The Cross-Section of Volatility and Expected Returns

Ang, Hodrick, Xing and Zhang (2006,JF)

Authors

Andrew Ang
Columbia

Robert J. Hodrick
Columbia

Yuhang Xing
Rice

Xiaoyan Zhang
Purdue

Theoretically,

High Risk ⇒ Return

Empirically,

High Risk ⇒ Low Return?

The Cross-Section of Volatility and Expected Returns

ANDREW ANG, ROBERT J. HODRICK, YUHANG XING, and XIAOYAN ZHANG*

ABSTRACT

We examine the pricing of aggregate volatility risk in the cross-section of stock returns. Consistent with theory, we find that stocks with high sensitivities to innovations in aggregate volatility have low average returns. Stocks with high idiosyncratic volatility relative to the Fama and French (1993, *Journal of Financial Economics* 25, 2349) model have abysmally low average returns. This phenomenon cannot be explained by exposure to aggregate volatility risk. Size, book-to-market, momentum, and liquidity effects cannot account for either the low average returns earned by stocks with high exposure to systematic volatility risk or for the low average returns of stocks with high idiosyncratic volatility.

Abstract

1. Pricing of Volatility Risk in Cross-Section of Stock Returns
2. High Sensitivity to Innovation in Volatility ⇒ Low Average Return
3. High Idiosyncratic Volatility ⇒ Abysmally Low Average Return
4. Exposure to Aggregate Volatility Risk ⇒ Cannot Explain
5. Size, B/M, Momentum and Liquidity Effects ⇒ Cannot Explain

Contents

I. Pricing Systematic Volatility in the Cross-Section

Theoretically,

If volatility change determines stock return,

$$r_{t+1}^{i} = a_{t}^{i} + \beta_{m,t}^{i}\left(r_{t+1}^{m} - \gamma_{m,t}\right) + \beta_{v,t}^{i}(v_{t+1} - \gamma_{v,t}) + \sum_{k=1}^{K} \beta_{k,t}^{i}(f_{k,t+1} - \gamma_{k,t})$$

the degree of sensitivity should be priced.

$$a_{t}^{i} = E_{t}\left(r_{t+1}^{i}\right) = \beta_{m,t}^{i}\lambda_{m,t} + \beta_{v,t}^{i}\lambda_{v,t} + \sum_{k=1}^{K} \beta_{k,t}^{i}\lambda_{k,t}$$

Volatility Sensitivity ↑ ⇒ Expected Return ↓ (∵ λ<0)

Intuitively, suppose that

∃Stock A: High σ-Sensitive Stock
(Market Volatility ↑ ⇒ Return_A ↑)

vs.

∃Stock B: High σ-Sensitive Stock
(Market Volatility ↑ ⇒ Return_B ↓)

What is your choice?

Why High Exposure to σ=Low Return?

1. Campbell (1993, 1996), Chen (2002): Opportunity Preserving
   - Investors Want to Hedge against $\Delta\sigma_{MKT}$,
   - $\because \sigma_{MKT} \uparrow \Rightarrow$ Investment Opportunity $\downarrow$

2. Bakshi and Kapadia (2003): Hedge Market Downside Risk
   - Periods of High Volatility $\Leftrightarrow$ Downward Market Movements
   - $\beta_{\text{Market Volatility}} \uparrow \Rightarrow$ Hedges against Market Downside Risk

3. Harvey and Siddique (2000): Skewness Preference
   - Do Badly in High σ $\Rightarrow$ (−) Skewed Returns
   - Do Well in Low σ $\Rightarrow$ (+) Skewed Returns
   - $\therefore$ Investors Prefer Coskewness $\Rightarrow$ Also Prefer High $\beta_{\text{Market Volatility}}$

