

Internet Appendix to “The Booms and Busts of Beta Arbitrage”

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Table A1: Event Time *CoBAR*

This table reports event-time statistics for *CoBAR*, the excess comovement among low beta stocks over the period 1970 to 2016. At the end of each month, all stocks are sorted into deciles based on their lagged-12-month market beta computed using daily returns. Pairwise partial return correlations (after controlling for the Fama-French three factors) for all stocks in the low beta decile are computed based on weekly stock returns in the previous 12 months. *CoBAR* is the average pair-wise correlation between any two stocks in the low-beta decile in year t . Panel A reports the autocorrelation in *CoBAR* in event time; that is, we form the beta portfolios in year 0, and compute *CoBAR* for the same set of low beta stocks in the following 1, 2, and 3 years. Panel B shows the average *CoBAR* in event time.

Panel A: Autocorrelation in event time				
	Year 0	Year 1	Year 2	Year 3
CoBAR0	1			
CoBAR1	0.142	1		
CoBAR2	0.241	0.557	1	
CoBAR3	0.245	0.397	0.532	1

Panel B: Average <i>CoBAR</i> in event time					
	Mean	Median	Std. Dev.	Min	Max
Year 0	0.104	0.101	0.026	0.037	0.203
Year 1	0.072	0.071	0.027	0.021	0.189
Year 2	0.071	0.068	0.031	0.009	0.187
Year 3	0.073	0.068	0.030	0.022	0.207

Table A2: Beta Arbitrage Timing Ability

This table reports regressions of monthly mutual funds' and hedge funds' returns on a conditional six-factor model. At the end of each month, we track mutual funds' and hedge funds' performance in the next six months. The dependent variable in columns (1) and (2) is the average monthly excess return of long-short equity hedge funds over that six-month window. Columns (3) and (4) use the average monthly excess returns of actively-managed mutual funds instead. We attribute those returns to *mktrf*, *smb*, *hml*, *umd*, and *BAB*, the four-factor adjusted portfolio return from buying bottom-beta-decile stocks and shorting top-beta-decile stocks. We allow the loading on *BAB* to be a function of lagged *CoBAR* (quintile ranks from 1 to 5) and *SizeRank*, the lagged cross-sectional ranking of the fund's assets under management. To compute *SizeRank*, we first rank all funds (within the respective hedge fund or mutual fund subset) into three groups as of the previous month, and then assign the value 2 if the fund is in the highest group, 1 if the fund is in the middle group, and 0 if the fund is in the lowest group. Standard errors, shown in bracket, are clustered at both fund and month levels. *, **, *** denote significance at the 10%, 5%, and 1% level, respectively.

	Equity Hedge Funds		Equity Mutual Funds	
	[1]	[2]	[3]	[4]
<i>mktrf</i>	0.354*** [0.056]	0.354*** [0.056]	1.036*** [0.022]	1.036*** [0.022]
<i>smb</i>	0.254*** [0.040]	0.254*** [0.040]	0.208*** [0.024]	0.208*** [0.024]
<i>hml</i>	-0.036 [0.033]	-0.036 [0.033]	0.106*** [0.033]	0.106*** [0.033]
<i>umd</i>	0.014 [0.020]	0.014 [0.020]	0.031** [0.015]	0.031** [0.015]
<i>BAB</i>	-0.080*** [0.022]	-0.103*** [0.029]	0.023 [0.023]	0.036 [0.026]
<i>CoBAR</i>	0.001*** [0.000]	0.001** [0.000]	0.000 [0.000]	0.000 [0.000]
<i>BAB * CoBAR</i>	0.017** [0.008]	0.030*** [0.009]	-0.002 [0.008]	0.002 [0.009]
<i>SizeRank</i>		-0.001** [0.000]		-0.000* [0.000]
<i>BAB * SizeRank</i>		0.023 [0.014]		-0.013 [0.013]
<i>CoBAR * SizeRank</i>		-0.000 [0.000]		-0.000 [0.000]
<i>BAB * CoBAR * SizeRank</i>		-0.013*** [0.004]		-0.004 [0.004]
Adj-R ²	0.018	0.019	0.461	0.462
No. Obs.	222,842	222,842	430,237	430,237

