	0.14	(0.00)	0.32	(0.00)	-0.05	(0.00)
90 days, 105%	0.92	(0.00)	-0.52	(0.00)	0.23	(0.00)	0.56	(0.00)	-0.09	(0.00)
					Betas, slope (for 2nd factor)					
30 days, 95%	-0.22	(0.00)	0.49	(0.00)	-0.22	(0.00)	-0.57	(0.00)	0.11	(0.00)
30 days, 105%	-0.04	(0.00)	0.81	(0.00)	-0.46	(0.00)	-1.05	(0.00)	0.24	(0.00)
90 days, 95%	-0.28	(0.00)	0.47	(0.00)	-0.20	(0.00)	-0.68	(0.00)	0.06	(0.00)
90 days, 105%	-0.57	(0.00)	0.74	(0.00)	-0.35	(0.00)	-1.13	(0.00)	0.17	(0.00)
					Alphas (using stock-based premia)					
30 days, 95%	-0.27	(0.20)	-0.31	(0.23)	-0.13	(0.22)	-0.46	(0.25)	-0.22	(0.21)
30 days, 105%	-0.63	(0.25)	-0.70	(0.34)	-0.32	(0.37)	-0.94	(0.43)	-0.49	(0.28)
90 days, 95%	-0.22	(0.20)	-0.26	(0.23)	-0.10	(0.22)	-0.46	(0.27)	-0.16	(0.21)
90 days, 105%	-0.22	(0.25)	-0.26	(0.31)	-0.04	(0.32)	-0.60	(0.41)	-0.16	(0.27)
					Alphas (using option-based premia)					
30 days, 95%	0.04	(0.13)	0.00	(0.03)	-0.01	(0.03)	-0.05	(0.02)	-0.01	(0.04)

30 days, 105%	-0.43	(0.25)	-0.01	(0.06)	0.00	(0.06)	0.01	(0.05)	0.01	(0.10)
90 days, 95%	0.11	(0.14)	0.01	(0.04)	-0.01	(0.03)	0.00	(0.02)	0.03	(0.04)
90 days, 105%	0.21	(0.23)	0.07	(0.03)	0.05	(0.04)	0.12	(0.03)	0.06	(0.05)

<div align="center">Put portfolios</div>

<div align="center">Betas, intercept (for 2 factor)</div>

Betas, intercept (for 2nd factor)

30 days, 95%	0.85	(0.00)	0.59	(0.00)	-0.39	(0.00)	-0.27	(0.00)	0.27	(0.00)
30 days, 105%	0.87	(0.00)	-0.04	(0.00)	-0.09	(0.00)	0.21	(0.00)	0.12	(0.00)
90 days, 95%	0.85	(0.00)	0.41	(0.00)	-0.29	(0.00)	-0.10	(0.00)	0.23	(0.00)
90 days, 105%	0.82	(0.00)	0.02	(0.00)	-0.11	(0.00)	0.12	(0.00)	0.11	(0.00)

Betas, slope (for 2nd factor)

30 days, 95%	0.81	(0.00)	-1.14	(0.00)	0.83	(0.00)	-0.54	(0.00)	-0.98	(0.00)
30 days, 105%	0.41	(0.00)	0.08	(0.00)	0.26	(0.00)	-1.17	(0.00)	-0.60	(0.00)
90 days, 95%	0.84	(0.00)	-0.80	(0.00)	0.67	(0.00)	-0.83	(0.00)	-0.88	(0.00)
90 days, 105%	0.66	(0.00)	-0.08	(0.00)	0.28	(0.00)	-0.96	(0.00)	-0.54	(0.00)

Alphas (using stock-based premia)

30 days, 95%	0.53	(0.27)	0.50	(0.39)	0.23	(0.40)	0.12	(0.43)	0.65	(0.40)
30 days, 105%	-0.15	(0.18)	-0.17	(0.21)	-0.19	(0.20)	-0.69	(0.30)	0.05	(0.28)
90 days, 95%	-0.04	(0.25)	-0.08	(0.31)	-0.23	(0.32)	-0.53	(0.36)	0.11	(0.36)
90 days, 105%	-0.24	(0.18)	-0.28	(0.21)	-0.25	(0.20)	-0.70	(0.28)	-0.05	(0.28)

Alphas (using option-based premia)

30 days, 95%	0.49	(0.18)	0.19	(0.10)	0.22	(0.06)	0.24	(0.06)	0.19	(0.10)
30 days, 105%	-0.05	(0.13)	0.02	(0.03)	-0.06	(0.04)	-0.02	(0.03)	-0.01	(0.05)
90 days, 95%	-0.08	(0.16)	-0.16	(0.05)	-0.15	(0.04)	-0.14	(0.04)	-0.19	(0.07)
90 days, 105%	-0.24	(0.11)	-0.01	(0.03)	-0.06	(0.04)	-0.07	(0.03)	-0.02	(0.05)

