Corporate Bond Price Reversals

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The Microstructure Exchange
July 14, 2020

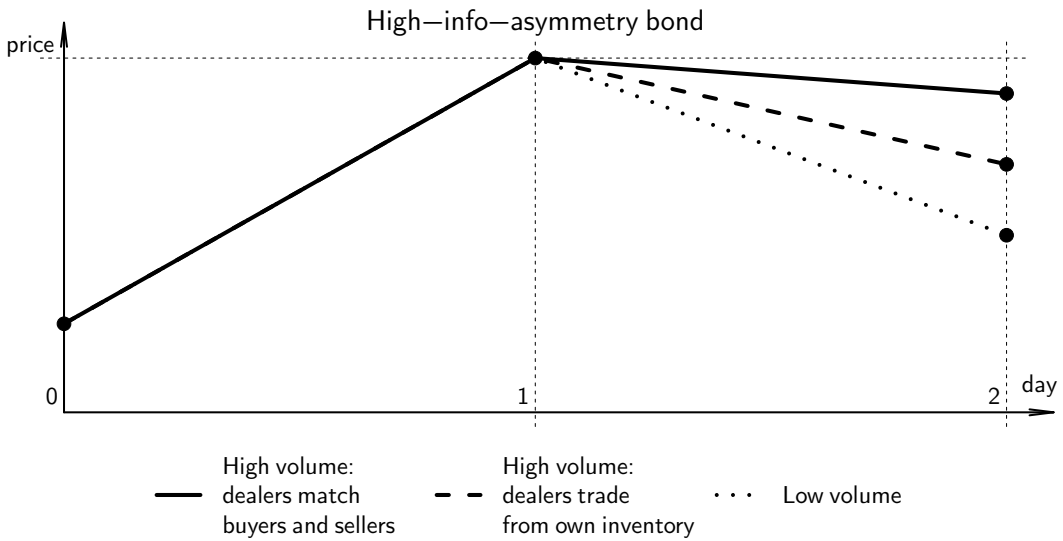
Both dealers and investors provide liquidity. Where do informed trades go?

- U.S. corporate bond trading volume and dealers' inventory (bln USD):

	2007	2017
Average daily volume	16	31
Dealers' inventory	80	16

↳ Investors become liquidity providers as dealers are more eager to offset trades

- **Of two liquidity providers, which one is more likely to be adversely selected?**
- Persistence of bond price changes depending on who provides liquidity:



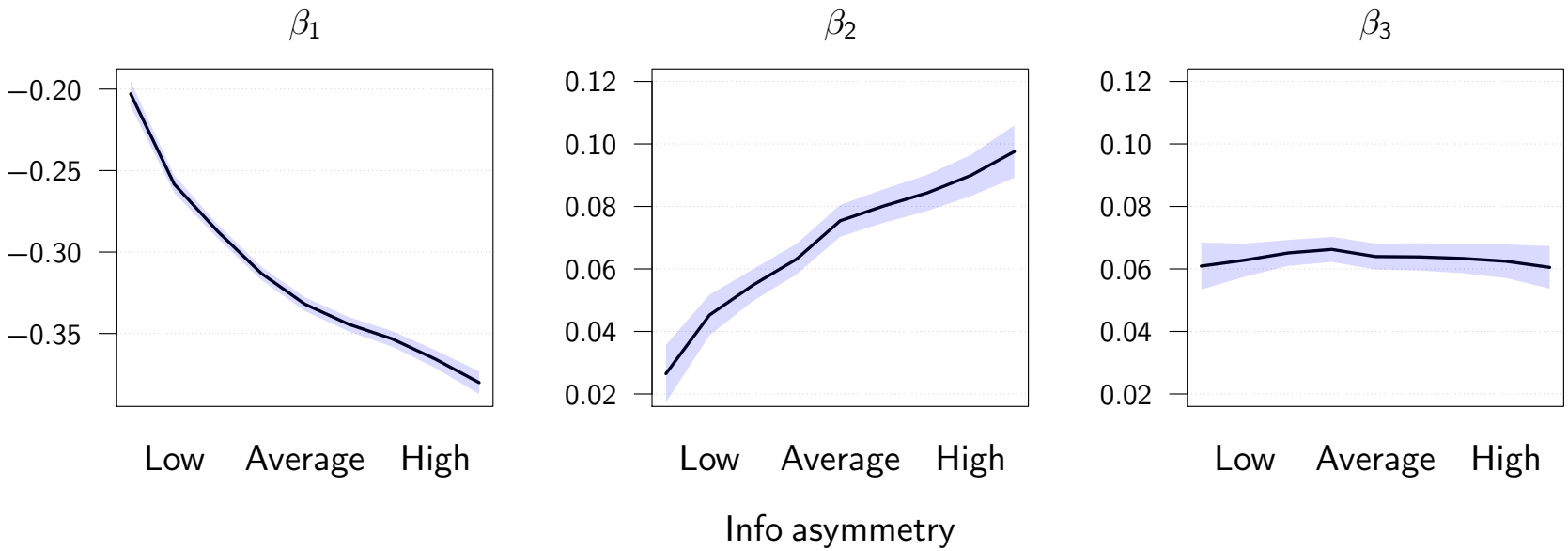
Cross-sectional differences in the relationship between reversal and volume

