Model-Based Cross-Section Factors in Corporate Bonds

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Motivations

- The U.S. corporate bond market
  - Amount outstanding: $11.55 trillion as of 2025.
  - The most important debt financing channel for large U.S. corporations.
  - An essential investment vehicle for global financial institutions and investors.
- In addition to its considerable size, it offers a large cross-section of corporate bonds
  - Over 1,900 issuers with 23,000 bonds.
  - Varying maturities, credit quality, and liquidity.
- This cross-section of corporate bonds contains rich information on
  - Duration risk: driven by the long-term interest rates.
  - Credit risk: determined by firm fundamentals and macroeconomic conditions.
  - Liquidity risk: linked directly to the balance-sheet capacity of dealers.

This Paper

- Empirically motivated portfolios constructed from firm or bond characteristics:
  - Time-series factor model (i.e., sorting): Fama and French (1992, 1993, 2015).
  - Cross-section factor model (via Fama-MacBeth): Fama and French (2020).
  - Characteristics as covariance: Kelly, Pruitt, and Su (2019).
- Our risk factors emerge from an arbitrage-free asset-pricing model:
  - Start with a structural model of default with interest-rate risk and liquidity shocks and derive the factor loadings from the model.
  - Use the model-implied factor loadings to extract the common risk factors – credit, liquidity, and duration – from the cross-section of corporate bond returns.
- **A theory-based diagnostic tool** for the empirically motivated portfolios – use the model-implied exposures to separate the risks and identify their economic origins.
- **A rich set of applications** that goes beyond the corporate bond market – decompose U.S. Treasury bond returns into pure duration and safety premium.

Methodology: Model-Based Factor Extraction

Let P_t^i be the time-t price of asset i and assume the existence of a risk-neutral measure

$$\frac{dP_t^i}{P_t^i} - r_t\,dt = \mathbf{b_i}\,dF_t^Q + dB_t^i\,,\ i = 1, 2, \ldots, N\,.$$

- Central to our factor extraction is the model-implied factor loading $\mathbf{b_i}$, which we derive from structural models of default.
- Fix time t, regress market-observed excess returns across i on their respective model-implied factor loadings $\mathbf{b_i}$ to back out the time-t risk factor dF_t^Q.
- The extracted risk factor, dF_t^Q, is zero mean under Q and non-zero under the physical measure, with the factor risk premium λ_t driving the difference.
- The unpriced idiosyncratic risk, dB_t^i, is zero mean under both measures.

Main Empirical Findings

- Trace and analyze the economic content of the model-based extracted factors
  - Extreme drops in Credit/Duration/ Liquidity $\Rightarrow$ episodes of flight-to-quality/cash/liquidity.
  - Credit driven by VIX, Duration by MOVE, and Liquidity by Financial Condition.
- Use the model-based factors to evaluate portfolio returns and identify economic drivers.
  - Credit and Liquidity: Positive and significant risk premiums, with importance reaching beyond the credit market. Duration is a prominent presence in fixed-income portfolios.
  - Our model can explain the empirically motivated portfolios in the literature and their exposures on our model-based factors identify the economic origins.
- The unique economic content of the model-based factors offers a rich set of applications:
  - Use Duration to extract the safety premium from UST, flight-to-safety vs. dash-to-cash.
  - Credit spread=credit+liquidity: corr(Duration,Credit)>0, while corr(Duration,Liquidity)<0.
  - Increasing interest rate hurts credit (especially high-yield bonds) and liquidity.
  - Strong evidence of credit-driven liquidity risk, but no evidence of liquidity-driven credit risk.

Related Literature

- Structural model of default
  - Merton (1974), Black and Cox (1976), Leland (1994), Longstaff and Schwartz (1995), Leland and Toft (1996), He and Xiong (2012).
  - **This paper**: A unified model of credit, interest-rate and liquidity risks and its empirical performance on cross-section bond returns.
- Risk factors in corporate bonds
  - Fama and French (1993), Bai et al. (2019), Fama and French (2020), Kelly et al. (2023), Dickerson et al. (2023), Dang et al. (2023), Dick-Nielsen et al. (2024).
  - **This paper**: Unique in its model-based approach – the economic content of the extracted factors offers a rich set of diagnostic tools and applications.

Part I

Model-Based Factor Extraction

Model Setup

- **Credit:** Under the risk-neutral measure, firm-i's asset value V_t^i follows

$$\frac{dV_t^i}{V_t^i} = r_t\, dt + \beta_i\, \sigma_V\, \mathbf{dB_t^V} + \sigma_i\, dB_t^{V,i}\,,$$

  where dB_t^V is the systematic shock driving the credit factor.
  - The firm-specific shock $dB_t^{V,i}$ is independent across i and of dB_t^V.
  - For pricing purpose, V_t^i is Merton (1974) with asset volatility $\left(\beta_i^2\sigma_V^2 + \sigma_i^2\right)^{1/2}$.
- **Duration:** We allow for stochastic interest rate

$$dr_t = (\alpha_r - \kappa_r\, r_t)\, dt + \eta_r\, \mathbf{dB_t^r}\,.$$

- **Liquidity:** Upon Poisson arrival with intensity ξ_t, liquidity shocks hit all bonds,

$$d\xi_t = (\alpha_\xi - \kappa_\xi\, \xi_t)\, dt + \eta_\xi\, \mathbf{dB_t^\xi}\,.$$

  The loss-given-liquidation $l_i > 0$, like Duffie and Singleton's loss-given-default, is applied to the market value of the bond.

