Do Distributional Characteristics of Corporate Bonds Predict their Future Returns?

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Summary

- We investigate the significance of vol, skew, kurt, and downside risk in predicting cross-sectional variation in future bond returns.
- Significantly positive (negative) link between volatility (skewness) and expected returns.
- Kurtosis does not have a robust incremental contribution to predictability.
- Bonds in the highest volatility quintile generate 6% to 7% more annual raw and risk-adjusted returns compared to bonds in the lowest volatility quintile.

Summary

- Controlling for vol, bonds with low skewness generate 2.5% to 3% more annual raw and risk-adjusted returns compared to bonds with high skewness.
- The cross-sectional relation between downside risk and bond returns is even stronger than volatility and skewness.
- These findings remain intact after controlling for transaction costs, liquidity and a large set of bond characteristics and risk factors.
- Hence, the distributional characteristics of corporate bonds are powerful determinants of the cross-sectional differences in future returns.

Distributional Characteristics and Expected Returns

- Expected value of end-of-period wealth:

$$\bar{W} = \sum_{i=1}^{n} w_i \bar{R}_i + w_f r_f$$

- Expected utility in terms of wealth distribution:

$$E[U(W)] = \int U(W) f(W) dW$$

- The infinite-order Taylor series expansion of U(W):

$$U(W) = \sum_{k=0}^{\infty} \frac{U^{(k)}(\bar{W})(W - \bar{W})^k}{k!}$$

Distributional Characteristics and Expected Returns

- Loistl (1976) and Scott and Horvath (1980):

$$E[U(W)] = U(\bar{W}) + U^{(1)}(\bar{W})E\left[(W-\bar{W})\right] + \tfrac{1}{2}U^{(2)}(\bar{W})E\left[(W-\bar{W})^2\right] + \tfrac{1}{3!}U^{(3)}(\bar{W})E\left[(W-\bar{W})^3\right] + \tfrac{1}{4!}U^{(4)}(\bar{W})E\left[(W-\bar{W})^4\right] + O(W^4)$$

- Expected utility is approximated by the following preference function:

$$E[U(W)] \approx U(\bar{W}) + \frac{1}{2}U^{(2)}(\bar{W})\sigma_p^2 + \frac{1}{3!}U^{(3)}(\bar{W})s_p^3 + \frac{1}{4!}U^{(4)}(\bar{W})\kappa_p^4$$

- E(U) depends positively on the mean and skewness, and negatively on the variance and kurtosis; aversion to variance and kurtosis and preference for (positive) skewness.

Distributional Characteristics and Expected Returns

- Under the assumptions of increasing marginal utility, risk aversion, and decreasing absolute risk aversion,
  - expected return on a risky asset is a function of the asset's distributional characteristics (volatility, skewness, and kurtosis).
- Using portfolio-level analyses and cross-sectional regressions,
  - we provide the first study to investigate if the distributional characteristics of corporate bonds predict their future returns.

Research Question

- In the literature of cross-sectional risk-return tradeoff,
  - Many studies on stock returns, option returns, and hedge fund returns; *little* is known on **corporate bond** returns
  - Likely due to the lack of high-quality data on corporate bonds

- In this paper,
  - We compile a comprehensive dataset for corporate bonds from six sources (1973-2012), including quote- and transaction-based data
  - We go beyond the mean-variance portfolio theory in Markowitz (1952) and examine the higher moments, **VOL, SKEW, KURT**, and **DOWNSIDE RISK** in predicting future corporate bond returns

