

Internet Appendix

This Appendix presents the results of variable selection tests, the results of the 14-factor model that further controls for the aggregate volatility and jump risk factors of Cremers, Halling, and Weinbaum (2015), and the results of time series and cross-sectional tests using statistical proxies of VOV, respectively.

Variable selection tests are based on the forward recursive variable selection method with the objective of identifying variables that achieve the highest improvement in adjusted R^2 , the least angle regression and shrinkage (LARS) method of Efron, Johnstone, Hastie, and Tibshirani (2004) based on least absolute shrinkage and selection operator (LASSO) method of Tibshirani (1996) as well as model selection tests using Bayesian information criteria (BIC) following Raftery (1995) and Raftery, Madigan, and Hoeting (1997).

LASSO method chooses a variable by minimizing the residual sum of squares subject to the sum of the absolute value of the coefficients being less than a constant and it drops a variable if the coefficient is equal to zero. We also report Mallow's C_p statistic that assesses the fit of the model and R -squareds for the selected models based on LASSO.

BIC method is based on estimating the probability that a variable is part of a model under model uncertainty. We also report the PRE statistic, which shows the proportional reduction in errors and root mean square error (RMSEs) for the selected models based on BIC. The results of variable selection tests are reported in Tables I1, I2, and I3, respectively.

<<Insert Tables I1, I2, and I3 near here>>

The 14-factor model to be tested is

$$\begin{aligned} r_{i,t} = & \alpha_i + \beta_i^1 PTF SBD_t + \beta_i^2 PTF SFX_t + \beta_i^3 PTF SCOM_t + \beta_i^4 BD10RET_t \\ & + \beta_i^5 BAAMTSY_t + \beta_i^6 SNPMRF_t + \beta_i^7 SCMLC_t + \beta_i^8 LBVIX_t \\ & + \beta_i^9 RetVIX_t + \beta_i^{10} LIQ_t + \beta_i^{11} CR_t + \beta_i^{12} UNC_t + \beta_i^{13} JUMP_t + \beta_i^{14} VOL_t + \varepsilon_{i,t}, \end{aligned} \quad (1)$$

where $r_{i,t}$ and the eight factors are as in Eq. (1), *RetVIX* is the orthogonalized version of monthly return on the VIX, *LIQ* is the permanent-variable price impact component of Sadka (2006) liquidity measure, *CR* is the orthogonalized version of correlation risk factor as defined in Buraschi, Kosowski, and Trojani (2014), *UNC* is the economic uncertainty index capturing macroeconomic risk exposure of hedge funds as defined in Bali, Brown, and Caglayan (2014), and *JUMP* and *VOL* are the orthogonalized versions of aggregate jump and volatility risk factors as defined in Cremers, Halling, and Weinbaum (2015).¹ The results of 14-factor model that controls for the aggregate volatility and jump risk factors of Cremers, Halling, and Weinbaum (2015) are reported in Tables I3 through I9, respectively.

<<Insert Tables I3 through I9 near here>>

The two statistical VOV proxies we use are the monthly range of the VIX and the monthly standard deviation of the VIX, which are defined in Eq. (6) and Eq. (7), respectively. The results of time series and cross-sectional tests using statistical proxies of VOV are reported in Tables I10, I11, and I12, respectively.

<<Insert Tables I10, I11, and I12 near here>>

¹ Due to the availability of aggregate volatility and jump risk factors up to March 2012, we conduct our empirical analyses of the 14-factor model over the period from April 2006 to March 2012.

Table 11

Variable selection test

This table reports the results of the variable selection test as in Lindsay and Sheather (2010), in which a 1 indicates if a factor is selected in time series regressions of excess fund index returns on the 12 factors based on its ability to improve the adjusted R^2 of the model. Panel A reports the results for the full sample period (April 2006-June 2012). Panels B and C report the results for the two subperiods: April 2006-March 2009 and April 2009-June 2012, respectively. The eight indexes are from Dow Jones Credit Suisse. HFI, CA, MN, ED, GM, LS, MF, and MS stand for Hedge Fund Index, Convertible Arbitrage, Equity Market Neutral, Event Driven, Global Macro, Long/Short Equity, Managed Futures, and Multi-Strategy, respectively. We report the root mean squared error (RMSE) and adjusted R -square value as model fit measures.

<i>Panel A : April 2006-June 2012</i>															
Index	PTFSBD	PTFSFX	PTFSCOM	BD10RET	BAAMTSY	SNPMRF	SCMLC	LBVIX	RetVIX	LIQ	CR	UNC	Total	RMSE	Adj. R^2 .
HFI					1	1		1			1		4	0.0107	70.75%
CA		1			1	1	1	1				1	6	0.0154	71.81%
MN	1				1	1			1				4	0.0411	29.78%
ED				1	1	1		1			1		5	0.0103	76.14%
GM	1				1			1			1		4	0.0158	23.51%
LS				1	1	1		1					4	0.0135	74.35%
MF	1		1				1	1			1		5	0.0256	35.92%
MS					1	1		1			1		4	0.0106	72.15%
Percent selected	37.50	12.50	12.50	25.00	87.50	75.00	25.00	87.50	12.50	0.00	62.50	12.50			
<i>Panel B : April 2006-March 2009</i>															
HFI					1	1		1			1		4	0.0124	66.21%
CA					1		1	1	1				4	0.0167	75.26%
MN	1	1					1						3	0.0487	49.06%
ED				1	1	1		1					4	0.0111	66.43%
GM					1		1	1		1			4	0.0176	37.23%
LS					1	1		1					3	0.0160	62.99%
MF			1			1		1			1		4	0.0241	45.89%
MS	1			1	1	1		1					5	0.0116	73.47%
Percent selected	25.00	12.50	12.50	25.00	75.00	62.50	37.50	87.50	12.50	12.50	25.00	0.00			
<i>Panel C : April 2009-June 2012</i>															
HFI		1				1			1		1	1	5	0.0068	83.32%
CA					1	1			1			1	4	0.0085	80.25%
MN						1	1						2	0.0097	65.99%
ED				1		1					1	1	5	0.0082	85.77%
GM	1		1			1					1		4	0.0097	39.90%
LS					1	1					1		3	0.0086	89.25%
MF	1					1	1				1		4	0.0256	34.58%
MS					1	1			1		1	1	5	0.0064	80.03%
Percent selected	25.00	12.50	12.50	12.50	37.50	100.00	25.00	0.00	37.50	0.00	75.00	50.00			