Defaultable Bond Pricing

- Consider a default-free zero-coupon bond maturing at date $T = t + \tau$

$$R(r_t, \xi_t, \tau) = \mathbb{E}_t^Q \left[\exp\left(-\int_t^T (r_s + l_i\, \xi_s)\, ds \right) \right] = e^{A(\tau) + B(\tau)\, r_t + C(\tau)\, \xi_t} .$$

  The expected loss rate $l_i\, \xi_t$ folds into the discount rate (Duffie and Singleton 1999).

- For a defaultable bond issued by firm i with default boundary K

$$\begin{aligned} P(V_t^i, r_t, \xi_t, \tau) &= \mathbb{E}_t^Q \left[\exp\left(-\int_t^T (r_s + l_i\, \xi_s)\, ds \right) \min(V_T^i, K) \right] \\ &= K\, R(r_t, \xi_t, \tau)\, N(d_2) + V_t^i\, R(r_t, \xi_t, \tau)\, e^{M(r_t, \tau) + S(\tau)^2/2}\, N(-d_1) \end{aligned}$$

  - Set the loss-given-liquidation $l_i = 0$, we recover Longstaff and Schwartz (1995).
  - Further turn off the stochastic nature of the short rate, we recover Merton (1974).

Model-Implied Factor Loadings

$$\boxed{\frac{dP_t^i}{P_t^i} - r_t dt = \mathbf{b_i^V}\,\sigma_V\,dB_t^V + \mathbf{b_i^r}\,\eta_r\,dB_t^r + \left(\mathbf{b_i^\xi}\,\eta_\xi\,dB_t^\xi + l_i\,\xi_t\,dt\right) + de_t^i\,,}$$

$$\text{Credit:} \quad b_i^V = \frac{\partial \ln P_t^i}{\partial \ln V_t^i} = \beta_i \frac{V_t^i}{P_t^i} \boxed{N(-d_1)}\, R(r_t, \xi_t, \tau)\, e^{M(r_t,\tau)+S(\tau)^2/2}$$

$$\text{Duration:} \quad b_i^r = \frac{\partial \ln P_t^i}{\partial r} = \boxed{-\frac{1-e^{-\kappa_r \tau}}{\kappa_r}}\, \frac{K}{P_t^i}\, N(d_2)\, R(r_t, \xi_t, \tau)$$

$$\text{Liquidity:} \quad b_i^\xi = \frac{\partial \ln P_t^i}{\partial \xi} = -\frac{1-e^{-\kappa_\xi \tau}}{\kappa_\xi} \boxed{l_i}$$

- Intuitively, $\mathbf{b_i^V}$ is larger for lower **quality** firms with $\boxed{N(-d_1)}$ closer to 1.
- Similarly, $-\mathbf{b_i^r}$ is larger for longer **duration** bonds with larger $\boxed{\tau}$.
- And $-\mathbf{b_i^\xi}$ is larger for **illiquid** bonds with more sizeable loss-given-liquidation $\boxed{l_i}$.

Model-Based Factor Extraction – Structurally Disciplined

$$\boxed{R_t^i - r_f} = \alpha + \boxed{b_i^V}\,\mathbf{R}_t^{\text{Credit}} + \boxed{-b_i^r}\,\mathbf{R}_t^{\text{Duration}} + \boxed{-b_i^\xi}\,\mathbf{R}_t^{\text{Liquidity}} + \epsilon_t^i$$

- For each month t, we regress bond excess returns cross-sectionally on the factor loadings
  - The month-t factor returns are the cross-sectional regression coefficients.
  - This factor extraction is done simultaneously – the three factors are jointly estimated.
- Key to the identification: when one particular factor is the major driver in month t, cross-sectional bond returns line up prominently along the respective factor loading.
  - Credit: low vs high quality $\Rightarrow$ high vs low $\boxed{b_i^V}$ $\Rightarrow R_t^{\text{Credit}}$
  - Duration: long vs short duration $\Rightarrow$ high vs low $\boxed{-b_i^r}$ $\Rightarrow R_t^{\text{Duration}}$
  - Liquidity: illiquid vs liquid $\Rightarrow$ high vs low $\boxed{-b_i^\xi}$ $\Rightarrow R_t^{\text{Liquidity}}$
- Each factor is a portfolio of excess bond returns, weighted by the factor loadings.

Data and Model-Driven Estimation

- TRACE Enhanced transactions, WRDS bond returns, FISD bond characteristics, CRSP equity data, and Compustat annual reports: 912,247 bond-months for 23,520 bonds and 1,966 firms, Aug 2002–Mar 2025.
- For each firm, solve jointly for asset value V_t^i and asset volatility σ:

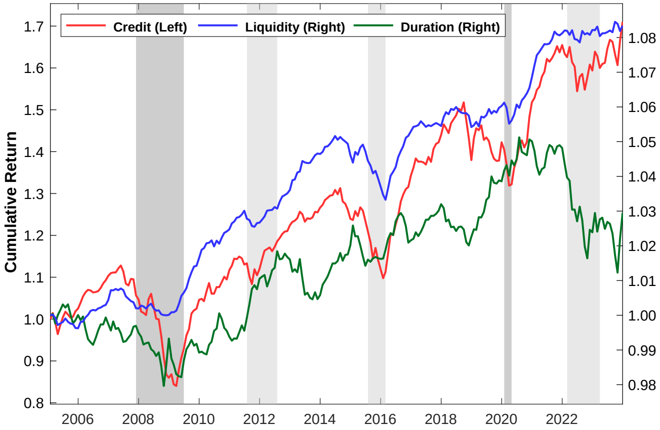
$$E_t^i = V_t^i R(r_t, \xi_t, \tau)\, e^{M+S^2/2} N(d_1) - K R(r_t, \xi_t, \tau)\, N(d_2), \qquad \sigma_E = \frac{V_t^i}{E_t^i} \frac{\partial E_t^i}{\partial V_t^i} \sigma.$$