- **Step 1:**

$$\underset{\text{autocorr}_t}{\text{Bond return}} = \beta_1 + \beta_2 \cdot \underset{\text{volume}_t}{\text{Client-to-client}} + \beta_3 \cdot \underset{\text{volume}_t}{\text{Client-to-dealer}} \qquad \text{[for individual bonds]}$$

- **Step 2:**

Explain the cross-section of $\hat{\beta}$ with info asymmetry [cross-section of bonds]



Two-step procedure implied by a noisy REE model of bond trading volume:
extension of Llorente, Michaely, Saar, and Wang (2002)

Literature and contribution

- **Informed trading in corporate bonds and price efficiency.** Asquith, Au, Covert, and Pathak (2013), Berndt and Zhu (2018), Hendershott, Kozhan, and Raman (2019);
  ⚠ I find information-driven trading even in the most actively traded IG bonds.
- **Non-dealer liquidity provision in corporate bonds.** Adrian, Boyarchenko, and Shachar (2017), Bessembinder, Jacobsen, Maxwell, and Venkataraman (2018), Choi and Huh (2018), Dick-Nielsen and Rossi (2018), Goldstein and Hotchkiss (2020);
  ⚠ Non-dealer liquidity providers are more likely to be adversely selected.
- **Reversal as a cross-sectional bond pricing factor.** Chordia, Goyal, Nozawa, Subrahmanyam, and Tong (2017), Bali, Subrahmanyam, and Wen (2018), Bai, Bali, and Wen (2019);
  ⚠ Reversal portfolios on high-asymmetry bonds earn 3% per year even after TC.
- **Volume-return relationships**. Campbell, Grossman, and Wang (1993), Wang (1994), Llorente, Michaely, Saar, and Wang (2002), Medhat and Schmeling (2019);
  ⚠ I extend LMSW with noisy supply and adapt the model to the perpetual bond.

Data and measurements

- TRACE aggregated to daily, 2010–2017, fixed coupon, non-convertible, not asset backed, USD, >1 year to maturity
- **'Active' periods:** sequences of $\geqslant$60 days with trades, consecutive days are $\leqslant$3 business days apart. No HY $\nearrow$ IG or IG $\searrow$ HY within an active period.
  $\approx$ 5k unique bonds by $\approx$ 1k issuers = 1/3 of the initial sample
- C-to-C volume for bond i on day t:

$$V_{it}^{(c)} = \min\left\{V_{it}^{\text{buy}}, V_{it}^{\text{sell}}\right\}; \text{ ex: } \min\{10, 8\} = 8$$

$$\tilde{V}_{it}^{(c)} = \text{ same, but demeaned and standardized across time}$$

- C-to-D volume for bond i on day t:

$$V_{it}^{(s)} = V_{it}^{\text{buy}} - V_{it}^{\text{sell}}; \text{ ex: } 10 - 8 = 2$$

$$\tilde{V}_{it}^{(s)} = |V_{it}^{(s)}|, \text{ demeaned and standardized across time}$$

Summary stats | Volume correlations

Volume-return relationship for individual bonds

Step 1: I estimate for every bond for every active period:

$$R_{t+1} = \beta_0 + \beta_1 R_t + \beta_2 \tilde{V}_t^c R_t + \beta_3 \tilde{V}_t^s R_t + \epsilon_{t+1}.$$

	Mean	Median	S.D.	5th	25th	75th	95th	N.Obs.
$\hat{\beta}_1$	-0.31	-0.33	0.12	-0.48	-0.40	-0.24	-0.09	5028
$\hat{\beta}_2$	0.07	0.06	0.12	-0.10	0.01	0.12	0.25	5028
$\hat{\beta}_3$	0.06	0.06	0.10	-0.10	-0.00	0.11	0.21	5028

β_1 measures average price reversal. β_2 and β_3 measure how the average reversal changes following high-volume days.