Table I
Portfolios Sorted by Exposure to Aggregate Volatility Shocks

								Factor Loadings			
Rank	Mean	Std. Dev.	% Mkt Share	Size	B/M	CAPM Alpha	FF-3 Alpha	Pre-Formation $\beta_{\Delta VIX}$	Pre-Formation β_{FVIX}	Next Month Post-Formation $\beta_{\Delta VIX}$	Full Sample Post-Formation β_{FVIX}
1	1.64	5.53	9.4%	3.70	0.89	0.27	0.30	−2.09	−2.00	−0.033	−5.06
						[1.66]	[1.77]				[−4.06]
2	1.39	4.43	28.7%	4.77	0.73	0.18	0.09	−0.46	−0.42	−0.014	−2.72
						[1.82]	[1.18]				[−2.64]
3	1.36	4.40	30.4%	4.77	0.76	0.13	0.08	0.03	0.08	0.005	−1.55
						[1.32]	[1.00]				[−2.86]
4	1.21	4.79	24.0%	4.76	0.73	−0.08	−0.06	0.54	0.62	0.015	3.62
						[−0.87]	[−0.65]				[4.53]
5	0.60	6.55	7.4%	3.73	0.89	−0.88	−0.53	2.18	2.31	0.018	8.07
						[−3.42]	[−2.88]				[5.32]
5-1	−1.04					−1.15	−0.83				
	[−3.90]					[−3.54]	[−2.93]				
Joint test p-value						0.01	0.03				0.00

To Form the Portfolios,

$$r_t^i = \beta_0 + \beta_{MKT}^i MKT_t + \beta_{\Delta VIX}^i \Delta VIX_t + \varepsilon_t^i$$

But, This is not a Factor.

Therefore,

$$r_t^i = \alpha^i + \beta_{MKT}^i MKT_t + \beta_{FVIX}^i FVIX_t + \varepsilon_t^i$$

Table I
Portfolios Sorted by Exposure to Aggregate Volatility Shocks

								Factor Loadings			
Rank	Mean	Std. Dev.	% Mkt Share	Size	B/M	CAPM Alpha	FF-3 Alpha	Pre-Formation $\beta_{\Delta VIX}$	Pre-Formation β_{FVIX}	Next Month Post-Formation $\beta_{\Delta VIX}$	Full Sample Post-Formation β_{FVIX}
1	1.64	5.53	9.4%	3.70	0.89	0.27	0.30	−2.09	−2.00	−0.033	−5.06
						[1.66]	[1.77]				[−4.06]
2	1.39	4.43	28.7%	4.77	0.73	0.18	0.09	−0.46	−0.42	−0.014	−2.72
						[1.82]	[1.18]				[−2.64]
3	1.36	4.40	30.4%	4.77	0.76	0.13	0.08	0.03	0.08	0.005	−1.55
						[1.32]	[1.00]				[−2.86]
4	1.21	4.79	24.0%	4.76	0.73	−0.08	−0.06	0.54	0.62	0.015	3.62
						[−0.87]	[−0.65]				[4.53]
5	0.60	6.55	7.4%	3.73	0.89	−0.88	−0.53	2.18	2.31	0.018	8.07
						[−3.42]	[−2.88]				[5.32]
5-1	−1.04					−1.15	−0.83				
	[−3.90]					[−3.54]	[−2.93]				
Joint test p-value						0.01	0.03				0.00

$$r_t^i = \alpha^i + \beta_{MKT}^i MKT_t + \beta_{SMB}^i SMB_t + \beta_{HML}^i HML_t + \varepsilon_t^i$$

$$r_t^i = \alpha^i + \beta_{MKT}^i MKT_t + \beta_{SMB}^i SMB_t + \beta_{HML}^i HML_t + \beta_{FVIX}^i FVIX_t + \varepsilon_t^i$$

Factor Mimicking Aggregate σ Risk

- $FVIX_t$: Breeden et al. (1989), Lamont (2001)

$$\Delta VIX_t = c + b' X_t + u_t$$

  - Where $b=(b_1 \ b_2 \ b_3 \ b_4 \ b_5)$, $X_t=(r_{1t} \ r_{2t} \ r_{3t} \ r_{4t} \ r_{5t})$
    - r_{it}s are the excess returns of base assets.
    - b has the interpretation of weights in a zero cost portfolio.
    - Run the regression in above equation at a daily frequency every month and use the estimates of b to construct the mimicking factor for aggregate volatility risk over the same month.
- STR_t: Coval and Shumway (2001) → Robustness Check
  - Market neutral straddle positions using options on the aggregate market. → provides exposure to aggregate volatility risk.
    - Approximate daily at-the-money straddle returns by taking a weighted average of zero-beta straddle positions, with strikes immediately above and below each day's opening level of the S&P100.