  - $K =$ current debt $+$ long-term debt; Equity volatility uses up to 60 preceding monthly returns.
  - Firm duration is debt-value weighted using 0.5, 1.5, 2.5, 3.5, and 10 years.
  - Illiquidity $l_i = 2\sqrt{\max(\gamma_i, 0)}$, with at least ten adjacent-return pairs.
  - Annual accounting data enter 120 days after fiscal year-end; other inputs come from the preceding month-end.
- Calibrated annualized parameters from the data: $(\alpha_r, \kappa_r, \eta_r, \rho_{Vr}) = (0.002, 0.03, 0.01, -0.25)$ and $(\bar{\xi}, \kappa_\xi, \eta_\xi, \rho_{V\xi}, \rho_{r\xi}) = (1, 0.8, 1.2, -0.25, -0.40)$.
- **Model-driven estimation:** substitute these inputs directly into the three loading formulas and jointly regress excess returns on the predetermined loadings.

Part II

Model-Based Factors: Credit, Liquidity, and Duration

Model-Based Factors and Factor Risk Premiums

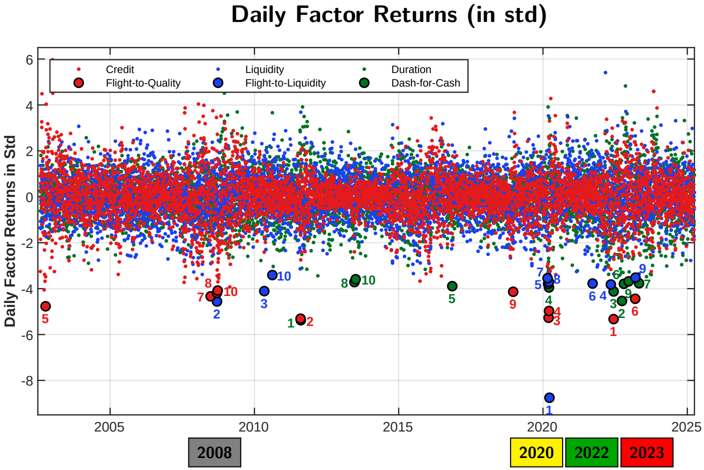


Estimated Factor Risk Premiums

	Credit	Liquidity	Duration
	0.298	0.054	0.012
	[3.36]	[4.64]	[0.73]

- Monthly average returns in % for one unit exposure of model-implied factor beta.
- Compensations for bearing
  - Credit: default risk.
  - Liquidity: intermediary-capacity risk.
  - Duration: long-term interest-rate risk.

Identify Flights-to-Safety using Model-Based Factors



Most Negative Duration-Factor Days

	Date	std	Main event
1	2011-08-11	-5.38	Reversal: UST downgrade+European stress (8/5-10)
2	2022-09-27	-4.54	Hot CPI & Hawkish Fed+UK fiscal crisis
3	2022-06-13	-4.12	Hot CPI + upcoming FOMC on 6/15 (+75bp)
4	2020-03-17	-3.95	Peak dash-for-cash + CPFF/PDCF
5	**2016-11-09**	-3.89	Reversal: Trump won on 11/8
6	2022-10-21	-3.79	Reversal: Fed signals slowdown (Nov last +75bp)
7	2023-05-01	-3.77	May FOMC (+25bp) tightening+FRB failure
8	**2013-06-20**	-3.72	Taper tantrum
9	2022-12-20	-3.68	BoJ surprise/bond selloff
10	2013-07-05	-3.59	Strong payrolls/Fed taper fear

Most Negative Credit-Factor Days

	Date	std	Main event
1	2022-06-13	-5.33	Hot CPI + upcoming FOMC on 6/15 (+75bp)
2	2011-08-08	-5.31	UST downgrade (8/5 Friday)
3	2020-03-12	-5.27	Continued dash-for-cash & global sell-off
4	2020-03-18	-4.97	Continued dash-for-cash & global sell-off + MMLF
5	2002-10-07	-4.77	Post-dot-com stress
6	2023-03-13	-4.44	SVB banking stress
7	2008-06-26	-4.34	Pre-Lehman selloff
8	2008-09-15	-4.19	Lehman bankruptcy
9	2018-12-20	-4.14	Fed hike/growth fears
10	2008-09-23	-4.08	TARP uncertainty

Most Negative Liquidity-Factor Days

	Date	std	Main event
1	2020-03-23	-8.75	QE infinite/PMCCF/SMCCF
2	2008-09-15	-4.56	Lehman bankruptcy
3	**2010-05-06**	-4.11	Flash Crash/liquidity withdraw
4	2022-05-09	-3.82	Inflation & aggressive rate hike (+50bp on 5/4)
5	**2020-03-06**	-3.79	COVID funding stress
6	2021-09-20	-3.78	Evergrande risk-off
7	2020-03-16	-3.71	Fed emergency cut and QE (3/15 Sunday)
8	**2020-02-28**	-3.55	COVID selloff
9	2023-03-17	-3.52	FRB banking stress and large banks' exposure
10	2010-08-16	-3.41	Growth/deflation fears