Background model

Models for the cross-section of volume-return coefficients

Step 2: I fit explanatory models to the cross-sections of $\hat{\beta}_1$, $\hat{\beta}_2$, and $\hat{\beta}_3$ separately:

$$\hat{\beta}_{n,i} = c_{n,1} \underbrace{(\text{No. funds, CDS, Issue/issuer size, No. dealers, } -\text{Equity volatility})_i}_{\text{Info asymmetry proxies. Expected loadings: } + \text{ for } \hat{\beta}_1, - \text{ for } \hat{\beta}_2, 0 \text{ for } \hat{\beta}_3} +$$
$$+ c_{n,2} \underbrace{(\text{Bid-ask, C-to-C/D volume correlation, Bond volatility, Credit rating})_i}_{\text{Controls}} +$$
$$+ c_{n,0} + \epsilon_{n,i},$$

- **No. funds**: the number of mutual funds that own the bond (SEC N-Q forms);
- **CDS dummy**: actively traded CDS contract on the bond issuer (DTCC reports);
- **Issue size**: bond outstanding notional amount;
- **No. dealers**: the number of dealers that intermediate trades in the bond (TRACE);
- **Issuer size**: issuer market cap (if traded);
- **Equity volatility**: realized daily stock return volatility (if traded);

Correlation between info asymmetry proxies | Summary stats for the 2nd stage

Cross-section of $\hat{\beta}_1$ and info asymmetry

β_1 = Return autocorrelation on an average-volume day

	Dependent variable: $\hat{\beta}_1$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	−0.331***	−0.301***	−0.416***	−0.399***	−0.349***	−0.301***	−0.429***	−0.450***
	(0.005)	(0.005)	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)	(0.008)
Average bid-ask	−0.055***	−0.062***	−0.054***	−0.098***	−0.070***	−0.067***	−0.064***	−0.073***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)
No. funds	0.033***						0.007***	0.007***
	(0.002)						(0.002)	(0.002)
CDS dummy		0.003*					0.002	0.001
		(0.001)					(0.001)	(0.001)
Issue size			0.059***				0.046***	0.040***
			(0.003)				(0.004)	(0.004)
No. dealers				0.044***			0.013***	0.017***
				(0.002)			(0.003)	(0.003)
Issuer size					0.024***			0.011***
					(0.002)			(0.002)
–Equity volatility						0.0001		0.005**
						(0.002)		(0.002)
Risk controls	YES	YES	YES	YES	YES	YES	YES	YES
Vlm controls	YES	YES	YES	YES	YES	YES	YES	YES
Observations	5,028	5,028	5,028	5,026	4,693	4,683	5,026	4,681
R^2	0.310	0.247	0.391	0.331	0.284	0.255	0.398	0.417

Note: *p<0.1; **p<0.05; ***p<0.01

Caveat: covariates are standardized, each has a standard deviation of 1 (different from a corresponding table in the paper).

Cross-section of $\hat{\beta}_2$ and info asymmetry

$$\beta_2 = \frac{\partial \text{ Return autocorrelation}}{\partial \text{ C-to-C volume}}$$

	Dependent variable: $\hat{\beta}_2$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	0.090***	0.082***	0.113***	0.117***	0.088***	0.076***	0.125***	0.126***
	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)	(0.006)	(0.008)	(0.009)
Average bid-ask	0.001	0.003	0.001	0.017***	0.006	0.005	0.008*	0.010*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
No. funds	−0.012***						−0.004**	−0.003*
	(0.002)						(0.002)	(0.002)
CDS dummy		−0.004**					−0.003*	−0.003*
		(0.002)					(0.002)	(0.002)
Issue size			−0.017***				−0.009***	−0.010***
			(0.002)				(0.003)	(0.003)
No. dealers				−0.017***			−0.009***	−0.010***
				(0.002)			(0.003)	(0.003)
Issuer size					−0.005***			−0.0002
					(0.002)			(0.002)
–Equity volatility						−0.003		−0.005**
						(0.002)		(0.002)
Risk controls	YES	YES	YES	YES	YES	YES	YES	YES
Vlm controls	YES	YES	YES	YES	YES	YES	YES	YES
Observations	5,028	5,028	5,028	5,026	4,693	4,683	5,026	4,681
R^2	0.021	0.013	0.026	0.025	0.015	0.014	0.030	0.036

Note: *p<0.1; **p<0.05; ***p<0.01

Caveat: covariates are standardized, each has a standard deviation of 1 (different from a corresponding table in the paper).