Table 12

Variable selection using least angle regression and shrinkage (LARS) based on least absolute shrinkage and selection operator (LASSO)

This table reports the results of the variable selection test as in Efron, Johnstone, Hastie, and Tibshirani (2004) based on LASSO method of Tibshirani (1996). A 1 indicates if a factor is selected in time series regressions of excess fund index returns on the 12 factors based on LASSO, which chooses a variable by minimizing the residual sum of squares subject to the sum of the absolute value of the coefficients being less than a constant, and drops a variable if the coefficient is equal to zero. The eight indexes are from Dow Jones Credit Suisse. HFI, CA, MN, ED, GM, LS, MF, and MS stand for Hedge Fund Index, Convertible Arbitrage, Equity Market Neutral, Event Driven, Global Macro, Long/Short Equity, Managed Futures, and Multi-Strategy, respectively. The last two columns report Mallows's C_p statistic and root mean squared error (RMSE) and R -squared for the selected modes. Panel A reports the results for the full sample period (April 2006-June 2012). Panels B and C report the results for the two subperiods: April 2006-March 2009 and April 2009-June 2012, respectively.

Panel A : April 2006-June 2012

Index	PTFSBD	PTFSFX	PTFSCOM	BD10RET	BAAMTSY	SNPMRF	SCMLC	LBVIX	RetVIX	LIQ	CR	UNC	Total	C_p	R^2
HFI				1	1	1		1		1	1		6	4.7434	72.49%
CA		1	1		1	1	1	1	1		1	1	9	8.6616	74.67%
MN	1	1	1		1	1	1		1		1	1	9	11.1392	40.12%
ED				1	1	1		1			1		5	5.9994	76.47%
GM	1		1		1	1	1	1	1	1	1		9	10.1460	29.74%
LS				1	1	1		1	1		1		6	3.6983	75.86%
MF	1		1				1	1			1		5	10.0420	33.11%
MS	1			1	1	1		1			1		6	6.5452	72.76%
Percent selected	50.00	25.00	50.00	50.00	87.50	87.50	50.00	87.50	50.00	25.00	100.00	25.00			

Panel B : April 2006-March 2009

HFI				1	1	1		1		1			5	8.6515	64.19%
CA		1			1	1	1	1	1				6	2.6063	76.73%
MN	1	1				1	1		1		1	1	7	10.0961	50.45%
ED				1	1	1		1		1			5	7.1793	65.98%
GM					1		1	1		1			4	5.3680	34.81%
LS				1	1	1		1	1	1			6	5.9117	66.33%
MF	1		1	1	1	1	1	1			1	1	9	9.5558	57.58%
MS	1			1	1	1		1			1		6	6.7671	75.12%
Percent selected	37.50	25.00	12.50	62.50	87.50	87.50	50.00	87.50	37.50	50.00	37.50	25.00			

Panel C : April 2009-June 2012

HFI		1			1	1		1	1		1	1	7	7.8498	84.85%
CA					1	1					1	1	4	5.5764	80.70%
MN					1	1	1						3	4.8052	63.87%
ED		1	1	1	1	1			1	1	1	1	9	9.0194	89.14%
GM	1		1	1	1	1	1				1	1	8	6.5210	49.73%
LS		1	1	1	1	1					1	1	7	6.5386	90.74%
MF	1		1			1	1				1		5	9.8280	36.13%
MS				1	1	1					1	1	5	8.5827	80.09%
Percent selected	25.00	37.50	50.00	50.00	87.50	100.00	37.50	12.50	25.00	12.50	87.50	75.00			

Table I3

Model selection using Bayesian information criteria (BIC)

This table reports the results of the model selection test under model uncertainty as in Raftery, Madigan, and Hoeting (1997). A 1 indicates if a factor is selected in time series regressions of excess fund index returns on the 12 factors based on BIC estimating the probability that a variable is part of a model under model uncertainty. The eight indexes are from Dow Jones Credit Suisse. HFI, CA, MN, ED, GM, LS, MF, and MS stand for Hedge Fund Index, Convertible Arbitrage, Equity Market Neutral, Event Driven, Global Macro, Long/Short Equity, Managed Futures, and Multi-Strategy, respectively. The last two columns in the table reports PRE statistic, which shows the proportional reduction in errors, and root mean squared error (RMSE). Panel A reports the results for the full sample period (April 2006-June 2012). Panels B and C report the results for the two subperiods: April 2006-March 2009 and April 2009-June 2012, respectively.

Panel A : April 2006-June 2012

Index	PTFSBD	PTFSFX	PTFSCOM	BD10RET	BAAMTSY	SNPMRF	SCMLC	LBVIX	RetVIX	LIQ	CR	UNC	Total	PRE	RMSE
HFI					1	1		1			1		4	0.720	0.0110
CA		1			1	1	1						4	0.729	0.0156
MN	1	1			1								3	0.271	0.0413
ED					1	1		1					3	0.548	0.0105
GM					1			1					2	0.239	0.0160
LS				1		1		1					3	0.730	0.0137
MF	1		1					1			1		4	0.403	0.0261
MS					1	1		1					3	0.734	0.0108
Percent selected	25.00	25.00	12.50	12.50	75.00	62.50	12.50	75.00	0.00	0.00	25.00	0.00			

Panel B : April 2006-March 2009

HFI				1	1	1		1			1		5	0.696	0.0129
CA					1		1	1	1				4	0.793	0.0175
MN	1	1					1				1		4	0.527	0.0518
ED				1	1	1							3	0.415	0.0109
GM					1		1	1		1			4	0.394	0.0175
LS					1	1		1					3	0.659	0.0167
MF	1					1		1			1	1	5	0.567	0.0250
MS					1	1		1					3	0.707	0.0120
Percent selected	25.00	12.50	0.00	25.00	75.00	62.50	37.50	75.00	12.50	12.50	37.50	12.50			

