Disagreement, Liquidity, and Price Drifts in the Corporate Bond Market

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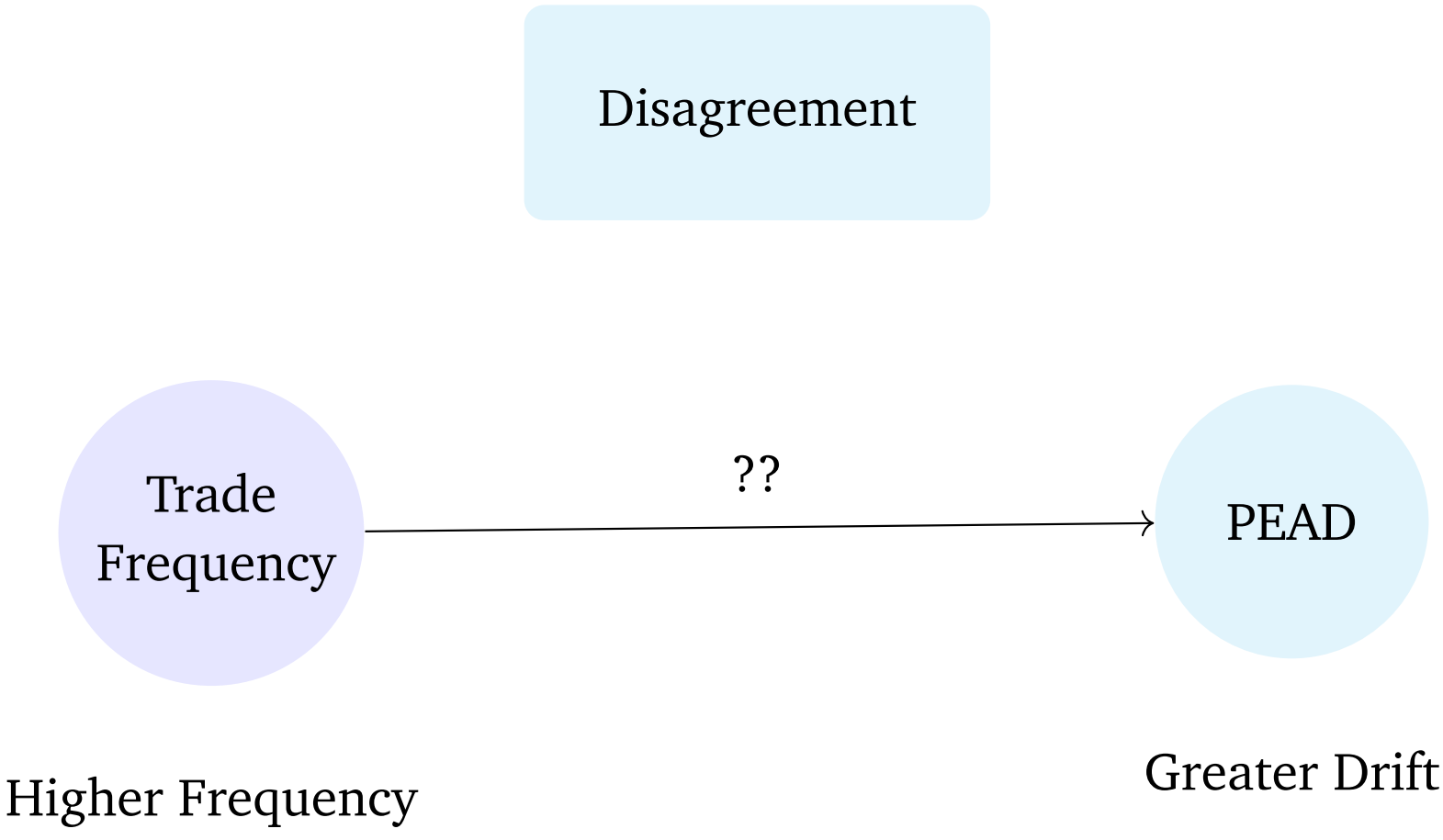
Disagreement on Corporate Bond Values

How does disagreement affect the price formation and illiquidity of corporate bonds?