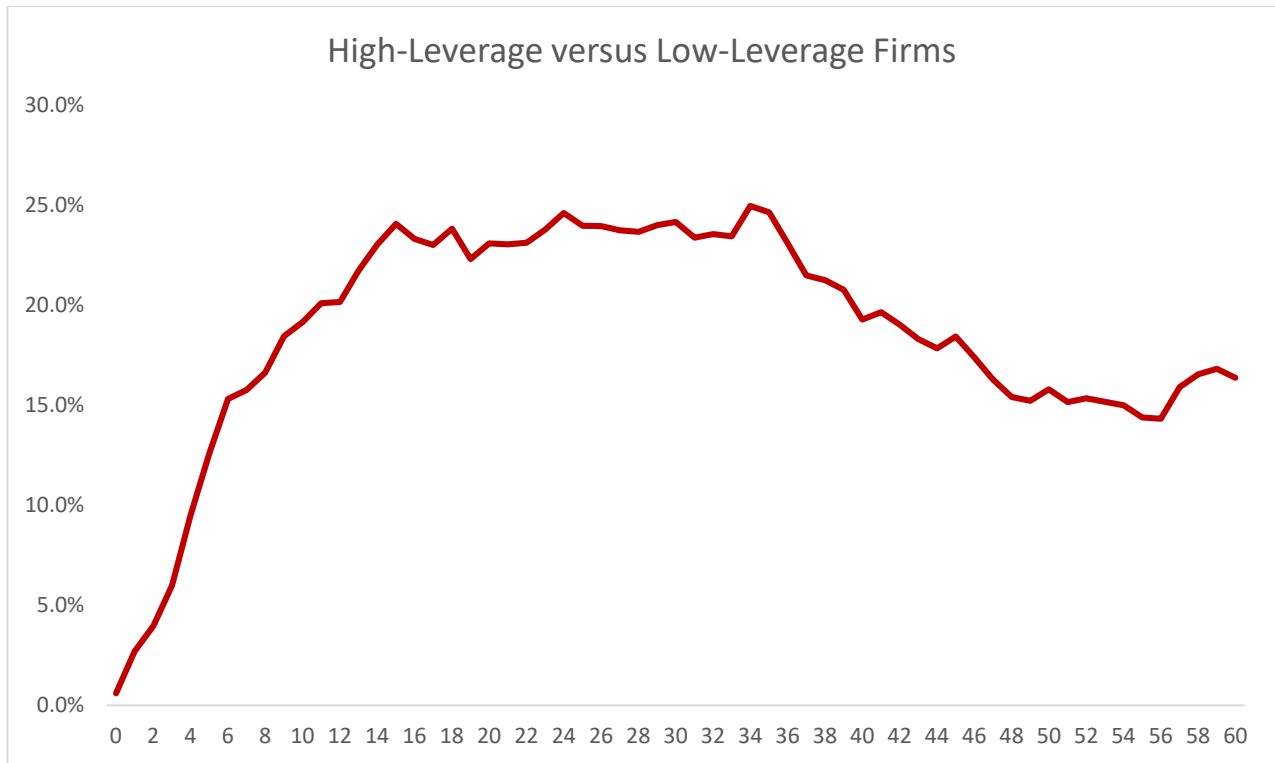


Figure A1: This figure shows how the relation between *CoBAR* and subsequent beta arbitrage returns varies with firm leverage. At the end of each month, all stocks are sorted into deciles based on their market beta calculated using daily returns in the past 12 months. To account for illiquidity and non-synchronous trading, on the right-hand side of the regression equation, we include five lags of the excess market return, in addition to the contemporaneous excess market return. The pre-ranking beta is the sum of the six coefficients from the OLS regression. All months are then sorted into five groups based on *CoBAR*, the average pairwise weekly three-factor residual correlation within the low-beta decile over the previous 12 months. At the beginning of the holding period, we sort stocks into four equal groups using book leverage. For each leverage quartile, we compute the *CoBAR* return spread – i.e., the difference in Carhart four-factor alpha to the beta arbitrage strategy (i.e., a portfolio that longs the value-weight low-beta decile and shorts the value-weighted high-beta decile) between high and low *CoBAR* periods. The solid red curve shows the cumulative difference in the *CoBAR* return spread between the highest and lowest leverage quartiles over the five years after portfolio formation. This difference in the *CoBAR* return spread is 1.67%/month in year one and is -0.60%/month in year four, both significant at 5%.

