When There is No Place to Hide - Correlation Risk and The Cross-Sectional of Hedge Fund Returns

(joint work with A. Buraschi, Imperial College London, and F. Trojani, University of St. Gallen)

Robert Kosowski

Imperial College London

2008

Motivation (1): Correlation Risk and Long/Short Positions

- Mutual Funds: Long positions $\Rightarrow \beta_{Equity\ Market}$ 

Motivation (1): Correlation Risk and Long/Short Positions

- Mutual Funds: Long positions $\Rightarrow \beta_{Equity\ Market}$
- In contrast, hedge funds do not face investment restrictions such as short sale constraints (Almazan et al (2004), Agarwal et al (2007))

Motivation (1): Correlation Risk and Long/Short Positions

- Mutual Funds: Long positions $\Rightarrow \beta_{Equity\ Market}$
- In contrast, hedge funds do not face investment restrictions such as short sale constraints (Almazan et al (2004), Agarwal et al (2007))
- Hedge Funds: Long & Short Baskets$\Rightarrow \downarrow \beta_{Equity\ Market}$ ...but

Motivation (1): Correlation Risk and Long/Short Positions

- Mutual Funds: Long positions $\Rightarrow \beta_{Equity\ Market}$
- In contrast, hedge funds do not face investment restrictions such as short sale constraints (Almazan et al (2004), Agarwal et al (2007))
- Hedge Funds: Long & Short Baskets$\Rightarrow\downarrow \beta_{Equity\ Market}$ ...but
- $\Rightarrow\uparrow \beta_{Correlation\ Risk}$

Motivation (1): Correlation Risk and Long/Short Positions

- Mutual Funds: Long positions $\Rightarrow \beta_{Equity\ Market}$
- In contrast, hedge funds do not face investment restrictions such as short sale constraints (Almazan et al (2004), Agarwal et al (2007))
- Hedge Funds: Long & Short Baskets$\Rightarrow\downarrow \beta_{Equity\ Market}$ ...but
- $\Rightarrow\uparrow \beta_{Correlation\ Risk}$
- Long-short spread trades

Motivation (1): Correlation Risk and Long/Short Positions

- Mutual Funds: Long positions $\Rightarrow \beta_{Equity\ Market}$
- In contrast, hedge funds do not face investment restrictions such as short sale constraints (Almazan et al (2004), Agarwal et al (2007))
- Hedge Funds: Long & Short Baskets$\Rightarrow\downarrow \beta_{Equity\ Market}$ ...but
- $\Rightarrow\uparrow \beta_{Correlation\ Risk}$
- Long-short spread trades
  - differ from directional option and dynamic stop-loss strategies in that they expose a fund particularly to *correlation* risk rather than *volatility* risk

Motivation (1): Correlation Risk and Long/Short Positions

- Mutual Funds: Long positions $\Rightarrow \beta_{Equity\ Market}$
- In contrast, hedge funds do not face investment restrictions such as short sale constraints (Almazan et al (2004), Agarwal et al (2007))
- Hedge Funds: Long & Short Baskets$\Rightarrow\downarrow \beta_{Equity\ Market}$ ...but
- $\Rightarrow\uparrow \beta_{Correlation\ Risk}$
- Long-short spread trades
    - differ from directional option and dynamic stop-loss strategies in that they expose a fund particularly to *correlation* risk rather than *volatility* risk
- Do hedge funds generate returns by 'insuring against' high correlation states?

Motivation (2): Recent HF Correlation Risk Examples

- (1) August 2007 crisis (Khandani and Lo (2007)), but careful to distinguish realization and risk premium

Motivation (2): Recent HF Correlation Risk Examples

- (1) August 2007 crisis (Khandani and Lo (2007)), but careful to distinguish realization and risk premium
- (2)'Fixed income traders pulled into deleveraging vortex' 

Motivation (2): Recent HF Correlation Risk Examples

- (1) August 2007 crisis (Khandani and Lo (2007)), but careful to distinguish realization and risk premium
- (2)'Fixed income traders pulled into deleveraging vortex' 
  - (May 1st, 2008, Financial Times):'Traders making some of the safest bets on the planet were hammered in March as hedge funds scrambled to sell assets to cover losses in other markets[...]