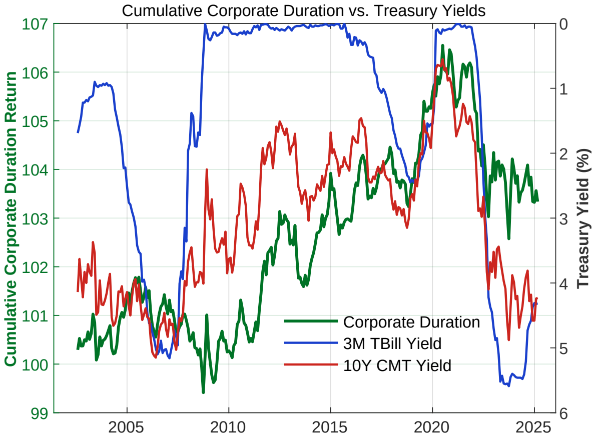
Key Macro and Market Uncertainty Drivers

Key Drivers of the Model-Based Factors

	Credit		Liquidity		Duration	
Financial Uncertainty		-0.21**	-0.41***	-0.25***		-0.04
		[-2.54]	[-6.92]	[-3.10]		[-0.55]
Macro Uncertainty		-0.01		-0.24*		0.08
		[-0.07]		[-1.75]		[0.49]
Real Uncertainty		-0.01		0.09		-0.05
		[-0.08]		[0.71]		[-0.34]
VIX Index	-0.53***	-0.38***		-0.18**		-0.12
	[-9.66]	[-5.71]		[-2.37]		[-1.49]
MOVE Index		-0.14**		0.04	-0.30***	-0.23***
		[-2.22]		[0.66]	[-4.30]	[-2.94]
Treasury Noise		0.02		0.01		-0.04
		[0.29]		[0.11]		[-0.50]
Obs.	272	272	272	272	272	272
Adj. R^2	0.28	0.32	0.17	0.20	0.08	0.08

Uncertainty measures: Jurado, Ludvigson, and Ng (2015); Treasury Noise: Hu, Pan, and Wang (2013); MOVE: VIX for bonds.

Duration: Relation to Long- and Short-Term Interest Rates

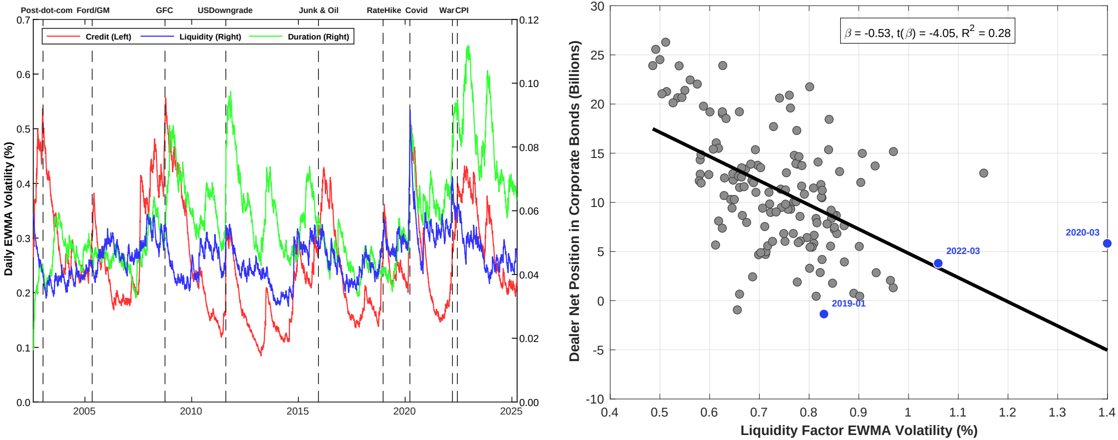


$$R_t^{\text{Duration}} = a + b_{\text{3M}}\,\Delta y_t^{\text{3M}} + b_{\text{10y}}\,\Delta y_t^{\text{10y}} + \epsilon_t$$

	Duration Factor		
Constant	0.013	0.012	0.010
	[0.83]	[1.13]	[0.99]
b_{3M}	-0.103		0.187**
	[-1.14]		[2.33]
b_{10Y}		-0.826***	-0.865***
		[-14.60]	[-16.02]
R^2	0.006	0.592	0.610
Obs	272	272	272

Duration factor loads negatively on changes in 10-year yields and positively on long-term bond returns.

Liquidity Factor: Relation to Dealers' Balance-Sheet Capacity



- Dealer net positions and Liquidity-factor volatility are negatively related ($\beta = -0.53$, $t = -4.05$, $R^2 = 28\%$).

Part III

Model-Based Factors as a Diagnostic Tool

Explaining Aggregate Returns Across Asset Classes

	U.S.					Foreign		
	CorpBond	HY	IG	Stock	UST	CorpBond	Sov. EM	Sov. EU
Mean (%)	0.35***	0.53***	0.26**	0.82***	0.12	0.41***	0.50***	0.15*
	[3.07]	[3.41]	[2.31]	[3.05]	[1.46]	[3.56]	[3.25]	[1.65]
α (%)	0.09	0.07	0.06	0.08	0.16***	0.11	0.16	-0.01
	[1.37]	[0.58]	[0.88]	[0.37]	[3.15]	[1.54]	[1.16]	[-0.08]
Duration	4.91***	1.35	5.87***	0.31	4.51***	4.84***	4.15***	3.58***
	[11.59]	[1.56]	[17.33]	[0.26]	[16.39]	[11.87]	[5.56]	[7.89]
Credit	0.30***	1.04***	0.07	1.86***	-0.37***	0.29***	0.60***	0.04
	[4.13]	[9.02]	[1.00]	[7.82]	[-6.63]	[3.91]	[5.00]	[0.56]
Liquidity	2.00***	2.52***	2.01***	3.33**	0.18	2.75***	1.95*	1.83***
	[3.73]	[2.73]	[3.71]	[2.06]	[0.41]	[4.67]	[1.93]	[3.00]
R^2	0.74	0.58	0.77	0.51	0.71	0.73	0.50	0.46