Stock portfolio test statistics (using stock-based premia)

R.m.s. (p)	0.22	(0.00)	0.21	(0.01)	0.21	(0.01)	0.20	(0.02)	0.19	(0.04)

Option portfolio test statistics (using stock-based premia)

R.m.s. (p)	0.33	(0.42)	0.36	(0.43)	0.20	(0.26)	0.59	(0.45)	0.31	(0.42)

Option portfolio test statistics (using option-based premia)

R.m.s. (p)	0.23	(0.60)	0.11	(0.32)	0.12	(0.43)	0.13	(0.13)	0.12	(0.34)

Table OA.VIII: Asset pricing tests with stock-based factors. The stock-based (option-based) results estimate factor premia from the 25 Fama-French portfolios (54 option portfolios). We report betas (factor loadings) and pricing errors (alphas) for four representative portfolios (the rest fall in between). We run two-stage OLS with 10,000 bootstrap simulations. We report bootstrapped standard errors, root-mean-squared pricing errors, and a bootstrapped p-value for the joint hypothesis that all pricing errors are zero. April 1986 to October 2010.

					Factor premia					
1st factor	S&P		Market		S&P		S&P		S&P	
Stock-based	0.64	(0.31)	0.61	(0.29)	0.70	(0.29)	0.63	(0.31)	0.61	(0.30)
Option-based	0.42	(0.28)	0.45	(0.29)	0.37	(0.30)	0.45	(0.32)	1.37	(0.55)
Difference	0.21	(0.17)	0.16	(0.17)	0.32	(0.19)	0.19	(0.23)	-0.76	(0.51)
2nd factor					Size		Value		Momentum	
Stock-based					-0.05	(0.21)	0.25	(0.23)	-1.42	(1.12)
Option-based					3.20	(1.39)	-15.23	(3.70)	20.16	(7.75)
Difference					-3.26	(1.33)	15.47	(3.69)	-21.58	(7.82)
					Call portfolios					
					Betas (for 2nd factor)					
30 days, 95%	0.86	(0.04)	0.81	(0.04)	-0.07	(0.03)	0.01	(0.04)	-0.04	(0.03)
30 days, 105%	0.72	(0.06)	0.67	(0.06)	-0.18	(0.06)	-0.01	(0.07)	-0.06	(0.03)
90 days, 95%	0.85	(0.04)	0.81	(0.04)	-0.07	(0.03)	0.01	(0.04)	-0.04	(0.03)
90 days, 105%	0.80	(0.05)	0.75	(0.05)	-0.13	(0.04)	-0.01	(0.06)	-0.04	(0.03)
					Alphas (using stock-based premia)					
30 days, 95%	-0.48	(0.17)	-0.43	(0.16)	-0.54	(0.15)	-0.48	(0.18)	-0.51	(0.17)
30 days, 105%	-0.75	(0.21)	-0.70	(0.20)	-0.81	(0.18)	-0.75	(0.21)	-0.82	(0.21)
90 days, 95%	-0.45	(0.17)	-0.41	(0.16)	-0.51	(0.14)	-0.45	(0.18)	-0.49	(0.17)
90 days, 105%	-0.54	(0.20)	-0.49	(0.19)	-0.60	(0.17)	-0.53	(0.21)	-0.57	(0.20)
					Alphas (using option-based premia)					
30 days, 95%	-0.30	(0.07)	-0.30	(0.08)	-0.03	(0.04)	-0.10	(0.08)	-0.25	(0.11)
30 days, 105%	-0.60	(0.14)	-0.59	(0.14)	0.00	(0.08)	-0.71	(0.15)	0.02	(0.24)
90 days, 95%	-0.27	(0.07)	-0.28	(0.07)	-0.01	(0.04)	-0.21	(0.06)	-0.27	(0.11)
90 days, 105%	-0.37	(0.12)	-0.37	(0.12)	0.09	(0.05)	-0.50	(0.11)	-0.31	(0.17)