Motivation (2): Recent HF Correlation Risk Examples

- (1) August 2007 crisis (Khandani and Lo (2007)), but careful to distinguish realization and risk premium
- (2)'Fixed income traders pulled into deleveraging vortex' 
  - (May 1st, 2008, Financial Times):'Traders making some of the safest bets on the planet were hammered in March as hedge funds scrambled to sell assets to cover losses in other markets[...]
  - The falls are a repeat in miniature of the near-collapse of LTCM in 1998[...]

Motivation (2): Recent HF Correlation Risk Examples

- (1) August 2007 crisis (Khandani and Lo (2007)), but careful to distinguish realization and risk premium
- (2)'Fixed income traders pulled into deleveraging vortex' 
  - (May 1st, 2008, Financial Times):'Traders making some of the safest bets on the planet were hammered in March as hedge funds scrambled to sell assets to cover losses in other markets[...]
  - The falls are a repeat in miniature of the near-collapse of LTCM in 1998[...]
  - But this time round the crisis spread even more rapidly 'from market to market, taking down arbitrageurs in US Treasuries and convertible bonds [...], because the amount of money hedge funds now run is so much higher.'

Motivation (2): Recent HF Correlation Risk Examples

- (1) August 2007 crisis (Khandani and Lo (2007)), but careful to distinguish realization and risk premium
- (2)'Fixed income traders pulled into deleveraging vortex' 
  - (May 1st, 2008, Financial Times):'Traders making some of the safest bets on the planet were hammered in March as hedge funds scrambled to sell assets to cover losses in other markets[...]
  - The falls are a repeat in miniature of the near-collapse of LTCM in 1998[...]
  - But this time round the crisis spread even more rapidly 'from market to market, taking down arbitrageurs in US Treasuries and convertible bonds [...], because the amount of money hedge funds now run is so much higher.'
- (3) 'We have hedge fund clients who are very active traders of volatility, correlation and dispersion. Trading correlation and dispersion as an asset class can have a diversification effect,...' (Denis Frances, Global Head of Equity Derivatives Flow Sales at BNP Paribas, (FTfm, 28/1/2008))

Presentation Outline

- Motivation
- Related Literature:
  - Volatility Risk and Hedge Fund Returns:
    - Fung and Hsieh (2001), Bondarenko (2003), Kong (2008)
  - Correlation Risk:
    - Buraschi, Porchia and Trojani (2006), Driessen, Maenhout and Vilkov (2007) and others
  - Correlations and Crisis Times
    - Bollerslev et al (1998), Moskowitz (2003) and others
  - Option-Implied Correlations
    - Longstaff, Santa-Clara and Schwartz (2003), Collin-Dufresne and Goldstein (2001) and others
- Methodology
- Empirical Results and Data
- Conclusions and Extensions

Theoretical Interpretation of Correlation Risk Premium

- Why should correlation risk be priced?

Theoretical Interpretation of Correlation Risk Premium

- Why should correlation risk be priced?
- Long-run risk, uncertainty and variance risk premium (Drechsler and Yaron(2008)))

$$
\begin{aligned}
Y_{t+1} &= \mu + FY_t + G_t z_{t+1} + J_{t+1} \\
m_{t,t+1} &= f\left(LR\ Risk,\ Uncertainty, \ldots\right)
\end{aligned}
$$

Theoretical Interpretation of Correlation Risk Premium

- Why should correlation risk be priced?
- Long-run risk, uncertainty and variance risk premium (Drechsler and Yaron(2008)))

$$
\begin{aligned}
Y_{t+1} &= \mu + FY_t + G_t z_{t+1} + J_{t+1} \\
m_{t,t+1} &= f\left(LR\ Risk,\ Uncertainty, \ldots\right)
\end{aligned}
$$

- Micro-Foundations of Uncertainty

Theoretical Interpretation of Correlation Risk Premium

- Why should correlation risk be priced?
- Long-run risk, uncertainty and variance risk premium (Drechsler and Yaron(2008)))

$$
\begin{aligned}
Y_{t+1} &= \mu + FY_t + G_t z_{t+1} + J_{t+1} \\
m_{t,t+1} &= f\left(LR\ Risk,\ Uncertainty, \ldots\right)
\end{aligned}
$$