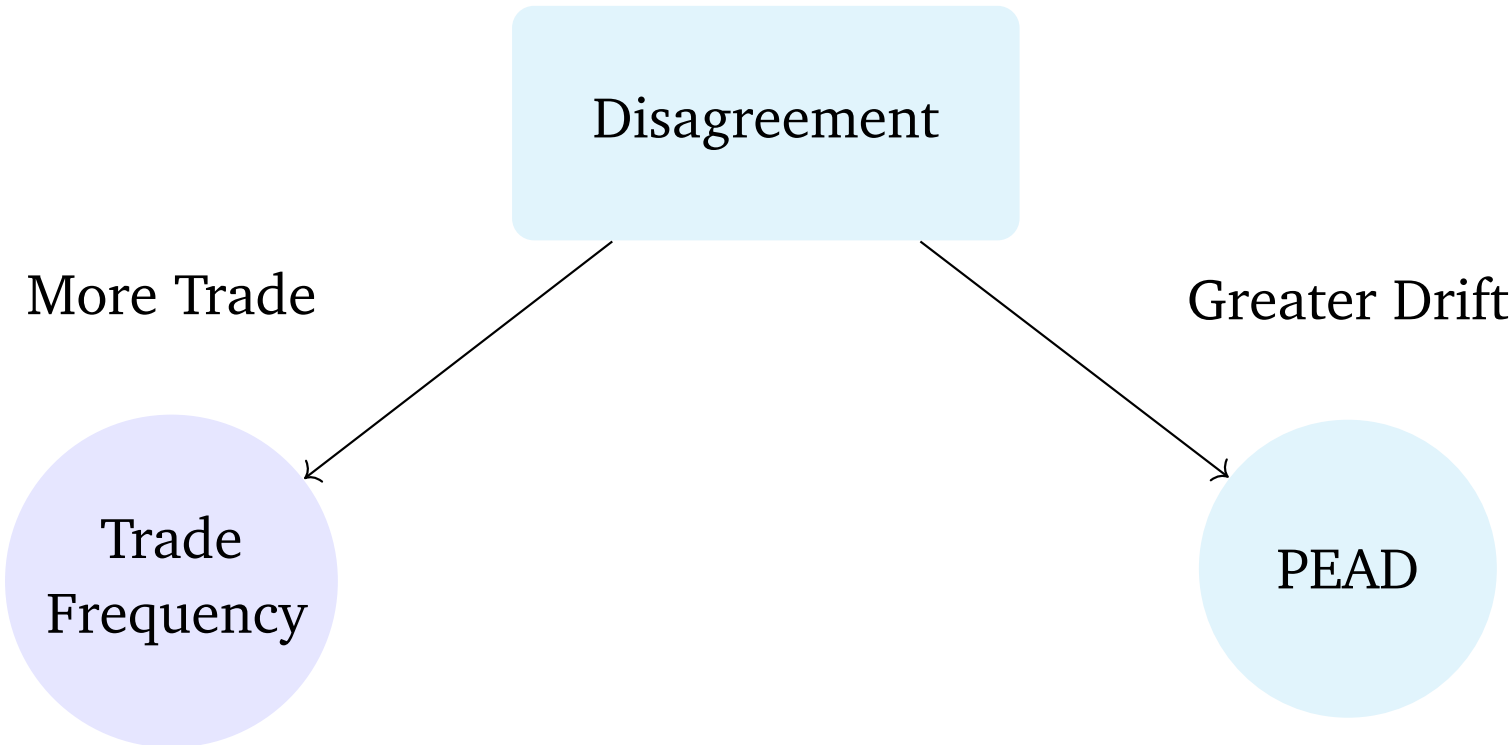
Puzzles and Disagreement

- A key feature of the bond market: infrequent transactions.
- However, this does not seem to make prices move slowly.



Puzzles and Disagreement

- Disagreement makes investors to trade more.
- Slow-moving prices.



Why Corporate Bond Market?

Key features:

- Bond cash flows are exposed to rare tail events
  - Difficult to assess based on historical data
  - Greater room for disagreement (e.g., Reaching for yield)
- Significant role of illiquidity
  - The link with PEAD is not well understood.

Out-of-sample evidence for PEAD:

- Same value-relevant information as for equities
- Bond transaction data (instead of quoted prices) has been available
  - Transparent OTC market data to evaluate institutional trading
  - No agreement on Bond PEAD in the literature (Hotchkiss and Ronen, 2002)

Research Questions

- How do bond prices respond to earnings announcements?
  - Initial reaction to announcement
  - Post announcement drift
- Is the slow price reaction due to infrequent transactions?
- What is the link between slow price movements, disagreement, and illiquidity?

Data

Transaction data from Enhanced TRACE:

- U.S. bonds with fixed coupons and no embedded options other than call provisions.
- Time to maturity no less than 1 year.
- July 2002 - December 2020
- Daily price: Volume-weighted average transaction price with transaction volume above $10,000.
- Month-end price: The last day in the last 5 business days in a month.

Bond characteristics from Mergent FISD

Analysts' earnings forecast from I/B/E/S

Bond holding data from eMAXX

- Portfolio weights for each investor at the quarterly frequency

Bond Price Reactions to Earnings News

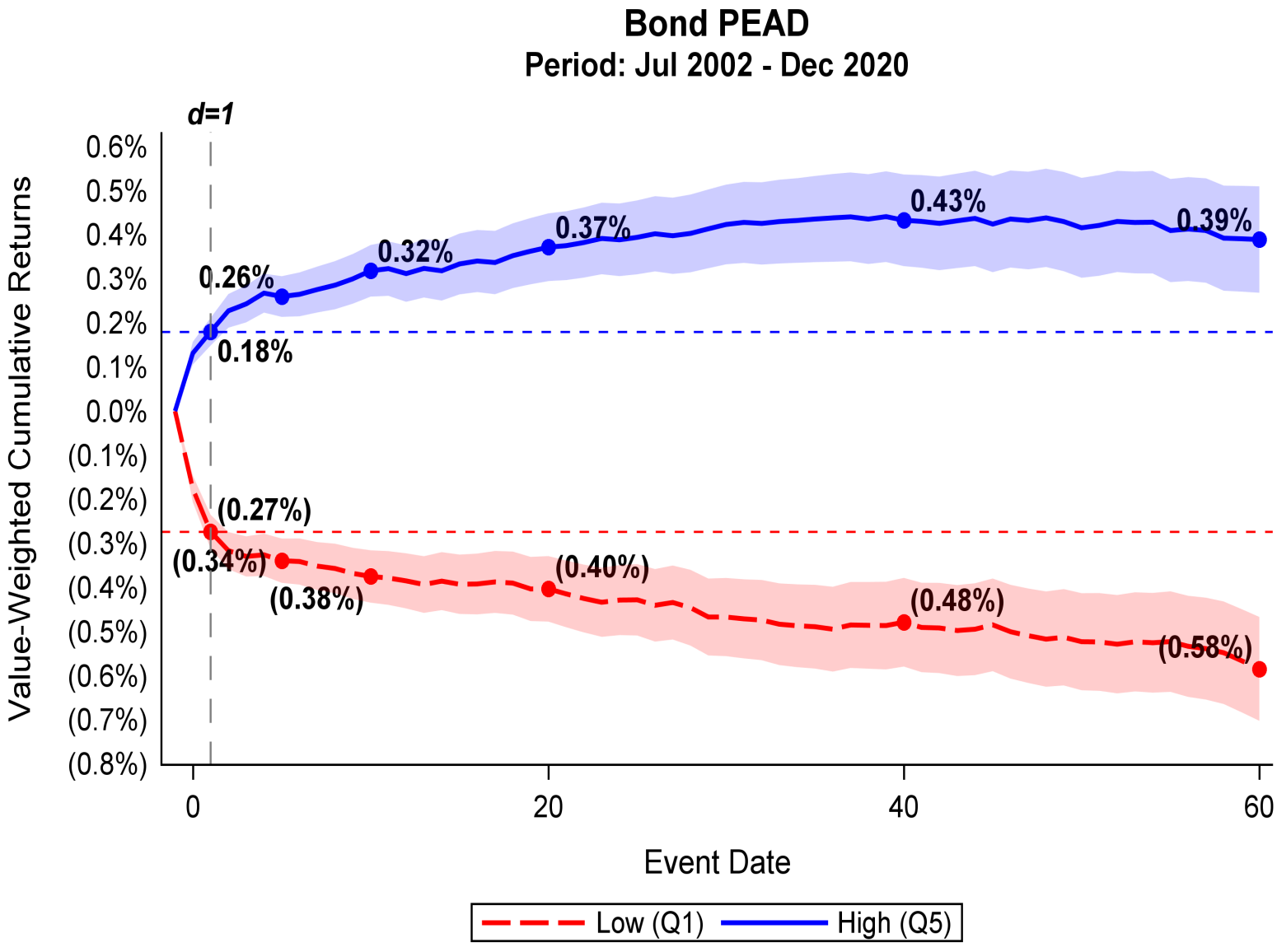
Regression of Bond CAR from day -1 to day +1 on stock CAR, median analyst forecast error (CE), fraction of forecasts that miss on the same side (FOM).

