

Value at Risk, Stock Returns and the Role of Investor Sentiment

Jia Bi^{1,2}

Yifeng Zhu¹

CUFE¹ Tilburg Univ.²

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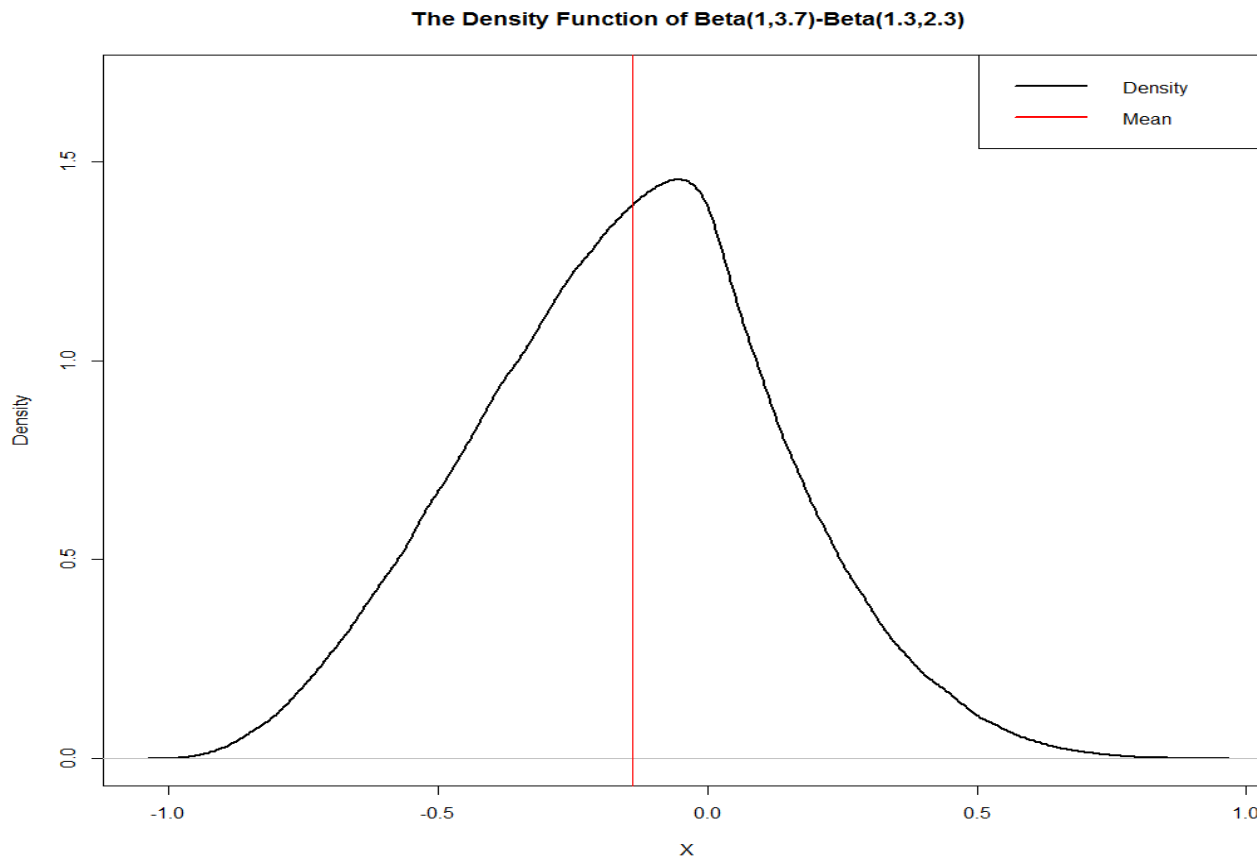
Emory University

Content

- 1. Background and Main Result
- 2. Data and Empirical Tests
- 3. Conclusion

Background

- Return distribution



Background

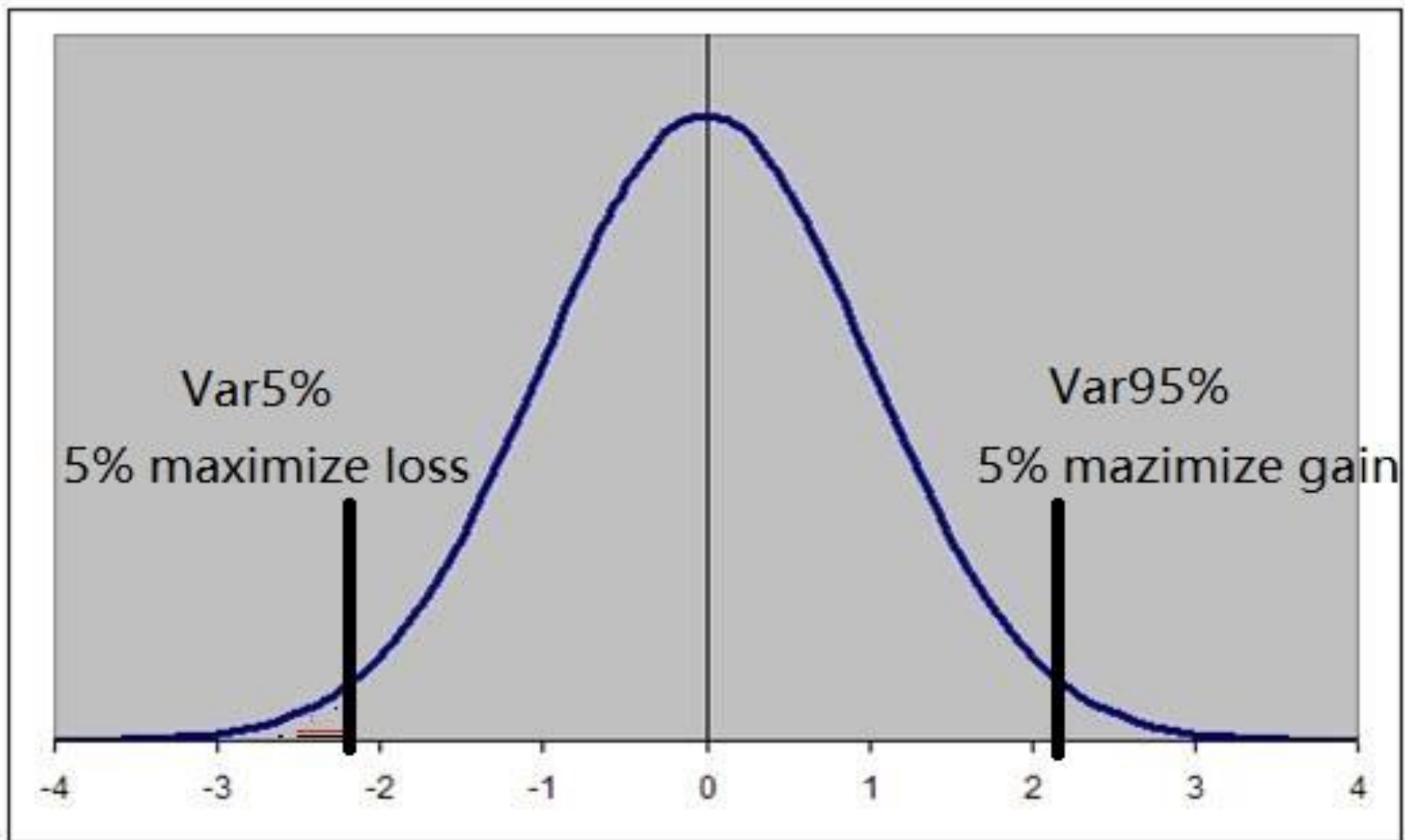
- Upside: right tail, lottery (Jiang, Wen, Zhou, and Zhu, 2019; Gui, Murray, and Zhu, 2019, Gui and Zhu, 2019)
- Downside: left tail, loss or risk (Bi and Zhu, 2019)
- Both: skewness or asymmetry (Jiang, Wu, Zhou, and Zhu, 2018; Han, Mo, Su, and Zhu, 2019)
- Systematic risk: left-tail beta, coskewness