Cross-section of $\hat{\beta}_3$ and info asymmetry

$$\beta_3 = \frac{\partial \text{ Return autocorrelation}}{\partial \text{ C-to-D volume}}$$

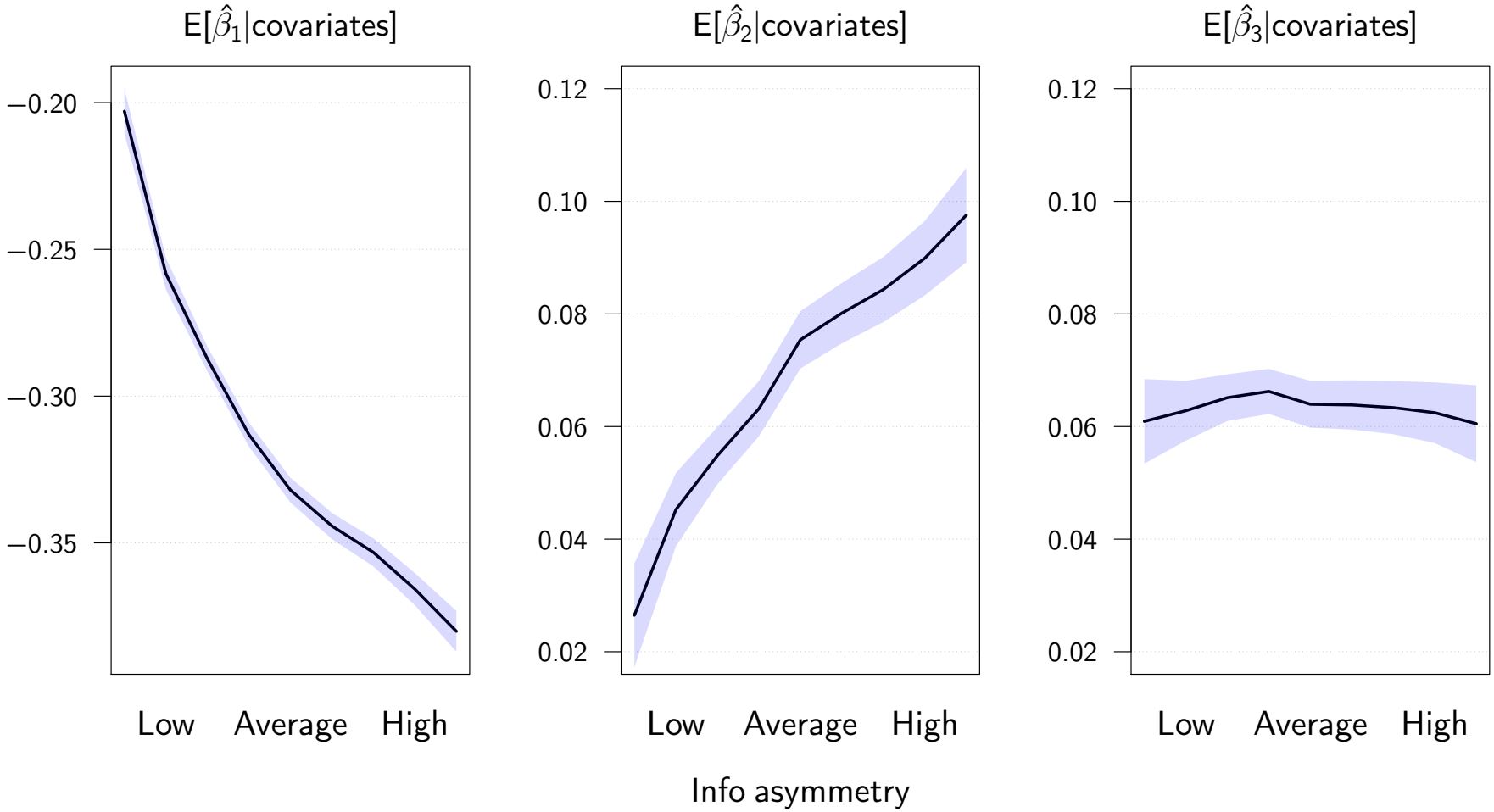
	Dependent variable: $\hat{\beta}_3$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	0.041***	0.041***	0.046***	0.051***	0.048***	0.042***	0.050***	0.054***
	(0.004)	(0.004)	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)	(0.007)
Average bid-ask	−0.046***	−0.046***	−0.047***	−0.044***	−0.043***	−0.042***	−0.041***	−0.038***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
No. funds	0.003**						0.005***	0.003
	(0.001)						(0.002)	(0.002)
CDS dummy		0.002*					0.002*	0.001
		(0.001)					(0.001)	(0.001)
Issue size			−0.001				−0.001	0.0001
			(0.002)				(0.002)	(0.002)
No. dealers				−0.003*			−0.005**	−0.003
				(0.002)			(0.002)	(0.002)
Issuer size					−0.005***			−0.005***
					(0.002)			(0.002)
–Equity volatility						0.003		0.003
						(0.002)		(0.002)
Risk controls	YES	YES	YES	YES	YES	YES	YES	YES
Vlm controls	YES	YES	YES	YES	YES	YES	YES	YES
Observations	5,028	5,028	5,028	5,026	4,693	4,683	5,026	4,681
R^2	0.106	0.106	0.106	0.106	0.105	0.103	0.108	0.106

