Internet Appendix to

"Overcoming Arbitrage Limits: Option Trading and Momentum Returns"

Appendix A: Data Description

1.1 Control Variables Construction

Idiosyncratic Volatility (IVOL): We estimate the monthly idiosyncratic volatility of each stock at month t as the standard deviation of daily residuals in the previous 3 months obtained from the Fama and French (1993) 3-factor model:

$$R_{i,d} - r_{f,d} = \alpha_i + \beta_{1,i}(R_{m,d} - r_{f,d}) + \beta_{2,i} HML_d + \beta_{3,i} SMB_d + \varepsilon_{i,d}, \tag{4}$$

where $R_{i,d}$ is the stock return i on day d, $R_{m,d}$ is the market return and $r_{f,d}$ is the risk-free rate. In addition, HML and SMB represent the zero-cost portfolios that are related to the high-minus-low book-to-market and the small-minus-big size factors. Thus, we define the idiosyncratic volatility (IVOL) of stock i in month t as the standard deviation of the daily residuals obtained from the model above: $IVOL_{i,t} = \sqrt{var(\varepsilon_{i,d})}$.

Stock Illiquidity (ILLIQ^{Stock}): Following Amihud (2002), we measure illiquidity as the monthly average of the daily ratio of each stock absolute return to its dollar volume.

Size: Firm size is defined as the market value of equity (that is stock price times shares outstanding at the end of the previous month)

Book-to-market (B/M): Following Fama and French (1992), we compute a firm's book to market ratio at the end of each month (book values are lagged 6 months while we consider the most recent market values in order to obtain the ratios).

Institutional Ownership (IOR): Institutional ownership is computed as the percentage of shares outstanding reported by 13F institutions at the end of each month. Institutional holdings are reported on a quarterly basis. We assume that the holdings remain constant during the quarter in order to compute our monthly measure.

Short-term reversals (REV): As in Jegadeesh (1990) and Lehmann (1990), the short term

reversal refers to the previous month return.

1.2 Implied Volatility Spread

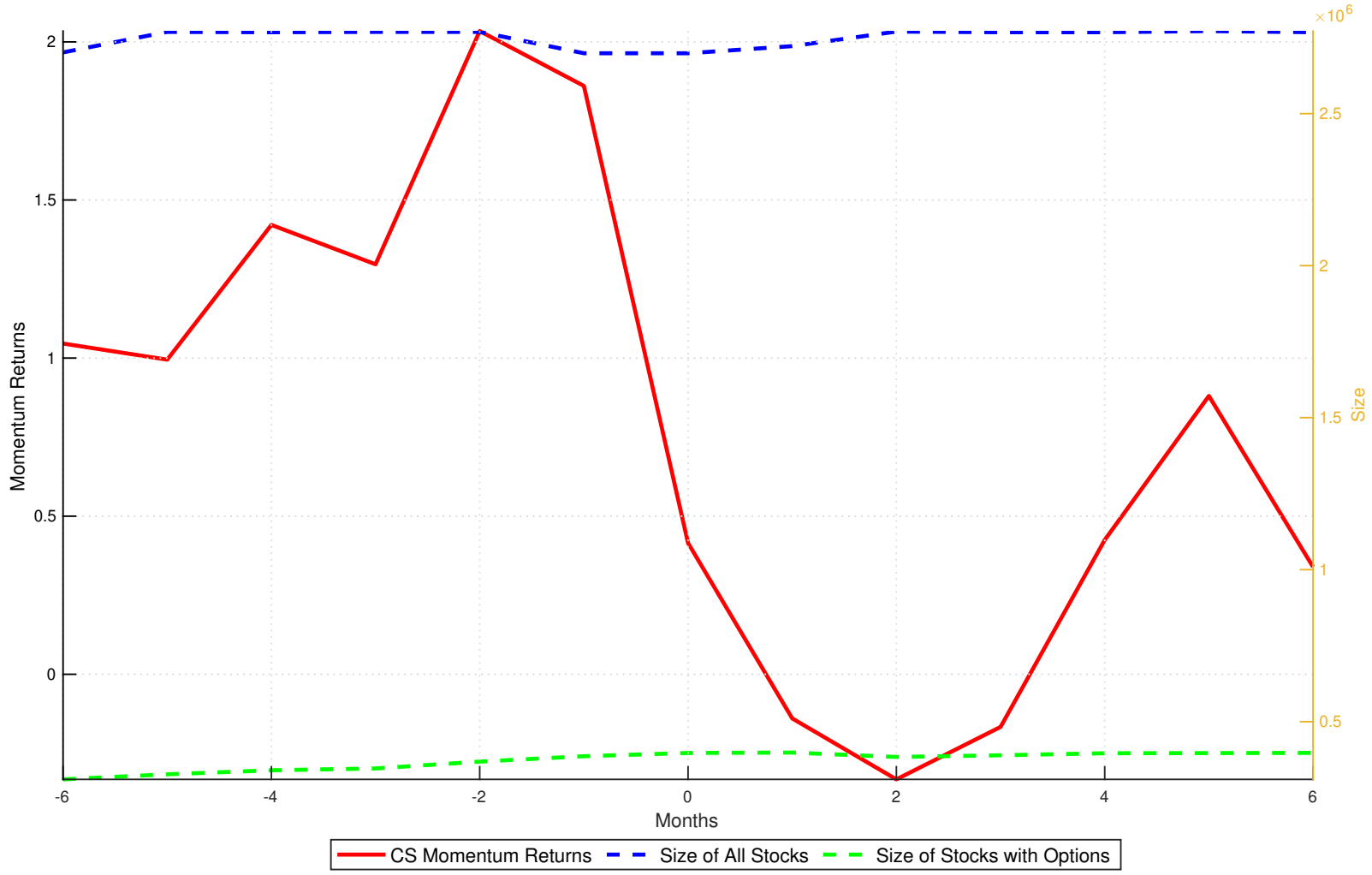
We use the OptionMetrics IvyDB US data to measure deviations from put-call parity. We follow Amin et al. (2004) and Cremers and Weinbaum (2010) and compute the average difference in implied volatilities between call and put options pairs with the same strike price and expiration date. We refer to the difference between call and put implied volatilities as the volatility spread. In particular, at the end of month t and for every stock i with put and call options data, we compute the volatility spread (VS) as