Background

- How to measure the total risk to which the financial institution or a portfolio is exposed becomes more important in recent years.
- Value-at-risk (VaR) or expected shortfall (ES) provide a single number that summarizes the total risk.
- Whether this total risk measure being priced in the stock market?

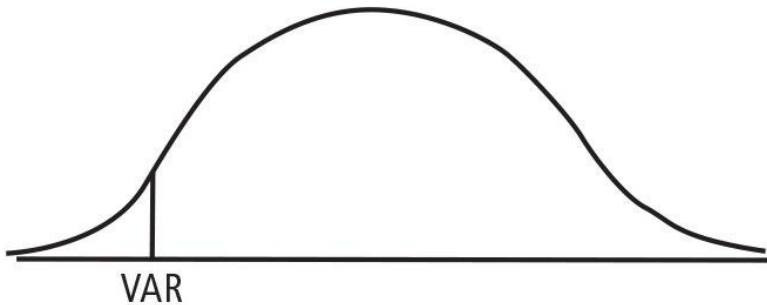
Background

- Value-at-risk (VaR)

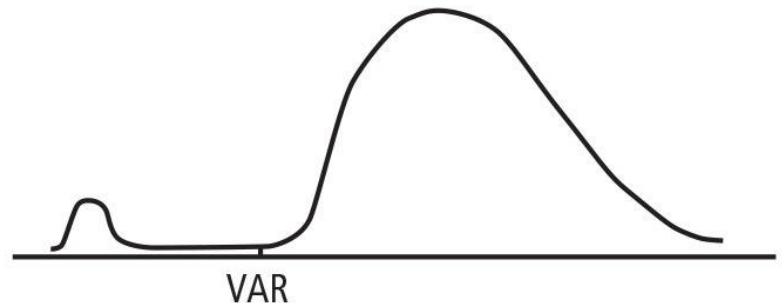


Background

1. Calculation of VAR from probability distribution of changes in portfolio value



2. Alternative situation to figure 1: VAR is the same, but the potential risk is higher



Literature

- Volatility and expected returns

Ang, Hodrick, Xing, and Zhang (2006, JF). The cross-section of volatility and expected returns.

- Value-at-risk and expected returns

Bali and Cakici (2004, FAJ). Value-at-risk and Stock Returns.

Atilgan, Bali, Demirtas, and Gunaydin (2018, JFE forthcoming). Left-tail momentum: underreaction to bad news, costly arbitrage and equity returns

- Sentiment

Baker and Wurgler (2006, JF), Huang, Jiang, Tu, and Zhou (2015, RFS),
Stambaugh, Yu, and Yuan (2012, JFE)

Research Questions

- Check the cross-section relationship between VaR and expected return in stock level at the US market? (Also examined by Atilgan, Bali, Demirtas, and Gunaydin, 2018)
- How the investor sentiment or CBOE Volatility Index (VIX) will affect

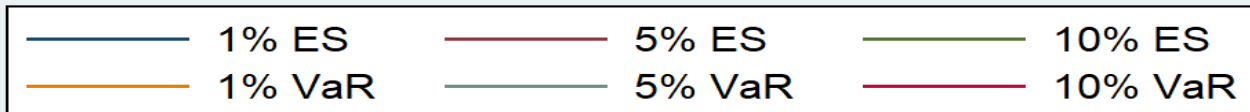
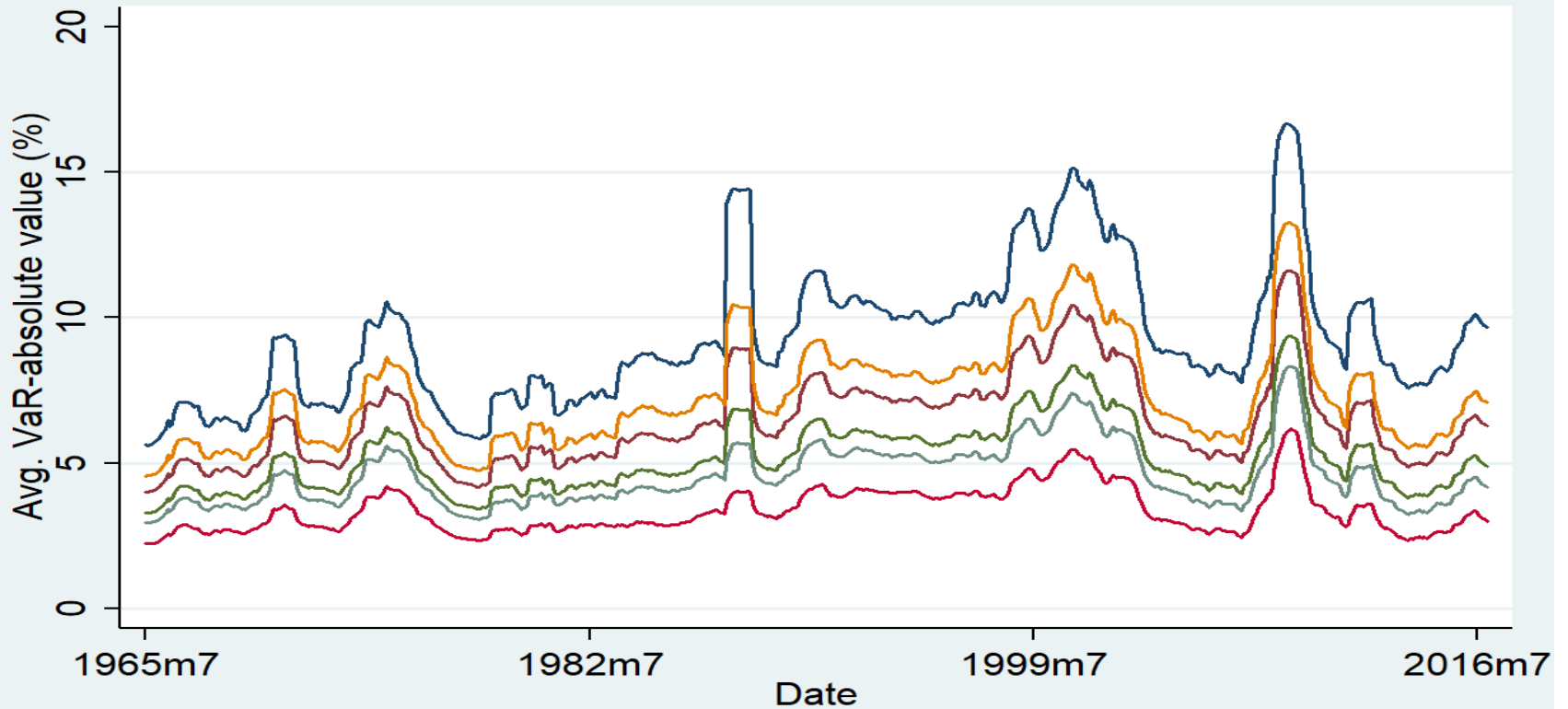
Main Results

- We confirm that the relationship between VaR and stock returns is negative, but it could be explained by the volatility.
- Under different level of investor sentiment, the relationship between the VaR and expected returns will also be diverse. It is negative for high-sentiment periods, but unclear for low-sentiment periods.