Note: *p<0.1; **p<0.05; ***p<0.01

Caveat: covariates are standardized, each has a standard deviation of 1 (different from a corresponding table in the paper).

Predicted volume-return coefficients under changing information asymmetry

$$\text{Return autocorr}_t = \beta_1(\text{info}) + \beta_2(\text{info}) \cdot \text{Client-to-client volume}_t + \beta_3(\text{info}) \cdot \text{Client-to-dealer volume}_t$$



Deciles of information asymmetry proxies are on x-axes. Controls are fixed at the median levels.

Robustness

1. Volumes (linear terms) in the 1st stage Pic
2. Market return in the 1st stage Pic
3. Initial observations of covariates in the 2nd stage Pic
4. (new) Weighted LS in the 2nd stage Pic
5. (new) Trading volumes in logs Pic
6. (new) Prices: simple avg between volume-weighted buys and sells (not VWAP) Pic
7. (new) Prices: VWAP, but small transactions are excluded Pic

Implication: performance of reversal portfolios

- **Reversal portfolios**: monthly re-balanced double sorted on negative past return (quintiles) and credit rating (terciles). Long-reversal return = size-weighted returns within each of 3 credit rating bins, averaged across top reversal quintile. Full sample, 2005–2017.
- **Trading cost adjustment**: half of the realized bid-ask spread. Only bonds with 12m backward average of the realized bid-ask less than 100 b.p. are considered.
- **Sub-portfolios**: 6m lag of the number of mutual fund owners below/above median.

	Cum trading costs				Net trading costs			
	Mean	S.D.	SR	IR	Mean	S.D.	SR	IR
Long reversal (LR)	8.40	6.44	1.12	1.83	1.96	6.34	0.13	0.18
LR: many funds	8.02	7.09	0.97	1.40	1.39	6.99	0.04	0.01
LR: few funds	9.01	6.11	1.28	2.06	2.81	6.01	0.28	0.44
Market	2.16	3.66	0.28		1.36	3.66	0.07	

Cumulative performance charts

Conclusion

- Investors trade U.S. corporate bonds, even investment-grade ones, not only for liquidity reasons but also on private information.
- **Non-dealer liquidity providers are more likely to be adversely selected.**

  Information reveals itself in prices on high-volume days when dealers are reluctant to accept inventory risk; more so in bonds with material information asymmetry.
- Implications for constructing bond reversal portfolios.

Appendix: extension of Llorente, Michaely, Saar, and Wang, 2002

- **Risky bond** in random supply s_t pays perpetually a log-coupon c.

$$\text{Log-return: } r_{t+1} \approx \underbrace{\kappa + c(1-\theta)}_{\text{Constant}} + \underbrace{\theta p_{t+1} - p_t}_{\text{Log-price change}} - \underbrace{d_{t+1}}_{\text{Loss}},$$

$$\text{Log default loss: } d_{t+1} = f_t + g_t;$$

  f_t is publicly observed and g_t is the private information of informed investors.