Related Literature

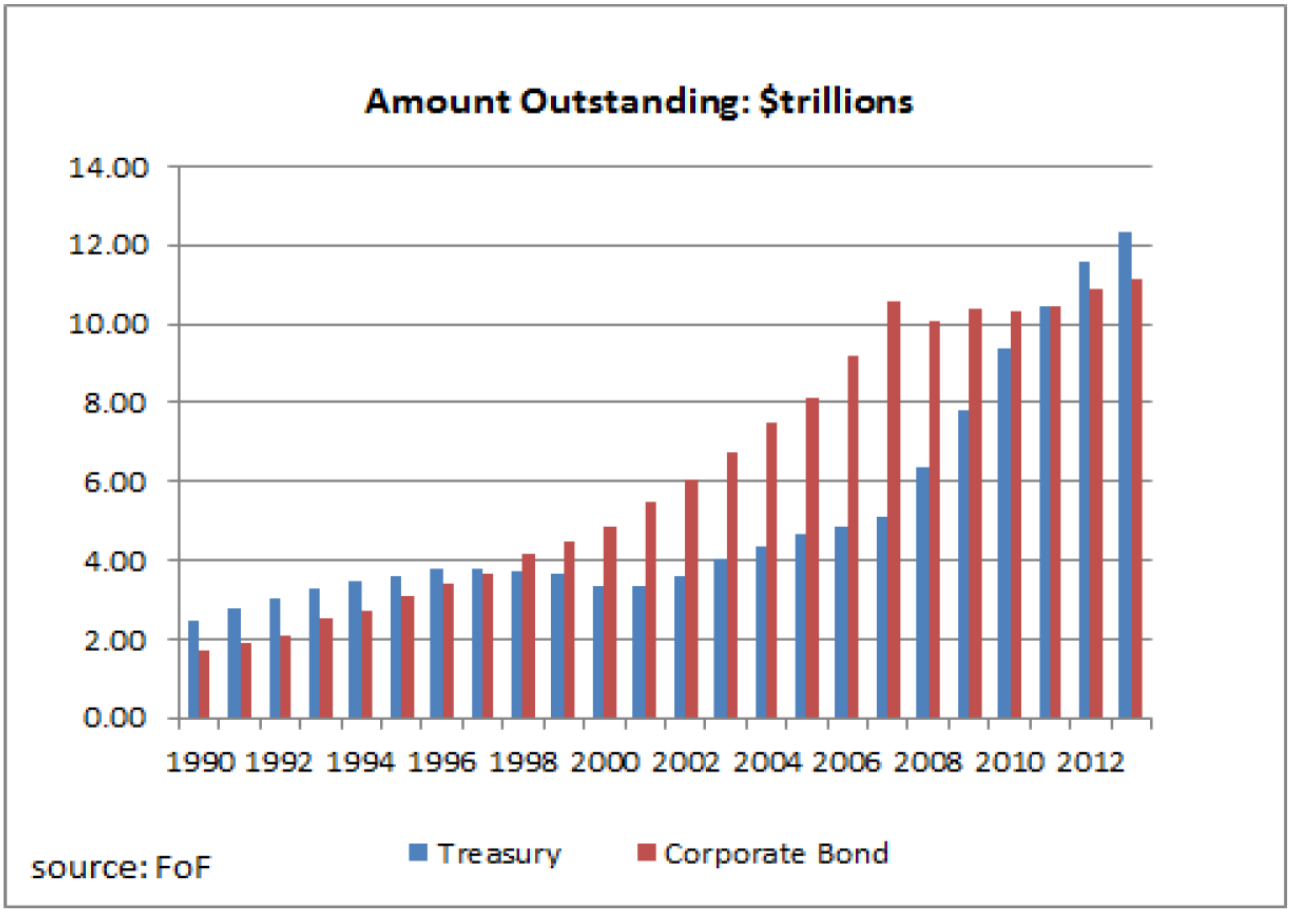
- Volatility (*VOL*)
  - Theory: Markowitz (1952), Levy (1978), Merton (1987)
  - Empirical: Ang et al. (2006), Fu (2009), Bali and Cakici (2008), An, Ang, Bali, and Cakici (2014), Goyal and Saretto (2009), Cao and Han (2013)
- Skewness (*SKEW*)
  - Theory: Arditti (1967), Kraus and Litzenberger (1976), Kane (1982), Harvey and Siddique (2000), etc.
  - Empirical: Boyer, Mitton, and Vorkink (2010), Bali, Cakici, and Whitelaw (2011), Xing, Zhang, and Zhao (2010), Conrad, Dittmar, and Ghysels (2013), Bali and Murray (2013)
- Kurtosis (*KURT*)
  - Theory: Kimball (1993), Pratt and Zeckhauser (1987), Dittmar (2002)
  - Empirical: Dittmar (2002), Bali, Brown, and Caglayan (2012)

Related Literature (Cont'd)

- The cross-sectional determinants of corporate bond returns
  - Fama and French (1993): default and term spread are important factors.
  - Gebhardt, Hvidkjaer, and Swaminathan (2005): default beta is significantly priced after controlling for bond rating, maturity, etc.
  - Lin, Wang, and Wu (2011): liquidity beta is significant and positively related to future corporate bond returns
  - Jostova et al. (2013): momentum is priced in corporate bond returns

Our question: do distributional characteristics – *VOL, SKEW, KURT, DOWNSIDE RISK* predict corporate bond future returns?