- Micro-Foundations of Uncertainty
- Differences in Beliefs (Buraschi, Trojani and Vedolin (2008))

$$
\begin{aligned}
\frac{dD}{D} &= \mu\left(z\right) dt + \sigma dW_t \\
\psi &= \left|\mu^i\left(z\right) - \mu^j\left(z\right)\right| \\
P_t &= E_t\left[m_{t,t+T}\left(\psi\right), D_{t+T}\right]
\end{aligned}
$$

Theoretical Interpretation of Correlation Risk Premium

- Why should correlation risk be priced?
- Long-run risk, uncertainty and variance risk premium (Drechsler and Yaron(2008)))

$$
\begin{aligned}
Y_{t+1} &= \mu + FY_t + G_t z_{t+1} + J_{t+1} \\
m_{t,t+1} &= f\left(LR\ Risk,\ Uncertainty, \ldots\right)
\end{aligned}
$$

- Micro-Foundations of Uncertainty
- Differences in Beliefs (Buraschi, Trojani and Vedolin (2008))

$$
\begin{aligned}
\frac{dD}{D} &= \mu\left(z\right) dt + \sigma dW_t \\
\psi &= \left|\mu^i\left(z\right) - \mu^j\left(z\right)\right| \\
P_t &= E_t\left[m_{t,t+T}\left(\psi\right), D_{t+T}\right]
\end{aligned}
$$

- Disagreement risk, endogenous correlations and priced correlation risk

Theoretical Interpretation of Correlation Risk Premium

- Why should correlation risk be priced?
- Long-run risk, uncertainty and variance risk premium (Drechsler and Yaron(2008)))

$$\begin{aligned} Y_{t+1} &= \mu + FY_t + G_t z_{t+1} + J_{t+1} \\ m_{t,t+1} &= f\left(LR\ Risk,\ Uncertainty, ...\right) \end{aligned}$$

- Micro-Foundations of Uncertainty
- Differences in Beliefs (Buraschi, Trojani and Vedolin (2008))

$$\begin{aligned} \frac{dD}{D} &= \mu\left(z\right) dt + \sigma dW_t \\ \psi &= \left|\mu^i\left(z\right) - \mu^j\left(z\right)\right| \\ P_t &= E_t\left[m_{t,t+T}\left(\psi\right), D_{t+T}\right] \end{aligned}$$

- Disagreement risk, endogenous correlations and priced correlation risk
- $\rho\left(\frac{dS^a}{S^a}, \frac{dS^b}{S^b}\right), \rho\left(t\right)$ and $Cov\left(m_{t,t+T}\left(\psi\right); d\rho\left(\psi_t\right)\right) < 0$

- BKT 9-Factor Model (FH(2001) + VR_t+CR_t):

$$
\begin{aligned}
r_{i,t} \quad = \quad & \alpha_i + \\
& \beta_i^1 SNPMRF_t \\
& + \beta_i^2 SCMLC_t + \beta_i^3 BD10RET_t + \beta_i^4 BAAMTSY_t + \\
& \beta_i^5 PTFSBD_t + \beta_i^6 PTFSFX_t + \beta_i^7 PTFSCOM_t + \\
& \beta_i^8 VR_t + \beta_i^9 CR_t + \varepsilon_t^i,
\end{aligned}
$$

Hedge Fund Performance, Correlation and Variance Risk

- BKT 9-Factor Model (FH(2001) + VR_t+CR_t):

$$\begin{aligned} r_{i,t} &= \alpha_i + \\ &\beta_i^1 SNPMRF_t \\ &+\beta_i^2 SCMLC_t + \beta_i^3 BD10RET_t + \beta_i^4 BAAMTSY_t + \\ &\beta_i^5 PTFSBD_t + \beta_i^6 PTFSFX_t + \beta_i^7 PTFSCOM_t + \\ &\beta_i^8 VR_t + \beta_i^9 CR_t + \varepsilon_t^i, \end{aligned}$$

- Volatility Risk Premium: Implied minus Realized Volatility (JT (2005))