Panel C : April 2009-June 2012

HFI		1				1		1			1	1	5	0.851	0.0070
CA					1	1			1			1	4	0.802	0.0087
MN					1	1	1				1		4	0.659	0.0100
ED				1		1							2	0.814	0.0084
GM	1		1			1					1		4	0.426	0.0101
LS						1					1		2	0.909	0.0089
MF	1					1	1				1		4	0.417	0.0261
MS					1	1					1	1	4	0.826	0.0066
Percent selected	25.00	12.50	12.50	12.50	37.50	100.00	25.00	12.50	12.50	0.00	75.00	37.50			

Table I4

Correlations among factors

The table reports correlations between the 14 factors used in the analysis over the April 2006-March 2012 period. *PTFSBD*, *PTFSFX*, and *PTFSCOM* are the bond, currency and trend following factors as defined in Fung and Hsieh (2004), *BD10RET* is the monthly change in the ten-year Treasury constant maturity bond yields, *BAAMTSY* is the monthly change in the difference between Moody's Baa-rated bond and ten-year Treasury constant maturity bond yields, *SNPMRF* is the monthly Standard and Poor's (S&P) 500 excess return, *SCMLC* is the difference between returns on the Russell 2000 index and S&P 500 index, *RetVIX* is the monthly return on the Chicago Board Options Exchange Volatility Index (VIX), *CR* is the correlation risk factor as defined in Buraschi, Kosowski, and Trojani (2014), *LIQ* is the liquidity risk factor as defined in Sadka (2010), *UNC* is the macroeconomic uncertainty index as defined in Bali, Brown, and Caglayan (2014), and *JUMP* and *VOL* are aggregate jump and volatility risk factors of Cremers, Halling, and Weinbaum (2015).

Factor	<i>PTFSBD</i>	<i>PTFSFX</i>	<i>PTFSCOM</i>	<i>BD10RET</i>	<i>BAAMTSY</i>	<i>SNPMRF</i>	<i>SCMLC</i>	<i>LBVIX</i>	<i>RetVIX</i>	<i>CR</i>	<i>LIQ</i>	<i>UNC</i>	<i>JUMP</i>	<i>VOL</i>
<i>PTFSBD</i>	1													
<i>PTFSFX</i>	0.43	1												
<i>PTFSCOM</i>	0.32	0.54	1											
<i>BD10RET</i>	0.43	0.21	0.19	1										
<i>BAAMTSY</i>	-0.27	-0.40	-0.29	-0.34	1									
<i>SNPMRF</i>	-0.40	-0.36	-0.23	-0.22	0.38	1								
<i>SCMLC</i>	-0.26	-0.21	-0.15	-0.11	0.18	0.45	1							
<i>LBVIX</i>	0.29	0.32	0.20	0.20	-0.26	-0.58	-0.23	1						
<i>RetVIX</i>	0.32	0.34	0.18	0.14	-0.26	-0.71	-0.33	0.74	1					
<i>CR</i>	0.36	0.32	0.23	0.26	-0.36	-0.60	-0.30	0.74	0.60	1				
<i>LIQ</i>	0.06	-0.21	-0.16	0.05	0.39	0.24	0.09	-0.20	-0.24	-0.19	1			
<i>UNC</i>	-0.05	-0.08	-0.19	-0.02	0.31	0.08	0.14	-0.14	-0.13	-0.22	0.14	1		
<i>JUMP</i>	0.18	0.14	0.18	0.00	-0.26	-0.39	-0.14	0.58	0.71	0.56	-0.42	-0.11	1	
<i>VOL</i>	0.17	0.29	0.21	0.07	-0.41	-0.34	-0.24	0.59	0.67	0.57	-0.21	-0.16	0.57	1

Table 15

Time series results with the 14-factor model

This table reports factor exposures of the 14-factor model in Eq. (1) during April 2006-March 2012 period:

$$r_{i,t} = \alpha_i + \beta_i^1 PTF SBD_t + \beta_i^2 PTF SFX_t + \beta_i^3 PTF SCOM_t + \beta_i^4 BD10RET_t(1) + \beta_i^5 BAAMTSY_t + \beta_i^6 SNPMRF_t + \beta_i^7 SCMLC_t + \beta_i^8 LBVIX_t + \beta_i^9 RetVIX_t + \beta_i^{10} LIQ_t + \beta_i^{11} CR_t + \beta_i^{12} UNC_t + \beta_i^{13} JUMP_t + \beta_i^{14} VOL_t + \varepsilon_{i,t},$$

where $r_{i,t}$ is the excess return on fund i in month t , $PTFSBD$, $PTFSFX$, and $PTFSCOM$ are the bond, currency, and trend following factors as defined in Fung and Hsieh (2004), $BD10RET$ is the monthly change in the ten-year Treasury constant maturity bond yields, $BAAMTSY$ is the monthly change in the difference between Moody's Baa-rated bond and ten-year Treasury constant maturity bond yields, $SNPMRF$ is the monthly Standard and Poor's (S&P) 500 excess return, $SCMLC$ is the difference between returns on the Russell 2000 index and S&P 500 index, $LBVIX$ is the volatility of aggregate volatility (VOV) factor defined as the monthly returns on a lookback straddle written on the Chicago Board Options Exchange Volatility Index (VIX), $RetVIX$ is the monthly return on the VIX, CR is the correlation risk factor as defined in Buraschi, Kosowski, and Trojani (2014), LIQ is the liquidity risk factor as defined in Sadka (2010), UNC is the macroeconomic uncertainty index as defined in Bali, Brown, and Caglayan (2014), and $JUMP$ and VOL are the aggregate jump and volatility risk factors as defined in Cremers, Halling, and Weinbaum (2015). The eight indexes are from Dow Jones Credit Suisse. HFI, CA, MN, ED, GM, LS, MF, and MS stand for Hedge Fund Index, Convertible Arbitrage, Equity Market Neutral, Event Driven, Global Macro, Long/Short Equity, Managed Futures, and Multi-Strategy, respectively. The final row reports the pooled panel regressions with heteroskedasticity-consistent standard errors after allowing for cross-correlations.