The U.S. Corporate Bond Market

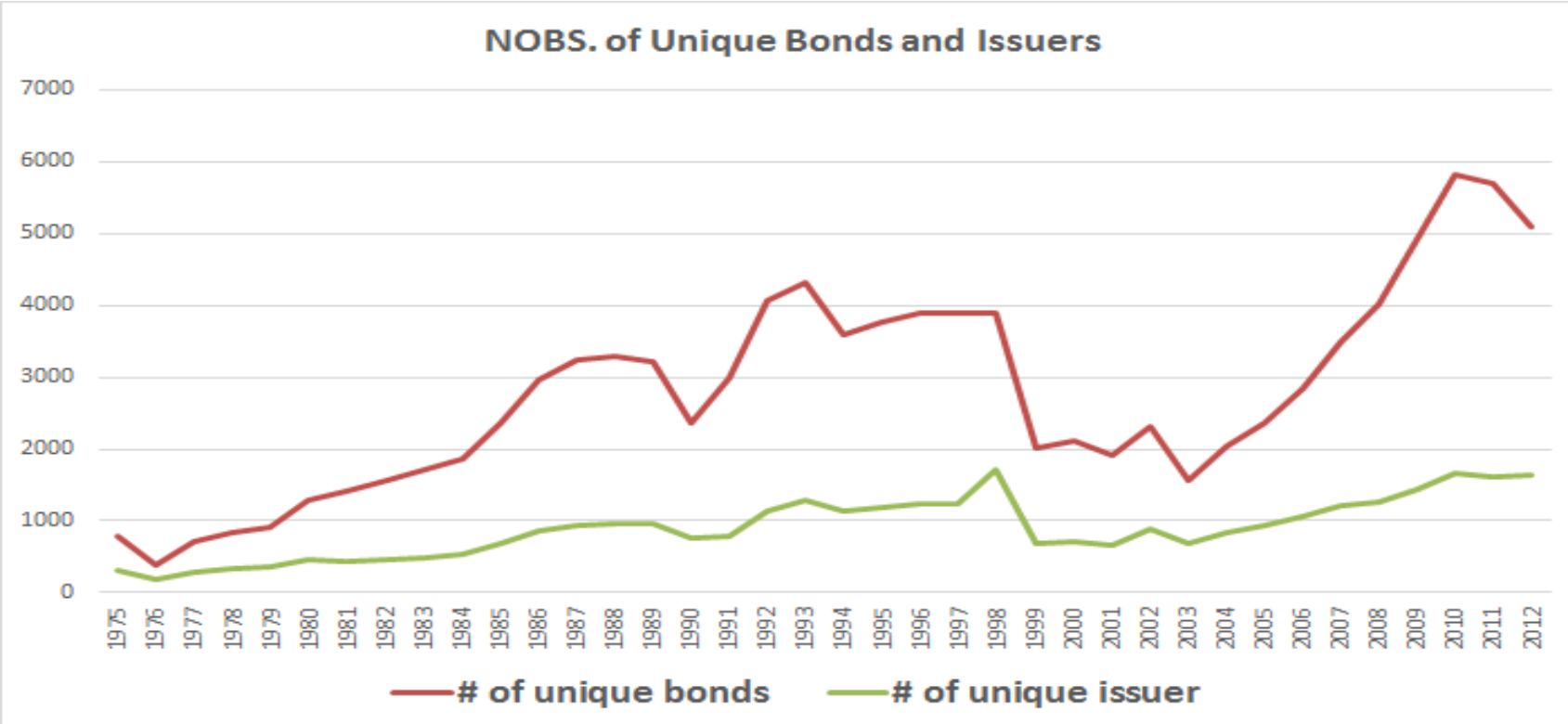


- $1.74 trillion in 1990; $11.10 trillion in 2013
- Annual growth rate 8.5% over 1990 - 2013
- Daily trading volume between $12.6 to $19.7 billion since 2000

Corporate Bond Data

- Pricing data are compiled from five sources:
  - [M,Q] Lehman Brothers fixed income database (Lehman), 1973-1998
  - [D,T] Bloomberg (1998-2002)
  - [D,T] Enhanced TRACE (2002-2012)
  - [M,T] NAIC (1994-2013)
  - [M,Q] Datastream (1990 - 2013)
- Data filtering rules:
  - Remove bonds that are structured, mortgage backed or asset backed
  - Remove bonds with private placement, or under Rule 144A
  - Remove bonds under convertible contract
  - Remove bonds with floating coupon payment
  - Remove bonds if price$<$ \$5 or time-to-maturity $<$ 1yr
- Bond characteristics are from Mergent Fixed Income Securities Database (FISD), including rating, coupon, bond type, option feature, etc.

Summary Statistics (1975-2012)



- Average unique # of bonds per year: 2777
- Average unique # of issuers per year: 895
- 14,796 bonds issued by 4,401 unique firms (total of 964,317 bond-month observations)

Summary Statistics

	N	Mean	Median	Std. dev	1st	25th	75th	99th
Panel A: All bonds								
Bond Return (%)	964,271	0.68	0.68	5.64	-10.42	-0.65	1.93	12.50
Price ($)	964,317	97.04	100.24	16.94	38.43	92.50	106.00	129.85
Amount Out($mil)	962,925	266	150	368	5	100	300	2000
Rating	959,713	8.02	7.00	4.13	1.00	5.50	10.00	20.50
Time-to-maturity	964,317	13.84	9.42	39.11	1.29	5.70	20.00	37.50
Panel B: Investment Grade Bonds								
Bond Return (%)	761,724	0.61	0.63	3.75	-8.43	-0.66	1.86	10.30
Price ($)	761,728	98.33	100.57	15.79	47.94	93.84	106.52	130.98
Amount Out($mil)	760,378	272	150	382	4	100	300	2000
Rating	757,124	6.30	6.50	2.29	1.00	5.00	8.00	10.00
Time-to-maturity	761,728	14.72	9.90	43.78	1.25	5.75	21.83	38.00
Panel C: High Yield Bonds								
Bond Return (%)	202,547	0.98	0.85	9.91	-20.15	-0.60	2.25	22.79
Price ($)	202,589	92.19	98.66	19.97	22.00	85.50	104.13	123.56
Amount Out($mil)	202,547	242	150	311	9	100	300	1500
Rating	202,589	14.43	14.50	3.04	10.50	12.00	16.00	24.00
Time-to-maturity	202,589	10.51	8.17	7.82	1.42	5.58	13.92	29.58

Measuring Volatility, Skewness, and Kurtosis

- Return on corporate bond i at month t,

$$R_{i,t} = \frac{P_{i,t} + AI_{i,t} + Coupon_{i,t}}{P_{i,t-1} + AI_{i,t-1}} - 1$$

- Using 60-month rolling-window to estimate the monthly time series:

$$\begin{aligned}
VOL_{i,t} &= \frac{1}{n-1}\sum_{t=1}^{n}(R_{i,t} - \overline{R_i})^2 \\
SKEW_{i,t} &= \frac{1}{n}\sum_{t=1}^{n}\left(\frac{R_{i,t} - R}{\sigma_{i,t}}\right)^3 \\
KURT_{i,t} &= \frac{1}{n}\sum_{t=1}^{n}\left(\frac{R_{i,t} - R}{\sigma_{i,t}}\right)^4 - 3 \\
1\%\ |VaR| &= \text{the 1st lowest return in the previous 60-month window} \\
5\%\ |VaR| &= \text{the 3rd lowest return in the previous 60-month window} \\
10\%\ |VaR| &= \text{the 6th lowest return in the previous 60-month window}
\end{aligned}$$