- BKT 9-Factor Model (FH(2001) + VR_t+CR_t):

$$
\begin{aligned}
r_{i,t} \quad = \quad & \alpha_i + \\
& \beta_i^1 SNPMRF_t \\
& +\beta_i^2 SCMLC_t + \beta_i^3 BD10RET_t + \beta_i^4 BAAMTSY_t + \\
& \beta_i^5 PTFSBD_t + \beta_i^6 PTFSFX_t + \beta_i^7 PTFSCOM_t + \\
& \beta_i^8 VR_t + \beta_i^9 CR_t + \varepsilon_t^i,
\end{aligned}
$$

- Volatility Risk Premium: Implied minus Realized Volatility (JT (2005))
- Correlation Risk Premium (Proxy): *Correlation Trading* strategy shorts the index put in order to exploit the correlation risk premium, while hedging the exposure to stock return shocks and to individual volatility shocks (DMV(2006))

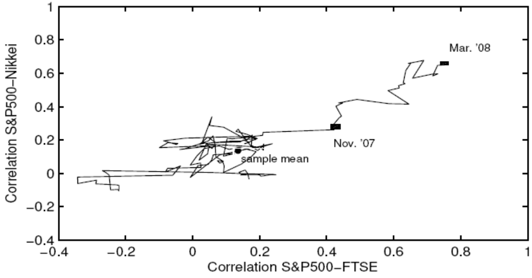
Hedge Fund Performance, Correlation and Variance Risk

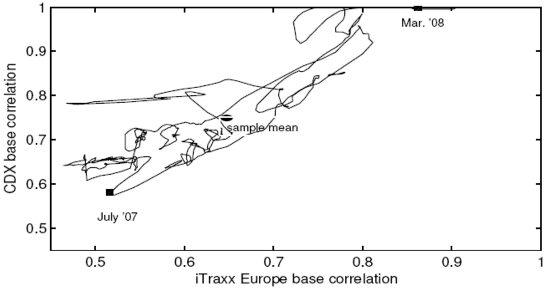
- BKT 9-Factor Model (FH(2001) + VR_t+CR_t):

$$\begin{aligned} r_{i,t} &= \alpha_i + \\ & \beta_i^1 SNPMRF_t \\ & + \beta_i^2 SCMLC_t + \beta_i^3 BD10RET_t + \beta_i^4 BAAMTSY_t + \\ & \beta_i^5 PTFSBD_t + \beta_i^6 PTFSFX_t + \beta_i^7 PTFSCOM_t + \\ & \beta_i^8 VR_t + \beta_i^9 CR_t + \varepsilon_t^i, \end{aligned}$$

- Volatility Risk Premium: Implied minus Realized Volatility (JT (2005))
- Correlation Risk Premium (Proxy): *Correlation Trading* strategy shorts the index put in order to exploit the correlation risk premium, while hedging the exposure to stock return shocks and to individual volatility shocks (DMV(2006))
- How does CR differ from OTM Put or straddle?

Correlation and Stock Market Return



- 

Variance Risk Premium Construction (1)

- Continuously-resampled realized variance from time 0 to time T can be expressed as follows:

$$V_{iT} = \int_{0}^{T} \phi_i^2\left(t\right) dt,$$

where $\phi_i^2\left(t\right)$ is the instantaneous variance of stock i at time t.

Variance Risk Premium Construction (1)

- Continuously-resampled realized variance from time 0 to time T can be expressed as follows:

$$V_{iT} = \int_0^T \phi_i^2(t)\, dt,$$

where $\phi_i^2(t)$ is the instantaneous variance of stock i at time t.

- We use U_0 to denote the time-0 price of the variance contract, which at maturity-T has a payoff V_T. The price of the variance risk contract is the risk-neutral expected integrated variance and thus reflects expectations of future variance:

$$U_0 = E_0^Q \left[V_T \right].$$

Variance Risk Premium Construction (1)

- Continuously-resampled realized variance from time 0 to time T can be expressed as follows:

$$V_{iT} = \int_0^T \phi_i^2(t)\,dt,$$

where $\phi_i^2(t)$ is the instantaneous variance of stock i at time t.