$$R_{i,j,d} = a + bEarningsSurprise_{j,d} + Ctrl_{i,d} + FE_d + \varepsilon_{i,j,d}$$

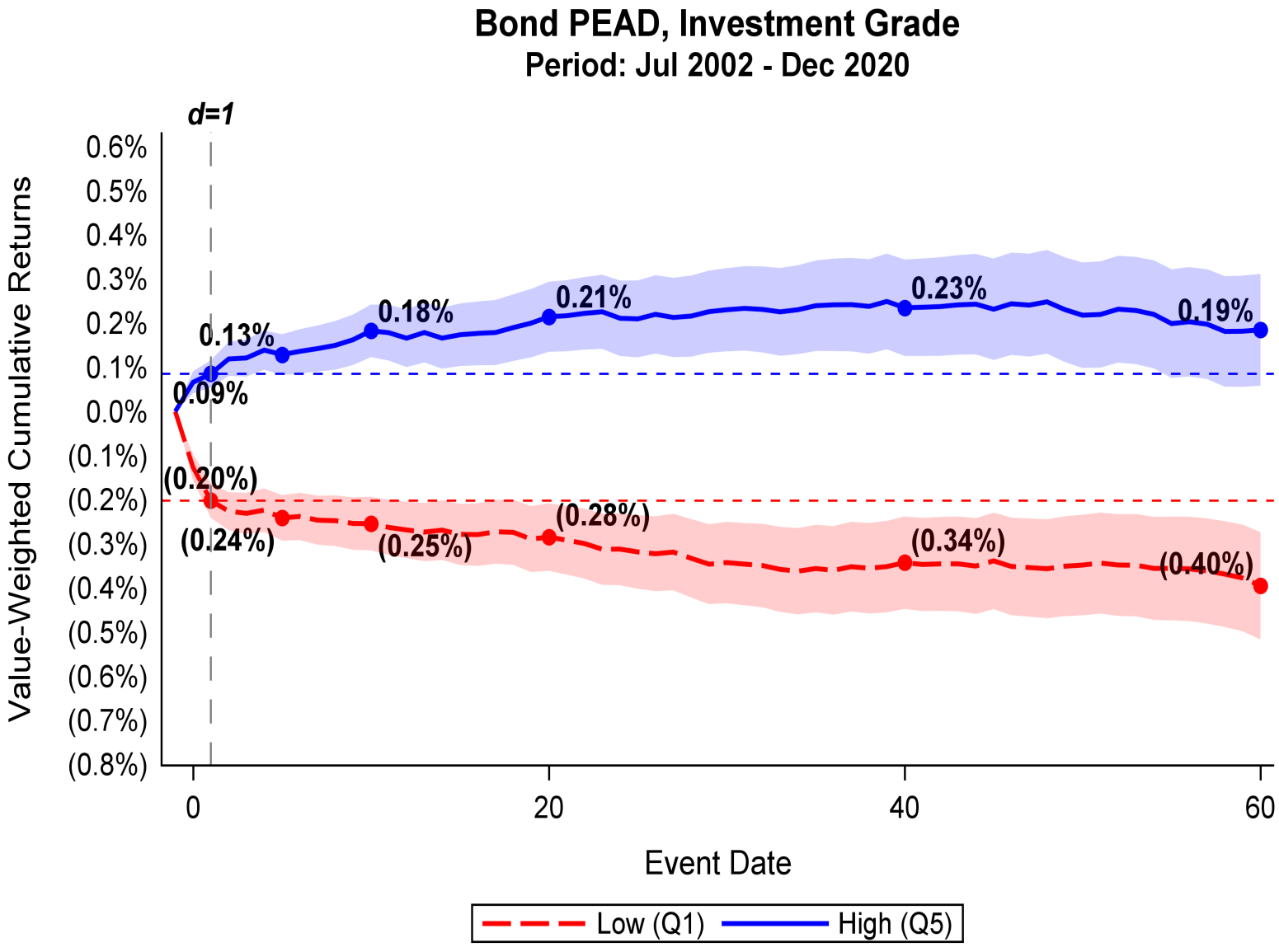
Stock CAR [-1, +1]	0.391***			0.382***	0.391***	0.385***
	(6.41)			(5.93)	(6.08)	(5.96)
Rank(CE)		0.134***		0.033*		0.113***
		(7.95)		(1.67)		(3.62)
FOM			0.100***		-0.003	-0.098***
			(9.03)		(-0.15)	(-3.64)
Rating	0.017***	0.016***	0.021***	0.017***	0.017***	0.012***
	(3.15)	(2.74)	(3.49)	(3.15)	(3.13)	(2.67)
Maturity	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(-0.35)	(-0.50)	(-0.43)	(-0.36)	(-0.35)	(-0.42)
Intercept	-0.131**	-0.118**	-0.167***	-0.130**	-0.130**	-0.084*
	(-2.57)	(-2.16)	(-2.95)	(-2.55)	(-2.57)	(-1.95)
Year-Quarter FE	YES	YES	YES	YES	YES	YES
Obs	103,199	103,199	103,199	103,199	103,199	103,199
Adj. R^2	0.070	0.014	0.011	0.071	0.070	0.072

- We use **stock CAR [-1, +1]** as our primary earnings surprise measure in the subsequent analysis.