Research Design

- Portfolio analysis
  - Construct quintile portfolios every month t from January 1975 to December 2012, based on *VOL*, *SKEW*, *KURT*, and *VaR*
  - Examine returns in month $t+1$, for both raw and adjusted returns

- Fama-MacBeth cross-sectional regressions
  - Univariate with and w/o controls (rating, maturity, amount outstanding, lagged return).

$$
\begin{aligned}
R_{i,t+1} &= w_t + \lambda_t VOL_{i,t} + \tau_t Controls_t + \epsilon_{i,t+1} \\
R_{i,t+1} &= w_t + \lambda_t SKEW_{i,t} + \tau_t Controls_t + \epsilon_{i,t+1} \\
R_{i,t+1} &= w_t + \lambda_t KURT_{i,t} + \tau_t Controls_t + \epsilon_{i,t+1} \\
R_{i,t+1} &= w_t + \lambda_t VaR_{i,t} + \tau_t Controls_t + \epsilon_{i,t+1}
\end{aligned}
$$

  - Multivariate with and w/o controls (rating, maturity, amount outstanding, lagged return).

$$R_{i,t+1} = w_t + \lambda_{1,t} VOL_{i,t} + \lambda_{2,t} SKEW_{i,t} + \lambda_{3,t} KURT_{i,t} + \tau_t Controls_t + \epsilon_{i,t+1}$$

Quintile Portfolios of Corporate Bonds Sorted by *VOL*

Quintiles	Average *VOL* in each quintile	Average excess returns	5-factor alpha	7-factor alpha with ΔDEF and ΔTERM	7-factor alpha with ΔCredSpr and Δ10Yr
Low VOL	4.536	0.046	-0.052	-0.056	-0.056
		(0.49)	(-0.59)	(-0.59)	(-0.98)
2	7.508	0.123	0.007	0.002	0.001
		(1.11)	(0.07)	(0.02)	(0.02)
3	10.297	0.146	-0.001	-0.005	-0.005
		(1.20)	(-0.01)	(-0.04)	(-0.08)
4	14.407	0.233	0.062	0.057	0.056
		(1.71)	(0.50)	(0.43)	(0.70)
High VOL	45.160	0.642	0.452	0.450	0.450
		(3.01)	(2.30)	(2.21)	(2.50)
High − Low		0.596***	0.504***	0.505***	0.505***
Return/Alpha diff.		(3.60)	(3.11)	(3.23)	(3.16)

Panel B: Portfolio Characteristics

Quintiles	Average *VOL* in each quintile	Portfolio Characteristics		
		Rating	Maturity (yr)	AmountOut ($billions)
Low VOL	4.536	6.600	9.996	0.261
2	7.508	6.623	12.770	0.236
3	10.297	6.631	15.348	0.240
4	14.407	7.019	17.881	0.231
High VOL	45.160	10.221	17.482	0.219

Controlling for Credit Rating

Average excess returns High *VOL* − Low *VOL*	5-factor alpha	7-factor alpha with ΔDEF and ΔTERM	7-factor alpha with ΔCredSpr and Δ10Yr
Panel A: All Bonds, (1 <= *rating* <= 21)			
0.423***	0.333***	0.331***	0.330***
(3.97)	(3.41)	(3.33)	(3.39)
Panel B: Investment Grade Bonds, (1 <= *rating* <= 10)			
0.284***	0.202**	0.200**	0.198**
(3.32)	(2.31)	(2.30)	(2.49)
Panel C: High Yield Bonds, (*rating* > 10)			
0.732***	0.701***	0.714***	0.694***
(3.84)	(3.92)	(4.14)	(3.96)

- Robust across rating groups, more pronounced for high yield bonds

Controlling for Maturity

Average excess returns High *VOL* − Low *VOL*	5-factor alpha	7-factor alpha with ΔDEF and ΔTERM	7-factor alpha with ΔCredSpr and Δ10Yr
Panel A: All Bonds			
0.435***	0.349**	0.351**	0.349**
(2.75)	(2.38)	(2.52)	(2.41)
Panel B: Short-term Bonds ($1yr <= TTM <= 5yr$)			
0.429*	0.377*	0.385**	0.388*
(1.73)	(1.71)	(1.97)	(1.86)
Panel C: Medium-term Bonds ($5yr < TTM <= 10yr$)			
0.380*	0.336*	0.352**	0.360*
(1.83)	(1.86)	(1.97)	(1.95)
Panel D: Long-term Bonds ($TTM > 10yr$)			
0.451***	0.384***	0.390***	0.402***
(3.60)	(3.24)	(3.41)	(3.27)

- Robust across maturity groups, more pronounced for bonds with longer maturity

Controlling for Size

Average excess returns High *VOL* − Low *VOL*	5-factor alpha	7-factor alpha with ΔDEF and ΔTERM	7-factor alpha with ΔCredSpr and Δ10Yr
Panel A: All Bonds			
0.504***	0.395***	0.395***	0.396***
(4.21)	(3.23)	(3.27)	(3.23)
Panel B: Small Bonds			
0.566***	0.519**	0.516**	0.522**
(3.18)	(2.46)	(2.47)	(2.46)
Panel C: Large Bonds			
0.346***	0.244**	0.245**	0.245**
(3.24)	(2.38)	(2.43)	(2.38)