Model-Based Factor Model as a Diagnostic Tool: Duration

	BondBeta-Sorted Portfolio					Duration-Sorted Portfolio				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Mean	0.14**	0.20**	0.26**	0.33**	0.46**	0.19***	0.27***	0.31**	0.35**	0.30
	[2.34]	[2.58]	[2.39]	[2.17]	[2.32]	[3.36]	[2.89]	[2.53]	[2.33]	[1.53]
α	0.01	0.06	0.07	0.05	0.06	0.06	0.05	0.05	0.06	0.03
	[0.19]	[1.03]	[0.93]	[0.58]	[0.53]	[1.15]	[0.62]	[0.55]	[0.66]	[0.48]
Duration	1.84***	3.17***	4.88***	6.95***	7.34***	0.93***	2.16***	3.65***	6.91***	10.56***
	[5.54]	[8.65]	[9.04]	[10.64]	[6.74]	[2.81]	[4.18]	[5.51]	[11.20]	[18.49]
Credit	0.09*	0.07	0.12*	0.24***	0.75***	0.19***	0.38***	0.42***	0.21**	0.19**
	[1.92]	[1.24]	[1.76]	[2.80]	[4.25]	[3.28]	[4.34]	[4.29]	[2.10]	[2.56]
Liquidity	1.65***	1.67***	2.22***	2.86***	2.80***	1.39***	2.02***	2.17***	3.20***	2.36***
	[3.80]	[3.59]	[3.93]	[3.85]	[2.70]	[3.42]	[3.37]	[3.07]	[4.08]	[4.24]
R^2	0.44	0.58	0.65	0.75	0.72	0.38	0.52	0.56	0.75	0.90
	Model-Based Factor Loadings					Model-Based Factor Loadings				
Duration	2.430	3.613	4.970	6.628	8.307	1.800	3.136	4.524	6.550	10.489
Credit	0.086	0.076	0.091	0.120	0.202	0.114	0.154	0.146	0.095	0.074
Liquidity	0.909	1.080	1.337	1.609	1.905	0.791	1.178	1.396	1.626	1.938

Model-Based Factor Model as a Diagnostic Tool: Credit

	Rating-Sorted Portfolio					CreditExposure-Sorted Portfolio				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Mean	0.19*	0.22*	0.27**	0.36***	0.46***	0.21**	0.24**	0.25**	0.29**	0.38**
	[1.72]	[1.88]	[2.14]	[2.65]	[2.59]	[2.03]	[2.14]	[2.22]	[2.27]	[2.09]
α	0.10**	0.07	0.05	0.04	-0.03	0.13***	0.12**	0.07	0.01	-0.15
	[2.14]	[1.22]	[0.70]	[0.42]	[-0.22]	[2.87]	[2.34]	[1.16]	[0.17]	[-1.12]
Duration	6.21***	6.17***	6.18***	4.20***	1.35	5.62***	5.94***	5.67***	4.91***	2.93***
	[17.05]	[14.86]	[13.80]	[5.47]	[1.36]	[16.82]	[13.81]	[14.05]	[9.49]	[3.12]
Credit	-0.10	0.01	0.10	0.48***	1.20***	-0.10	0.01	0.05	0.39***	1.03***
	[-1.62]	[0.12]	[1.58]	[4.43]	[8.60]	[-1.62]	[0.11]	[0.75]	[5.57]	[7.42]
Liquidity	1.14***	1.69***	2.54***	2.99***	3.20***	0.99**	1.18***	2.10***	2.50***	4.46***
	[2.97]	[3.52]	[4.66]	[3.36]	[3.23]	[2.57]	[2.72]	[4.10]	[4.12]	[3.76]
R^2	0.84	0.81	0.77	0.60	0.61	0.82	0.81	0.79	0.71	0.65
	Model-Based Factor Loadings					Model-Based Factor Loadings				
Duration	5.921	5.916	5.748	4.888	3.520	5.747	6.021	5.884	5.291	3.603
Credit	0.015	0.054	0.070	0.163	0.417	0.000	0.001	0.011	0.075	0.532
Liquidity	1.182	1.263	1.421	1.560	1.754	1.193	1.291	1.370	1.474	1.682