- We use U_0 to denote the time-0 price of the variance contract, which at maturity-T has a payoff V_T. The price of the variance risk contract is the risk-neutral expected integrated variance and thus reflects expectations of future variance:

$$U_0 = E_0^Q[V_T].$$

- Return on the variance contract, r_{VR}, can be expressed as $r_{VR} = \frac{V_T}{U_0} - 1$ and serves as the variance risk premium.

Variance Risk Premium Construction (1)

- Continuously-resampled realized variance from time 0 to time T can be expressed as follows:

$$V_{iT} = \int_0^T \phi_i^2(t)\, dt,$$

where $\phi_i^2(t)$ is the instantaneous variance of stock i at time t.
- We use U_0 to denote the time-0 price of the variance contract, which at maturity-T has a payoff V_T. The price of the variance risk contract is the risk-neutral expected integrated variance and thus reflects expectations of future variance:

$$U_0 = E_0^Q[V_T].$$

- Return on the variance contract, r_{VR}, can be expressed as $r_{VR} = \frac{V_T}{U_0} - 1$ and serves as the variance risk premium.
- $Model - free\ implied\ variance\ (MFIV)$ (Britten-Jones and Neuberger (2000) and Jiang and Tian (2005))

Correlation Risk Premium Construction (1)

- To derive an expression for *unexpected* individual stock option returns, we apply Ito's lemma to changes in individual put option prices P_i :

$$\frac{dP_{it}}{P_{it}} - E_t\left[\frac{dP_i}{P_i}\right] = \frac{S_{it}}{P_{it}}\frac{\partial P_{it}}{\partial S_{it}}\phi_{it}dB_{it} + \frac{1}{P_{it}}\frac{\partial P_{it}}{\partial \phi_{it}^2}\varsigma_i\left(\phi_{it}\right)dB_{\phi_{it}}.$$

Correlation Risk Premium Construction (1)

- To derive an expression for *unexpected* individual stock option returns, we apply Ito's lemma to changes in individual put option prices P_i :

$$\frac{dP_{it}}{P_{it}} - E_t\left[\frac{dP_i}{P_i}\right] = \frac{S_{it}}{P_{it}}\frac{\partial P_{it}}{\partial S_{it}}\phi_{it} dB_{it} + \frac{1}{P_{it}}\frac{\partial P_{it}}{\partial \phi_{it}^2}\varsigma_i\left(\phi_{it}\right) dB_{\phi_{it}}.$$

- Unexpected returns on index put options with price P_I are given by

$$\begin{aligned}\frac{dP_{It}}{P_{It}} - E_t\left[\frac{dP_I}{P_I}\right] &= \sum_{i=1}^{N}\frac{S_{it}}{P_{It}}\frac{\partial P_{It}}{\partial S_{it}}\phi_{it} dB_{it} + \sum_{i=1}^{N}\frac{1}{P_{It}}\frac{\partial P_{It}}{\partial \phi_{it}^2}\varsigma_i\left(\phi_{it}\right) dB_{\phi_{it}} \\ &\quad + \frac{1}{P_{It}}\frac{\partial P_{It}}{\partial \rho}\sigma\left(\rho\right) dB_\rho.\end{aligned}$$

The correlation trading strategy implies shorting the index put in order to exploit the correlation risk premium, while hedging the exposure to stock return shocks dB_i and to individual volatility shocks dB_{ϕ_i}.

Correlation Risk Premium Construction (2)

- To implement this strategy, we first short index puts worth 100% of initial wealth, and invest the proportion y_i of the initial wealth in individual put option i, where y_i is obtained by solving the following equation:

$$-\frac{1}{P_{It}}\frac{\partial P_{It}}{\partial \phi_{it}^2}\varsigma_{it}\left(\phi_{it}\right)+y_{it}\frac{1}{P_{it}}\frac{\partial P_{it}}{\partial \phi_{it}^2}\varsigma_{it}\left(\phi_{it}\right)=0.$$

To delta-hedge the portfolio we invest a proportion z_i of initial wealth in each individual stock i where z_i satisfies:

$$-\frac{S_{it}}{P_{It}}\frac{\partial P_{It}}{\partial S_{it}}\phi_{it}+y_{it}\frac{S_{it}}{P_{it}}\frac{\partial P_{it}}{\partial S_{it}}\phi_{it}+z_{it}\phi_{it}=0.$$