	Put portfolios									
	Betas (for 2nd factor)									
30 days, 95%	1.02	(0.06)	1.01	(0.06)	0.18	(0.06)	-0.02	(0.06)	-0.01	(0.04)
30 days, 105%	0.96	(0.04)	0.93	(0.04)	0.05	(0.04)	0.01	(0.03)	-0.05	(0.03)
90 days, 95%	1.03	(0.05)	1.01	(0.05)	0.15	(0.05)	0.01	(0.05)	-0.04	(0.03)
90 days, 105%	0.97	(0.04)	0.94	(0.04)	0.07	(0.04)	0.01	(0.04)	-0.05	(0.03)
	Alphas (using stock-based premia)									
30 days, 95%	0.59	(0.22)	0.62	(0.22)	0.55	(0.21)	0.61	(0.23)	0.60	(0.22)
30 days, 105%	-0.17	(0.17)	-0.13	(0.16)	-0.22	(0.14)	-0.17	(0.17)	-0.21	(0.16)
90 days, 95%	0.08	(0.19)	0.11	(0.19)	0.03	(0.17)	0.08	(0.20)	0.05	(0.19)
90 days, 105%	-0.18	(0.17)	-0.14	(0.16)	-0.23	(0.14)	-0.18	(0.17)	-0.23	(0.17)
	Alphas (using option-based premia)									
30 days, 95%	0.81	(0.15)	0.79	(0.14)	0.28	(0.07)	0.42	(0.16)	0.15	(0.28)
30 days, 105%	0.04	(0.04)	0.02	(0.04)	-0.07	(0.05)	0.15	(0.06)	0.18	(0.11)
90 days, 95%	0.30	(0.10)	0.28	(0.10)	-0.12	(0.05)	0.40	(0.10)	0.19	(0.16)
90 days, 105%	0.03	(0.05)	0.01	(0.05)	-0.13	(0.05)	0.16	(0.06)	0.21	(0.12)
	Stock portfolio test statistics (using stock-based premia)									
R.m.s. (p)	0.26	(0.00)	0.27	(0.00)	0.26	(0.00)	0.20	(0.00)	0.25	(0.00)
	Option portfolio test statistics (using stock-based premia)									
R.m.s. (p)	0.48	(0.02)	0.45	(0.02)	0.51	(0.02)	0.48	(0.02)	0.51	(0.01)
	Option portfolio test statistics (using option-based premia)									
R.m.s. (p)	0.44	(0.02)	0.43	(0.02)	0.14	(0.21)	0.39	(0.74)	0.30	(0.59)

Table OA.IX: Asset pricing tests with volatility-related. The stock-based (option-based) results estimate factor premia from the 25 Fama-French portfolios (54 option portfolios). We report betas (factor loadings) and pricing errors (alphas) for four representative portfolios (the rest fall in between). We run two-stage OLS with 10,000 bootstrap simulations. We report bootstrapped standard errors, root-mean-squared pricing errors, and a bootstrapped p-value for the joint hypothesis that all pricing errors are zero. April 1986 to October 2010.

					Factor premia							
1st factor	S&P		S&P		S&P		S&P		S&P		S&P	
Stock-based	0.49	(0.29)	0.53	(0.28)	0.57	(0.32)	0.61	(0.28)	0.62	(0.29)	0.61	(0.32)
Option-based	0.53	(0.47)	0.35	(0.29)	0.42	(0.33)	0.41	(0.29)	0.37	(0.30)	0.27	(0.33)
Difference	-0.05	(0.40)	0.18	(0.17)	0.16	(0.25)	0.21	(0.18)	0.25	(0.20)	0.34	(0.26)
2nd factor	Jump		Volatility		Volatility Jump		RV		RV-IV		Slope	
Stock-based	1.39	(0.79)	-1.05	(0.92)	-4.02	(1.69)	-0.37	(1.60)	-0.35	(2.10)	0.85	(0.57)
Option-based	2.36	(1.73)	-1.79	(0.48)	-4.78	(3.35)	-3.52	(1.14)	4.57	(1.52)	-2.94	(1.24)
Difference	-0.98	(1.85)	0.73	(0.96)	0.76	(3.65)	3.15	(1.81)	-4.92	(2.44)	3.78	(1.37)
					Call portfolios							
					Betas (for 2nd factor)							
30 days, 95%	-0.19	(0.06)	0.14	(0.05)	0.06	(0.03)	0.08	(0.02)	-0.06	(0.02)	0.03	(0.08)
30 days, 105%	-0.29	(0.09)	0.32	(0.06)	0.13	(0.04)	0.17	(0.04)	-0.12	(0.03)	0.02	(0.12)
90 days, 95%	-0.20	(0.06)	0.15	(0.05)	0.07	(0.02)	0.08	(0.03)	-0.06	(0.02)	0.05	(0.08)
90 days, 105%	-0.27	(0.07)	0.28	(0.06)	0.12	(0.03)	0.13	(0.04)	-0.09	(0.03)	0.09	(0.10)
					Alphas (using stock-based premia)							
30 days, 95%	-0.11	(0.23)	-0.28	(0.18)	-0.20	(0.24)	-0.44	(0.20)	-0.50	(0.19)	-0.48	(0.19)
30 days, 105%	-0.29	(0.31)	-0.44	(0.32)	-0.24	(0.34)	-0.71	(0.32)	-0.80	(0.31)	-0.72	(0.24)
90 days, 95%	-0.08	(0.23)	-0.26	(0.18)	-0.16	(0.24)	-0.42	(0.19)	-0.48	(0.19)	-0.48	(0.19)
90 days, 105%	-0.09	(0.28)	-0.25	(0.28)	-0.06	(0.31)	-0.49	(0.27)	-0.57	(0.26)	-0.57	(0.22)
					Alphas (using option-based premia)							
30 days, 95%	0.03	(0.07)	0.00	(0.03)	-0.02	(0.10)	0.00	(0.03)	0.00	(0.03)	-0.07	(0.13)
30 days, 105%	-0.05	(0.10)	-0.04	(0.06)	-0.01	(0.10)	0.00	(0.06)	0.01	(0.06)	-0.38	(0.22)
90 days, 95%	0.07	(0.06)	0.02	(0.03)	0.03	(0.07)	0.02	(0.03)	0.01	(0.03)	0.01	(0.12)
90 days, 105%	0.13	(0.08)	0.13	(0.04)	0.17	(0.09)	0.11	(0.04)	0.09	(0.05)	0.03	(0.16)