Model-Based Factor Model as a Diagnostic Tool: Liquidity

	YieldSpread-Sorted Portfolio					Illiquidity-Sorted Portfolio				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Mean	0.13*	0.21*	0.27**	0.35**	0.55**	0.23*	0.23***	0.26**	0.34**	0.41**
	[1.75]	[1.82]	[2.08]	[2.43]	[2.54]	[1.91]	[2.63]	[2.39]	[2.46]	[2.40]
α	0.07	0.09	0.11	0.07	-0.08	0.03	0.10	0.08	0.07	-0.05
	[1.42]	[1.48]	[1.62]	[0.71]	[-0.48]	[0.32]	[1.64]	[1.14]	[0.86]	[-0.49]
Duration	3.87***	6.08***	6.78***	5.51***	2.56**	4.42***	3.83***	4.90***	6.26***	6.58***
	[9.72]	[13.19]	[14.47]	[7.40]	[2.22]	[6.15]	[9.95]	[10.90]	[12.20]	[9.12]
Credit	-0.13**	-0.08	0.08	0.44***	1.35***	0.34***	0.10*	0.19***	0.31***	0.50***
	[-1.97]	[-1.25]	[1.11]	[4.24]	[7.88]	[3.41]	[1.79]	[2.69]	[3.79]	[4.36]
Liquidity	1.20***	1.60***	1.60***	2.25***	4.94***	1.52**	1.33***	1.70***	2.67***	5.21***
	[3.01]	[3.55]	[2.97]	[2.75]	[3.69]	[2.08]	[3.16]	[3.17]	[4.18]	[5.61]
R^2	0.63	0.77	0.82	0.68	0.63	0.58	0.66	0.74	0.78	0.75
	Model-Based Factor Loadings					Model-Based Factor Loadings				
Duration	3.743	5.734	6.907	6.333	4.405	4.734	4.280	5.319	6.410	6.941
Credit	0.019	0.037	0.064	0.152	0.419	0.111	0.084	0.098	0.131	0.210
Liquidity	0.906	1.253	1.443	1.643	2.054	0.218	0.714	1.275	2.067	3.702

Part IV

Applications of the Model-Based Factors

Application 1: Decompose U.S. Treasury Returns

$$\boxed{\text{U.S. Treasury Safety} = \text{Treasury Duration - Corp Duration}}$$

- Corp Duration: Estimated from IG bonds (credit & liquidity controlled) $\Rightarrow$ Pure Duration.
- Treasury Duration: Estimated from Treasuries $\Rightarrow$ Pure Duration $+$ Safety.

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$$R_t = a + \beta^D \,\text{Corp Duration}_t + \beta^S \,\text{Safety}_t + \epsilon_t$$

	R_t^{Stock}	R_t^{UST}
Duration β^D	0.00	0.05***
	[0.13]	[28.38]
Safety β^S	-0.16***	0.05***
	[-7.27]	[17.31]
Obs.	272	272
R^2	0.37	0.85

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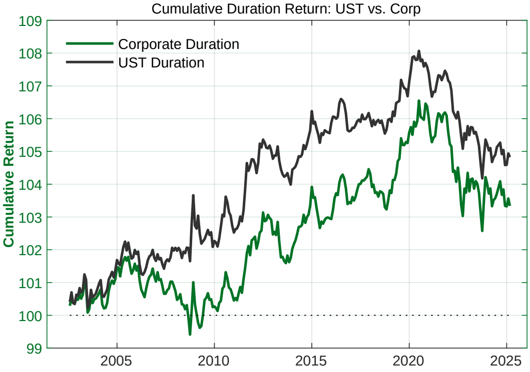
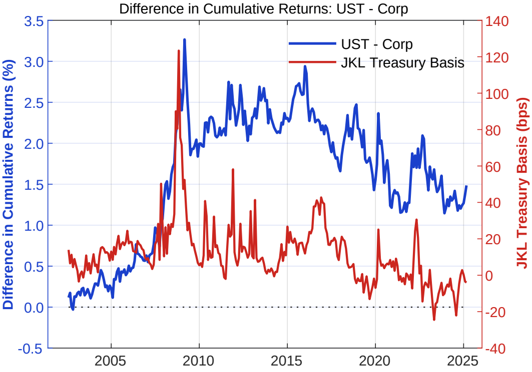
- Pure duration factor returns are positively related to UST returns, but not stock returns.
- A strong negative relation between stock returns and the safety component of UST returns.

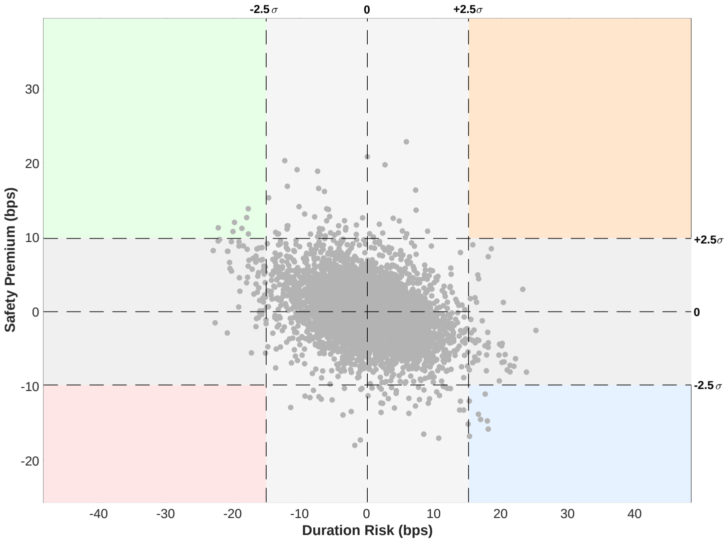
A Return-Based Convenience Yield of U.S. Treasuries

$$\boxed{\text{U.S. Treasury Safety} = \text{Treasury Duration - Corp Duration}}$$