Correlation Risk Premium Construction (2)

- To implement this strategy, we first short index puts worth 100% of initial wealth, and invest the proportion y_i of the initial wealth in individual put option i, where y_i is obtained by solving the following equation:

$$-\frac{1}{P_{It}}\frac{\partial P_{It}}{\partial \phi_{it}^2}\varsigma_{it}\left(\phi_{it}\right)+y_{it}\frac{1}{P_{it}}\frac{\partial P_{it}}{\partial \phi_{it}^2}\varsigma_{it}\left(\phi_{it}\right)=0.$$

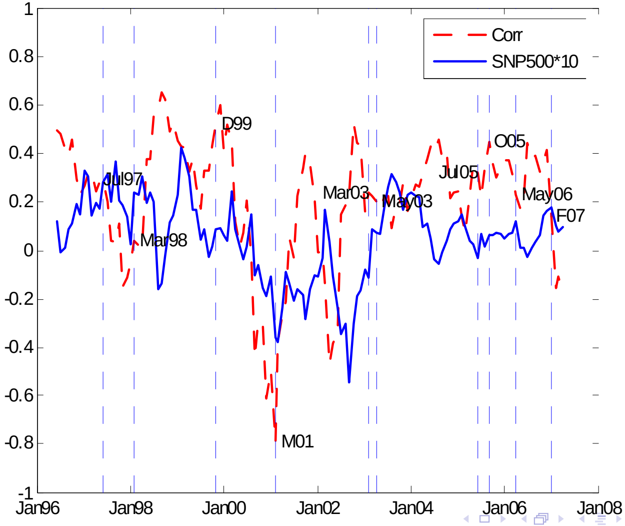
  To delta-hedge the portfolio we invest a proportion z_i of initial wealth in each individual stock i where z_i satisfies:

$$-\frac{S_{it}}{P_{It}}\frac{\partial P_{It}}{\partial S_{it}}\phi_{it}+y_{it}\frac{S_{it}}{P_{it}}\frac{\partial P_{it}}{\partial S_{it}}\phi_{it}+z_{it}\phi_{it}=0.$$

- We use the Black-Scholes formula to calculate the individual and index put vegas, $\frac{\partial P_{It}}{\partial \phi_{it}^2}$ and $\frac{\partial P_{it}}{\partial \phi_{It}^2}$, and the individual and index put deltas, $\frac{\partial P_{It}}{\partial S_{It}}$ and $\frac{\partial P_{it}}{\partial S_{it}}$. The correlation coefficient $\rho\left(t\right)$ is the estimate as the average 30-day moving window pairwise correlation.

Correlation Risk Premium and S&P Return

- 12-month MA of correlation risk return and S&P return (1996-2007)
-



Data (1996-2007)

Hedge Funds

- Survivorship bias-free hedge fund return data
- BarclayHedge 1990-2008.
- 5660 HFs and FoFs in January 2008

Variance and Correlation Risk (1996-2007)

- Optionmetrics

- Indiv. HF Ret. (% p.m.):

Data (1996-2007)

Hedge Funds

- Survivorship bias-free hedge fund return data
- BarclayHedge 1990-2008.
- 5660 HFs and FoFs in January 2008

Variance and Correlation Risk (1996-2007)

- Optionmetrics

- Indiv. HF Ret. (% p.m.):
-

	#	Mean	Std
ALL	3114	0.61	1.37
LSE	469	0.79	2.35
LNX	167	0.99	2.29
EL	395	0.69	2.87
OPTS	22	0.59	0.74
EMKN	110	0.34	0.64
MA	61	0.62	1.38
ED	142	0.86	2.11

CAPM Model Alphas and Betas for HF Indices

- 1996-2007, value (AuM) weighted indices:

	EL	*LSE*	*LNX*	*EMKN*	*OPTS*	*ED*	*MA*
$\overline{r_i}$ (% p.a.)	8.2	9.4	11.8	4.0	7.0	10.3	7.4
α(% p.a.)	**4.5**	**7.1**	**10.1**	3.8	6.7	8.5	6.6
t_α	2.6	3.7	4.8	5.9	9.0	4.5	4.9
β_{SNP}	**0.55**	0.34	0.26	**0.02**	0.04	0.27	0.11
t_β	16.3	9.0	6.2	1.8	3.1	7.4	4.4
adj. R^2	66.3	**37.5**	**22.2**	1.7	5.8	28.4	11.7

BKT Model Alphas and Betas for HF Indices

	EL	*LSE*	*LNX*	*EMKN*	*OPTS*	*ED*	*MA*
$\overline{r_i}$ (% p.a.)	8.2	9.4	11.8	4.1	7.1	10.3	7.4
α(% p.a.)	2.6	**4.0**	**7.4**	4.5	**7.42**	7.2	7.3
t_α	1.6	2.56	3.6	6.02	8.88	3.74	4.96
β_{SNP}	0.56	0.36	0.26	**0.04**	0.05	0.24	0.118
$t_{\beta_{SNP}}$	20.6	13.1	7.5	2.63	3.19	7.31	4.53
β_{CR}	-0.002	0.007	0.005	0.001	0.002	-0.005	-0.005
$t_{\beta_{CR}}$	-0.9	**3.76**	**2.09**	0.58	**2.12**	**-2.08**	**-3.06**
β_{VR}	0.005	0.004	0.003	-0.003	-0.003	0.004	-0.001
t_{VR}	1.7	**1.33**	**0.84**	-2.02	**-1.97**	1.11	-0.49
adj. R^2	**80.71**	**71.16**	**49.09**	10.73	17.81	46.46	25.38

Long-Short Equity Funds Sorted By Correlation Risk Beta

		Low	2	3	4	*High*	*Mean*
	β_{CR}	-0.016	-0.004	0.000	0.005	0.019	0.001
	Total Ret.	12.7	8.5	7.7	8.1	11.7	9.8
CAPM	α_{CAPM}	**11.3**	7.6	6.6	6.9	**9.7**	8.4
BKT	α_{BKT}	**14.2**	7.9	6.4	4.6	**2.0**	7.0
	$t_{\alpha_{BKT}}$	1.89	1.61	1.58	0.93	0.28	1.26
	$t_{\beta_{CR}}$	-1.86	-0.84	0.01	0.91	2.23	0.09
	$t_{\beta_{VR}}$	0.028	0.22	0.04	0.32	0.55	0.23
	cont. α	**14.2**	7.9	6.3	4.6	**2.0**	7.0
	cont. β_{CR}	**-3.6**	-1.0	0.1	1.2	**3.6**	0.1
	cont. β_{VR}	**-0.2**	0.4	0.1	1.4	**2.2**	0.8
	cont. β_{SNP}	**1.2**	0.7	1.0	1.1	**1.8**	1.1
	drawdown	**26.0**	15.5	**11.6**	19.7	**41.5**	22.9
	adj R^2	**26.5**	22.7	**24.1**	22.3	**36.4**	26.6
	% dead	**52.1**	32.6	38.0	36.9	**58.7**	43.7

Summary of Results by Investment Objective

- Positive Index Level β_{CR}
  - Long/Short Equity
  - Low Net Exposure (LNX)
  - Option Trader
- Negative Index Level β_{CR}
  - Merger Arbitrage
  - Event Driven

LNX Funds Sorted By Correlation Risk Beta

		Low	2	3	4	*High*	*Mean*
	β_{CR}	-0.017	-0.005	0.0	0.003	0.011	-0.002
	Total Ret.	12.3	11.2	8.4	8.9	8.8	9.9
CAPM	α_{CAPM}	**11.1**	9.9	6.8	8.0	**7.6**	8.5
BKT	α_{BKT}	**16.1**	8.9	6.4	5.7	**2.4**	7.9
	$t_{\alpha_{BKT}}$	2.43	1.79	1.46	1.31	0.31	1.46
	$t_{\beta_{CR}}$	-2.21	-0.94	-0.06	0.67	1.56	-0.19
	$t_{\beta_{VR}}$	-0.14	0.53	0.28	0.16	0.17	0.20
	cont. α	**16.1**	8.8	6.3	5.7	**2.4**	7.9
	cont. β_{CR}	**-3.9**	-1.1	-0.1	0.7	**2.6**	-0.3
	cont. β_{VR}	**-0.5**	2.1	0.8	0.7	**1.1**	0.8
	cont. β_{SNP}	**1.1**	0.1	0.9	1.4	**0.7**	0.8
	drawdown	**16.0**	9.1	7.3	10.0	**19.1**	12.3
	adj R^2	**18.7**	16.1	14.6	16.5	**16.4**	16.4