					Put portfolios							
					Betas (for 2nd factor)							
30 days, 95%	0.22	(0.17)	-0.41	(0.13)	-0.13	(0.06)	-0.18	(0.06)	0.14	(0.05)	-0.30	(0.23)
30 days, 105%	0.00	(0.11)	-0.10	(0.09)	-0.02	(0.04)	-0.05	(0.04)	0.03	(0.03)	0.04	(0.12)
90 days, 95%	0.15	(0.14)	-0.32	(0.10)	-0.09	(0.05)	-0.14	(0.05)	0.11	(0.04)	-0.15	(0.20)
90 days, 105%	0.02	(0.12)	-0.13	(0.09)	-0.04	(0.03)	-0.05	(0.04)	0.04	(0.03)	0.00	(0.10)
					Alphas (using stock-based premia)							
30 days, 95%	0.48	(0.35)	0.40	(0.45)	0.19	(0.35)	0.63	(0.33)	0.70	(0.35)	0.87	(0.33)
30 days, 105%	-0.03	(0.21)	-0.14	(0.19)	-0.20	(0.21)	-0.13	(0.15)	-0.14	(0.16)	-0.19	(0.18)
90 days, 95%	0.05	(0.27)	-0.05	(0.34)	-0.18	(0.27)	0.11	(0.25)	0.14	(0.27)	0.21	(0.25)
90 days, 105%	-0.06	(0.22)	-0.17	(0.20)	-0.27	(0.21)	-0.15	(0.16)	-0.16	(0.17)	-0.18	(0.18)
					Alphas (using option-based premia)							
30 days, 95%	0.23	(0.13)	0.24	(0.06)	0.24	(0.10)	0.24	(0.07)	0.22	(0.07)	0.08	(0.25)
30 days, 105%	-0.07	(0.11)	-0.05	(0.04)	-0.07	(0.11)	-0.09	(0.04)	-0.08	(0.05)	0.29	(0.17)
90 days, 95%	-0.14	(0.08)	-0.14	(0.04)	-0.09	(0.10)	-0.13	(0.04)	-0.14	(0.05)	0.00	(0.19)
90 days, 105%	-0.12	(0.10)	-0.10	(0.04)	-0.15	(0.07)	-0.13	(0.04)	-0.11	(0.04)	0.16	(0.11)
					Stock portfolio test statistics (using stock-based premia)							
R.m.s. (p)	0.24	(0.00)	0.26	(0.00)	0.23	(0.00)	0.27	(0.00)	0.27	(0.00)	0.24	(0.00)
					Option portfolio test statistics (using stock-based premia)							
R.m.s. (p)	0.23	(0.07)	0.29	(0.01)	0.21	(0.39)	0.46	(0.03)	0.52	(0.10)	0.54	(0.22)
					Option portfolio test statistics (using option-based premia)							
R.m.s. (p)	0.13	(0.21)	0.13	(0.06)	0.14	(0.51)	0.14	(0.12)	0.13	(0.30)	0.21	(0.63)

Table OA.X: Asset pricing tests with liquidity-related. The stock-based (option-based) results estimate factor premia from the 25 Fama-French portfolios (54 option portfolios). We report betas (factor loadings) and pricing errors (alphas) for four representative portfolios (the rest fall in between). We run two-stage OLS with 10,000 bootstrap simulations. We report bootstrapped standard errors, root-mean-squared pricing errors, and a bootstrapped p-value for the joint hypothesis that all pricing errors are zero. April 1986 to October 2010.