- **Informed investors** have a random exposure z_t to a non-traded asset that pays n_{t+1} and $\sigma_{rn} > 0$. Their private knowledge is: $\{g_t, z_t\}$. Both ω informed and $1-\omega$ uninformed know $\{d_t, p_t, n_t, f_t, s_t\}$.
- **CARA-Normal** setting, investors born at t consume at $t+1$. Variances of g, z, f, and n are fixed. Costless riskless borrowing and lending.
- **Random supply** follows:

$$s_{t+1} = \delta s_t + \epsilon_{t+1}.$$

Back to step 1 empirics

Appendix: model equilibrium

Define $\tilde{p}_t \equiv p_t + (f_t - \kappa - c(1-\theta))$. Under mild restrictions on model parameters there exists a unique REE with a linear pricing function

$$\tilde{p}_t = -a(g_t + bz_t + es_t),$$

where a, b, and e are positive economically reasonable constants.

- Uninformed investors learn g_t and z_t from prices, hence

$$\mathbb{E}_t^{(1)}[g_t] = g_t,$$

$$\mathbb{E}_t^{(2)}[g_t|\tilde{p}_t, s_t] = -\frac{1}{a}\tilde{p}_t - es_t = \gamma(g_t + bz_t),$$

  where $\gamma > 0$. Conditional return variances are constant for both types of investors.
- Informed and uninformed investors' demands $X_t^{(1)}$ and $X_t^{(2)}$ are linear in g_t, z_t, and s_t.
- The market clears:

$$\omega X_t^{(1)}(g_t, z_t, s_t) + (1-\omega)X_t^{(2)}(g_t, z_t, s_t) = s_t.$$

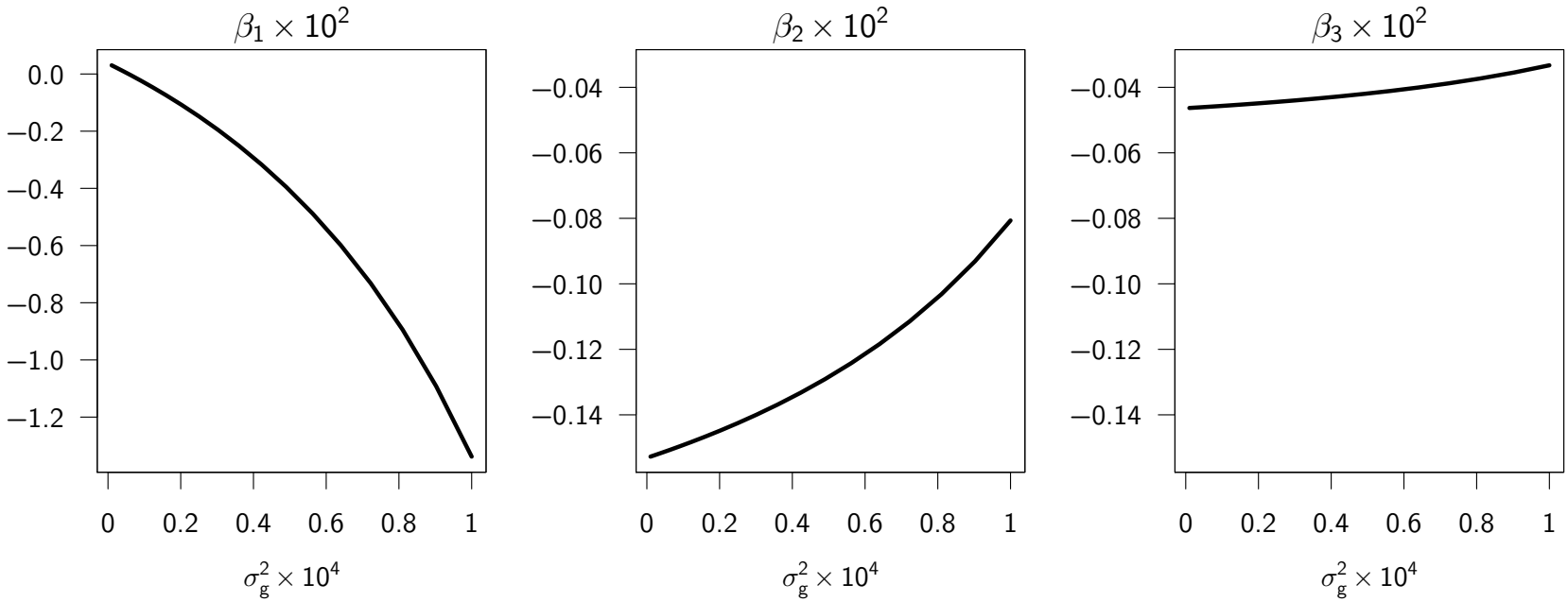
Appendix: volume-return coefficients and information asymmetry

An econometrician observing the data generated by such economy finds:

$$\mathbb{E}_t\left[r_{t+1}|r_t, v_{c,t}, v_{s,t}\right] \approx \left(\beta_1 + \beta_2 v_{c,t}^2 + \beta_3 v_{s,t}^2\right) r_t,$$

where β_1, β_2, and β_3 depend on the degree of information asymmetry σ_g^2.