Index	<i>PTFSBD</i>	<i>PTFSFX</i>	<i>PTFSCOM</i>	<i>BD10RET</i>	<i>BAAMTSY</i>	<i>SNPMRF</i>	<i>SCMLC</i>	<i>LBVIX</i>	<i>RetVIX</i>	<i>LIQ</i>	<i>CR</i>	<i>UNC</i>	<i>JUMP</i>	<i>VOL</i>	Alpha	Adj. R^2
HFI	0.002 [0.15]	0.001 [0.06]	0.012 [1.07]	-0.136 [-1.84]	0.182 [2.68]	0.222 [4.46]	-0.046 [-0.77]	-0.007 [-1.79]	0.013 [0.93]	0.072 [0.39]	-0.029 [-1.72]	0.000 [0.09]	-0.029 [-1.80]	-0.013 [-0.45]	0.001 [0.67]	70.10%
CA	0.003 [0.22]	-0.030 [-2.48]	-0.005 [-0.34]	-0.029 [-0.28]	0.478 [5.14]	0.214 [3.13]	-0.192 [-2.30]	-0.006 [-1.21]	0.014 [0.74]	-0.245 [-0.97]	0.010 [0.44]	0.001 [2.21]	-0.061 [-2.75]	-0.022 [-0.54]	-0.001 [-0.56]	73.74%
MN	-0.122 [-2.95]	0.056 [1.69]	0.052 [1.26]	0.065 [0.23]	0.279 [1.09]	0.512 [2.72]	0.220 [0.96]	0.025 [1.74]	0.145 [2.74]	0.381 [0.55]	-0.028 [-0.45]	-0.002 [-1.01]	-0.032 [-0.53]	-0.202 [-1.79]	-0.008 [-1.33]	29.99%
ED	-0.010 [-0.92]	0.013 [1.50]	-0.006 [-0.53]	-0.285 [-3.92]	0.171 [2.56]	0.189 [3.85]	0.007 [0.11]	-0.007 [-1.96]	0.001 [0.07]	0.137 [0.75]	-0.033 [-1.99]	-0.000 [-0.08]	-0.005 [-0.34]	-0.006 [-0.21]	0.002 [1.21]	74.28%
GM	0.027 [1.71]	-0.017 [-1.36]	0.027 [1.69]	0.020 [0.19]	0.123 [1.25]	0.060 [0.83]	-0.154 [-1.75]	-0.010 [-1.79]	0.001 [0.05]	0.100 [0.37]	-0.033 [-1.35]	-0.000 [-0.18]	-0.040 [-1.70]	0.011 [0.26]	0.005 [2.18]	22.71%
LS	0.009 [0.67]	0.005 [0.47]	0.001 [0.07]	-0.193 [-2.06]	0.123 [1.43]	0.284 [4.48]	0.001 [0.01]	-0.014 [-2.83]	-0.017 [-0.98]	-0.005 [-0.02]	-0.032 [-1.52]	0.000 [0.18]	-0.020 [-0.99]	0.026 [0.68]	0.001 [0.56]	72.12%
MF	0.078 [2.97]	-0.002 [-0.12]	0.072 [2.75]	-0.278 [-1.58]	-0.182 [-1.12]	-0.051 [-0.43]	-0.159 [-1.09]	-0.032 [-3.46]	0.010 [0.31]	0.217 [0.49]	-0.127 [-3.17]	0.000 [0.04]	-0.037 [-0.96]	0.032 [0.44]	0.006 [1.55]	32.89%
MS	-0.010 [-0.96]	-0.001 [-0.12]	-0.001 [-0.06]	-0.119 [-1.62]	0.259 [3.86]	0.206 [4.19]	-0.089 [-1.49]	-0.004 [-1.98]	0.020 [1.47]	0.005 [0.03]	-0.015 [-0.88]	0.000 [0.49]	-0.026 [-1.60]	-0.042 [-1.43]	0.000 [0.26]	71.57%
Pooled	-0.005 [-0.64]	0.004 [0.59]	0.019 [2.20]	-0.123 [-2.16]	0.189 [3.62]	0.205 [5.33]	-0.053 [-1.13]	-0.006 [-2.13]	0.023 [2.15]	0.082 [0.58]	-0.030 [-2.35]	-0.000 [-1.04]	-0.032 [-2.56]	-0.026 [-1.11]	0.003 [2.18]	30.05%

Table 16

Subperiod analysis

This table reports the estimates of the 14-factor model for subperiods April 2006-March 2009 and April 2009-March 2012. *PTFSBD*, *PTFSFX*, and *PTFSCOM* are the bond, currency, and trend following factors as defined in Fung and Hsieh (2004), *BD10RET* is the monthly change in the ten-year Treasury constant maturity bond yields, *BAAMTSY* is the monthly change in the difference between Moody's Baa-rated bond and ten-year Treasury constant maturity bond yields, *SNPMRF* is the monthly Standard and Poor's (S&P) 500 excess return, *SCMLC* is the difference between returns on the Russell 2000 index and S&P 500 index, *LBVIX* is the volatility of aggregate volatility (VOV) factor defined as the monthly returns on a lookback straddle written on the Chicago Board Options Exchange Volatility Index (VIX), *RetVIX* is the monthly return on the VIX, *CR* is the correlation risk factor as defined in Buraschi, Kosowski, and Trojani (2014), *LIQ* is the liquidity risk factor as defined in Sadka (2010), *UNC* is the macroeconomic uncertainty index as defined in Bali, Brown, and Caglayan (2014), and *JUMP* and *VOL* are the aggregate jump and volatility risk factors as defined in Cremers, Halling, and Weinbaum (2015). The eight indexes are from Dow Jones Credit Suisse. HFI, CA, MN, ED, GM, LS, MF, and MS stand for Hedge Fund Index, Convertible Arbitrage, Equity Market Neutral, Event Driven, Global Macro, Long/Short Equity, Managed Futures, and Multi-Strategy, respectively.