Table II
Factor Correlations

Panel A: Daily Correlation

	ΔVIX
FVIX	0.91

Panel B: Monthly Correlations

	FVIX	$\Delta_m VIX$	*MKT*	*SMB*	*HML*	*UMD*	*LIQ*
$\Delta_m VIX$	0.70	1.00	−0.58	−0.18	0.22	−0.11	−0.33
FVIX	1.00	0.70	−0.66	−0.14	0.26	−0.25	−0.40
STR	0.75	0.83	−0.39	−0.39	0.08	−0.26	−0.59

FVIX's Consistency

When Volatility ↑,
Market Returns ↓.

Low ρ with Extant Factors
∴ FVIX=Separate Pricing Factor

Strong Negative −ρ,
But Also Far from −1.

Table III
Characteristic Controls for Portfolios Sorted on $\beta_{\Delta VIX}$

	All Firms		Excluding Small, Growth Firms	
Rank	Mean	Std. Dev.	Mean	Std. Dev.
1	0.32	2.11	0.36	1.90
2	0.04	1.25	0.02	0.94
3	0.04	0.94	0.05	0.89
4	−0.11	1.04	−0.10	1.02
5	−0.58	3.39	−0.29	2.17
5-1	−0.90		−0.64	
	[−3.59]		[−3.75]	

$Return_{i,t} - Benchmark_{i,t} \rightarrow$ Portfolio
$\Rightarrow$ High Sensitive Group=Low Return

Small Growth Firms
=Firms with Option Values
=Do Well When Aggregate σ ↑
$\therefore$ If High $\beta_{\Delta VIX}$=Small Growth, then this is reasonable.

Same Pattern is Observed.
$\Rightarrow$ Small Growth Cannot Explain This.

Consistent with Size, B/M

Table IV
Portfolios Sorted on $\beta_{\Delta VIX}$ Controlling for Liquidity, Volume and Momentum

Rank	Mean	Std. Dev.	CAPM Alpha	FF-3 Alpha	Pre-Formation $\beta_{\Delta VIX}$ Loading	Post-Formation β_{FVIX} Loading
Panel A: Controlling for Liquidity						
1	1.57	5.47	0.21	0.19	−1.89	−1.87
			[1.31]	[1.34]		[−1.65]
2	1.48	4.48	0.27	0.15	−0.43	−2.70
			[2.25]	[1.68]		[−2.78]
3	1.40	4.54	0.15	0.09	0.03	−1.34
			[1.59]	[0.97]		[−1.90]
4	1.30	4.74	0.02	−0.02	0.49	0.49
			[0.21]	[−0.17]		[0.54]
5	0.89	5.84	−0.52	−0.36	1.96	5.38
			[−2.87]	[−2.09]		[4.26]
5-1	−0.68		−0.73	−0.55		
	[−3.04]		[−2.99]	[−2.15]		
Joint test p-value			0.04	0.01		0.00

Consistent with Liquidity

Table IV
Portfolios Sorted on $\beta_{\Delta VIX}$ Controlling for Liquidity, Volume and Momentum

Rank	Mean	Std. Dev.	CAPM Alpha	FF-3 Alpha	Pre-Formation $\beta_{\Delta VIX}$ Loading	Post-Formation β_{FVIX} Loading
			Panel B: Controlling for Volume			
1	1.10	4.73	−0.11	−0.13	−2.08	−3.12
			[−0.58]	[−1.34]		[−3.17]
2	1.18	4.01	0.08	−0.08	−0.47	−3.39
			[0.46]	[−0.92]		[−4.19]
3	1.18	3.78	0.10	−0.04	0.04	−2.84
			[0.66]	[−0.50]		[−4.84]
4	0.98	4.18	−0.17	−0.23	0.55	0.14
			[−1.06]	[2.16]		[0.24]
5	0.38	5.31	−0.90	−0.71	2.17	4.29
			[−3.86]	[−4.84]		[5.07]
5-1	−0.72		−0.79	−0.58		
	[−3.49]		[−3.22]	[−3.03]		
Joint test p-value			0.00	0.00		0.00

Consistent with Volume

Table IV
Portfolios Sorted on $\beta_{\Delta VIX}$ Controlling for Liquidity, Volume and Momentum