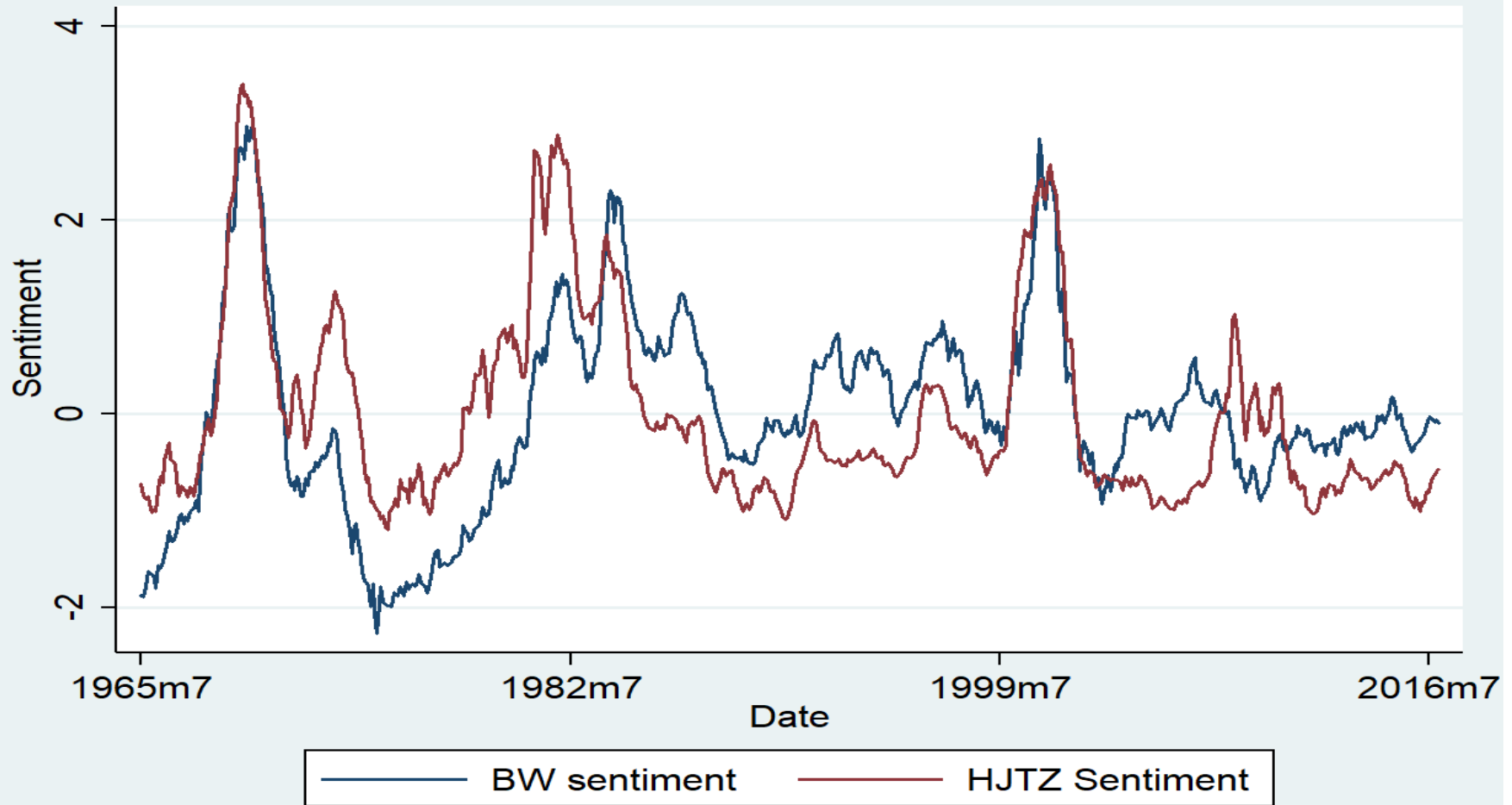
Explanation

- The result due to the disposition effect that investors tend to keep stocks with higher VaRs or in the capital loss region during a high-sentiment period.
- The disposition effect is caused by “prospect theory”, investors possess risk-seeking behavior when the wealth is below the reference point (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992)
- Atilgan et al. (2018) think investors underestimate the persistence in left-tail risk and overprice stocks with large recent losses.

VaR



BW-sentiment & HJTZ-sentiment



Data

- Center for Research in Securities Prices (CRSP) from July 1965 to December 2016 (July 1965 to December 2018 for some of the full sample analysis), including all common stocks listed on NYSE, AMEX and NASDAQ
- Value-at-risk (VaR) and expected shortfall (ES)
- calculated based on the current one year daily returns with the requirement of 200 non-missing observations, and updated every month.
- BW-Sentiment
- Available from Jeffrey Wurgler's website
- <http://people.stern.nyu.edu/jwurgler/>
- From July 1965 to September 2015
- (We extend the data to December 2016 due to Guofu Zhou's website)

Data

- Seven factor models
- (i) The FFCPS 5-factor model based on the following factors: market (MKT), size (SMB), book-to-market (HML), momentum (MOM), and liquidity risk (LIQ) factors of Fama and French (1993), Carhart (1997), and Pastor and Stambaugh (2003)
- (ii) The Fama-French 5-factor (FF5) model based on the five factors proposed in Fama and French (2015): market (MKT), size (SMB), book-to-market (HML), investment (CMA), and profitability (RMW)
- (iii) The Q-4 factor model based on Hou, Xue, and Zhang (2015), using market (MKT), size (SMB), investment ($R_{I/A}$), and profitability (R_{ROE})
- (iv) The FMAX-6 factor model based on the five factors inside the FFCPS-5 factor model together with the lottery demand factor (FMAX) proposed by Bali, Brown, Murray, and Tang (2017)
- (v) The M-4 factor model based on the mispricing factors MGMT and PEPF besides MKT and SMB following Stambaugh and Yuan (2017)
- (vi) The BF-3 factor model based on the long- and short-run behavioral factors FIN and PEAD besides MKT following Daniel, Hirshleifer, and Sun (2019)
- (vii) The T-4 factor model based on the tail-risk factor proposed by Kelly and Jiang (2014) besides the three Fama-French factors: MKT, SMB, and HML