<i>Panel A: April 2006-March 2009</i>																
Index	<i>PTFSBD</i>	<i>PTFSFX</i>	<i>PTFSCOM</i>	<i>BD10RET</i>	<i>BAAMTSY</i>	<i>SNPMRF</i>	<i>SCMLC</i>	<i>LBVIX</i>	<i>RetVIX</i>	<i>LIQ</i>	<i>CR</i>	<i>UNC</i>	<i>JUMP</i>	<i>VOL</i>	Alpha	Adj. R^2
HFI	-0.006	-0.017	0.042	-0.108	0.439	0.082	-0.011	-0.011	-0.004	0.246	-0.051	0.000	-0.058	0.143	-0.001	-0.006
	[-0.33]	[-1.33]	[2.61]	[-1.01]	[4.31]	[1.07]	[-0.10]	[-1.76]	[-0.16]	[1.03]	[-1.20]	[0.06]	[-2.18]	[2.51]	[-0.28]	[-0.33]
CA	-0.004	-0.041	0.024	0.000	0.799	0.075	-0.260	-0.015	-0.018	-0.065	0.019	0.001	-0.077	0.123	-0.001	-0.004
	[-0.13]	[-2.09]	[0.96]	[0.00]	[5.14]	[0.65]	[-1.60]	[-1.78]	[-0.51]	[-0.18]	[0.29]	[1.16]	[-1.88]	[1.41]	[-0.21]	[-0.13]
MN	-0.229	0.088	0.029	-0.283	-0.083	0.646	1.076	0.049	0.231	0.892	-0.114	0.001	-0.127	-0.234	-0.013	-0.229
	[-2.61]	[1.50]	[0.39]	[-0.58]	[-0.18]	[1.84]	[2.21]	[1.76]	[2.20]	[0.81]	[-0.59]	[0.21]	[-1.04]	[-0.90]	[-1.21]	[-2.61]
ED	-0.009	-0.005	0.028	-0.204	0.396	0.075	0.013	-0.007	-0.015	0.219	-0.025	-0.000	-0.040	0.122	0.000	-0.009
	[-0.52]	[-0.42]	[1.81]	[-2.01]	[4.12]	[1.04]	[0.12]	[-1.64]	[-0.68]	[0.97]	[-0.62]	[-0.51]	[-1.60]	[2.26]	[0.13]	[-0.52]
GM	0.023	-0.036	0.056	0.137	0.488	-0.164	-0.233	-0.020	-0.021	0.360	-0.063	-0.001	-0.060	0.182	0.003	0.023
	[0.78]	[-1.81]	[2.24]	[0.82]	[3.10]	[-1.38]	[-1.42]	[-2.17]	[-0.59]	[0.97]	[-0.96]	[-0.55]	[-1.44]	[2.06]	[0.74]	[0.78]
LS	0.013	-0.031	0.053	-0.093	0.444	0.137	-0.085	-0.018	-0.031	0.174	-0.049	0.001	-0.060	0.220	0.000	0.013
	[0.53]	[-1.95]	[2.62]	[-0.69]	[3.47]	[1.42]	[-0.64]	[-2.37]	[-1.10]	[0.58]	[-0.92]	[0.54]	[-1.80]	[3.07]	[0.12]	[0.53]
MF	0.094	-0.020	0.075	-0.287	-0.021	-0.317	-0.047	-0.040	-0.007	0.208	-0.223	-0.002	-0.023	0.126	0.000	0.094
	[2.09]	[-0.67]	[1.96]	[-1.14]	[-0.09]	[-1.76]	[-0.19]	[-2.81]	[-0.13]	[0.37]	[-2.23]	[-0.94]	[-0.37]	[0.94]	[0.02]	[2.09]
MS	-0.021	-0.007	0.022	-0.158	0.509	0.073	-0.079	-0.010	-0.005	0.183	-0.023	0.000	-0.040	0.092	-0.001	-0.021
	[-1.06]	[-0.51]	[1.28]	[-1.41]	[4.80]	[0.92]	[-0.71]	[-1.57]	[-0.23]	[0.73]	[-0.52]	[0.40]	[-1.44]	[1.54]	[-0.50]	[-1.06]
<i>Panel B: April 2009-March 2012</i>																
HFI	0.016	0.016	0.004	0.009	-0.016	0.265	-0.006	-0.007	0.006	0.340	-0.060	0.002	0.024	-0.044	-0.002	83.95%
	[1.61]	[1.63]	[0.28]	[0.10]	[-0.19]	[4.31]	[-0.11]	[-1.81]	[0.37]	[1.33]	[-3.94]	[2.78]	[1.22]	[-1.17]	[-0.81]	
CA	0.005	-0.006	-0.007	0.075	0.272	0.151	-0.051	-0.004	0.011	-0.314	-0.033	0.004	0.012	-0.004	-0.002	73.72%
	[0.34]	[-0.43]	[-0.34]	[0.59]	[2.17]	[1.66]	[-0.60]	[-0.59]	[0.47]	[-0.83]	[-1.46]	[3.98]	[0.41]	[-0.07]	[-0.58]	
MN	-0.021	0.025	-0.002	0.200	0.323	0.224	-0.066	0.003	-0.011	-0.119	-0.028	-0.001	0.062	0.035	0.000	61.33%
	[-1.37]	[1.71]	[-0.09]	[1.55]	[2.52]	[2.41]	[-0.76]	[0.46]	[-0.48]	[-0.31]	[-1.21]	[-1.28]	[2.04]	[0.62]	[0.02]	
ED	0.001	0.024	-0.022	-0.156	0.007	0.240	0.019	-0.011	0.007	0.476	-0.065	0.002	0.037	-0.059	-0.003	85.85%
	[0.11]	[2.02]	[-1.33]	[-1.46]	[0.07]	[3.13]	[0.27]	[-2.12]	[0.37]	[1.49]	[-3.39]	[2.33]	[1.46]	[-1.26]	[-1.18]	
GM	0.036	-0.001	0.033	0.089	-0.144	0.147	-0.057	-0.001	-0.005	0.266	-0.061	0.002	0.027	0.002	0.004	33.67%
	[2.32]	[-0.04]	[1.65]	[0.69]	[-1.13]	[1.58]	[-0.66]	[-0.13]	[-0.22]	[0.69]	[-2.64]	[1.92]	[0.88]	[0.03]	[1.16]	