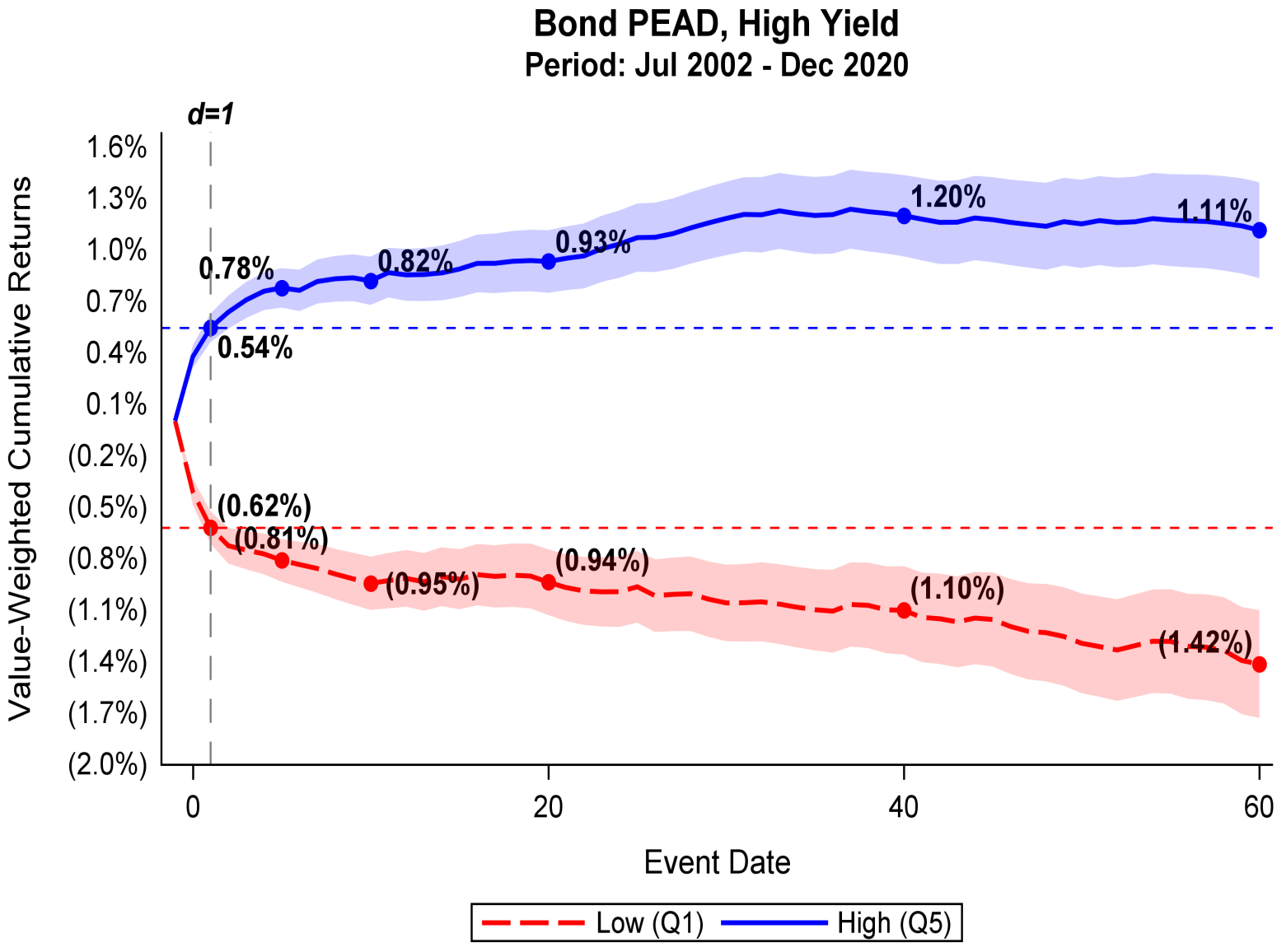
Initial Look at PEAD (Small Sample of Liquid Bonds)



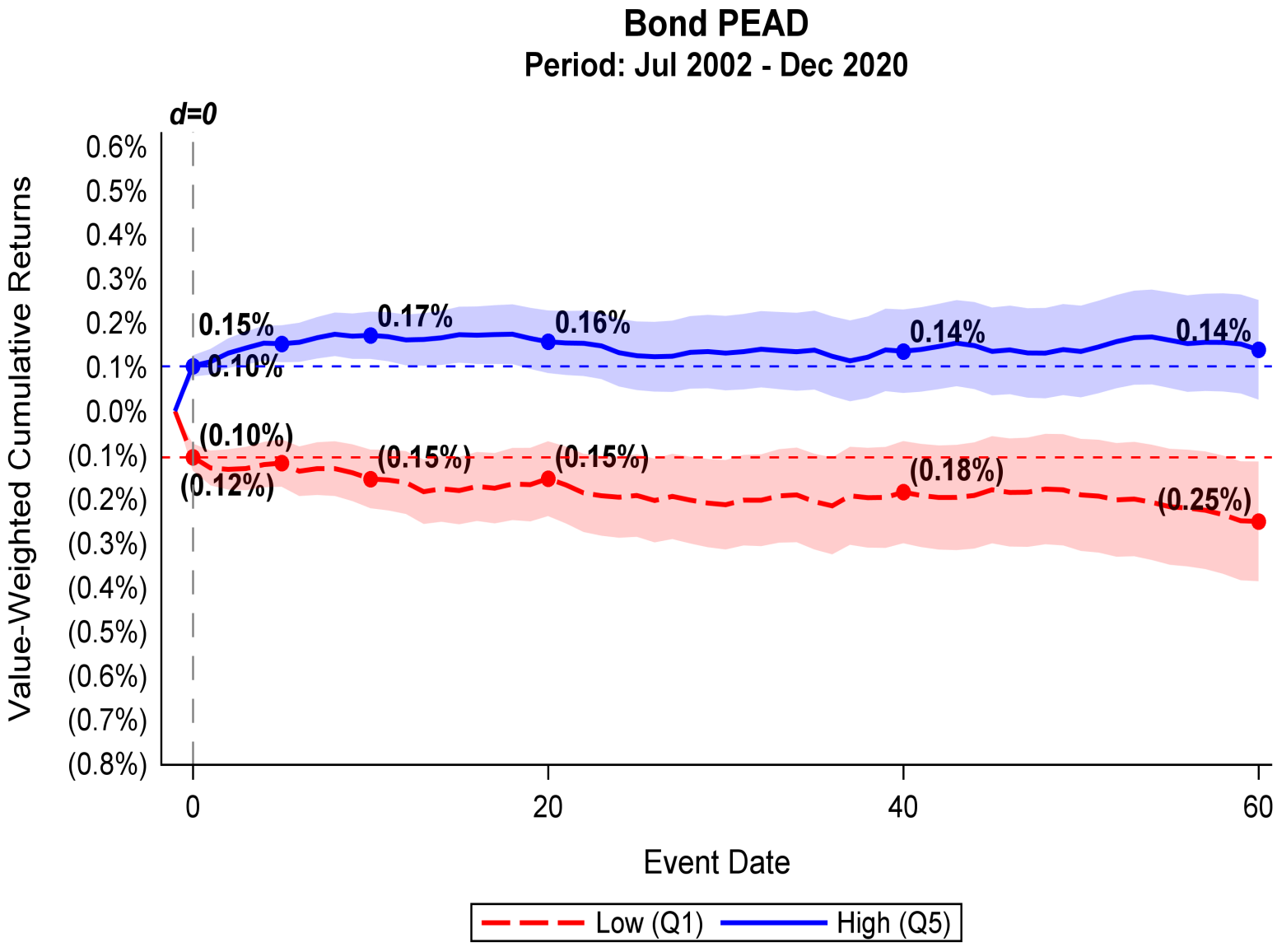
Initial Look at PEAD (Small Sample of Liquid Bonds, IG)