Rank	Mean	Std. Dev.	CAPM Alpha	FF-3 Alpha	Pre-Formation $\beta_{\Delta VIX}$ Loading	Post-Formation β_{FVIX} Loading
Panel C: Controlling for Past 12-Month Returns						
1	1.25	5.55	−0.11	−0.17	−2.03	0.39
			[−0.64]	[−1.08]		[0.28]
2	1.19	4.87	−0.08	−0.19	−0.49	0.82
			[−0.57]	[−1.54]		[0.68]
3	1.28	4.76	0.02	−0.08	0.03	0.97
			[0.15]	[−0.73]		[0.89]
4	1.06	4.88	−0.22	−0.27	0.56	4.86
			[−1.64]	[−2.26]		[5.50]
5	0.36	5.87	−1.05	−0.90	2.11	7.17
			[−5.01]	[−4.72]		[5.50]
5-1	−0.89		−0.93	−0.74		
	[−4.72]		[−4.00]	[−3.42]		
Joint test p-value			0.00	0.00		0.00

Consistent with Momentum

Table V
Estimating the Price of Volatility Risk

Panel A: Fama–MacBeth (1973) Factor Premiums

	I	II	III	IV
Constant	−0.145	−0.527	−0.202	−0.247
	[−0.23]	[−0.88]	[−0.31]	[−0.36]
MKT	0.977	1.276	1.034	1.042
	[1.11]	[1.47]	[1.13]	[1.13]
FVIX	−0.080		−0.082	−0.071
	[−2.49]		[−2.39]	[−2.02]
STR		−0.194		
		[−2.32]		
SMB	−0.638	−0.246	−0.608	−0.699
	[−1.24]	[−0.59]	[−1.13]	[−1.25]
HML	−0.590	−0.247	−0.533	−0.232
	[−0.95]	[−0.40]	[−0.82]	[−0.34]
UMD			0.827	0.612
			[0.83]	[0.59]
LIQ				−0.021
				[−1.00]
Adj R^2	0.67	0.56	0.65	0.79

Always (−) Significant

$$r_t^i = c + \beta_{MKT}^i \lambda_{MKT} + \beta_{FVIX}^i \lambda_{FVIX} + \beta_{SMB}^i \lambda_{SMB} + \beta_{HML}^i \lambda_{HML} + \beta_{UMD}^i \lambda_{UMD} + \beta_{LIQ}^i \lambda_{LIQ} + \varepsilon_t^i$$

Table V
Estimating the Price of Volatility Risk

Panel B: Ex Post Factor Loadings on *FVIX*

Pre-ranking on $\beta_{\Delta VIX}$

Pre-ranking on β_{MKT}	1 low	2	3	4	5
Low 1	−1.57	−5.89	−3.83	−3.35	−1.03
	[−0.46]	[−3.23]	[−1.93]	[−1.99]	[−0.45]
2	−3.49	−4.47	−4.01	−2.00	−0.54
	[−1.67]	[−3.18]	[−3.11]	[−1.66]	[−0.31]
3	−5.74	−3.49	−2.56	−0.95	3.72
	[−3.16]	[−2.84]	[−2.21]	[−0.78]	[2.30]
4	−5.80	−1.41	−0.34	3.39	6.66
	[−4.13]	[−1.00]	[−0.29]	[2.69]	[3.85]
High 5	−3.69	−0.57	3.52	7.81	11.70
	[−2.05]	[−0.45]	[1.76]	[3.32]	[3.13]

Portfolios are correctly formed by using $\beta_{\Delta VIX}$.

(except for the two lowest β_{MKT} portfolios corresponding to the lowest $\beta_{\Delta VIX}$ quintile)

II. Pricing Idiosyncratic Volatility in the Cross-Section

Table VI
Portfolio Sorted by Volatility

Rank	Mean	Std. Dev.	% Mkt Share	Size	B/M	CAPM Alpha	FF-3 Alpha
Panel A: Portfolios Sorted by Total Volatility							
1	1.06	3.71	41.7%	4.66	0.88	0.14	0.03
						[1.84]	[0.53]
2	1.15	4.48	33.7%	4.70	0.81	0.13	0.08
						[2.14]	[1.41]
3	1.22	5.63	15.5%	4.10	0.82	0.07	0.12
						[0.72]	[1.55]
4	0.99	7.15	6.7%	3.47	0.86	−0.28	−0.17
						[−1.73]	[−1.42]
5	0.09	8.30	2.4%	2.57	1.08	−1.21	−1.16
						[−5.07]	[−6.85]
5-1	−0.97					−1.35	−1.19
	[−2.86]					[−4.62]	[−5.92]

$$r_t^i = \mu^i + \varepsilon_t^i, \quad \sqrt{\mathrm{var}(\varepsilon_t^i)}$$

High Past Volatility ⇒ Low Future Return?