	Factor premia									
1st factor	S&P		Market		S&P		S&P		S&P	
Stock-based	0.46	(0.31)	0.66	(0.30)	0.44	(0.42)	0.59	(0.31)	0.60	(0.31)
Option-based	0.58	(0.57)	0.33	(0.31)	-0.22	(0.48)	0.52	(0.36)	-0.04	(0.49)
Difference	-0.11	(0.58)	0.32	(0.20)	0.66	(0.38)	0.07	(0.25)	0.64	(0.45)
2nd factor	Liquidity		Volume		Open Interest		OTM Put Volume		Bid-Ask	
Stock-based	5.90	(2.22)	0.12	(0.10)	-0.09	(0.09)	0.48	(0.22)	-1.30	(1.08)
Option-based	14.33	(11.65)	-0.39	(0.19)	-1.01	(0.44)	-0.79	(0.48)	9.59	(8.52)
Difference	-8.44	(11.72)	0.51	(0.20)	0.92	(0.44)	1.27	(0.53)	-10.89	(8.63)
	Call portfolios									
	Betas (for 2nd factor)									
30 days, 95%	-0.03	(0.03)	0.45	(0.29)	-0.06	(0.62)	0.41	(0.18)	0.02	(0.03)
30 days, 105%	-0.05	(0.04)	1.41	(0.46)	0.28	(1.01)	0.88	(0.30)	-0.03	(0.04)
90 days, 95%	-0.03	(0.03)	0.45	(0.28)	-0.21	(0.59)	0.35	(0.17)	0.01	(0.03)
90 days, 105%	-0.04	(0.03)	1.04	(0.42)	-0.05	(0.85)	0.72	(0.28)	-0.01	(0.03)
	Alphas (using stock-based premia)									
30 days, 95%	-0.19	(0.23)	-0.54	(0.16)	-0.61	(0.24)	-0.63	(0.20)	-0.42	(0.18)
30 days, 105%	-0.35	(0.28)	-0.90	(0.23)	-0.67	(0.29)	-1.10	(0.27)	-0.76	(0.20)
90 days, 95%	-0.13	(0.23)	-0.52	(0.16)	-0.59	(0.23)	-0.58	(0.19)	-0.41	(0.17)
90 days, 105%	-0.16	(0.26)	-0.66	(0.20)	-0.56	(0.28)	-0.82	(0.24)	-0.51	(0.19)
	Alphas (using option-based premia)									
30 days, 95%	-0.07	(0.13)	-0.04	(0.05)	-0.09	(0.11)	-0.05	(0.08)	-0.10	(0.15)
30 days, 105%	-0.03	(0.22)	0.06	(0.09)	0.08	(0.21)	0.07	(0.12)	0.01	(0.23)
90 days, 95%	0.03	(0.11)	-0.02	(0.05)	-0.22	(0.11)	-0.08	(0.08)	0.02	(0.11)
90 days, 105%	0.10	(0.17)	0.13	(0.06)	-0.08	(0.17)	0.15	(0.10)	0.05	(0.18)