Initial Look at PEAD (Small Sample of Liquid Bonds, HY)

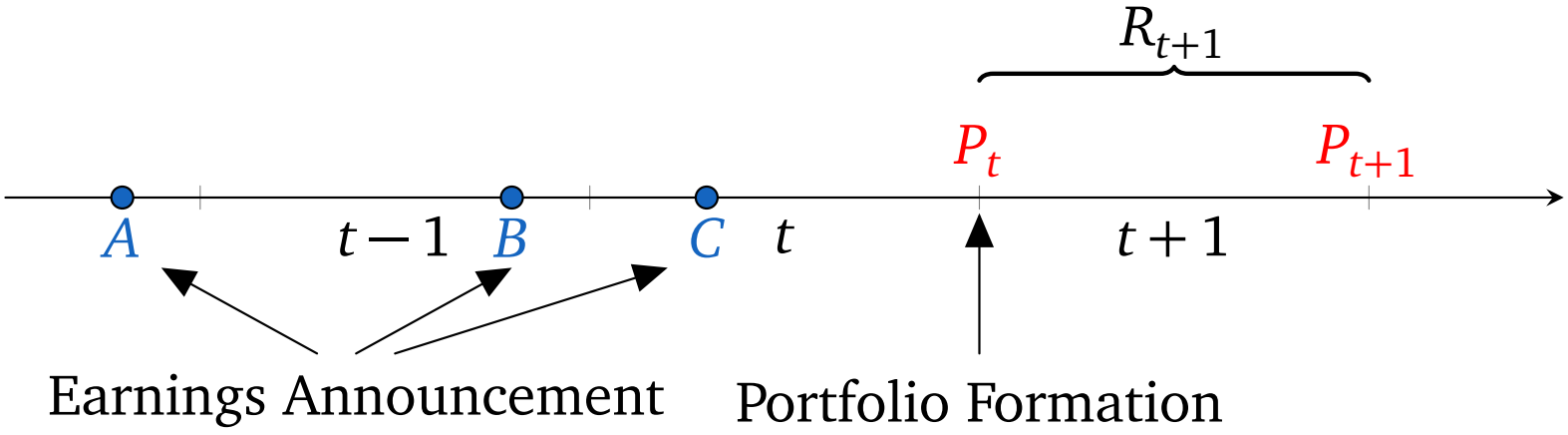


Initial Look at PEAD (Small Sample of Liquid Bonds, CE)



Main Results Based On Implementable Trading Strategy

- Observe announcements in months $t-2$, $t-1$, and t.
- At the end of month t, rank bonds and form portfolios.
- Hold them for one month.



- No look-ahead bias
- Increased sample size

Univariate Sort on Earnings Surprise

	Low	2	3	4	High	High-Low
			Value-weighted			
Average excess return	0.40***	0.44***	0.46***	0.44***	0.57***	0.17***
	(2.88)	(3.64)	(3.91)	(4.09)	(4.20)	(3.57)
Five bond factor alpha	-0.14***	-0.04	-0.03	0.02	0.06**	0.20***
	(-3.96)	(-1.38)	(-1.48)	(0.74)	(2.47)	(4.28)
Six stock factor alpha	0.21	0.30**	0.31***	0.30***	0.40***	0.20***
	(1.59)	(2.42)	(2.73)	(2.91)	(3.26)	(4.23)
11 factor alpha	-0.14***	-0.04	-0.02	0.01	0.07***	0.21***
	(-3.82)	(-1.14)	(-1.09)	(0.61)	(2.89)	(4.37)

- A calendar-month portfolio strategy sorted on earnings surprise (Stock CAR) yields a significantly positive return (alpha) difference of 17 (21) bps per month.
- Annualized Sharpe ratio: 0.73

Bond Portfolio Characteristics

Univariate sort on earnings surprise.

	Low	2	3	4	High
CAR (%)	-7.41	-2.05	0.06	2.20	7.39
Bid Fraction at t (%)	36.07	36.77	36.88	36.95	35.95
Bid Fraction at t+1 (%)	35.37	36.24	36.34	36.45	35.67
Size (millions)	669.58	696.70	677.88	700.26	678.27
Rating	9.66	8.41	8.17	8.30	9.60
Maturity (years)	9.51	10.46	10.59	10.40	9.40
DOWN (5% VaR)	4.05	3.26	3.17	3.15	3.87
ILLIQ	1.46	1.06	1.06	1.04	1.25
Age (years)	4.05	4.02	4.02	4.00	3.92
Duration	6.45	7.06	7.14	7.03	6.41

- The similarity in risk characteristics for bonds with extreme earnings surprise suggests that a hedge portfolio has little risk exposure.