Summary statistics and correlations

Panel A: summary statistics for decile portfolios of stocks sorted by 5% ES

Decile	5% ES (%)	5% VaR (%)	SIZE	BM	MOM	TURN	ILLIQ	BETA	MAX	IVOL
1(lowest)	2.751	1.971	6.824	-0.366	7.145	1.051	0.298	0.520	2.473	1.089
2	3.540	2.552	6.478	-0.478	7.146	1.268	0.311	0.711	3.240	1.409
3	4.164	2.998	6.038	-0.479	6.816	1.375	0.361	0.800	3.796	1.662
4	4.792	3.435	5.656	-0.491	6.211	1.472	0.436	0.874	4.367	1.924
5	5.481	3.924	5.303	-0.534	5.799	1.592	0.508	0.960	5.030	2.216
6	6.234	4.469	5.003	-0.584	5.132	1.698	0.598	1.057	5.735	2.534
7	7.097	5.083	4.768	-0.618	3.538	1.804	0.696	1.154	6.512	2.877
8	8.170	5.829	4.549	-0.642	1.387	1.904	0.866	1.240	7.447	3.284
9	9.486	6.744	4.274	-0.688	0.614	1.962	1.237	1.274	8.485	3.756
10(highest)	11.897	8.388	3.947	-0.779	6.434	2.038	2.206	1.283	9.887	4.323

Panel B: Correlations of different measures of VaRs and other stock characteristics

Decile	1% ES	5% ES	10% ES	1% VaR	5% VaR	10% VaR	SIZE	BM	MOM	IVOL
1% ES	1.000									
5% ES	0.937	1.000								
10% ES	0.894	0.990	1.000							
1% VaR	0.901	0.970	0.957	1.000						
5% VaR	0.792	0.943	0.975	0.904	1.000					
10% VaR	0.763	0.910	0.954	0.872	0.967	1.000				
SIZE	-0.400	-0.464	-0.476	-0.454	-0.471	-0.462	1.000			
BM	-0.101	-0.119	-0.120	-0.119	-0.121	-0.111	-0.218	1.000		
MOM	-0.040	-0.006	0.003	-0.000	0.022	0.013	0.011	-0.244	1.000	
IVOL	0.604	0.671	0.680	0.646	0.665	0.659	-0.402	-0.086	0.0187	1.000

2.2 Methodology

- Single and double sorting
- Fama and MacBeth (1973) regressions

$$ExR_{i,t+1} = b_{0,t} + b_{1,t}VaR_{i,t} + \varepsilon_{i,t+1}$$

$$ExR_{i,t+1} = b_{0,t} + b_{1,t}VaR_{i,t} + b_{2,t}X_{i,t} + \varepsilon_{i,t+1}$$

Panel A:		Value-weighted returns on 5% ES portfolios							
5% ES		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Excess	FFCPS	FF5	Q-4	FMAX-6	M-4	BF-3	T-4	
Portfolio	Return (%)	alpha (%)	alpha (%)	alpha (%)	alpha (%)	alpha (%)	alpha (%)	alpha (%)	alpha (%)
1(lowest)	0.521*** (3.50)	0.049 (0.74)	-0.035 (-0.55)	-0.065 (-0.97)	-0.121** (-2.21)	-0.111 (-1.61)	-0.178** (-2.48)	0.109* (1.65)	
2	0.605*** (3.39)	0.057 (0.88)	-0.069 (-1.26)	-0.084 (-1.35)	-0.104* (-1.92)	-0.125* (-1.90)	-0.111* (-1.68)	0.114* (1.78)	
3	0.665*** (3.31)	0.052 (0.86)	-0.002 (-0.04)	-0.035 (-0.59)	-0.026 (-0.45)	-0.035 (-0.55)	-0.050 (-0.79)	0.114* (1.89)	
4	0.544** (2.40)	-0.142* (-1.89)	-0.186** (-2.57)	-0.229*** (-3.02)	-0.160** (-2.10)	-0.181** (-2.27)	-0.101 (-1.26)	-0.092 (-1.25)	
5	0.683*** (2.66)	0.034 (0.40)	0.043 (0.50)	0.031 (0.35)	0.125 (1.47)	0.076 (0.84)	0.179* (1.95)	0.036 (0.42)	
6	0.549** (2.02)	-0.072 (-0.83)	-0.065 (-0.76)	-0.048 (-0.54)	0.053 (0.63)	0.018 (0.20)	0.175* (1.81)	-0.148* (-1.73)	
7	0.539* (1.78)	-0.045 (-0.41)	0.072 (0.69)	0.124 (1.14)	0.219** (2.34)	0.214* (1.90)	0.321*** (2.78)	-0.119 (-1.08)	
8	0.328 (1.00)	-0.236** (-1.98)	-0.168 (-1.44)	-0.084 (-0.70)	0.034 (0.33)	0.019 (0.16)	0.202 (1.50)	-0.364*** (-3.03)	
9	0.069 (0.19)	-0.552*** (-4.11)	-0.410*** (-3.24)	-0.379*** (-2.79)	-0.212* (-1.89)	-0.190 (-1.38)	0.022 (0.15)	-0.710*** (-5.29)	
10(highest)	-0.638 (-1.56)	-1.144*** (-6.51)	-1.027*** (-6.17)	-0.948*** (-5.29)	-0.720*** (-4.82)	-0.596*** (-3.40)	-0.336* (-1.69)	-1.435*** (-8.00)	
10-1 spread	-1.156*** (-3.29)	-1.192*** (-5.73)	-0.994*** (-5.17)	-0.882*** (-4.21)	-0.598*** (-3.72)	-0.485** (-2.36)	-0.156 (-0.67)	-1.544*** (-7.26)	