- Robust after controlling for amount outstanding

Quintile Portfolios of Corporate Bonds Sorted by *VOL* Within IG Bonds

Quintiles	Average *VOL* in each quintile	Average excess returns	5-factor alpha	7-factor alpha with ΔDEF and ΔTERM	7-factor alpha with ΔCredSpr and Δ10Yr
Low VOL	4.440	0.031	-0.063	-0.067	-0.067
		(0.33)	(-0.71)	(-0.70)	(-1.20)
2	7.169	0.124	0.015	0.010	0.008
		(1.15)	(0.14)	(0.09)	(0.14)
3	9.561	0.139	0.004	-0.002	-0.002
		(1.16)	(0.03)	(-0.01)	(-0.04)
4	12.678	0.204	0.048	0.042	0.040
		(1.56)	(0.39)	(0.33)	(0.62)
High VOL	27.592	0.439	0.295	0.289	0.287
		(2.77)	(1.89)	(1.75)	(2.54)
High − Low		0.408***	0.358***	0.356***	0.354***
Return/Alpha diff.		(4.06)	(3.30)	(3.28)	(3.47)

Panel B: Portfolio Characteristics

Quintiles	Average *VOL* in each quintile	Portfolio Characteristics		
		Rating	Maturity (yr)	AmountOut ($billions)
Low VOL	4.440	5.888	9.837	0.272
2	7.169	5.902	12.450	0.242
3	9.561	5.862	15.250	0.242
4	12.678	5.888	17.980	0.233
High VOL	27.592	6.472	20.240	0.229

Quintile Portfolios of Corporate Bonds Sorted by *SKEW*, Controlling for *VOL*

- Theory: expected return is a function of both volatility and skewness in the 3-moment asset pricing models.

Quintiles	Average *SKEW* in each quintile	Average excess returns	5-factor alpha	7-factor alpha with ΔDEF and ΔTERM	7-factor alpha with ΔCredSpr and Δ10Yr
SKEW,1	-0.874	0.383	0.306	0.300	0.304
		(3.35)	(2.64)	(2.60)	(3.11)
SKEW,2	-0.221	0.219	0.066	0.062	0.061
		(1.94)	(0.62)	(0.59)	(0.82)
SKEW,3	0.040	0.183	0.030	0.025	0.021
		(1.60)	(0.26)	(0.22)	(0.28)
SKEW,4	0.325	0.182	0.018	0.014	0.012
		(1.64)	(0.17)	(0.13)	(0.19)
SKEW,5	0.904	0.172	0.046	0.039	0.043
		(1.63)	(0.46)	(0.39)	(0.62)
SKEW,5 − SKEW,1		-0.211***	-0.260***	-0.260***	-0.261***
Return/Alpha diff.		(-3.76)	(-3.77)	(-3.84)	(-3.84)

Quintile Portfolios of Corporate Bonds Sorted by *SKEW*, Controlling for Credit Rating, Maturity, and Size

Panel A: Quintile portfolios of corporate bonds sorted by SKEW controlling for credit rating

	All Bonds			Investment Grade			High Yield		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
SKEW,5 − SKEW,1	-0.236***	-0.235***	-0.235***	-0.206***	-0.205***	-0.205***	-0.502***	-0.503***	-0.515***
Return/Alpha diff.	(-3.07)	(-3.15)	(-3.12)	(-2.90)	(-2.98)	(-2.95)	(-3.03)	(-2.99)	(-3.04)

Panel B: Quintile portfolios of corporate bonds sorted by SKEW controlling for maturity

	All Bonds			Short Maturity Bonds			Medium Maturity Bonds			Long Maturity Bonds		
	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3
SKEW,5 − SKEW,1	-0.186**	-0.185**	-0.185**	-0.127	-0.133	-0.134	-0.244*	-0.23*	-0.239*	-0.271***	-0.265***	-0.253***
Return/Alpha diff.	(-2.50)	(-2.55)	(-2.51)	(-0.86)	(-0.86)	(-0.96)	(-1.75)	(-1.79)	(-1.76)	(-2.75)	(-2.81)	(-2.77)

Panel C: Quintile portfolios of corporate bonds sorted by SKEW controlling for size

	All Bonds			Small Bonds			Large Bonds		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
SKEW,5 − SKEW,1	-0.208***	-0.207***	-0.207***	-0.250***	-0.248***	-0.249**	-0.160**	-0.160**	-0.159**
Return/Alpha diff.	(-2.64)	(-2.69)	(-2.67)	(-2.59)	(-2.64)	(-2.58)	(-2.07)	(-2.11)	(-2.13)

Quintile Portfolios of Corporate Bonds Sorted by *KURT*

Quintiles	Average *KURT* in each quintile	Average excess returns	5-factor alpha	7-factor alpha with ΔDEF and ΔTERM	7-factor alpha with ΔCredSpr and Δ10Yr
Low KURT	-0.075	0.151	0.009	0.005	0.003
		(1.25)	(0.08)	(0.04)	(0.05)
2	0.636	0.153	0.012	0.008	0.006
		(1.24)	(0.10)	(0.06)	(0.09)
3	1.294	0.177	0.015	0.011	0.010
		(1.40)	(0.13)	(0.09)	(0.14)
4	2.276	0.205	0.055	0.051	0.051
		(1.57)	(0.47)	(0.40)	(0.61)
High KURT	6.396	0.502	0.373	0.370	0.371
		(3.14)	(2.54)	(2.37)	(2.82)
High − Low		0.351***	0.365***	0.365***	0.367***
Return/Alpha diff.		(3.32)	(3.38)	(3.44)	(3.57)