Firm-Level Data and Alternative Measures of Earnings Surprises

	Low	2	3	4	High	High - Low	*SR*
Firm-Level Data, Sorted on Earnings Announcement Stock CAR							
11 Factor Alpha	-0.17**	-0.05	0.03	-0.01	0.11**	0.28***	1.80
	(-2.47)	(-0.74)	(0.70)	(-0.19)	(2.24)	(5.69)	
Alternative Measures for Earnings Surprises (11-Factor Alpha)							
Bond CAR	-0.22***	-0.02	0.01	0.02	0.07	0.30***	1.53
	(-4.98)	(-0.97)	(0.74)	(0.97)	(1.55)	(4.53)	
CE	-0.14***	-0.04	0.05**	0.00	-0.01	0.12**	1.02
	(-3.79)	(-1.65)	(2.30)	(0.15)	(-0.38)	(2.38)	
FOM	-0.07	-0.10***	-0.03	-0.00	0.03**	0.10*	0.76
	(-1.27)	(-3.00)	(-1.28)	(-0.19)	(2.59)	(1.82)	

Uniqueness of Earnings Surprises

- *SRet6m*: Past 6-month stock returns excluding announcement days
- *NoAnnCAR*: 3-day stock returns randomly selected from non-announcement days in the past 6 months

Left-Hand Side Variable: One-Month-Ahead Corporate Bond Excess Returns							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CAR	0.069***	0.065***				0.070***	0.037***
	(3.30)	(4.84)				(4.80)	(2.61)
SRet6m			0.120***			0.129***	
			(6.84)			(6.85)	
SRet6mAll							0.134***
							(6.10)
NoAnnCAR				0.015		-0.014	-0.009
				(1.15)		(-1.03)	(-0.69)
Dummy: *Downgrade*					-0.123**	-0.113**	-0.108**
					(-2.07)	(-2.04)	(-1.99)
Dummy: *Upgrade*					-0.005	-0.016	-0.022
					(-0.15)	(-0.47)	(-0.63)
Bond Char. Controls	NO	YES	YES	YES	YES	YES	YES
Industry Controls	YES	YES	YES	YES	YES	YES	YES
Obs	250,110	250,110	250,110	250,110	250,110	250,110	250,110
R^2	0.120	0.428	0.429	0.429	0.430	0.442	0.442

Does Illiquidity Explain PEAD?

- Independent sort on earnings surprise and illiquidity measures.
- Alphas for high surprise bonds minus low surprise bonds.

	Amihud	ACOV	BAS	IRC	NegTurn	Zero	AILLIQ
Liquid	0.22***	0.27***	0.18**	0.18***	0.30***	0.26***	0.19***
	(3.21)	(3.04)	(2.57)	(3.63)	(3.12)	(3.42)	(2.86)
2	0.22***	0.13***	0.17**	0.22***	0.27***	0.18***	0.25***
	(3.31)	(3.13)	(2.56)	(3.70)	(4.16)	(2.84)	(3.19)
3	0.26***	0.23***	0.21***	0.12**	0.14**	0.21***	0.23***
	(4.22)	(3.46)	(3.94)	(2.23)	(2.28)	(4.45)	(4.70)
4	0.18***	0.25***	0.14**	0.37***	0.15***	0.19***	0.20***
	(4.09)	(4.63)	(2.41)	(4.02)	(2.79)	(4.23)	(3.92)
Illiquid	0.12**	0.21**	0.38***	0.27***	0.14**	0.10*	0.17**
	(2.07)	(2.20)	(4.00)	(3.46)	(2.50)	(1.95)	(2.54)
Illiquid - Liquid	-0.10	-0.06	0.20**	0.09	-0.16**	-0.16**	-0.03
	(-1.43)	(-0.54)	(2.54)	(1.29)	(-2.01)	(-2.12)	(-0.40)

PEAD in CDS Returns

We calculate the return for protection sellers as

$$R_{t+1} = \frac{P_{t+1} - P_t}{\Phi_t}$$

where the fraction of notional collateralized, Φ_t, is set to one.

	Low	2	3	4	High	High - Low	*SR*
Pane A: Value-Weighted Portfolios, Collateralized CDS Returns							
Avg R^e	-0.14***	-0.12***	-0.12***	-0.11***	-0.07	0.07***	0.94
	(-2.74)	(-2.89)	(-2.82)	(-2.69)	(-1.51)	(3.61)	
5 Bond Factor α	-0.24***	-0.18***	-0.19***	-0.17***	-0.13***	0.11***	1.56
	(-6.85)	(-5.86)	(-5.78)	(-5.23)	(-3.76)	(5.06)	
6 Stock Factor α	-0.20***	-0.16***	-0.16***	-0.15***	-0.11***	0.09***	1.27
	(-5.72)	(-5.28)	(-4.92)	(-4.92)	(-3.65)	(4.45)	
11 Factor α	-0.24***	-0.18***	-0.19***	-0.16***	-0.13***	0.11***	1.65
	(-7.31)	(-5.93)	(-5.71)	(-5.14)	(-3.69)	(5.09)	
Panel B: Value-Weighted Portfolios, Log CDS Spread Changes							
Avg ΔSpread	0.38	-0.19	0.02	-0.16	-0.92	-1.30***	
	(0.48)	(-0.24)	(0.03)	(-0.22)	(-1.39)	(-4.34)	

Disagreement and Bond PEAD

Disagreement Proxy 1: Analyst Forecast Dispersion

	Average DISP	PEAD α	Average Portfolio Characteristics						
			d=0 Turn	*t=0 Turn*	*Bond Vol*	*Size*	*Rating*	*Maturity*	*ILLIQ*
Low	0.0005	0.10**	0.48	0.41	1.73	661	7.27	10.59	0.77
		(2.01)							
2	0.0011	0.11***	0.55	0.44	1.80	688	7.69	11.07	0.92
		(2.91)							
3	0.0022	0.16***	0.60	0.46	1.89	713	8.31	10.52	1.02
		(3.12)							
4	0.0048	0.10*	0.75	0.54	2.09	749	9.14	9.86	1.12
		(1.69)							
High	0.0306	0.43***	1.14	0.68	3.31	660	11.29	8.76	1.83
		(3.31)							
High minus Low		0.33**							
		(2.25)							

- More pronounced PEAD for bonds with higher analyst disagreement.
- Higher DISP $\Rightarrow$ higher bond turnover.