Panel B:		Equal-weighted returns on 5% ES portfolios							
5% ES		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Excess	FFCPS	FF5	Q-4	FMAX-6	M-4	BF-3	T-4	
Portfolio	Return (%)	alpha (%)	alpha (%)	alpha (%)	alpha (%)	alpha (%)	alpha (%)	alpha (%)	alpha (%)
1(lowest)	0.762*** (5.45)	0.232*** (3.30)	0.144** (2.16)	0.154** (2.00)	0.030 (0.56)	0.100 (1.31)	0.192** (2.47)	0.277*** (4.00)	
2	0.871*** (5.00)	0.242*** (3.80)	0.100* (1.84)	0.108 (1.54)	0.043 (0.94)	0.096 (1.40)	0.239*** (3.13)	0.260*** (4.18)	
3	0.844*** (4.41)	0.179*** (2.89)	0.016 (0.30)	0.024 (0.36)	0.010 (0.20)	0.037 (0.54)	0.248*** (2.98)	0.186*** (3.09)	
4	0.897*** (4.26)	0.197*** (3.14)	0.009 (0.16)	0.044 (0.61)	0.041 (0.77)	0.054 (0.79)	0.329*** (3.36)	0.174*** (2.80)	
5	0.893*** (3.94)	0.174*** (2.86)	-0.014 (-0.28)	0.027 (0.39)	0.056 (1.02)	0.045 (0.70)	0.382*** (3.57)	0.142** (2.35)	
6	0.851*** (3.51)	0.131** (2.23)	-0.024 (-0.44)	0.015 (0.23)	0.035 (0.63)	0.042 (0.65)	0.358*** (3.08)	0.080 (1.35)	
7	0.801*** (3.03)	0.091 (1.62)	-0.037 (-0.64)	0.017 (0.26)	0.064 (1.12)	0.057 (0.89)	0.445*** (3.46)	0.012 (0.20)	
8	0.587** (2.02)	-0.108* (-1.73)	-0.172*** (-2.65)	-0.118* (-1.74)	-0.063 (-1.01)	-0.051 (-0.72)	0.347** (2.46)	-0.217*** (-3.37)	
9	0.299 (0.93)	-0.367*** (-4.61)	-0.387*** (-4.74)	-0.281*** (-3.42)	-0.233*** (-3.11)	-0.178** (-2.07)	0.228 (1.46)	-0.545*** (-6.47)	
10(highest)	-0.435 (-1.22)	-1.027*** (-9.21)	-1.006*** (-9.14)	-0.883*** (-7.84)	-0.783*** (-7.94)	-0.682*** (-5.85)	-0.263 (-1.48)	-1.268*** (-10.80)	
10-1 spread	-1.193*** (-4.13)	-1.260*** (-8.24)	-1.151*** (-7.99)	-1.036*** (-6.67)	-0.814*** (-6.99)	-0.782*** (-4.90)	-0.453** (-2.41)	-1.546*** (-9.79)	

Decile portfolios for 5% ES (value-weighted)

Panel A: 5% ES	High-sentiment periods (the BW sentiment index is higher than its mean)			
	(1)	(2)	(3)	(4)
Portfolio	Excess Return (%)	FFCPS alpha (%)	FF5 alpha (%)	Q-4 alpha (%)
1(lowest)	0.533** (2.46)	0.000 (0.00)	-0.125 (-1.35)	-0.157 (-1.61)
2	0.578** (2.31)	0.055 (0.55)	-0.130 (-1.51)	-0.138 (-1.44)
3	0.558** (1.98)	0.049 (0.54)	-0.101 (-1.20)	-0.083 (-0.91)
4	0.405 (1.30)	-0.110 (-1.01)	-0.233** (-2.23)	-0.194* (-1.70)
5	0.399 (1.12)	0.046 (0.36)	0.034 (0.26)	0.100 (0.76)
6	0.126 (0.33)	-0.111 (-0.83)	-0.157 (-1.17)	-0.072 (-0.52)
7	-0.119 (-0.27)	-0.123 (-0.78)	0.001 (0.01)	0.157 (1.02)
8	-0.386 (-0.80)	-0.324* (-1.81)	-0.224 (-1.27)	-0.061 (-0.34)
9	-0.633 (-1.20)	-0.488** (-2.47)	-0.298 (-1.58)	-0.172 (-0.90)
10(highest)	-1.744*** (-2.99)	-1.336*** (-5.52)	-1.200*** (-5.04)	-1.112*** (-4.41)
10-1 spread	-2.277*** (-4.39)	-1.336*** (-4.72)	-1.075*** (-3.99)	-0.954*** (-3.32)

Decile portfolios for 5% ES (value-weighted)

Panel B: 5% ES	Low-sentiment periods (the BW sentiment index is less than its mean)			
	(1)	(2)	(3)	(4)
Portfolio	Excess Return (%)	FFCPS alpha (%)	FF5 alpha (%)	Q-4 alpha (%)
1(lowest)	0.417** (2.34)	0.024 (0.31)	-0.024 (-0.35)	-0.002 (-0.03)
2	0.539** (2.46)	0.005 (0.08)	-0.047 (-0.79)	-0.066 (-0.98)
3	0.666*** (2.72)	0.011 (0.16)	0.034 (0.53)	-0.024 (-0.37)
4	0.631** (2.21)	-0.198** (-2.21)	-0.132 (-1.59)	-0.253*** (-2.86)
5	0.854*** (2.68)	-0.009 (-0.09)	0.041 (0.43)	-0.036 (-0.35)
6	0.879** (2.58)	-0.111 (-1.07)	0.004 (0.04)	-0.036 (-0.34)
7	1.039*** (2.83)	-0.044 (-0.35)	0.102 (0.86)	0.059 (0.46)
8	0.974** (2.50)	-0.145 (-1.07)	-0.048 (-0.36)	-0.079 (-0.58)
9	0.797* (1.81)	-0.532*** (-3.38)	-0.323** (-2.18)	-0.465*** (-2.95)
10(highest)	0.351 (0.71)	-0.865*** (-4.04)	-0.810*** (-4.19)	-0.764*** (-3.60)
10-1 spread	-0.061 (-0.15)	-0.889*** (-3.51)	-0.787*** (-3.50)	-0.761*** (-3.04)

2.3 Full sample

	(1)	(2)	(3)	(4)	(5)
5% ES	-0.1329*** (-3.24)	-0.0261 (-0.67)	-0.2553*** (-11.76)	-0.2277*** (-10.48)	-0.2374*** (-10.85)
SIZE			-0.2890*** (-7.25)	-0.2942*** (-7.40)	-0.2935*** (-7.39)
BM			0.1758*** (3.22)	0.1774*** (3.26)	0.1756*** (3.22)
MOM			0.0069*** (4.90)	0.0071*** (5.07)	0.0070*** (5.01)
TURN			-0.0008 (-0.02)	0.0212 (0.60)	0.0119 (0.33)
ILLIQ			0.0355* (1.80)	0.0470** (2.24)	0.0416** (2.03)
BETA			1.0519*** (4.99)	1.0627*** (4.94)	1.0535*** (5.03)
MAX			-0.0857*** (-11.21)	-0.0436*** (-4.04)	-0.0586*** (-5.48)
VOL		-0.2242*** (-9.57)		-0.1976*** (-5.10)	
IVOL					-0.1269*** (-3.74)
Constant	1.3641*** (8.19)	1.3613*** (8.15)	3.0217*** (9.95)	3.0742*** (10.12)	3.0599*** (10.10)
R-squared	0.031	0.034	0.087	0.088	0.088

High-sentiment

Panel A:					
5% ES	High-sentiment periods (the BW sentiment index is larger than its mean)				
	(1)	(2)	(3)	(4)	(5)
5% ES	-0.2878*** (-5.30)	-0.1479*** (-2.93)	-0.2835*** (-9.57)	-0.2419*** (-8.54)	-0.2489*** (-8.84)
SIZE			-0.2591*** (-5.23)	-0.2712*** (-5.56)	-0.2726*** (-5.60)
BM			0.3396*** (5.12)	0.3355*** (5.16)	0.3329*** (5.10)
MOM			0.0098*** (5.23)	0.0100*** (5.38)	0.0099*** (5.35)
TURN			0.0378 (0.88)	0.0607 (1.42)	0.0530 (1.25)
ILLIQ			0.0412* (1.78)	0.0541** (2.31)	0.0500** (2.17)
BETA			0.9121*** (3.58)	0.8352*** (3.13)	0.7994*** (2.99)
COSKEW				-0.6647* (-1.71)	-0.6539* (-1.69)
MAX			-0.0983*** (-12.30)	-0.0490*** (-3.83)	-0.0602*** (-4.97)
VOL		-0.2864*** (-8.74)		-0.2228*** (-4.61)	
IVOL					-0.1720*** (-4.08)
Constant	1.9580*** (7.60)	1.9510*** (7.64)	3.2993*** (8.71)	3.2637*** (8.73)	3.2723*** (8.76)
R-squared	0.034	0.037	0.086	0.094	0.093