LS	0.012	0.033	-0.017	0.029	0.004	0.398	0.081	-0.011	-0.011	0.434	-0.069	0.001	0.035	-0.042	-0.003	90.99%
	[1.06]	[3.02]	[-1.11]	[0.30]	[0.04]	[5.64]	[1.22]	[-2.44]	[-0.64]	[1.48]	[-3.94]	[1.26]	[1.53]	[-0.98]	[-1.49]	
MF	0.103	0.002	0.064	-0.135	-0.594	0.412	-0.374	-0.024	0.030	1.593	-0.126	0.002	-0.056	-0.064	-0.004	26.55%
	[2.46]	[0.04]	[1.16]	[-0.38]	[-1.70]	[1.63]	[-1.58]	[-1.43]	[0.46]	[1.51]	[-1.99]	[0.66]	[-0.68]	[-0.41]	[-0.52]	
MS	-0.001	0.007	0.002	0.061	0.107	0.236	-0.016	-0.001	0.015	0.136	-0.043	0.001	0.028	-0.071	-0.000	82.62%
	[-0.14]	[0.76]	[0.18]	[0.79]	[1.39]	[4.22]	[-0.31]	[-0.40]	[1.08]	[0.59]	[-3.07]	[2.38]	[1.53]	[-2.09]	[-0.13]	

Table 17

Variable selection test

This table reports the results of the variable selection test as in Lindsay and Sheather (2010), in which a 1 indicates if a factor is selected in time series regressions of excess fund index returns on the 14 factors based on its ability to improve the adjusted R^2 of the model. The eight indexes are from Dow Jones Credit Suisse. HFI, CA, MN, ED, GM, LS, MF, and MS stand for Hedge Fund Index, Convertible Arbitrage, Equity Market Neutral, Event Driven, Global Macro, Long/Short Equity, Managed Futures, and Multi-Strategy, respectively. Panel A reports the results for the full sample period (April 2006-March 2012). Panels B and C report the results for the two subperiods: April 2006-March 2009 and April 2009-March 2012, respectively.

Panel A: April 2006-March 2012

Index	PTFSBD	PTFSFX	PTFSCOM	BD10RET	BAAMTSY	SNPMRF	SCMLC	LBVIX	RetVIX	LIQ	CR	UNC	JUMP	VOL	Total
HFI				1	1	1		1			1		1		6
CA		1			1	1	1	1				1	1		7
MN	1	1			1	1									4
ED				1	1	1		1			1				5
GM	1				1			1					1		4
LS				1		1		1					1		4
MF	1		1				1	1			1				5
MS				1	1	1			1				1	1	6
Percent selected	37.50	25.00	12.50	50.00	75.00	75.00	25.00	75.00	12.50	0.00	37.50	12.50	62.50	12.50	

Panel B: April 2006-March 2009

HFI					1	1		1					1		4
CA		1			1			1					1	1	5
MN	1	1					1								3
ED			1	1	1	1							1	1	6
GM					1			1					1		3
LS					1	1		1					1	1	5
MF			1			1		1							3
MS				1	1	1		1					1	1	6
Percent selected	12.50	25.00	25.00	25.00	75.00	62.50	12.50	75.00	0.00	0.00	0.00	0.00	75.00	50.00	

Panel C: April 2009-December 2012

HFI	1	1				1		1			1	1	1		7
CA					1	1			1			1			4
MN						1	1			1					2
ED				1		1		1	1		1	1		1	7
GM	1		1			1					1				4
LS		1	1		1	1		1			1				6
MF			1								1				2
MS					1	1					1	1	1	1	6
Percent selected	25.00	25.00	37.50	12.50	37.50	87.50	12.50	37.50	25.00	0.00	75.00	50.00	25.00	25.00	

Table 18

Variable selection using least angle regression and shrinkage (LARS) based on least absolute shrinkage and selection operator (LASSO)

This table reports the results of the variable selection test as in Efron, Johnstone, Hastie, and Tibshirani (2004) based on LASSO method of Tibshirani (1996). A 1 indicates if a factor is selected in time series regressions of excess fund index returns on the 14 factors based on LASSO, which chooses a variable by minimizing the residual sum of squares subject to the sum of the absolute value of the coefficients being less than a constant and drops a variable if the coefficient is equal to zero. The eight indexes are from Dow Jones Credit Suisse. HFI, CA, MN, ED, GM, LS, MF, and MS stand for Hedge Fund Index, Convertible Arbitrage, Equity Market Neutral, Event Driven, Global Macro, Long/Short Equity, Managed Futures, and Multi-Strategy, respectively. Panel A reports the results for the full sample period (April 2006-March 2012). Panels B and C report the results for the two subperiods: April 2006-March 2009 and April 2009-March 2012, respectively.

Panel A: April 2006-March 2012

Index	PTFSBD	PTFSFX	PTFSCOM	BD10RET	BAAMTSY	SNPMRF	SCMLC	LBVIX	RetVIX	LIQ	CR	UNC	JUMP	VOL	Total
HFI				1	1	1		1			1		1		6
CA		1			1	1	1	1				1	1		7
MN	1	1			1	1									4
ED				1	1	1		1			1				5
GM	1				1			1					1		4
LS				1		1		1					1		4
MF	1		1				1	1			1				5
MS				1	1	1			1				1	1	6
Percent selected	37.50	25.00	12.50	50.00	75.00	75.00	25.00	75.00	12.50	0.00	37.50	12.50	62.50	12.50	

Panel B: April 2006-March 2009

HFI					1	1		1					1		4
CA		1			1			1					1	1	5
MN	1	1					1								3
ED			1	1	1	1							1	1	6
GM					1			1					1		3
LS					1	1		1					1	1	5
MF			1			1		1							3
MS				1	1	1		1					1	1	6
Percent selected	12.50	25.00	25.00	25.00	75.00	62.50	12.50	75.00	0.00	0.00	0.00	0.00	75.00	50.00	

Panel C: April 2009-December 2012

HFI	1	1				1		1			1	1	1		7
CA					1	1			1			1			4
MN						1	1			1					2
ED				1		1		1	1		1	1		1	7
GM	1		1			1					1				4
LS		1	1		1	1		1			1				6
MF			1								1				2
MS					1	1					1	1	1	1	6
Percent selected	25.00	25.00	37.50	12.50	37.50	87.50	12.50	37.50	25.00	0.00	75.00	50.00	25.00	25.00	

Table 19**Model selection using Bayesian information criteria (BIC)**

This table reports the results of the model selection test under model uncertainty as in Raftery, Madiagan, and Hoeting (1997). A 1 indicates if a factor is selected in time series regressions of excess fund index returns on the 14 factors based on BIC estimating the probability that a variable is part of a model under model uncertainty. The eight indexes are from Dow Jones Credit Suisse. HFI, CA, MN, ED, GM, LS, MF, and MS stand for Hedge Fund Index, Convertible Arbitrage, Equity Market Neutral, Event Driven, Global Macro, Long/Short Equity, Managed Futures, and Multi-Strategy, respectively. Panel A reports the results for the full sample period (April 2006-March 2012). Panels B and C report the results for the two subperiods: April 2006-March 2009 and April 2009-March 2012, respectively.