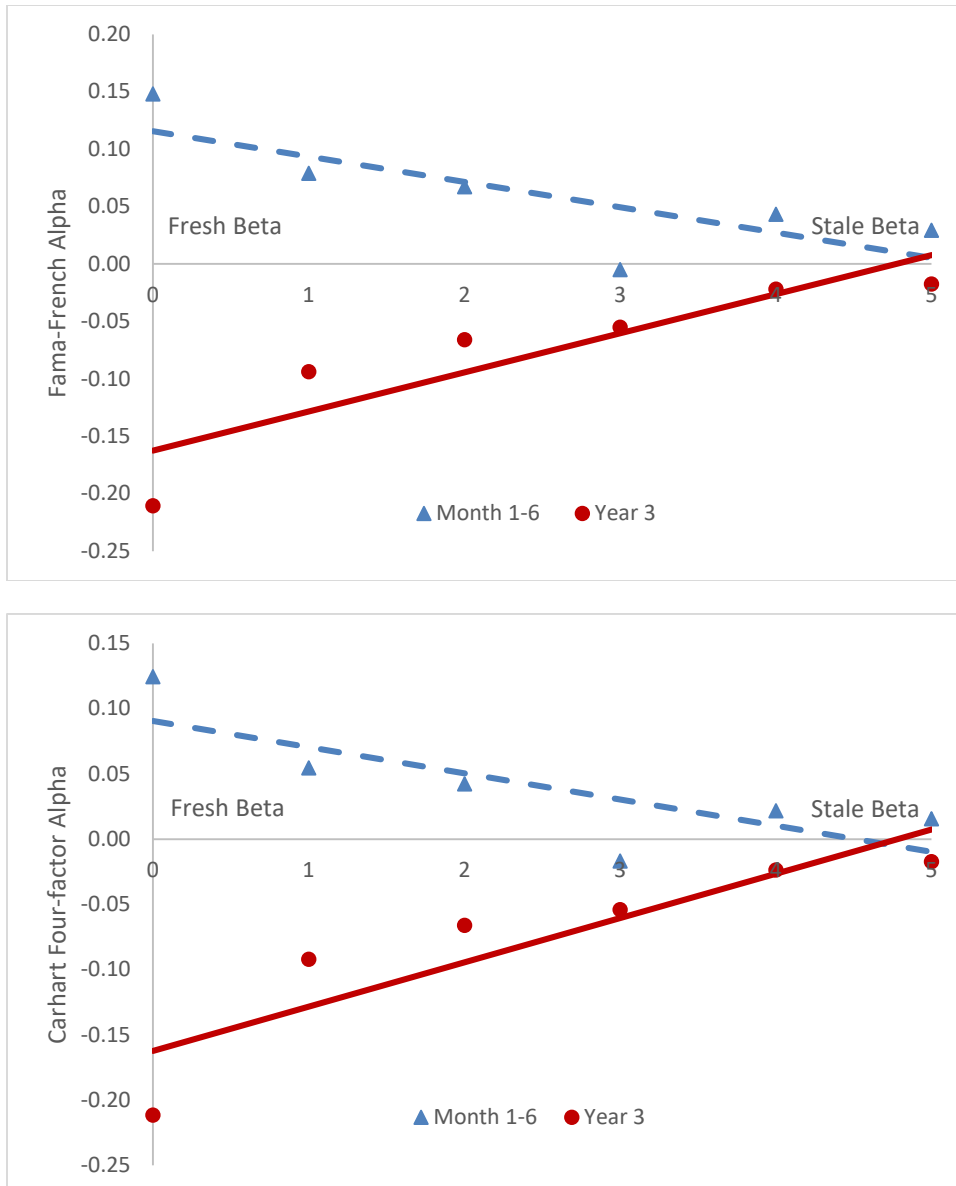


Figure A2: This figure shows how the information in *CoBAR* about time-variation in the expected holding and post-holding return to beta-arbitrage strategies decays as staler estimates of beta are used to form the beta-arbitrage strategy. At the end of each month, all stocks are sorted into deciles based on their market beta calculated using daily returns in the past 12 months. To account for illiquidity and non-synchronous trading, on the right-hand side of the regression equation, we include five lags of the excess market return, in addition to the contemporaneous excess market return. The pre-ranking beta is the sum of the six coefficients from the OLS regression. We then compute the strategy return as the value-weight low-beta decile return minus the value-weight high-beta decile return. We separately regress the abnormal return of the beta-arbitrage strategy in months 1-6 and year 3 on *CoBAR*. In this process, we first use a fresh estimate of beta, calculated using daily returns in the past 12 months. We then repeat the analysis using stale betas, computed from daily returns in each of the prior 5 years (thus having different beta portfolios as of time zero for each degree of beta staleness). We plot the corresponding regression coefficients (results for months 1-6 are plotted with blue triangles and results for year 3 are plotted with red circles) for each of the six beta-arbitrage strategies, ranging from fresh beta to five years stale beta. The top (bottom) panel reports results based on three-factor (four-factor) alpha.