Low-sentiment

Panel B:					
5% ES	Low-sentiment periods (the BW sentiment index is less than its mean)				
	(1)	(2)	(3)	(4)	(5)
5% ES	-0.0087 (-0.17)	0.0778 (1.64)	-0.2417*** (-9.22)	-0.2164*** (-8.24)	-0.2255*** (-8.64)
SIZE			-0.3359*** (-7.82)	-0.3385*** (-8.17)	-0.3357*** (-8.14)
BM			0.0797 (1.25)	0.0936 (1.48)	0.0925 (1.47)
MOM			0.0046** (2.46)	0.0051*** (2.73)	0.0050*** (2.69)
TURN			-0.0239 (-0.53)	-0.0116 (-0.27)	-0.0202 (-0.46)
ILLIQ			0.0316 (1.64)	0.0498** (2.40)	0.0440** (2.13)
BETA			1.2099*** (4.81)	1.1528*** (4.48)	1.1684*** (4.56)
COSKEW				-0.8151* (-1.83)	-0.8299* (-1.87)
MAX			-0.0822*** (-10.26)	-0.0456*** (-3.87)	-0.0605*** (-4.93)
VOL		-0.1883*** (-6.05)		-0.1687*** (-3.66)	
IVOL					-0.0967** (-2.26)
Constant	0.9272*** (5.22)	0.9293*** (5.24)	3.0190*** (9.44)	3.0057*** (9.79)	2.9670*** (9.71)
R-squared	0.029	0.032	0.089	0.098	0.098

Low-VIX

Panel A:					
5% ES	Low-VIX periods (VIX is less than its mean)				
	(1)	(2)	(3)	(4)	(5)
5% ES	-0.1696*** (-4.11)	-0.1061*** (-2.68)	-0.2005*** (-7.04)	-0.1504*** (-5.07)	-0.1669*** (-5.74)
SIZE			-0.1446*** (-3.95)	-0.1553*** (-4.25)	-0.1536*** (-4.19)
BM			0.1059 (1.60)	0.1070 (1.63)	0.1043 (1.58)
MOM			0.0078*** (4.91)	0.0081*** (5.13)	0.0079*** (5.00)
TURN			-0.0304 (-0.77)	0.0038 (0.10)	-0.0085 (-0.22)
ILLIQ			0.0155** (2.26)	0.0239*** (3.35)	0.0217*** (3.07)
BETA			0.4170* (1.89)	0.4399** (1.99)	0.4105* (1.86)
MAX			-0.0210*** (-2.77)	0.0447*** (3.78)	0.0230** (2.03)
VOL		-0.1471*** (-5.07)		-0.3128*** (-6.29)	
IVOL					-0.2092*** (-4.68)
Constant	1.6275*** (9.25)	1.6418*** (9.33)	2.4400*** (7.15)	2.5172*** (7.39)	2.5087*** (7.35)
R-squared	0.017	0.020	0.056	0.057	0.057

High-VIX

Panel B:					
5% ES	High-VIX periods (VIX is larger than its mean)				
	(6)	(6)	(6)	(6)	(6)
5% ES	-0.0781 (-0.94)	0.0078 (0.11)	-0.1462*** (-3.48)	-0.1431*** (-3.33)	-0.1415*** (-3.48)
SIZE			-0.2993*** (-4.08)	-0.3053*** (-4.16)	-0.3019*** (-4.14)
BM			0.2084** (2.27)	0.2046** (2.24)	0.2057** (2.25)
MOM			0.0005 (0.17)	0.0007 (0.23)	0.0007 (0.23)
TURN			0.2093*** (2.97)	0.2153*** (3.09)	0.2119*** (3.08)
ILLIQ			-0.0276** (-2.26)	-0.0267** (-2.11)	-0.0260** (-2.11)
BETA			1.2077** (2.39)	1.1969** (2.36)	1.2353** (2.44)
MAX			-0.0769*** (-7.10)	-0.0679*** (-4.37)	-0.0684*** (-4.22)
VOL		-0.1591*** (-3.06)		-0.0461 (-0.71)	
IVOL					-0.0463 (-0.87)
Constant	1.3446*** (3.29)	1.2940*** (3.21)	3.0258*** (5.78)	3.0794*** (5.90)	3.0360*** (5.82)
R-squared	0.041	0.046	0.107	0.109	0.108

Double-Sorted Portfolio Returns by Momentum and 5% ES

Panel A: 5% ES	High-sentiment periods (the BW sentiment index is higher than its mean)					
	Excess Return			FFCPS 5-factor Alpha		
	V1	V5	V5-V1	V1	V5	V5-V1
MOM1	0.196 (0.57)	-1.750*** (-3.01)	-2.011*** (-4.86)	0.253 (1.44)	-1.151*** (-4.27)	-1.425*** (-4.25)
MOM2	0.615** (2.38)	-0.894* (-1.74)	-1.509*** (-3.64)	0.299** (2.05)	-0.557** (-2.33)	-0.856*** (-2.92)
MOM3	0.694*** (3.02)	-0.576 (-1.16)	-1.270*** (-3.11)	0.293** (2.33)	-0.578** (-2.30)	-0.871*** (-2.94)
MOM4	0.394 (1.61)	-0.435 (-0.93)	-0.829** (-2.15)	-0.222* (-1.84)	-0.577*** (-2.69)	-0.355 (-1.36)
MOM5	0.608** (2.10)	-0.500 (-0.87)	-1.108** (-2.49)	-0.180 (-1.20)	-0.765*** (-2.72)	-0.586* (-1.76)
Avg(M1-M5)	0.501** (2.14)	-0.843* (-1.73)	-1.345*** (-3.78)	0.089 (1.16)	-0.742*** (-4.43)	-0.830*** (-4.09)
Panel B: 5% ES	Low-sentiment periods (the BW sentiment index is less than its mean)					
	Excess Return			FFCPS 5-factor Alpha		
	V1	V5	V5-V1	V1	V5	V5-V1
MOM1	0.742** (2.49)	-0.004 (-0.01)	-0.746** (-2.27)	0.464*** (3.07)	-1.038*** (-4.50)	-1.502*** (-5.53)
MOM2	0.609*** (2.71)	0.854** (1.99)	0.245 (0.80)	0.332*** (3.05)	-0.248 (-1.33)	-0.580*** (-2.62)
MOM3	0.502** (2.45)	0.861** (2.08)	0.359 (1.11)	0.146 (1.36)	-0.288 (-1.46)	-0.434* (-1.79)
MOM4	0.435** (2.05)	0.419 (1.03)	-0.016 (-0.05)	-0.167 (-1.64)	-0.882*** (-4.81)	-0.715*** (-3.18)
MOM5	0.733*** (2.84)	0.948* (1.89)	0.218 (0.61)	-0.135 (-1.08)	-0.824*** (-2.99)	-0.678** (-2.25)
Avg(M1-M5)	0.604*** (2.89)	0.615 (1.47)	0.010 (0.04)	0.128** (2.23)	-0.654*** (-4.62)	-0.782*** (-4.62)