Panel A: April 2006-March 2012

Index	PTFSBD	PTFSFX	PTFSCOM	BD10RET	BAAMTSY	SNPMRF	SCMLC	LBVIX	RetVIX	LIQ	CR	UNC	JUMP	VOL	Total
HFI				1	1	1		1			1		1		6
CA		1			1	1	1	1				1	1		7
MN	1	1			1	1									4
ED				1	1	1		1			1				5
GM	1				1			1					1		4
LS				1		1		1					1		4
MF	1		1				1	1			1				5
MS				1	1	1			1				1	1	6
Percent selected	37.50	25.00	12.50	50.00	75.00	75.00	25.00	75.00	12.50	0.00	37.50	12.50	62.50	12.50	

Panel B: April 2006-March 2009

HFI					1	1		1					1		4
CA		1			1			1					1	1	5
MN	1	1					1								3
ED			1	1	1	1							1	1	6
GM					1			1					1		3
LS					1	1		1					1	1	5
MF			1			1		1							3
MS				1	1	1		1					1	1	6
Percent selected	12.50	25.00	25.00	25.00	75.00	62.50	12.50	75.00	0.00	0.00	0.00	0.00	75.00	50.00	

Panel C: April 2009-December 2012

HFI	1	1				1		1			1	1	1		7
CA					1	1			1			1			4
MN						1	1			1					2
ED				1		1		1	1		1	1		1	7
GM	1		1			1					1				4
LS		1	1		1	1		1			1				6
MF			1								1				2
MS					1	1					1	1	1	1	6
Percent selected	25.00	25.00	37.50	12.50	37.50	87.50	12.50	37.50	25.00	0.00	75.00	50.00	25.00	25.00	

Table I10

Time series results with the eight-factor model using *RVIX* and *SDVIX* as volatility of aggregate volatility (VOV) proxies

This table reports VOV factor exposures of the eight-factor model in Eq. (1) during January 1994-December 2013 period using either *RVIX* or *SDVIX* as VOV factor. The eight indexes are from Dow Jones Credit Suisse. HFI, CA, MN, ED, GM, LS, MF, and MS stand for Hedge Fund Index, Convertible Arbitrage, Equity Market Neutral, Event Driven, Global Macro, Long/Short Equity, Managed Futures, and Multi-Strategy, respectively. The final row reports the pooled panel regressions with heteroskedasticity-consistent standard errors after allowing for cross-correlations.

Index	January 1994- December 2013		January 1994- June 1998		July 1998- March 2000		April 2000- March 2006		April 2006- March 2009		April 2009- December 2013	
	<i>RVIX</i>	<i>SDVIX</i>	<i>RVIX</i>	<i>SDVIX</i>	<i>RVIX</i>	<i>SDVIX</i>	<i>RVIX</i>	<i>SDVIX</i>	<i>RVIX</i>	<i>SDVIX</i>	<i>RVIX</i>	<i>SDVIX</i>
HFI	-0.030 [-3.39]	-0.002 [-2.73]	-0.034 [-1.22]	-0.003 [-1.01]	-0.022 [-1.73]	-0.007 [-1.60]	-0.006 [-0.49]	-0.000 [-0.02]	-0.022 [-2.39]	-0.002 [-1.76]	-0.020 [-2.33]	-0.003 [-2.64]
CA	-0.026 [-3.05]	-0.001 [-1.73]	-0.036 [-2.70]	-0.003 [-1.82]	-0.047 [-4.35]	-0.016 [-3.97]	0.000 [0.01]	0.002 [1.55]	-0.023 [-1.70]	-0.000 [-0.36]	-0.019 [-1.49]	-0.000 [-0.02]
MN	-0.011 [-0.69]	-0.005 [-3.18]	0.009 [0.77]	0.000 [0.22]	-0.004 [-0.86]	-0.001 [-0.72]	-0.005 [-0.63]	-0.000 [-0.34]	-0.011 [-0.31]	-0.008 [-2.30]	-0.007 [-0.66]	-0.001 [-0.47]
ED	-0.020 [-3.05]	-0.002 [-2.68]	0.000 [0.01]	0.000 [0.14]	-0.028 [-3.88]	-0.009 [-3.01]	-0.011 [-0.95]	-0.001 [-0.85]	-0.015 [-1.69]	-0.001 [-1.35]	-0.021 [-1.96]	-0.004 [-3.31]
GM	-0.036 [-2.43]	-0.003 [-1.80]	-0.041 [-0.85]	-0.004 [-0.63]	-0.039 [-1.80]	-0.014 [-1.77]	0.032 [1.66]	0.004 [2.29]	-0.021 [-1.57]	-0.001 [-1.09]	-0.004 [-0.30]	-0.000 [-0.18]
LS	-0.020 [-2.03]	-0.000 [-0.45]	-0.010 [-0.59]	0.001 [0.34]	0.013 [0.69]	0.005 [0.80]	-0.024 [-1.23]	-0.002 [-0.99]	-0.020 [-1.75]	0.000 [0.29]	-0.020 [-2.08]	-0.003 [-2.48]
MF	-0.034 [-1.87]	-0.001 [-0.83]	0.024 [0.56]	-0.002 [-0.33]	0.034 [1.61]	0.012 [1.56]	0.030 [0.63]	0.004 [0.94]	-0.082 [-3.29]	-0.003 [-1.21]	-0.074 [-2.45]	-0.009 [-2.75]
MS	-0.005 [-0.67]	-0.001 [-1.78]	0.052 [2.51]	0.005 [1.97]	-0.020 [-1.95]	-0.007 [-2.03]	-0.015 [-1.25]	-0.001 [-0.55]	-0.017 [-1.91]	-0.001 [-1.74]	-0.013 [-1.69]	-0.002 [-1.78]
Pooled	-0.023 [-5.01]	-0.002 [-4.50]	-0.005 [-0.42]	-0.001 [-0.51]	-0.022 [-1.71]	-0.005 [-1.69]	0.001 [0.09]	0.001 [1.22]	-0.037 [-2.37]	-0.001 [-0.73]	-0.023 [-3.68]	-0.003 [-3.77]