Panel B: Portfolio Characteristics

Quintiles	Average *KURT* in each quintile	Portfolio Characteristics		
		Rating	Maturity (yr)	AmountOut ($billions)
Low KURT	-0.075	6.639	15.535	0.242
2	0.636	6.639	15.744	0.239
3	1.294	6.875	15.216	0.242
4	2.276	7.299	14.370	0.245
High KURT	6.396	9.635	12.483	0.219

Quintile Portfolios of Corporate Bonds Sorted by *KURT*, Controlling for Credit Rating, Maturity, and Size

Panel A: Quintile portfolios of corporate bonds sorted by KURT controlling for credit rating

	All Bonds			Investment Grade			High Yield		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
KURT, 5 – KURT,1	0.220***	0.220***	0.219***	0.091	0.090	0.089	0.437***	0.441***	0.429***
Return/Alpha diff.	(2.70)	(2.74)	(2.84)	(1.32)	(1.38)	(1.40)	(2.66)	(2.69)	(2.66)

Panel B: Quintile portfolios of corporate bonds sorted by KURT controlling for maturity

	All Bonds			Short Maturity Bonds			Medium Maturity Bonds			Long Maturity Bonds		
	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3
KURT, 5 – KURT,1	0.286***	0.287***	0.284***	0.315**	0.308**	0.330***	0.293***	0.311***	0.330***	0.280***	0.285***	0.300***
Return/Alpha diff.	(3.04)	(3.06)	(3.18)	(2.38)	(2.35)	(2.60)	(2.64)	(2.70)	(2.93)	(2.91)	(2.98)	(3.12)

Panel C: Quintile portfolios of corporate bonds sorted by KURT controlling for size

	All Bonds			Small Bonds			Large Bonds		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
KURT, 5 – KURT,1	0.306***	0.308***	0.305***	0.310**	0.309**	0.298**	0.229***	0.231***	0.228***
Return/Alpha diff.	(3.37)	(3.40)	(3.59)	(2.28)	(2.31)	(2.34)	(2.93)	(2.97)	(3.08)

Fama-MacBeth Regressions

	Intercept	VOL	SKEW	KURT	Lagged Return	Rating	Maturity	AmountOut	Adj. R^2
(1)	0.008	**0.014**							0.044
	(0.07)	(3.58)							
(2)	-0.045	**0.009**			**-0.170**	0.009	**0.005**	-0.338	0.174
	(-0.37)	(2.65)			(-9.94)	(0.81)	(1.65)	(-1.10)	
(3)	0.208		-0.041						0.012
	(1.60)		(-1.08)						
(4)	-0.122		-0.038		**-0.156**	**0.034**	**0.007**	-0.336	0.157
	(-0.95)		(-1.39)		(-9.36)	(2.22)	(2.26)	(-1.07)	
(5)	0.111			**0.050**					0.020
	(0.91)			(3.83)					
(6)	-0.167			**0.020**	**-0.157**	**0.030**	**0.008**	-0.368	0.159
	(-1.26)			(2.29)	(-9.30)	(2.11)	(2.42)	(-1.01)	
(7)	-0.023	**0.016**	**-0.180**						0.057
	(-0.20)	(3.72)	(-4.28)						
(8)	-0.051	**0.009**	**-0.120**		**-0.166**	0.007	**0.006**	-0.359	0.178
	(-0.40)	(2.50)	(-3.59)		(-9.74)	(0.65)	(1.85)	(-0.96)	
(9)	-0.030	**0.017**	**-0.168**	0.003					0.071
	(-0.26)	(3.84)	(-3.68)	(0.26)					
(10)	-0.114	**0.010**	**-0.170**	-0.012		0.009	**0.004**	-0.096	0.121
	(-1.02)	(2.84)	(-4.30)	(-1.56)		(0.88)	(1.71)	(-0.55)	
(11)	-0.056	**0.008**	**-0.101**	-0.005	**-0.169**	0.009	**0.006**	-0.267	0.181
	(-0.43)	(2.42)	(-2.98)	(-0.49)	(-9.68)	(0.76)	(1.64)	(-0.81)	

Quintile Portfolios of Corporate Bonds Sorted by 5% *VaR*

- Empirical evidence: a significantly positive relation between value-at-risk (VaR) and expected returns in the cross-section.

Quintiles	Average 5% VaR in each quintile	Average excess returns	5-factor alpha	7-factor alpha with ΔDEF and ΔTERM	7-factor alpha with ΔCredSpr and Δ10Yr
Low	2.111	0.061	-0.059	-0.064	-0.063
		(0.59)	(-0.59)	(-0.66)	(-0.82)
2	3.196	0.266	0.151	0.147	0.141
		(1.87)	(1.12)	(1.11)	(1.32)
3	4.008	0.238	0.117	0.111	0.110
		(1.93)	(0.94)	(0.93)	(1.15)
4	4.859	0.259	0.195	0.192	0.189
		(1.35)	(1.02)	(1.01)	(1.12)
High	8.670	0.955	0.767	0.764	0.764
		(2.83)	(2.15)	(2.13)	(2.14)
High − Low		0.894***	0.826**	0.828**	0.826**
Return/Alpha diff.		(2.76)	(2.34)	(2.36)	(2.34)