Double-Sorted Portfolio Returns by Short Term Reversal and 5% ES

Panel A: 5% ES	High-sentiment periods (the BW sentiment index is higher than its mean)					
	Excess Return			FFCPS 5-factor Alpha		
	V1	V5	V5-V1	V1	V5	V5-V1
REV1	0.757** (2.31)	-1.262** (-2.04)	-2.050*** (-4.46)	0.400** (2.18)	-0.924*** (-2.97)	-1.328*** (-3.89)
REV2	0.771*** (3.03)	-0.743 (-1.31)	-1.514*** (-3.18)	0.276** (2.00)	-0.579** (-2.17)	-0.855*** (-2.64)
REV3	0.733*** (3.16)	-0.252 (-0.48)	-0.986** (-2.17)	0.209* (1.77)	-0.174 (-0.72)	-0.383 (-1.35)
REV4	0.347 (1.51)	-0.799 (-1.64)	-1.146*** (-2.76)	-0.110 (-0.94)	-0.658*** (-3.02)	-0.548** (-2.11)
REV5	0.106 (0.42)	-1.674*** (-3.21)	-1.779*** (-4.35)	-0.461*** (-3.25)	-1.625*** (-6.20)	-1.164*** (-4.08)
Avg(R1-R5)	0.543** (2.35)	-0.939* (-1.82)	-1.482*** (-3.73)	0.063 (0.90)	-0.795*** (-4.51)	-0.857*** (-4.04)
Panel B: 5% ES	Low-sentiment periods (the BW sentiment index is less than its mean)					
	Excess Return			FFCPS 5-factor Alpha		
	V1	V5	V5-V1	V1	V5	V5-V1
REV1	0.745*** (2.67)	0.500 (0.99)	-0.246 (-0.74)	0.112 (0.78)	-0.780*** (-3.39)	-0.891*** (-3.52)
REV2	0.505** (2.36)	0.915** (2.02)	0.410 (1.20)	0.060 (0.53)	-0.326* (-1.75)	-0.386* (-1.69)
REV3	0.370* (1.84)	0.838* (1.97)	0.468 (1.42)	-0.052 (-0.49)	-0.225 (-1.16)	-0.172 (-0.72)
REV4	0.495** (2.53)	0.836* (1.96)	0.341 (1.02)	0.087 (0.89)	-0.246 (-1.24)	-0.333 (-1.40)
REV5	0.376* (1.66)	0.299 (0.65)	-0.077 (-0.22)	-0.210* (-1.84)	-0.877*** (-3.51)	-0.667** (-2.45)
Avg(R1-R5)	0.498** (2.47)	0.678 (1.58)	0.179 (0.61)	-0.001 (-0.01)	-0.491*** (-3.41)	-0.490*** (-2.78)

Double-Sorted Portfolio Returns by Volatility and 5% ES

Panel A: 5% ES	High-sentiment periods (the BW sentiment index is higher than its mean)					
	Excess Return			FFCPS 5-factor Alpha		
	V1	V5	V5-V1	V1	V5	V5-V1
VOL1	0.571*** (2.72)	0.584* (1.88)	0.013 (0.06)	-0.034 (-0.26)	0.045 (0.24)	0.079 (0.37)
VOL2	0.699*** (2.78)	0.440 (1.11)	-0.258 (-0.93)	0.263** (2.05)	-0.083 (-0.38)	-0.346 (-1.42)
VOL3	0.541* (1.89)	0.155 (0.33)	-0.386 (-1.14)	-0.070 (-0.53)	0.133 (0.56)	0.063 (0.23)
VOL4	0.341 (0.98)	-0.482 (-0.86)	-0.823*** (-2.15)	-0.033 (-0.19)	-0.259 (-1.00)	-0.227 (-0.72)
VOL5	-0.192 (-0.45)	-1.900*** (-3.15)	-1.928*** (-4.97)	-0.143 (-0.64)	-1.667*** (-5.38)	-1.406*** (-3.89)
Avg(VOL1-VOL5)	0.392 (1.49)	-0.249 (-0.59)	-0.641*** (-2.66)	0.025 (0.33)	-0.419*** (-2.75)	-0.444** (-2.53)
Panel B: 5% ES	Low-sentiment periods (the BW sentiment index is less than its mean)					
	Excess Return			FFCPS 5-factor Alpha		
	V1	V5	V5-V1	V1	V5	V5-V1
VOL1	0.362** (2.08)	0.729*** (2.62)	0.367* (1.75)	0.104 (0.89)	0.062 (0.42)	-0.042 (-0.23)
VOL2	0.513** (2.43)	0.797** (2.36)	0.284 (1.26)	0.034 (0.37)	-0.066 (-0.40)	-0.099 (-0.49)
VOL3	0.779*** (3.02)	1.023*** (2.53)	0.244 (0.92)	0.112 (1.10)	-0.112 (-0.56)	-0.225 (-0.98)
VOL4	0.864*** (2.72)	1.144** (2.42)	0.280 (0.93)	0.032 (0.20)	-0.124 (-0.61)	-0.156 (-0.60)
VOL5	0.787** (2.21)	-0.045 (-0.08)	-0.774** (-2.41)	-0.234 (-1.27)	-1.354*** (-4.84)	-1.123*** (-3.77)
Avg(VOL1-VOL5)	0.661*** (2.78)	0.748** (2.00)	0.086 (0.43)	0.010 (0.15)	-0.312*** (-2.74)	-0.322** (-2.32)