By Calculating Past Volatility,

Table VI
Portfolio Sorted by Volatility

Rank	Mean	Std. Dev.	% Mkt Share	Size	B/M	CAPM Alpha	FF-3 Alpha
Panel B: Portfolios Sorted by Idiosyncratic Volatility Relative to FF-3							
1	1.04	3.83	53.5%	4.86	0.85	0.11	0.04
						[1.57]	[0.99]
2	1.16	4.74	27.4%	4.72	0.80	0.11	0.09
						[1.98]	[1.51]
3	1.20	5.85	11.9%	4.07	0.82	0.04	0.08
						[0.37]	[1.04]
4	0.87	7.13	5.2%	3.42	0.87	−0.38	−0.32
						[−2.32]	[−3.15]
5	−0.02	8.16	1.9%	2.52	1.10	−1.27	−1.27
						[−5.09]	[−7.68]
5-1	−1.06					−1.38	−1.31
	[−3.10]					[−4.56]	[−7.00]

High Past Volatility ⇒ Low Future Return (Severe)

$$r_t^i = \alpha^i + \beta_{MKT}^i MKT_t + \beta_{SMB}^i SMB_t + \beta_{HML}^i HML_t + \varepsilon_t^i$$

$$\sqrt{\text{var}(\varepsilon_t^i)}$$

Table VII
Alphas of Portfolios Sorted on Idiosyncratic Volatility

		Ranking on Idiosyncratic Volatility					
		1 Low	2	3	4	5 High	5-1
NYSE Stocks Only		0.06	0.04	0.02	−0.04	−0.60	−0.66
		[1.20]	[0.75]	[0.30]	[−0.40]	[−5.14]	[−4.85]
Size Quintiles	Small 1	0.11	0.26	0.31	0.06	−0.43	−0.55
		[0.72]	[1.56]	[1.76]	[0.29]	[−1.54]	[−1.84]
	2	0.19	0.20	−0.07	−0.65	−1.73	−1.91
		[1.49]	[1.74]	[−0.67]	[−5.19]	[−8.14]	[−7.69]
	3	0.12	0.21	0.03	−0.27	−1.49	−1.61
		[1.23]	[2.40]	[0.38]	[−3.36]	[−10.1]	[−7.65]
	4	0.03	0.22	0.17	−0.03	−0.82	−0.86
		[0.37]	[2.57]	[2.47]	[−0.45]	[−6.61]	[−4.63]
	Large 5	0.09	0.04	0.03	0.14	−0.17	−0.26
		[1.62]	[0.72]	[0.51]	[1.84]	[−1.40]	[−1.74]
Controlling for Size		0.11	0.18	0.09	−0.15	−0.93	−1.04
		[1.30]	[2.49]	[1.35]	[−1.99]	[−6.81]	[−5.69]
Controlling for Book-to-Market		0.61	0.69	0.71	0.50	−0.19	−0.80
		[3.02]	[2.80]	[2.49]	[1.47]	[−0.48]	[−2.90]
Controlling for Leverage		0.11	0.11	0.08	−0.24	−1.12	−1.23
		[2.48]	[2.20]	[1.19]	[−2.45]	[−7.81]	[−7.61]
Controlling for Liquidity		0.08	0.09	−0.01	−0.16	−1.01	−1.08
		[1.71]	[1.53]	[−0.09]	[−1.62]	[−8.61]	[−7.98]
Controlling for Volume		−0.03	0.02	−0.01	−0.39	−1.25	−1.22
		[−0.49]	[0.39]	[−0.32]	[−7.11]	[−10.9]	[−8.04]
Controlling for Turnover		0.11	0.03	−0.11	−0.49	−1.34	−1.46
		[2.49]	[0.58]	[−1.79]	[−6.27]	[−11.0]	[−10.7]
Controlling for Bid–Ask Spreads		−0.07	−0.01	−0.09	−0.49	−1.26	−1.19
		[−1.21]	[−0.18]	[−1.14]	[−5.36]	[−9.13]	[−6.95]
Controlling for Coskewness		−0.02	−0.00	0.01	−0.37	−1.40	−1.38
		[−0.32]	[−0.02]	[0.08]	[−2.30]	[−6.07]	[−5.02]
Controlling for Dispersion in Analysts' Forecasts		0.12	−0.07	0.11	0.01	−0.27	−0.39
		[1.57]	[−0.76]	[1.12]	[0.09]	[−1.76]	[−2.09]