Quintile Portfolios of Corporate Bonds Sorted by 5% *VaR* Within IG Bonds

Quintiles	Average VaR in each quintile	Average excess returns	5-factor alpha	7-factor alpha with ΔDEF and ΔTERM	7-factor alpha with ΔCredSpr and Δ10Yr
Low VaR	2.121	0.060	-0.059	-0.063	-0.065
		(0.61)	(-0.62)	(-0.68)	(-0.97)
2	3.142	0.191	0.072	0.068	0.066
		(1.79)	(0.69)	(0.66)	(1.02)
3	3.876	0.316	0.182	0.175	0.169
		(2.19)	(1.25)	(1.26)	(1.58)
4	4.610	0.130	0.006	-0.002	-0.006
		(0.87)	(0.04)	(-0.01)	(-0.05)
High VaR	6.156	0.410	0.297	0.293	0.297
		(2.95)	(1.85)	(1.82)	(2.23)
High-Low		0.349***	0.356***	0.356***	0.362***
Return/Alpha diff.		(3.48)	(2.63)	(2.73)	(2.79)

Panel B: Portfolio Characteristics

Quintiles	Average VaR in each quintile	Portfolio Characteristics		
		Rating	Maturity (yr)	AmountOut ($billions)
Low VaR	2.121	6.109	11.319	0.187
2	3.142	6.080	13.460	0.169
3	3.876	5.938	15.670	0.182
4	4.610	5.858	17.847	0.186
High VaR	6.156	6.369	21.089	0.190

Quintile Portfolios of Corporate Bonds Sorted by 1% VaR and 10% VaR

Panel A: Quintile portfolios of corporate bonds sorted by 1% VaR

Quintiles	Average *VaR* in each quintile	Average excess returns	5-factor alpha	7-factor alpha with ΔDEF and ΔTERM	7-factor alpha with ΔCredSpr and Δ10Yr
High — Low		0.805***	0.663**	0.663**	0.661**
Return/Alpha diff.		(3.17)	(2.42)	(2.41)	(2.40)

Panel B: Quintile portfolios of corporate bonds sorted by 10% VaR

Quintiles	Average *VaR* in each quintile	Average excess returns	5-factor alpha	7-factor alpha with ΔDEF and ΔTERM	7-factor alpha with ΔCredSpr and Δ10Yr
High — Low		0.914***	0.899***	0.899***	0.900***
Return/Alpha diff.		(3.05)	(2.73)	(2.72)	(2.71)

Quintile Portfolios of Corporate Bonds Sorted by 5% VaR, Controlling for Credit Rating, Maturity, and Size

Panel A: Quintile portfolios of corporate bonds sorted by 5% VaR controlling for credit rating

	All Bonds			Investment Grade			High Yield		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
VaR, 5 − VaR,1	0.433***	0.432***	0.433***	0.335***	0.334***	0.337***	0.930***	0.940***	0.929***
Return/Alpha diff.	(3.18)	(3.19)	(3.31)	(2.81)	(2.85)	(2.99)	(4.54)	(4.65)	(4.62)

Panel B: Quintile portfolios of corporate bonds sorted by 5% VaR controlling for maturity

	All Bonds			Short Maturity Bonds			Medium Maturity Bonds			Long Maturity Bonds		
	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3
VaR, 5 − VaR,1	0.661***	0.660***	0.666***	0.336	0.347*	0.337	0.686**	0.727**	0.687**	0.574***	0.577***	0.586***
Return/Alpha diff.	(2.95)	(3.03)	(3.00)	(1.53)	(1.73)	(1.57)	(2.26)	(2.40)	(2.27)	(2.73)	(2.83)	(2.80)

Panel C: Quintile portfolios of corporate bonds sorted by 5% VaR controlling for size

	All Bonds			Small Bonds			Large Bonds		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
VaR, 5 − VaR,1	0.758***	0.760***	0.760***	0.701**	0.696**	0.686**	0.510**	0.509**	0.510**
Return/Alpha diff.	(3.03)	(3.07)	(3.05)	(2.48)	(2.54)	(2.51)	(2.21)	(2.22)	(2.19)

Univariate and Multivariate Fama-MacBeth Regression

Intercept	1% VaR	5% VaR	10% VaR	Rating	Maturity	AmountOut	Lagged Return
			Panel A: Univariate Regression				
-0.194	0.049***						
(-1.63)	(4.92)						
-0.212**		0.096***					
(-2.00)		(4.82)					
-0.186*			0.156***				
(-1.78)			(4.63)				
			Panel B: Multivariate Regression				
-0.214	0.038***			0.010	0.003	-0.285	-0.147***
(-1.57)	(4.09)			(0.82)	(1.16)	(-0.84)	(-8.78)
-0.211		0.082***		0.014	0.000	-0.359	-0.146***
(-1.53)		(4.73)		(1.22)	(0.11)	(-1.00)	(-7.70)
-0.204			0.109***	0.023*	0.001	-0.446	-0.148***
(-1.48)			(3.94)	(1.89)	(0.29)	(-1.22)	(-7.52)

- VaR is positively related to cross-sectional returns of corporate bonds

Liquidity and Transaction Cost

- Controlling for liquidity beta: Amihud (2002) and Pastor-Stambaugh (2003) liquidity beta.

- Estimate the portfolio transaction costs using Bao, Pan, and Wang (2011) measure, which extracts the transitory component in the bond price.