For the model calibrated to a typical corporate bond in the TRACE data, holding unconditional **variance of returns fixed**:



Back to step 2 empirics

Appendix: summary statistics

	Mean	Median	S.D.	Min	5th	25th	75th	95th	Max	N.Obs.
Issue size, mln USD	655.24	500.00	708.38	0.61	9.40	250.00	850.00	2000.00	15000.00	5746678
Rating	7.97	7.33	3.27	1.00	4.00	6.00	10.00	14.00	21.00	5746678
Age, years	4.93	3.58	4.63	0.00	0.33	1.67	6.75	15.50	62.42	5746678
Maturity, years	9.37	6.50	8.05	1.00	1.50	3.50	12.08	27.33	29.92	5746678
Duration	6.75	5.57	4.49	0.84	1.41	3.20	9.00	15.86	27.93	5746678
Total return, %	0.03	0.03	1.25	-8.19	-1.85	-0.36	0.43	1.90	8.49	5746678
Credit spread, %	2.55	1.90	2.84	0.00	0.69	1.28	2.98	6.24	88.70	5746678
Average bid-ask, %	1.14	0.74	1.16	0.00	0.08	0.31	1.62	3.37	19.99	2308138
No. trades per day	6.45	3.00	11.17	1.00	1.00	2.00	7.00	22.00	2540.00	5746678
No. days since last trade	2.33	1.00	7.25	1.00	1.00	1.00	2.00	7.00	1436.00	5735632
C-to-C volume, % of size	0.50	0.00	1.97	0.00	0.00	0.00	0.08	2.50	15.99	5746678
C-to-D volume, % of size	0.01	0.00	3.52	-19.67	-4.35	-0.22	0.33	4.29	17.91	5746678
|C-to-D volume|, % of size	1.52	0.28	3.18	0.00	0.00	0.05	1.31	7.86	19.67	5746678

(a) Full sample

	Mean	Median	S.D.	Min	5th	25th	75th	95th	Max	N.Obs.
Issue size, mln USD	1011.28	750.00	820.94	9.07	166.07	500.00	1250.00	2500.00	15000.00	2720325
Rating	7.73	7.00	3.29	1.00	3.00	6.00	9.00	14.00	21.00	2720325
Age, years	4.15	3.08	3.96	0.00	0.25	1.42	5.75	12.17	31.50	2720325
Maturity, years	8.20	5.58	7.62	1.00	1.42	3.17	9.08	27.33	29.92	2720325
Duration	6.07	4.86	4.24	0.86	1.40	2.94	7.62	15.57	21.57	2720325
Total return, %	0.02	0.02	0.81	-8.19	-1.15	-0.24	0.29	1.18	8.49	2720325
Credit spread, %	2.33	1.70	2.68	0.00	0.59	1.13	2.70	6.01	88.70	2720325
Average bid-ask, %	0.98	0.63	1.02	0.00	0.08	0.29	1.33	3.02	19.99	1550785
No. trades per day	9.06	6.00	12.77	1.00	1.00	3.00	11.00	28.00	2540.00	2720325
No. days since last trade	1.10	1.00	0.35	1.00	1.00	1.00	1.00	2.00	3.00	2718673
C-to-C volume, % of size	0.53	0.02	1.89	0.00	0.00	0.00	0.16	2.83	15.99	2720325
C-to-D volume, % of size	0.01	0.00	3.11	-19.67	-4.00	-0.20	0.32	3.91	17.91	2720325
|C-to-D volume|, % of size	1.35	0.26	2.81	0.00	0.00	0.06	1.17	6.80	19.67	2720325

(b) Filtered sample

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Appendix: correlations between trading volume measures