	Put portfolios									
	Betas (for 2nd factor)									
30 days, 95%	0.04	(0.06)	-1.68	(0.67)	-0.95	(1.28)	-0.53	(0.35)	0.11	(0.09)
30 days, 105%	-0.02	(0.04)	-0.43	(0.37)	-0.15	(0.70)	-0.03	(0.21)	0.06	(0.06)
90 days, 95%	0.02	(0.05)	-1.22	(0.55)	-0.34	(1.06)	-0.20	(0.30)	0.09	(0.07)
90 days, 105%	-0.01	(0.04)	-0.51	(0.37)	-0.21	(0.75)	-0.05	(0.22)	0.07	(0.06)
	Alphas (using stock-based premia)									
30 days, 95%	0.53	(0.31)	0.77	(0.28)	0.08	(0.32)	0.89	(0.28)	0.78	(0.29)
30 days, 105%	0.09	(0.24)	-0.15	(0.17)	-0.43	(0.23)	-0.12	(0.19)	-0.05	(0.20)
90 days, 95%	0.11	(0.26)	0.18	(0.23)	-0.26	(0.27)	0.20	(0.22)	0.23	(0.25)
90 days, 105%	0.06	(0.24)	-0.16	(0.17)	-0.47	(0.23)	-0.13	(0.19)	-0.06	(0.21)
	Alphas (using option-based premia)									
30 days, 95%	0.05	(0.29)	0.24	(0.09)	-0.05	(0.22)	0.29	(0.12)	0.23	(0.22)
30 days, 105%	0.12	(0.18)	-0.06	(0.06)	0.11	(0.12)	-0.09	(0.07)	-0.10	(0.10)
90 days, 95%	-0.21	(0.19)	-0.11	(0.07)	0.15	(0.15)	0.02	(0.13)	-0.13	(0.16)
90 days, 105%	0.05	(0.15)	-0.10	(0.06)	0.02	(0.11)	-0.12	(0.09)	-0.15	(0.10)
	Stock portfolio test statistics (using stock-based premia)									
R.m.s. (p)	0.21	(0.01)	0.27	(0.00)	0.30	(0.01)	0.23	(0.01)	0.26	(0.00)
	Option portfolio test statistics (using stock-based premia)									
R.m.s. (p)	0.28	(0.15)	0.58	(0.16)	0.50	(0.40)	0.69	(0.21)	0.50	(0.01)
	Option portfolio test statistics (using option-based premia)									
R.m.s. (p)	0.11	(0.63)	0.13	(0.59)	0.11	(0.94)	0.15	(0.53)	0.14	(0.78)

Table OA.XI: Asset pricing tests with factors related to demand and sentiment. The stock-based (option-based) results estimate factor premia from the 25 Fama-French portfolios (54 option portfolios). We report betas (factor loadings) and pricing errors (alphas) for four representative portfolios (the rest fall in between). We run two-stage OLS with 10,000 bootstrap runs and report bootstrapped standard errors, root-mean-squared pricing errors, and a bootstrapped p-value for the joint hypothesis that all pricing errors are zero. April 1986 to October 2010.

	Factor premia							
1st factor	\multicolumn{2}{c}{S&P}		\multicolumn{2}{c}{Market}		\multicolumn{2}{c}{S&P}		\multicolumn{2}{c}{S&P}
Stock-based	0.83	(0.31)	0.62	(0.32)	0.58	(0.31)	0.74	(0.31)
Option-based	0.52	(0.30)	0.53	(0.29)	0.24	(0.34)	0.30	(0.30)
Difference	0.32	(0.25)	0.09	(0.21)	0.35	(0.25)	0.44	(0.19)
2nd factor	Sentiment		SPF Dispersion		Retail Call Dem.		Retail Put Dem.	
Stock-based	-0.05	(0.10)	-2.58	(1.29)	-0.11	(0.22)	0.25	(0.35)
Option-based	-2.95	(1.07)	4.44	(2.21)	-0.59	(0.42)	-0.69	(0.47)
Difference	2.90	(1.08)	-7.02	(2.54)	0.48	(0.45)	0.94	(0.55)

	Call portfolios							
	Betas (for 2nd factor)							
30 days, 95%	0.00	(0.11)	-0.01	(0.04)	0.20	(0.27)	0.36	(0.16)
30 days, 105%	0.07	(0.16)	-0.03	(0.05)	0.75	(0.41)	0.78	(0.29)
90 days, 95%	0.01	(0.11)	-0.01	(0.04)	0.13	(0.25)	0.30	(0.14)
90 days, 105%	0.11	(0.15)	-0.04	(0.04)	0.62	(0.38)	0.64	(0.22)
	Alphas (using stock-based premia)							
30 days, 95%	-0.55	(0.18)	-0.50	(0.18)	-0.49	(0.18)	-0.76	(0.21)
30 days, 105%	-0.80	(0.22)	-0.81	(0.23)	-0.61	(0.26)	-1.05	(0.33)
90 days, 95%	-0.52	(0.18)	-0.47	(0.18)	-0.49	(0.17)	-0.73	(0.20)
90 days, 105%	-0.58	(0.21)	-0.63	(0.22)	-0.46	(0.24)	-0.85	(0.29)
	Alphas (using option-based premia)							
30 days, 95%	-0.29	(0.06)	-0.33	(0.06)	-0.09	(0.07)	-0.02	(0.04)
30 days, 105%	-0.37	(0.13)	-0.55	(0.10)	0.01	(0.11)	0.04	(0.09)
90 days, 95%	-0.23	(0.06)	-0.31	(0.05)	-0.12	(0.07)	-0.05	(0.04)
90 days, 105%	-0.01	(0.13)	-0.26	(0.09)	0.12	(0.08)	0.12	(0.07)