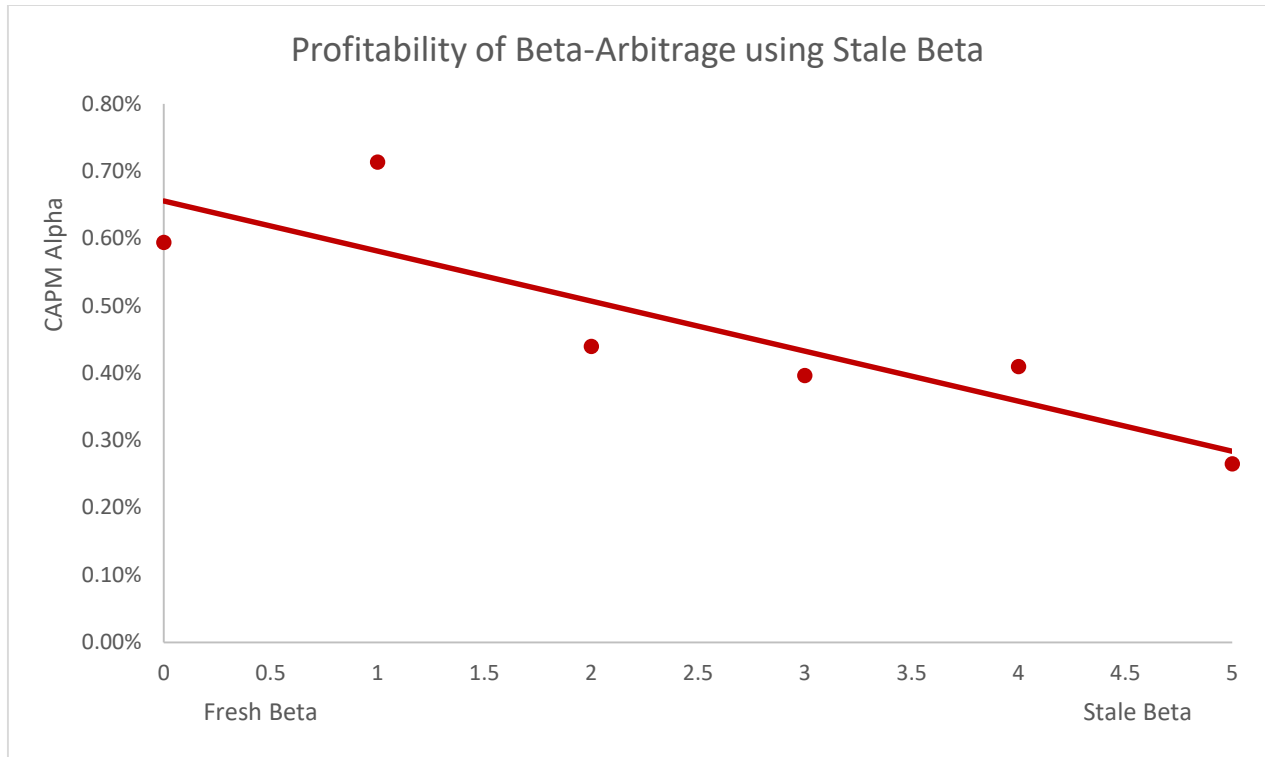


Figure A3: This figure shows how the post-holding return to beta-arbitrage strategies decays as stale estimates of beta are used to form beta-arbitrage strategy. At the end of each month, all stocks are sorted into deciles based on their market beta calculated using daily returns in the past 12 months. To account for illiquidity and non-synchronous trading, on the right-hand side of the regression equation, we include five lags of the excess market return, in addition to the contemporaneous excess market return. The pre-ranking beta is the sum of the six coefficients from the OLS regression. We then compute the strategy return as the value-weight low-beta decile return minus the value-weight high-beta decile return. We then repeat the analysis using stale betas, computed from daily returns in each of the prior 5 years (thus having different beta portfolios as of time zero for each degree of beta staleness). We plot the corresponding beta-arbitrage strategies' CAPM alphas (averaged over the first six months after portfolio formation) for each of the six beta-arbitrage strategies, ranging from fresh beta to five-year stale beta.