Consistent with Controlling Suspected Variables

Table VIII
Alphas of Portfolios Sorted on Idiosyncratic Volatility Controlling for Past Returns

	Ranking on Idiosyncratic Volatility					
	1 Low	2	3	4	5 High	5-1
Panel A: Controlling for Momentum						
Past 1 month	0.07	0.08	0.09	−0.05	−0.59	−0.66
	[0.43]	[0.94]	[1.26]	[−0.47]	[−3.60]	[−2.71]
Past 6 months	−0.01	−0.12	−0.28	−0.45	−1.11	−1.10
	[−0.20]	[−1.86]	[−3.60]	[−5.20]	[−9.35]	[−7.18]
Past 12 months	0.01	−0.05	−0.28	−0.64	−1.21	−1.22
	[0.15]	[−0.76]	[−3.56]	[−6.95]	[−11.5]	[−9.20]
Panel B: Past 12-Month Quintiles						
Losers 1	−0.41	−0.83	−1.44	−2.11	−2.66	−2.25
	[−1.94]	[−3.90]	[−6.32]	[−9.40]	[−10.6]	[−7.95]
2	−0.08	−0.24	−0.64	−1.09	−1.70	−1.62
	[−0.49]	[−1.58]	[−4.40]	[−6.46]	[−8.90]	[−7.00]
3	−0.06	−0.11	−0.26	−0.48	−1.03	−0.97
	[−0.52]	[−1.16]	[−2.15]	[−3.49]	[−7.93]	[−5.85]
4	0.15	0.07	0.23	−0.03	−0.65	−0.80
	[1.57]	[0.65]	[2.27]	[−0.29]	[−4.76]	[−4.89]
Winners 5	0.45	0.85	0.71	0.52	−0.03	−0.48
	[3.52]	[5.44]	[3.97]	[2.63]	[−0.13]	[−2.01]

Consistent with Momentum Length Setup

Table IX
The Idiosyncratic Volatility Effect Controlling for Aggregate Volatility Risk

Cannot Explain!

Panel A: FF-3 Alphas

	Ranking on Idiosyncratic Volatility					
	1 Low	2	3	4	5 High	5-1
Controlling for Exposure to Aggregate Volatility Risk	0.05 [0.83]	0.01 [0.09]	−0.14 [−1.14]	−0.49 [−3.08]	−1.14 [−5.00]	−1.19 [−4.72]

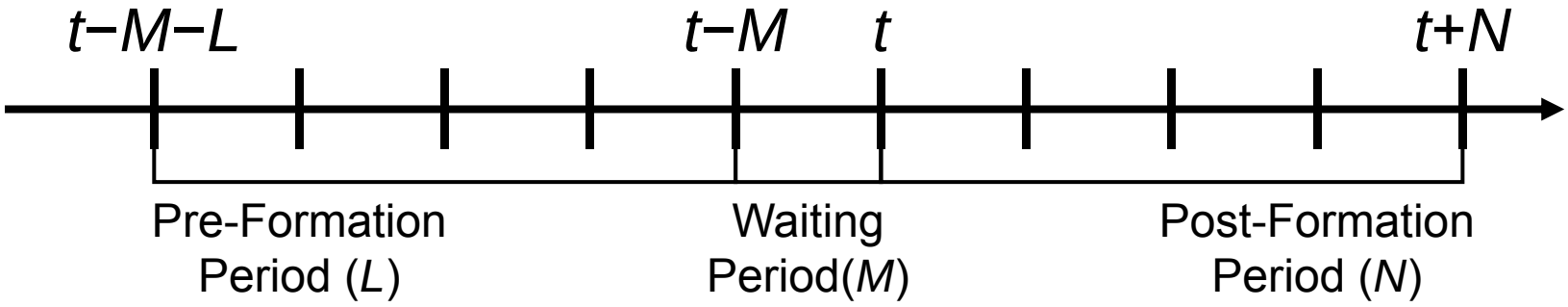
Panel B: *FVIX* Factor Loadings

		Ranking on Idiosyncratic Volatility				
		1 Low	2	3	4	5 High
$\beta_{\Delta VIX}$ Quintiles	Low 1	−6.40 [−3.82]	−1.98 [−0.78]	−0.55 [−0.23]	8.80 [2.16]	7.51 [2.31]
	2	−2.66 [−2.27]	−3.21 [−2.06]	0.06 [0.05]	−3.04 [−2.00]	5.37 [1.80]
	3	−6.51 [−4.50]	−2.74 [−2.41]	−1.93 [−1.14]	−0.31 [−0.29]	7.25 [3.37]
	4	5.65 [2.31]	3.73 [2.08]	3.50 [2.83]	1.33 [0.87]	8.22 [3.97]
	High 5	7.53 [5.16]	2.46 [1.16]	8.60 [3.72]	7.53 [2.53]	5.79 [1.65]