Fama-MacBeth Regression with VOL, SKEW, KURT Controlling for Liquidity Beta

	Intercept	VOL	SKEW	KURT	LIQ1	LIQ2	Rating	Maturity	Size	Lagged Ret	Adj. R^2
(1)	-0.117	**0.011**	**-0.164**	-0.011	0.002			0.010	0.003	-0.080	0.125
	(-1.06)	(3.18)	(-4.35)	(-1.49)	(0.11)			(0.99)	(1.47)	(-0.45)	
(2)	-0.114	**0.009**	**-0.149**	-0.005		-0.002		0.010	**0.004**	-0.086	0.127
	(-1.02)	(2.89)	(-3.86)	(-0.71)		(-0.07)		(1.03)	(1.70)	(-0.49)	
(3)	-0.064	**0.010**	**-0.100**	-0.006	-0.007		0.010	0.005	-0.257	**-0.172**	0.186
	(-0.50)	(2.57)	(-2.97)	(-0.60)	(-0.46)		(1.00)	(1.57)	(-0.78)	(-9.67)	
(4)	-0.051	**0.009**	**-0.087**	-0.004	-0.008		0.011	0.005	-0.261	**-0.172**	0.186
	(-0.40)	(2.51)	(-2.44)	(-0.42)		(-0.32)	(1.06)	(1.59)	(-0.79)	(-9.80)	

Fama-MacBeth Regression with VaR Controlling for Liquidity Beta

	Intercept	1%VaR	5%VaR	10%VaR	LIQ1	LIQ2	Rating	Maturity	Size	Lagged Ret	Adj. R^2
(1)	-0.219	**0.038**			-0.004		**-0.150**	0.010	0.003	-0.277	0.163
	(-1.63)	(4.25)			(-0.26)		(-8.73)	(0.96)	(1.13)	(-0.81)	
(2)	-0.497	**0.034**				-0.010	**-0.202**	0.004	0.001	0.320	0.134
	(-2.54)	(2.58)				(-0.16)	(-14.28)	(0.14)	(0.17)	(1.29)	
(3)	-0.224		**0.083**		-0.000		**-0.148**	0.014	0.000	-0.343	0.166
	(-1.64)		(5.19)		(-0.02)		(-7.71)	(1.32)	(0.10)	(-0.95)	
(4)	-0.441		**0.046**			0.002	**-0.207**	0.006	0.001	0.316	0.129
	(-2.18)		(2.67)			(0.03)	(-14.05)	(0.23)	(0.27)	(1.27)	
(5)	-0.207			**0.107**	0.003		**-0.150**	**0.023**	0.001	-0.432	0.165
	(-1.53)			(4.28)	(0.18)		(-7.51)	(1.97)	(0.31)	(-1.18)	
(6)	-0.394			**0.053**		0.033	**-0.204**	0.006	0.000	0.382	0.128
	(-1.90)			(2.65)		(0.53)	(-13.60)	(0.23)	(0.01)	(1.19)	

Transaction Costs for Bond Portfolios Sorted by VOL

Panel A: Quintile portfolios of corporate bonds sorted by VOL

	Low	2	3	4	High	High-Low
			Panel A1: All Bonds			
L^{BPW}	0.360	0.276	0.378	0.635	2.207	
Turnover	0.043	0.043	0.042	0.044	0.048	
TransCosts	0.016	0.012	0.016	0.028	0.106	0.122
			Panel A2: Invstment Grade bonds			
L^{BPW}	0.426	0.253	0.373	0.481	1.376	
Turnover	0.043	0.042	0.040	0.042	0.047	
TransCosts	0.018	0.011	0.015	0.020	0.064	0.083
			Panel A3: Non-Invstment Grade bonds			
L^{BPW}	0.266	0.264	1.153	1.333	3.767	
Turnover	0.054	0.054	0.050	0.047	0.045	
TransCosts	0.014	0.014	0.058	0.062	0.170	0.185

Transaction Costs for Bond Portfolios Sorted by 5% VaR

Panel B: Quintile portfolios of corporate bonds sorted by 5% VaR

	Low	2	3	4	High	High-Low
			Panel B1: All Bonds			
L^{BPW}	0.556	0.653	2.036	1.223	5.586	
Turnover	0.028	0.027	0.024	0.053	0.026	
TransCosts	0.015	0.017	0.049	0.065	0.146	0.162
			Panel B2: Invstment Grade bonds			
L^{BPW}	0.548	0.582	2.082	0.817	1.316	
Turnover	0.028	0.028	0.024	1.747	0.027	
TransCosts	0.015	0.016	0.049	1.427	0.036	0.051
			Panel B3: Non-Invstment Grade bonds			
L^{BPW}	0.728	1.021	5.119	3.821	11.805	
Turnover	0.028	0.027	0.024	0.053	0.026	
TransCosts	0.020	0.027	0.122	0.203	0.309	0.330

Transaction Cost Adjusted Return/Alpha Spreads

- Volatility-sorted portfolios:
  - 4.6% and 5.7% per annum for all bonds
  - 3.3% and 3.9% per annum for investment grade bonds
  - more than 10% per annum for non-investment grade bonds
- VaR-sorted portfolios:
  - 8% and 8.7% per annum for all bonds
  - 3.6% and 3.7% per annum for investment grade bonds
  - more than 10% per annum for non-investment grade bonds

Conclusion

Distributional characteristics predict future corporate bond returns in the cross section

- Volatility is significantly positively related to expected corporate bond returns.
- Skewness is significantly negatively related to expected returns, after controlling for volatility.
- Downside risk (VaR) is significantly positively related to expected corporate bond returns.
- Results are robust after controlling for bond characteristics such as rating, maturity, and size.
- Main findings remain intact after controlling for transaction costs, liquidity and a large set of stock/bond market risk factors.
- No robust evidence on kurtosis.