Disagreement Proxy 2: Portfolio Weight Dispersion

	Average	PEAD	Average Portfolio Characteristics						
	CV1	α	*d=0 Turn*	*t=0 Turn*	*Bond Vol*	*Size*	*Rating*	*Maturity*	*ILLIQ*
Low	1.07	-0.02	0.62	0.48	1.93	1,034	7.99	11.17	0.83
		(-0.17)							
2	1.25	0.14*	0.60	0.45	1.87	774	7.72	10.68	0.83
		(1.80)							
3	1.37	0.21**	0.68	0.48	2.01	633	8.43	10.32	0.98
		(2.50)							
4	1.53	0.37***	0.75	0.51	2.25	538	9.33	9.47	1.25
		(3.73)							
High	1.89	0.36***	0.94	0.61	2.88	467	10.63	8.69	1.76
		(4.56)							
High minus Low		0.37***							
		(2.67)							

- $CV1_{k,t} = \sigma_{k,t}[w_{k,j,t}]/E_{k,t}[w_{k,j,t}]$ where $w_{k,j,t}$ is portfolio weights of investor j.

Disagreement Proxy 3: Reaching For Yield

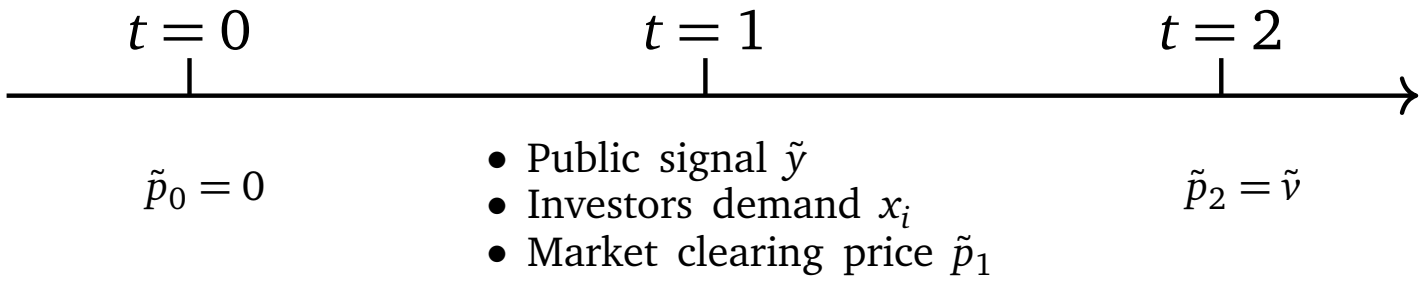
	Average	PEAD	Average Portfolio Characteristics						
	RFY	α	*d=0 Turn*	*t=0 Turn*	*Bond Vol*	*Size*	*Rating*	*Maturity*	*ILLIQ*
Low	-1.75	0.11***	0.48	0.42	1.00	657	8.88	3.09	0.44
		(3.52)							
2	-0.83	0.08**	0.54	0.44	1.37	704	8.39	5.00	0.62
		(2.24)							
3	-0.18	0.08**	0.66	0.51	1.83	707	8.56	7.62	0.82
		(2.34)							
4	0.56	0.29***	0.83	0.56	2.57	698	8.49	14.95	1.27
		(4.77)							
High	1.91	0.48***	0.98	0.57	3.70	696	8.73	20.23	2.52
		(4.44)							
High minus Low		0.37***							
		(3.65)							

- $RFY_{k,t} = s_{k,t} - \bar{s}_{R(k),t}$ where $\bar{s}_{R(k),t}$ is the average credit spread in month t for rating R.

Fama-MacBeth Regressions of Monthly Bond Returns

	(1)	(2)	(3)	(4)	(5)
CAR	0.070***	0.066***	0.063***	0.057***	0.059***
	(3.32)	(5.11)	(4.85)	(5.21)	(5.88)
DISP			-0.083*		
			(-1.78)		
*CAR * DISP*			0.039**		
			(2.42)		
CV				-0.035*	
				(-1.88)	
*CAR * CV*				0.025**	
				(2.34)	
RFY					0.187***
					(4.39)
*CAR * RFY*					0.032**
					(2.22)
Intercept	0.347***	0.453***	0.486***	0.464***	0.539***
	(3.98)	(3.83)	(3.89)	(3.86)	(3.40)
Controls	NO	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES
Obs	250,845	250,845	236,048	250,721	243,627
R^2	0.120	0.433	0.458	0.439	0.460

A Stylized Model of Disagreement and PEAD



- Two assets
  - Risk-free asset, zero return
  - Risky asset (corporate bond), terminal value $\tilde{v} \sim N\left(0, \tau_v^{-1}\right)$, supply 1
- Earnings announcement at $t = 1$
  - Public signal: $\tilde{y} = \tilde{v} + \tilde{\eta}$, with $\tilde{\eta} \sim N\left(0, \tau_\eta^{-1}\right)$
  - Differential interpretation: $\tilde{s}_i = \tilde{v} + \tilde{\eta} + \tilde{\varepsilon}_i$, with $\tilde{\varepsilon}_i \sim N\left(0, \tau_\varepsilon^{-1}\right)$
    - Agree to disagree, Banerjee, Kaniel, and Kremer (2009)
  - Noise trading: $\tilde{u} \sim N\left(0, \sigma_u^2\right)$
- CARA investors: $x_i = \frac{E[\tilde{v}|\tilde{s}_i] - \tilde{p}_1}{\gamma Var[\tilde{v}|\tilde{s}_i]}$
- Mkt-clearing $\int_0^1 x_i di + \tilde{u} = 1 \Rightarrow \tilde{p}_1 = \frac{\tau_\varepsilon \tau_\eta (\tilde{v} + \tilde{\eta}) + \gamma\left(\tau_\varepsilon + \tau_\eta\right)\tilde{u} - \gamma\left(\tau_\varepsilon + \tau_\eta\right)}{\tau_\varepsilon \tau_\eta + \tau_v\left(\tau_\varepsilon + \tau_\eta\right)}$