Flight to Safety and Dash to Cash



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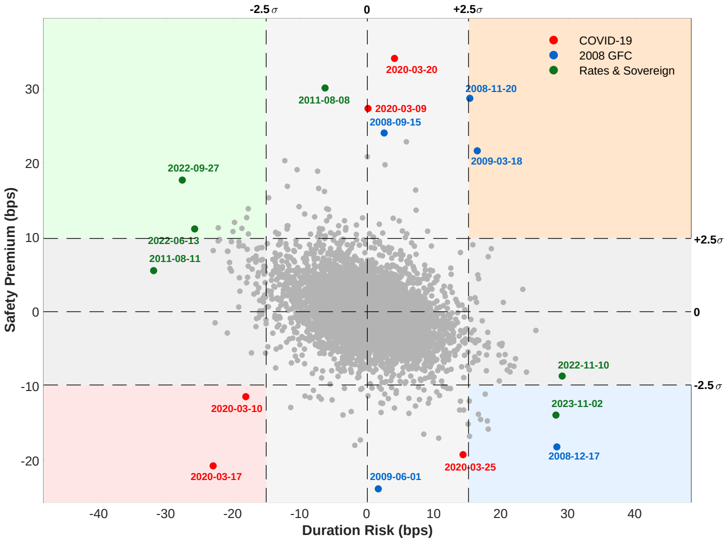
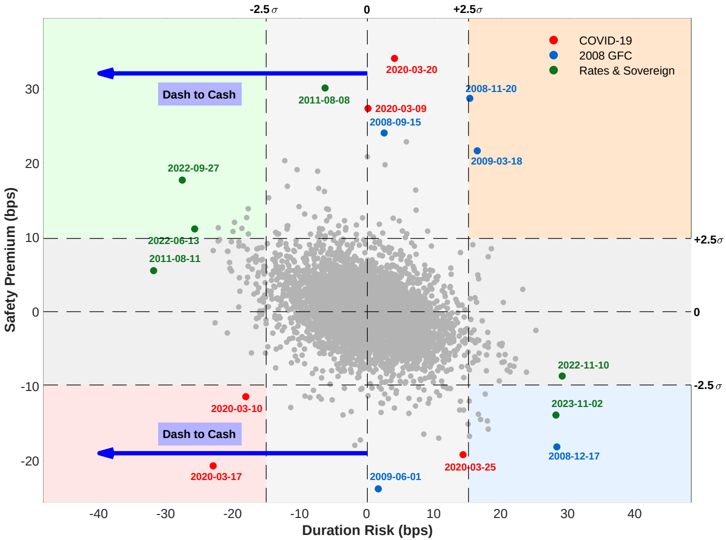


- Colored observations identify major market, policy, and sovereign-risk episodes.

Flight to Safety and Dash to Cash



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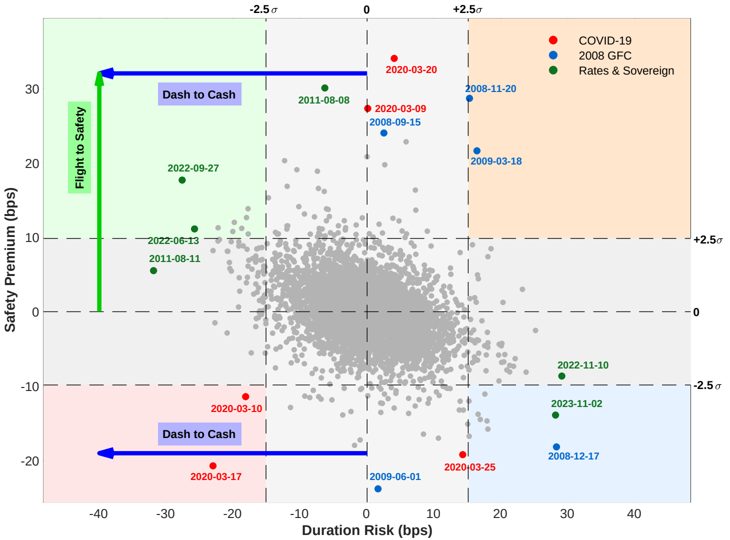
Flight to Safety and Dash to Cash



- Colored observations identify major market, policy, and sovereign-risk episodes.
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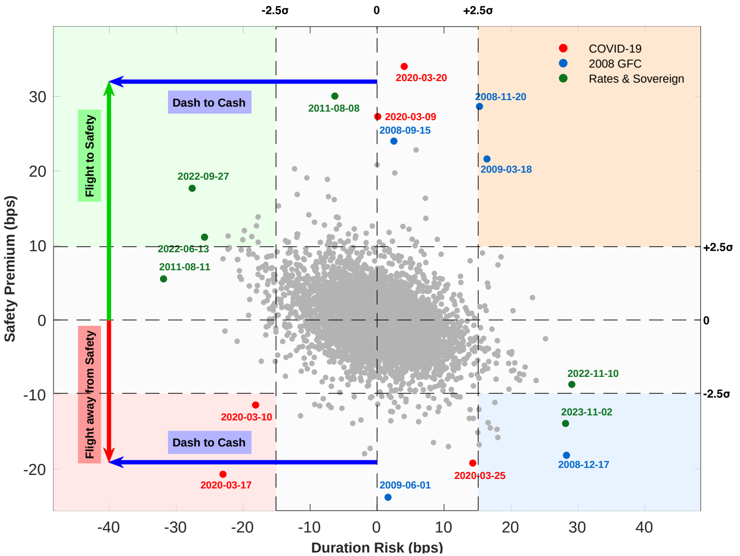
- Positive Safety distinguishes a simultaneous flight into Treasury safety.