	Put portfolios							
	Betas (for 2nd factor)							
30 days, 95%	0.02	(0.24)	-0.03	(0.06)	-0.64	(0.40)	-0.88	(0.33)
30 days, 105%	-0.03	(0.13)	-0.01	(0.04)	-0.42	(0.21)	-0.12	(0.18)
90 days, 95%	-0.08	(0.18)	-0.03	(0.06)	-0.61	(0.26)	-0.49	(0.25)
90 days, 105%	-0.04	(0.13)	0.00	(0.04)	-0.49	(0.21)	-0.20	(0.18)
	Alphas (using stock-based premia)							
30 days, 95%	0.62	(0.21)	0.53	(0.27)	0.41	(0.26)	0.56	(0.35)
30 days, 105%	-0.21	(0.16)	-0.19	(0.18)	-0.34	(0.18)	-0.42	(0.17)
90 days, 95%	0.03	(0.17)	0.02	(0.23)	-0.07	(0.22)	-0.03	(0.24)
90 days, 105%	-0.24	(0.16)	-0.17	(0.19)	-0.38	(0.18)	-0.43	(0.17)
	Alphas (using option-based premia)							
30 days, 95%	0.98	(0.15)	0.83	(0.11)	0.47	(0.17)	0.19	(0.09)
30 days, 105%	-0.02	(0.05)	0.00	(0.05)	-0.19	(0.06)	-0.09	(0.07)
90 days, 95%	0.11	(0.10)	0.31	(0.07)	0.01	(0.08)	-0.03	(0.05)
90 days, 105%	-0.05	(0.06)	-0.07	(0.06)	-0.26	(0.06)	-0.17	(0.07)
	Stock portfolio test statistics (using stock-based premia)							
R.m.s. (p)	0.26	(0.00)	0.22	(0.01)	0.28	(0.00)	0.28	(0.01)
	Option portfolio test statistics (using stock-based premia)							
R.m.s. (p)	0.52	(0.03)	0.50	(0.06)	0.44	(0.05)	0.68	(0.01)
	Option portfolio test statistics (using option-based premia)							
R.m.s. (p)	0.43	(0.48)	0.43	(0.49)	0.24	(0.35)	0.14	(0.45)

Table OA.XII: Asset pricing tests with macroeconomic factors, described in Appendix C. The stock-based (option-based) results estimate factor premia from the 25 Fama-French portfolios (54 option portfolios). We report betas (factor loadings) and pricing errors (alphas) for four representative portfolios (the rest fall in between). We run two-stage OLS with 10,000 bootstrap runs and report bootstrapped standard errors, root-mean-squared pricing errors, and a bootstrapped p-value for the joint hypothesis that all pricing errors are zero. April 1986 to October 2010.

	Factor premia											
1st factor	S&P		Market		S&P		S&P		S&P		S&P	
Stock-based	0.62	(0.29)	0.67	(0.31)	0.84	(0.41)	0.68	(0.30)	0.81	(0.40)	0.55	(0.36)
Option-based	0.56	(0.63)	0.10	(0.44)	1.62	(0.48)	0.65	(0.35)	1.26	(0.46)	0.64	(0.39)
Difference	0.07	(0.58)	0.56	(0.40)	-0.78	(0.45)	0.04	(0.29)	-0.45	(0.39)	-0.10	(0.33)
2nd factor	Default		Term		Sharpe		Riskfree		Inflation		GDP	
Stock-based	-0.01	(0.03)	-0.16	(0.08)	-0.08	(0.04)	0.19	(0.09)	0.15	(0.15)	0.09	(0.03)
Option-based	-0.13	(0.16)	-0.53	(0.43)	-0.47	(0.16)	-1.55	(0.67)	-1.06	(0.42)	0.57	(0.30)
Difference	0.12	(0.16)	0.37	(0.44)	0.39	(0.16)	1.74	(0.68)	1.21	(0.44)	-0.48	(0.30)
	Call portfolios											
	Betas (for 2nd factor)											
30 days, 95%	3.58	(1.17)	-0.07	(0.48)	1.24	(1.14)	0.35	(0.41)	0.39	(0.39)	-0.38	(0.34)
30 days, 105%	5.41	(1.59)	0.67	(0.65)	2.62	(2.08)	0.32	(0.73)	0.54	(0.60)	-1.58	(0.54)
90 days, 95%	3.43	(1.15)	-0.04	(0.47)	1.37	(1.08)	0.27	(0.37)	0.41	(0.37)	-0.43	(0.33)
90 days, 105%	4.37	(1.63)	0.28	(0.58)	2.10	(1.76)	0.32	(0.57)	0.44	(0.55)	-1.11	(0.49)
	Alphas (using stock-based premia)											
30 days, 95%	-0.45	(0.16)	-0.52	(0.20)	-0.21	(0.27)	-0.58	(0.17)	-0.35	(0.23)	-0.26	(0.23)
30 days, 105%	-0.71	(0.21)	-0.67	(0.25)	-0.37	(0.34)	-0.85	(0.21)	-0.64	(0.28)	-0.50	(0.27)
90 days, 95%	-0.42	(0.16)	-0.49	(0.20)	-0.17	(0.28)	-0.54	(0.17)	-0.32	(0.22)	-0.24	(0.23)
90 days, 105%	-0.50	(0.19)	-0.52	(0.23)	-0.18	(0.32)	-0.63	(0.20)	-0.39	(0.26)	-0.28	(0.26)
	Alphas (using option-based premia)											
30 days, 95%	0.05	(0.11)	-0.06	(0.12)	-0.41	(0.12)	0.05	(0.12)	-0.27	(0.12)	-0.16	(0.12)
30 days, 105%	0.00	(0.24)	-0.01	(0.20)	0.04	(0.24)	-0.27	(0.18)	-0.35	(0.23)	0.18	(0.16)
90 days, 95%	0.05	(0.12)	-0.02	(0.11)	-0.31	(0.12)	-0.05	(0.11)	-0.21	(0.11)	-0.12	(0.10)
90 days, 105%	0.09	(0.16)	0.03	(0.16)	-0.02	(0.17)	-0.05	(0.14)	-0.24	(0.19)	0.17	(0.12)