Disagreement, Price Drift, Trading Volume, and Illiquidity

1. Prices exhibit **drift** if $k > 0$, where $E[\tilde{p}_2 - \tilde{p}_1 | \tilde{p}_1 - \tilde{p}_0] = k(\tilde{p}_1 - \tilde{p}_0)$.

$$k = \underbrace{-\frac{\gamma^2 \tau_v (\tau_\varepsilon + \tau_\eta)^2 \sigma_u^2}{\tau_\varepsilon^2 \tau_\eta (\tau_v + \tau_\eta) + \gamma^2 \sigma_u^2 \tau_v (\tau_\varepsilon + \tau_\eta)^2}}_{\text{Noise trading}} + \underbrace{\frac{\tau_v \tau_\varepsilon \tau_\eta^2}{\tau_\varepsilon^2 \tau_\eta (\tau_v + \tau_\eta) + \gamma^2 \sigma_u^2 \tau_v (\tau_\varepsilon + \tau_\eta)^2}}_{\text{Disagreement}}.$$

   Thus, $k > 0$ when σ_u^2 is low.

2. Following Banerjee (2011), **investor disagreement** is as follows:

$$DISP = Var\left[E[\tilde{v}|\tilde{s}_i] - \int_0^1 E[\tilde{v}|\tilde{s}_i]\, di\right] = \frac{\tau_\varepsilon \tau_\eta^2}{\left(\tau_\varepsilon \tau_\eta + \tau_v\left(\tau_\varepsilon + \tau_\eta\right)\right)^2}$$

3. **Trading volume** at $t = 1$ is $TV = E\left[\int_0^1 |x_i|\, di\right] > 0$

4. **Illiquidity** at $t = 1$ is $Illiq = \frac{\partial \tilde{p}_1}{\partial \tilde{u}} = \frac{\gamma(\tau_\varepsilon + \tau_\eta)}{\tau_\varepsilon \tau_\eta + \tau_v(\tau_\varepsilon + \tau_\eta)}$

Model Implications

- Implication 1: With low noise trading, it is possible to observe price drift
  - Bond market featured with more institutions (low σ_u^2)
- Implication 2: More likely to observe price drift on announcement day
  - $\partial k / \partial \tau_\eta > 0$; recall $\tilde{y} = \tilde{v} + \tilde{\eta}$
  - This potentially explains weak bond momentum vs strong bond PEAD
- Implication 3: More disagreement can be associated with (i) more pronounced price drift and (ii) higher trading volume
  - As $\tau_\varepsilon \uparrow$, the model predicts that *DISP* $\uparrow$, $k \uparrow$, and *TV* $\uparrow$
  - This reconciles the puzzle that high trade frequency can be associated with greater PEAD
- Implication 4: To the extent that disagreement drives PEAD, more pronounced drift can be associated with less illiquidity
  - This is the case when τ_ε is low (disagreement mechanism is salient)
  - This potentially explains the insignificant (or even negative) relation between PEAD and illiquidity

Stock PEAD

	A: Bond Issuers, 2002 - 2020, VW			D: Bond Issuers, 2002 - 2020, EW		
	CAR	CE	FOM	CAR	CE	FOM
Six Factor Alpha	0.19	-0.08	0.13	0.23**	-0.16	0.02
	(1.33)	(-0.48)	(0.98)	(2.49)	(-1.15)	(0.13)
	B: All Firms, 2002 - 2020, VW			E: All Firms, 2002 - 2020, EW		
	CAR	CE	FOM	CAR	CE	FOM
Six Factor Alpha	0.22*	0.31*	0.16	0.42***	0.32***	0.24***
	(1.65)	(1.94)	(1.45)	(4.30)	(3.23)	(3.11)
	C: All Firms, 1984 - 2001, VW			F: All Firms, 1984 - 2001, EW		
	CAR	CE	FOM	CAR	CE	FOM
Six Factor Alpha	0.65***	0.37**	0.56***	0.72***	1.31***	1.06***
	(3.63)	(2.00)	(4.16)	(7.71)	(10.38)	(8.23)

- Stock PEAD decays over time.
- No stock PEAD for bond issuers in our sample period.
- In other periods, it concentrates in small firms.

Do Stocks with High Disagreement Exhibit More PEAD?

Fama-MacBeth regression (observations are weighted by lagged market values) on earnings surprise and disagreement proxies.

	1984 - 2020		1984 - 2001		2002 - 2020	
	(1)	(2)	(3)	(4)	(5)	(6)
CAR	0.212***	0.289***	0.346***	0.500***	0.085***	0.090***
	(6.02)	(6.10)	(6.77)	(7.94)	(3.70)	(4.36)
DISP	-0.024		0.096		-0.137*	
	(-0.37)		(1.04)		(-1.75)	
*CAR * DISP*	0.081*		0.066		0.095**	
	(1.90)		(0.90)		(2.06)	
CV_{Stock}		0.001		-0.070		0.068**
		(0.03)		(-1.64)		(2.51)
$CAR * CV_{Stock}$		0.098***		0.188***		0.014
		(3.16)		(3.64)		(0.65)
Stock Control	YES	YES	YES	YES	YES	YES
Industry Controls	YES	YES	YES	YES	YES	YES
Obs	724,514	963,061	285,249	427,463	439,265	535,598
R^2	0.195	0.175	0.213	0.187	0.178	0.164

Conclusion

- PEAD exists in the corporate bond market.
  - Little systematic risk exposure.
  - Prevalent across characteristics.
- Bond prices react more slowly when they trade more frequently.
  - Liquidity is unlikely to be the origin of PEAD.
- PEAD is more pronounced for bonds with high disagreement among analysts and investors.
  - Explains why more liquid bonds exhibit stronger PEAD.
  - Not explained by limited attention or disposition effect.