Case Study

- α_{CAPM} of the 3 funds with highest β_{CORR} explained by β_{CORR} exposure

Name	Category	Ret
3. AP	Equity Long-Bias	42.5
2. OS	Equity Long/Short	14.7
1. AL	Equity Long/Short	20.1

Name	Ret	α_{CAPM}	$\alpha_{S\&P,VC,COR}$	β_{COR}	$t_{\beta_{CORR}}$	$t_{\beta_{VC}}$
3.	42.5	27.9	10.1	6.2%	1.7	0.5
2.	14.7	13.9	-6.1	6.5%	2.1	1.11
1.	20.1	19.9	3.1	8.5%	2.9	-0.05

Conclusions and Extensions

Conclusions

- Several hedge fund categories such as Long-Short Equity have significant positive exposure to correlation risk factor

Extensions

Conclusions and Extensions

Conclusions

- Several hedge fund categories such as Long-Short Equity have significant positive exposure to correlation risk factor
  - These funds are implicity selling insurance against unexpected increases in correlations

Extensions

Conclusions and Extensions

Conclusions

- Several hedge fund categories such as Long-Short Equity have significant positive exposure to correlation risk factor
    - These funds are implicity selling insurance against unexpected increases in correlations
    - These funds have higher maximum drawdown

Extensions

Conclusions and Extensions

Conclusions

- Several hedge fund categories such as Long-Short Equity have significant positive exposure to correlation risk factor
  - These funds are implicity selling insurance against unexpected increases in correlations
  - These funds have higher maximum drawdown
- Ignoring correlation risk exposure biases α performance measure

Extensions

Conclusions and Extensions

Conclusions

- Several hedge fund categories such as Long-Short Equity have significant positive exposure to correlation risk factor
  - These funds are implicity selling insurance against unexpected increases in correlations
  - These funds have higher maximum drawdown
- Ignoring correlation risk exposure biases α performance measure
- $\beta_{Correlation-Risk}$ important for HF risk management

Extensions

Conclusions and Extensions

Conclusions

- Several hedge fund categories such as Long-Short Equity have significant positive exposure to correlation risk factor
  - These funds are implicity selling insurance against unexpected increases in correlations
  - These funds have higher maximum drawdown
- Ignoring correlation risk exposure biases α performance measure
- $\beta_{Correlation-Risk}$ important for HF risk management
- Many funds, especially Event Driven category, have negative exposure to correlation risk factor, i.e. funds buy insurance against increases in correlation

Extensions

Conclusions and Extensions

Conclusions

- Several hedge fund categories such as Long-Short Equity have significant positive exposure to correlation risk factor
  - These funds are implicity selling insurance against unexpected increases in correlations
  - These funds have higher maximum drawdown
- Ignoring correlation risk exposure biases α performance measure
- $\beta_{Correlation-Risk}$ important for HF risk management
- Many funds, especially Event Driven category, have negative exposure to correlation risk factor, i.e. funds buy insurance against increases in correlation

Extensions

- Alternative Trading Strategies and Proxies for (Equity and Non-Equity) Correlation Risk

Conclusions and Extensions

Conclusions

- Several hedge fund categories such as Long-Short Equity have significant positive exposure to correlation risk factor
  - These funds are implicity selling insurance against unexpected increases in correlations
  - These funds have higher maximum drawdown
- Ignoring correlation risk exposure biases α performance measure
- $\beta_{Correlation-Risk}$ important for HF risk management
- Many funds, especially Event Driven category, have negative exposure to correlation risk factor, i.e. funds buy insurance against increases in correlation

Extensions

- Alternative Trading Strategies and Proxies for (Equity and Non-Equity) Correlation Risk
- Transaction Costs and Margin Calls