Portfolios are formed well.
However, for high $\beta_{\Delta VIX}$, sorting has no power

Table X
Quintile Portfolios of Idiosyncratic Volatility for $L/M/N$ Strategies

	Ranking on Idiosyncratic Volatility					
Strategy	1 low	2	3	4	5 High	5-1
1/1/1	0.06	0.04	0.09	−0.18	−0.82	−0.88
	[1.47]	[0.77]	[1.15]	[−1.78]	[−4.88]	[−4.63]
1/1/12	0.03	0.02	−0.02	−0.17	−0.64	−0.67
	[0.91]	[0.43]	[−0.37]	[−1.79]	[−5.27]	[−4.71]
12/1/1	0.04	0.08	−0.01	−0.29	−1.08	−1.12
	[1.15]	[1.32]	[−0.08]	[−2.02]	[−5.36]	[−5.13]
12/1/12	0.04	0.04	−0.02	−0.35	−0.73	−0.77
	[1.10]	[0.54]	[−0.23]	[−2.80]	[−4.71]	[−4.34]



Consistent with Statistics Measuring Period Setup

Table XI
The Idiosyncratic Volatility Effect over Different Subsamples

	Ranking on Idiosyncratic Volatility					
Subperiod	1 Low	2	3	4	5 High	5-1
Jul 1963–Dec 1970	0.06	0.03	0.09	−0.36	−0.94	−1.00
	[1.23]	[0.42]	[0.73]	[−2.18]	[−5.81]	[−5.62]
Jan 1971–Dec 1980	−0.24	0.32	0.19	0.03	−1.02	−0.77
	[−2.53]	[3.20]	[1.55]	[0.21]	[−5.80]	[−3.14]
Jan 1981–Dec 1990	0.15	0.08	−0.16	−0.66	−2.08	−2.23
	[2.14]	[1.07]	[−1.25]	[−4.82]	[−10.1]	[−9.39]
Jan 1991–Dec 2000	0.16	−0.01	0.14	−0.48	−1.39	−1.55
	[1.34]	[−0.08]	[0.77]	[−2.41]	[−3.31]	[−3.19]
NBER Expansions	0.06	0.02	0.08	−0.33	−1.19	−1.25
	[1.26]	[0.25]	[1.01]	[−3.18]	[−7.07]	[−6.55]
NBER Recessions	−0.10	0.64	−0.01	−0.34	−1.88	−1.79
	[−0.65]	[3.58]	[−0.04]	[−1.32]	[−3.32]	[−2.63]
Stable Periods	0.05	−0.02	−0.11	−0.62	−1.66	−1.71
	[0.44]	[−0.25]	[−1.07]	[−4.06]	[−6.56]	[−4.75]
Volatile Periods	−0.04	0.24	0.32	0.18	−0.93	−0.89
	[−0.29]	[1.69]	[2.32]	[0.55]	[−2.40]	[−2.02]

Consistent with Sample Period Setup

III. Conclusion

Conclusion

- Pricing Systematic Volatility in the Cross-Section
  - High Past Exposure to $\Delta\sigma \Rightarrow$ Low Future E(r)
  - FVIX Factor Loading $\uparrow \Rightarrow$ Fama-French Alpha $\downarrow$
  - A Cross-Sectional Price of Volatility Risk = −1% per annum
  - "*because risk-averse agents reduce current consumption to increase precautionary savings in the presence of higher uncertainty about future market returns.*"
- Pricing Idiosyncratic Volatility in the Cross-Section
  - Stocks with High Idiosyncratic $\sigma \Rightarrow$ Low E(r)
  - Exposure to Volatility Risk $\not\Rightarrow$ Low Returns of Stocks with High Idiosyncratic Volatility

Theoretically,

High Risk ⇒ High Return

Empirically,

High Risk ⇒ Low Return?

(Cannot be Explained by Volatility Sensitivity!)

$\nexists$Low-Volatility Anomaly

Q&A Session

Thanks for Listening