Table I11Univariate portfolio sorts with *RVIX* and *SDVIX* betas

This table reports next month equally weighted return, next month eight-factor alpha, and average volatility of aggregate volatility (VOV) exposures of five portfolios sorted with respect to either *RVIX* or *SDVIX* exposures. Funds' monthly VOV betas are estimated via time series regressions over 24-month rolling windows:

$$r_{i,t} = \alpha_{i,t} + \beta_{i,t}^{VOV} VOV_t + \varepsilon_{i,t},$$

where $r_{i,t}$ is the excess return on fund i in month t , VOV is defined as either monthly range of the Chicago Board Options Exchange Volatility Index (VIX) (*RVIX*), or monthly standard deviation of the VIX (*SDVIX*), and $\beta_{i,t}^{VOV}$ is the VOV beta for fund i in month t . Each month, from January 1994 to December 2013, hedge funds are sorted into quintile portfolios based on their $\beta_{i,t}^{VOV}$. Quintile 1 (5) contains funds with the lowest (highest) VOV betas.

Panel A: Quintile portfolios sorted with respect to RVIX betas

Performance and beta	1 (low)	2	3	4	5 (high)	5-1
Average return	1.334	1.010	0.876	0.845	0.750	-0.584
	[4.36]	[5.46]	[5.30]	[7.06]	[8.03]	[-2.28]
Eight-factor alpha	1.139	0.919	0.786	0.737	0.701	-0.439
	[3.96]	[5.39]	[5.53]	[7.17]	[8.77]	[-1.81]
Average β_{RVIX}	-22.683	-9.713	-4.317	0.021	9.560	

Panel B: Quintile portfolios sorted with respect to SDVIX betas

Average return	1.241	1.022	0.905	0.792	0.722	-0.519
	[3.59]	[5.30]	[6.14]	[6.38]	[9.00]	[-1.75]
Eight-factor alpha	1.058	0.918	0.832	0.708	0.653	-0.405
	[3.53]	[5.41]	[5.01]	[6.58]	[8.73]	[-1.55]
Average β_{SDVIX}	-2.752	-1.213	-0.588	-0.067	1.067	

Table I12Fama-MacBeth regressions with *RVIX* and *SDVIX* betas

This table reports average intercept and time series averages of the slope coefficients from the monthly cross-sectional regressions of one-month-ahead hedge fund excess returns on *SVOL* beta and a large set of fund characteristics for the period of January 1994-December 2013:

$$r_{i,t+1} = \lambda_{0,t} + \lambda_{VOV,t}\beta_{i,t}^{VOV} + \lambda_{r,t}r_{i,t} + \lambda_{Size,t}Size_{i,t} + \lambda_{Age,t}Age_{i,t} + \lambda_{MgmtFee,t}MgmtFee_{i,t} \\ + \lambda_{IncFee,t}IncFee_{i,t} + \lambda_{Redemption,t}Redemption_{i,t} + \lambda_{MinInv,t}MinInv_{i,t} + \lambda_{Lockup,t}Lockup_{i,t} \\ + \lambda_{Delta,t}Delta_{i,t} + \lambda_{Vega,t}Vega_{i,t} + \lambda_{VOL,t}\beta_{i,t}^{VOL}\varepsilon_{i,t+1},$$

where $r_{i,t+1}$ is the excess return on fund i in month $t+1$, $\beta_{i,t}^{VOV}$ is the volatility of aggregate volatility (VOV) (*RVIX* or *SDVIX*) beta of fund i in month t , $r_{i,t}$ is the one-month lagged return on fund i in month t , *Size* is the monthly assets under management (in billions of dollars), *Age* is number of months that a fund is in business since inception, *MgmtFee* is a fixed percentage fee of assets under management, *IncFee* is a fixed percentage fee of the fund's net annual profits above a pre-specified hurdle rate, *Redemption* is the minimum number of days an investor needs to notify the fund before she can redeem the invested amount from the fund, *MinInv* is the minimum initial investment amount (in millions of dollars) that the fund requires its investors to invest in the fund, *Lockup* is the minimum number of days that the investor has to wait before she can withdraw her investment from the fund, *Delta* is the expected dollar change in the manager's compensation for a 1% change in the fund's net asset value, *Vega* is the expected dollar change in the manager's compensation for a 1% change in the volatility of fund's net asset value; and $\beta_{i,t}^{VOL}$ is the VOL beta of fund i in month t estimated using Eq. (4). The numbers in brackets are the Newey and West (1987) and Shanken (1992) corrected t -statistics.

Factor	Using <i>RVIX</i> betas	Using <i>SDVIX</i> betas
β_{VOV}	-0.0179 [-2.44]	-0.1773 [-2.54]
Ret_t	0.0942 [5.64]	0.0844 [4.89]
<i>Size</i>	0.6330 [1.12]	0.7140 [1.21]
<i>Age</i>	-0.0013 [-1.48]	-0.0022 [-2.59]
<i>MgmtFee</i>	0.0624 [1.45]	0.0668 [1.50]
<i>IncFee</i>	0.0164 [4.58]	0.0157 [3.95]
<i>Redemption</i>	0.0000 [0.08]	0.0001 [0.46]
<i>MinInv</i>	0.0041 [1.06]	0.0046 [1.20]
<i>Lockup</i>	0.0003 [2.79]	0.0003 [2.37]
<i>Delta</i>	0.5600 [1.02]	0.6560 [1.13]
<i>Vega</i>	0.0764 [0.09]	0.1790 [0.20]
β_{VOL}	-0.0728 [-0.49]	-0.1421 [-0.99]
Intercept	0.2203 [1.76]	0.2860 [2.15]
Adj. R^2	17.53%	17.80%