$$\text{VS}_{\text{i,t}} = \text{IV}_{\text{i,t}}^{\text{calls}} - \text{IV}_{\text{i,t}}^{\text{puts}} = \sum_{j=1}^{N_{i,t}} w_{j,t}^{i} (\text{IV}_{\text{j,t}}^{\text{i,call}} - \text{IV}_{\text{j,t}}^{\text{i,put}}) \tag{5}$$

where j refers to pairs of put and call options and thus indexes both strike prices and maturities, $w_{j,t}^{i}$ are weights, there are N_t^i valid pairs of options on stock i on day t, and $IV_{j,t}^{i}$ denotes the implied volatility (adjusted for expected dividends and early exercise). The results that we report use equal weights.

In addition, we select stocks with at least one pair of a call and a put options that satisfies the following filters: (i) the put moneyness is not greater than 1.1; (ii) the options expire between 15 and 90 days; (iii) the sum of the call and put bid-ask spreads over the stock price is less than or equal to 5%; and (iv) the sum of dividends paid during the remaining life of the option is less than 5% of the stock price. Moreover, the open interest is positive, the absolute delta is between 0.01 and 0.99, implied volatility is between 0.03 and 2, the bid is greater than 0.1, and the bid is less than the ask.

Figure A1. Momentum Returns Around Option Listing



The figure displays cross-sectional momentum median abnormal returns around the introduction of an option based on the Fama and French (1993) model that is estimated using a 36-month estimation window. The dashed lines show the median of the size of the stocks with options as well as the median size of all firms. The graph depicts results for the period of January 1996 to December 2018.

Table A1. Stocks with and without Options

This table presents the number and percentage of firms with and without options in our sample annually from 1996 to 2018. In this table we define a stock as optionable if it appears in OptionMetrics data the last trading of each year.

Stocks with and without Options

Year	Total Number of Stocks	Number of Stocks with Options	% Stocks with Options	Number of Stocks without Options	% Stocks without Options
1996	6217	1580	0.254	4637	0.746
1997	6582	1887	0.287	4695	0.713
1998	6526	2111	0.324	4415	0.676
1999	6153	2144	0.349	4009	0.652
2000	5811	1875	0.323	3936	0.677
2001	5535	1810	0.327	3725	0.673
2002	5097	1836	0.360	3261	0.640
2003	4708	1702	0.362	3006	0.639
2004	4448	1787	0.402	2662	0.598
2005	4357	1879	0.431	2479	0.569
2006	4287	1955	0.456	2333	0.544
2007	4193	2058	0.491	2135	0.509
2008	4119	2077	0.504	2042	0.496
2009	3933	2082	0.530	1852	0.471
2010	3704	2087	0.564	1617	0.437
2011	3579	2205	0.616	1374	0.384
2012	3466	2257	0.651	1209	0.349
2013	3364	2342	0.696	1022	0.304
2014	3357	2403	0.716	955	0.284
2015	3451	2482	0.719	969	0.281
2016	3418	2581	0.755	837	0.245
2017	3335	2493	0.748	841	0.252
2018	3315	2433	0.734	881	0.266

Table A2. Double Sorts: Momentum Returns and Utilization

Double-sorted quintile portfolios of momentum returns are formed every month from January 2007 to December 2018 for the matched stocks with and without options by sorting stocks based on the previous period 12-month cumulative returns (R(2,12)) after controlling for utilization. Specifically, we first sort the stocks into quintiles using utilization, then within each quintile, we sort stocks into quintile portfolios based on the previous period 12-month cumulative returns (R(2,12)) after skipping the most recent month so that WML contains the winner-minus-loser portfolio for each level of utilization. The table reports the value weighted average excess monthly returns for each of the double-sorted portfolios and as well as for the WML with their associated HAC adjusted t-statistics (t-stat). All returns are in percentages.

Utilization and Momentum Returns						
	Stocks with Options			Stocks without Options		
	Low Utilization	2	High Utilization	Low Utilization	2	High Utilization
Loser	0.016	0.015	0.001	0.013	0.008	-0.011
2	0.016	0.002	0.005	0.010	0.009	0.010
3	0.011	0.011	0.012	0.012	0.009	0.005
4	0.008	0.009	0.010	0.008	0.006	0.002
5	0.013	0.006	0.006	0.010	0.001	0.015
WML	-0.003	-0.010	0.005	-0.004	-0.006	0.026
t-stat	[-0.29]	[-1.30]	[0.50]	[-0.49]	[-0.74]	[2.61]