	Put portfolios											
	Betas (for 2nd factor)											
30 days, 95%	-2.60	(3.76)	-1.30	(1.33)	1.00	(2.82)	0.15	(0.97)	0.35	(1.03)	0.85	(0.62)
30 days, 105%	-0.74	(2.39)	-0.84	(0.86)	1.86	(1.35)	-0.09	(0.49)	0.32	(0.56)	0.19	(0.35)
90 days, 95%	-1.98	(3.38)	-1.34	(1.14)	1.35	(2.43)	-0.21	(0.75)	0.12	(0.90)	0.81	(0.53)
90 days, 105%	-0.91	(2.56)	-0.90	(0.89)	1.77	(1.48)	-0.08	(0.50)	0.34	(0.55)	0.24	(0.37)
	Alphas (using stock-based premia)											
30 days, 95%	0.59	(0.23)	0.36	(0.28)	0.98	(0.31)	0.52	(0.23)	0.86	(0.30)	0.92	(0.22)
30 days, 105%	-0.16	(0.16)	-0.33	(0.19)	0.20	(0.27)	-0.20	(0.17)	0.03	(0.22)	0.06	(0.20)
90 days, 95%	0.08	(0.20)	-0.17	(0.24)	0.39	(0.28)	0.07	(0.19)	0.28	(0.26)	0.31	(0.21)
90 days, 105%	-0.17	(0.16)	-0.35	(0.20)	0.17	(0.26)	-0.21	(0.17)	0.00	(0.21)	0.04	(0.20)
	Alphas (using option-based premia)											
30 days, 95%	0.35	(0.19)	0.45	(0.24)	0.67	(0.24)	0.82	(0.24)	0.89	(0.29)	0.43	(0.18)
30 days, 105%	-0.18	(0.09)	-0.10	(0.10)	0.22	(0.10)	-0.32	(0.14)	0.00	(0.10)	-0.11	(0.08)
90 days, 95%	-0.09	(0.14)	-0.09	(0.14)	0.18	(0.19)	-0.26	(0.19)	0.01	(0.18)	-0.16	(0.12)
90 days, 105%	-0.21	(0.10)	-0.14	(0.09)	0.16	(0.11)	-0.31	(0.13)	0.01	(0.09)	-0.16	(0.08)
	Stock portfolio test statistics (using stock-based premia)											
R.m.s. (p)	0.26	(0.00)	0.22	(0.00)	0.23	(0.01)	0.25	(0.00)	0.28	(0.01)	0.21	(0.00)
	Option portfolio test statistics (using stock-based premia)											
R.m.s. (p)	0.46	(0.03)	0.45	(0.02)	0.42	(0.24)	0.53	(0.17)	0.49	(0.37)	0.44	(0.02)
	Option portfolio test statistics (using option-based premia)											
R.m.s. (p)	0.17	(0.39)	0.19	(0.57)	0.30	(0.94)	0.31	(0.79)	0.30	(0.92)	0.23	(0.45)