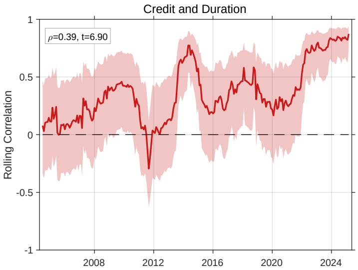
Flight to Safety and Dash to Cash

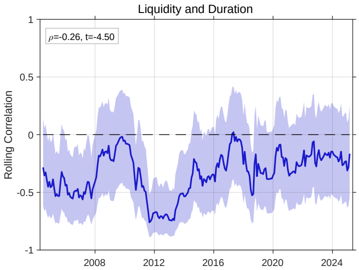


- Colored observations identify major market, policy, and sovereign-risk episodes.
- Negative Duration identifies a dash to cash.
- Positive Safety distinguishes a simultaneous flight into Treasury safety.
- March 10 and 17, 2020 are the only days combining dash to cash with flight away from Treasury safety.

Application 2: Decompose Credit Spreads

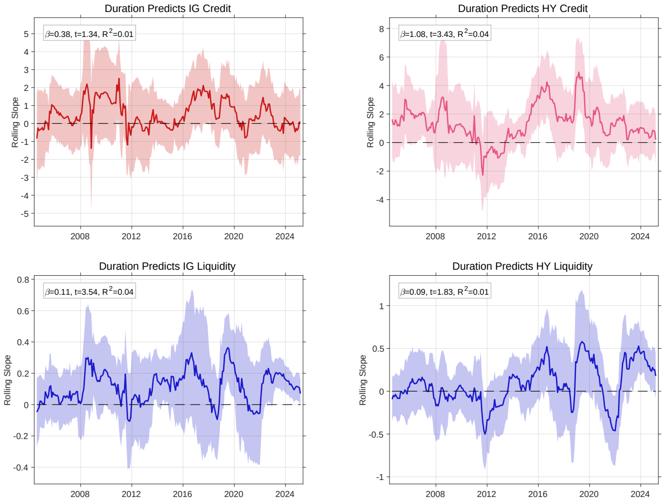
- Credit spread, often used to proxy for credit quality, is driven by both credit and liquidity.
  - Our result shows that corr(Credit_t, Duration_t)=0.39, significantly positive – increasing long-term interest rate is associated with worsening credit conditions.
  - By contrast, corr(Liquidity_t, Duration_t)$=-0.26$, significantly negative – decreasing long rate associated with liquidity deterioration





- A direct implication is the sign of corr(ΔCredit Spread, $\Delta\text{yield}^{10\text{yr}}$)
  - Negative because of the liquidity component, and positive because of the credit component.

Application 3: Duration-Driven Credit and Liquidity Risk

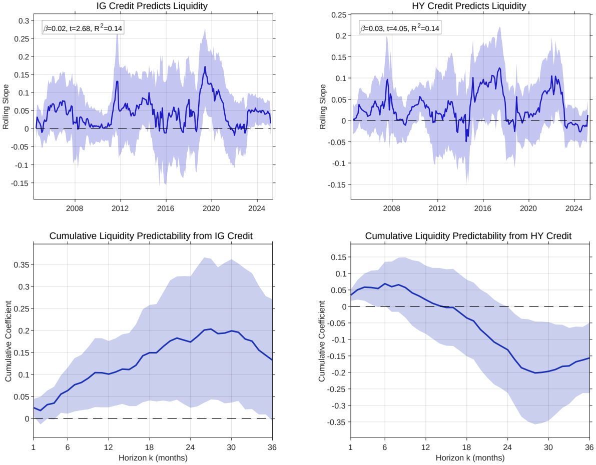


	Credit_{t+1}	
	IG	HY
Duration_t	0.38 [1.34]	$\boxed{1.08\ [3.43]}$
	Liquidity_{t+1}	
	IG	HY
Duration_t	$\boxed{0.11\ [3.54]}$	0.09 [1.83]

Increasing long-term rate hurts HY Credit and IG Liquidity.

Application 4: Credit-Driven Liquidity Risk

$$R_{t+1}^{\text{Liquidity}} = a + \beta_{\text{IG}}\, R_t^{\text{IG Credit}} + \beta_{\text{HY}}\, R_t^{\text{HY Credit}} + \epsilon_{t+1}$$



Strong evidence of credit-driven liquidity.

	β_{IG}	β_{HY}
estm	0.02	0.03
t-stat	[2.68]	[4.05]
R-sqrd	14%	

IG's predictability builds up and is long lasting.

HY's predictability reverts after a few months.

No evidence of liquidity-driven credit risk.

Conclusions

- Methodology: Use model-implied factor loadings to jointly extract Credit, Liquidity, and Duration from cross-section bond returns.
- Empirical Pricing: Explain asset returns within the credit market and beyond. Identify the economic driver of the empirically motivated portfolios in the literature.
- Four Applications:

1. Decompose UST Returns

UST = DurationRisk + SafetyPremium

$\downarrow$ $\boxed{\text{dash-to-cash}}$ $\quad$ $\downarrow$ $\boxed{\text{flight-to-safety}}$

2. Explain Corr$(\Delta\text{CS}, \Delta r) < 0$

ΔCS = "Credit" + "Liquidity"

Corr with Δr $\quad$ $\downarrow$ $\boxed{>0}$ $\quad$ $\downarrow$ $\boxed{<0}$

3. Interest-Rate Driven Risk

$r \uparrow$ hurts HY Credit

$r \uparrow$ hurts IG Liquidity

4. Credit-Driven Liquidity

IG Credit predicts at long horizon

HY Credit predicts at short horizon

- Compared with existing empirical models in the literature, our three-factor model performs well in benchmark measures such as model pricing errors and Sharpe ratios.