Double-Sorted Portfolio Returns by Financial Distress and 5% ES

Panel A: P_CHS	High-sentiment periods (the BW sentiment index is higher than its mean)					
	Excess Return			FFCPS 5-factor Alpha		
	V1	V5	V5-V1	V1	V5	V5-V1
P_CHS1	0.674** (2.49)	-0.089 (-0.16)	-0.763 (-1.54)	0.168 (0.94)	-0.133 (-0.45)	-0.301 (-0.84)
P_CHS2	0.620** (2.40)	0.011 (0.02)	-0.609 (-1.07)	-0.093 (-0.66)	0.052 (0.16)	0.145 (0.40)
P_CHS3	0.653** (2.59)	-0.545 (-0.89)	-1.198** (-2.24)	0.092 (0.58)	-0.442 (-1.44)	-0.534 (-1.55)
P_CHS4	0.667** (2.26)	-1.188* (-1.82)	-1.854*** (-3.25)	0.169 (0.87)	-0.689** (-2.05)	-0.858** (-2.02)
P_CHS5	-0.108 (-0.26)	-1.529** (-2.33)	-1.599*** (-3.25)	-0.554** (-2.19)	-1.555*** (-4.44)	-1.074** (-2.52)
Avg(P1-P5)	0.501** (2.02)	-0.727 (-1.24)	-1.228*** (-2.65)	-0.043 (-0.49)	-0.592** (-2.58)	-0.549** (-2.10)
Panel B: P_CHS	Low-sentiment periods (the BW sentiment index is less than its mean)					
	Excess Return			FFCPS 5-factor Alpha		
	V1	V5	V5-V1	V1	V5	V5-V1
P_CHS1	0.641*** (2.70)	1.658*** (3.26)	1.017** (2.56)	-0.047 (-0.40)	-0.053 (-0.20)	-0.005 (-0.02)
P_CHS2	0.811*** (3.26)	1.243** (2.49)	0.431 (1.11)	0.040 (0.34)	-0.375 (-1.40)	-0.415 (-1.30)
P_CHS3	0.784*** (3.12)	1.935*** (3.60)	1.151*** (2.62)	0.186 (1.14)	0.099 (0.38)	-0.087 (-0.27)
P_CHS4	0.631** (2.09)	1.309** (2.23)	0.678 (1.37)	0.052 (0.28)	-0.546* (-1.74)	-0.597 (-1.56)
P_CHS5	1.010** (2.50)	0.643 (1.05)	-0.285 (-0.66)	-0.147 (-0.75)	-1.135*** (-3.14)	-0.993** (-2.44)
Avg(P1-P5)	0.775*** (3.05)	1.379*** (2.74)	0.604* (1.71)	0.017 (0.18)	-0.391** (-1.99)	-0.408* (-1.70)

Double-Sorted Portfolio Returns by Financial Distress and 5% ES

Panel C:						
O_SCORE	High-sentiment periods (the BW sentiment index is higher than its mean)					
	Excess Return			FFCPS 5-factor Alpha		
	V1	V5	V5-V1	V1	V5	V5-V1
O_SCORE1	0.588** (2.07)	-0.604 (-0.91)	-1.191** (-2.14)	0.154 (1.08)	-0.142 (-0.42)	-0.296 (-0.74)
O_SCORE2	0.672** (2.51)	-1.026 (-1.63)	-1.698*** (-3.05)	0.017 (0.11)	-0.643** (-2.10)	-0.660* (-1.87)
O_SCORE3	0.533** (2.27)	-1.684** (-2.57)	-2.217*** (-3.73)	-0.129 (-0.79)	-1.439*** (-4.38)	-1.310*** (-3.72)
O_SCORE4	0.696*** (2.93)	-1.435** (-2.29)	-2.131*** (-3.52)	-0.102 (-0.55)	-1.383*** (-4.66)	-1.281*** (-3.68)
O_SCORE5	0.706*** (2.84)	-1.783*** (-3.29)	-2.489*** (-5.16)	-0.152 (-0.90)	-2.145*** (-7.35)	-1.993*** (-5.67)
Avg(O1-O5)	0.639*** (2.90)	-1.306** (-2.23)	-1.945*** (-3.87)	-0.042 (-0.42)	-1.150*** (-5.40)	-1.108*** (-4.51)
Panel D:						
O_SCORE	Low-sentiment periods (the BW sentiment index is less than its mean)					
	Excess Return			FFCPS 5-factor Alpha		
	V1	V5	V5-V1	V1	V5	V5-V1
O_SCORE1	0.821*** (3.23)	1.456*** (2.68)	0.635 (1.59)	0.042 (0.41)	-0.283 (-1.02)	-0.325 (-1.07)
O_SCORE2	0.777*** (2.88)	1.822*** (3.33)	1.045** (2.54)	0.011 (0.08)	0.009 (0.03)	-0.002 (-0.01)
O_SCORE3	0.687*** (2.91)	1.235** (2.21)	0.547 (1.16)	0.146 (0.96)	-0.651** (-2.58)	-0.797** (-2.47)
O_SCORE4	0.813*** (3.56)	1.234** (2.17)	0.422 (0.84)	0.348** (2.10)	-0.622** (-2.19)	-0.970*** (-2.80)
O_SCORE5	0.898*** (3.34)	0.723 (1.31)	-0.149 (-0.34)	0.354** (2.03)	-0.988*** (-3.68)	-1.341*** (-4.25)
Avg(O1-O5)	0.799*** (3.59)	1.297** (2.51)	0.497 (1.28)	0.180* (1.84)	-0.505*** (-2.79)	-0.686*** (-2.92)

Double-Sorted Portfolio Returns by Institutional Ownership Ratio and 5% ES

Panel A: 5% ES	High-sentiment periods (the BW sentiment index is higher than its mean)					
	Excess Return			FFCPS 5-factor Alpha		
	V1	V5	V5-V1	V1	V5	V5-V1
IOR1	0.479** (1.99)	-1.743*** (-2.81)	-2.222*** (-3.97)	-0.203 (-1.30)	-1.590*** (-4.50)	-1.387*** (-3.45)
IOR2	0.666*** (2.80)	-1.396** (-2.36)	-2.062*** (-3.78)	-0.055 (-0.34)	-1.347*** (-4.74)	-1.292*** (-3.83)
IOR3	0.616*** (2.61)	-0.946 (-1.54)	-1.562*** (-2.77)	0.045 (0.33)	-0.783*** (-2.70)	-0.829** (-2.55)
IOR4	0.719*** (2.84)	-0.580 (-0.98)	-1.299** (-2.56)	0.124 (1.06)	-0.291 (-1.14)	-0.415 (-1.35)
IOR5	0.759*** (2.77)	-0.546 (-0.95)	-1.305*** (-2.76)	0.038 (0.27)	-0.570** (-2.12)	-0.607* (-1.91)
DIFF			0.917*** (2.43)			0.780* (1.90)
Panel B: 5% ES	Low-sentiment periods (the BW sentiment index is less than its mean)					
	Excess Return			FFCPS 5-factor Alpha		
	V1	V5	V5-V1	V1	V5	V5-V1
IOR1	0.590** (2.53)	0.237 (0.39)	-0.354 (-0.68)	0.142 (0.81)	-1.278*** (-3.70)	-1.420*** (-3.69)
IOR2	0.611** (2.49)	0.637 (0.93)	0.026 (0.04)	0.093 (0.55)	-1.082*** (-2.91)	-1.175*** (-2.65)
IOR3	0.701*** (2.94)	1.003* (1.69)	0.302 (0.63)	0.154 (1.20)	-0.579** (-2.29)	-0.733** (-2.44)
IOR4	0.821*** (3.18)	1.107* (1.96)	0.286 (0.70)	0.110 (0.97)	-0.458** (-2.05)	-0.568** (-2.06)
IOR5	0.883*** (3.14)	1.187** (2.06)	0.303 (0.77)	0.089 (0.75)	-0.415** (-2.00)	-0.504* (-1.87)
DIFF			0.657 (1.63)			0.916** (2.23)

3. Conclusion

- We explore a new way to detect the relationship between risk and stock returns under different kind of investor sentiments by applying the VaR to present the risk.
- For a high sentiment period, VaR is negatively related with the expected return and cannot be explained by momentum, short-term reversal, volatility, and financial distress.
- The negative relationship holds when the CBOE Volatility Index (VIX) is low.

- Thank you