	Mean	Med.	No.>0	No.<0	No.>0*	No.<0*	No. Obs.
$\mathrm{Corr}(V_t^{(c)}, \lvert V_t^{(s)} \rvert)$	0.142	0.130	8356	1466	5052	89	9822
$\mathrm{Corr}(V_t^{(c)}, V_t^{(s)})$	-0.052	-0.044	3233	6589	665	2624	9822
$\mathrm{Corr}(V_t^{(c)}, V_{t-1}^{(c)})$	0.063	0.028	5758	4064	2920	11	9822
$\mathrm{Corr}(\lvert V_t^{(s)} \rvert, \lvert V_{t-1}^{(s)} \rvert)$	0.091	0.085	7612	2210	3876	28	9822

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Appendix: variation in info asymmetry proxies in the cross-section of bonds

	Mean	Median	S.D.	Min	5th	25th	75th	95th	Max	N.Obs.
$\hat{\beta}_1$	-0.31	-0.33	0.12	-0.62	-0.48	-0.40	-0.24	-0.09	0.05	5028
$\hat{\beta}_2$	0.07	0.06	0.12	-0.48	-0.10	0.01	0.12	0.25	0.79	5028
$\hat{\beta}_3$	0.06	0.06	0.10	-0.33	-0.10	-0.00	0.11	0.21	0.49	5028
No. mutual fund owners	35.47	28.41	31.31	0.00	0.00	12.91	49.55	97.29	230.46	5028
Active CDS (dummy)	0.44	0.00	0.50	0.00	0.00	0.00	1.00	1.00	1.00	5028
Issue size, bln USD	0.82	0.60	0.70	0.01	0.07	0.40	1.00	2.25	9.39	5028
No. dealers	33.98	29.50	15.13	7.96	17.65	23.96	39.89	65.46	168.72	5026
Issuer size, bln USD	76.09	40.92	92.71	0.02	2.58	13.44	115.85	236.12	761.79	4693
Stock return volatility, %	1.77	1.57	0.84	0.65	0.93	1.23	2.06	3.25	10.52	4683
Average bid-ask, %	1.05	0.77	0.83	0.07	0.22	0.46	1.38	2.82	8.66	5028
C-to-C volume correlation	0.08	0.06	0.11	-0.18	-0.05	-0.00	0.14	0.29	0.66	5028
C-to-D volume correlation	0.10	0.10	0.09	-0.24	-0.05	0.04	0.15	0.25	0.79	5028
Bond return volatility, %	0.72	0.59	0.51	0.05	0.17	0.36	0.94	1.68	4.96	5028
Credit spread, %	2.42	1.74	2.85	0.14	0.58	1.11	2.78	6.39	68.96	5028

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Appendix: CS correlation between information asymmetry proxies

	No. funds	Active CDS	Issue size	No. dealers	Issuer size	Stock vol
Active CDS	0.09***					
Issue size	0.59***	0.02				
No. dealers	0.42***	-0.01	0.61***			
Issuer size	0.04***	-0.08***	0.40***	0.30***		
Stock vol	0.04***	-0.10***	-0.13***	0.14***	-0.27***	
Bid-ask	-0.24***	-0.13***	-0.40***	-0.05***	-0.15***	0.41***

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Appendix: models for $\mathbb{E}\left[\hat{\beta}_i \mid \text{info asymmetry}\right]$

	$\hat{\beta}_1$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_2$	$\hat{\beta}_3$	$\hat{\beta}_3$
Intercept	-0.429^{***}	-0.450^{***}	0.125^{***}	0.126^{***}	0.050^{***}	0.054^{***}
	(0.007)	(0.008)	(0.008)	(0.009)	(0.006)	(0.007)
Average bid-ask	-0.064^{***}	-0.073^{***}	0.008^{*}	0.010^{*}	-0.041^{***}	-0.038^{***}
	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)
No. funds	0.007^{***}	0.007^{***}	-0.004^{**}	-0.003^{*}	0.005^{***}	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
CDS dummy	0.002	0.001	-0.003^{*}	-0.003^{*}	0.002^{*}	0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Issue size	0.046^{***}	0.040^{***}	-0.009^{***}	-0.010^{***}	-0.001	0.0001
	(0.004)	(0.004)	(0.003)	(0.003)	(0.002)	(0.002)
No. dealers	0.013^{***}	0.017^{***}	-0.009^{***}	-0.010^{***}	-0.005^{**}	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Issuer size		0.011^{***}		-0.0002		-0.005^{***}
		(0.002)		(0.002)		(0.002)
–Equity volatility		0.005^{**}		-0.005^{**}		0.003
		(0.002)		(0.002)		(0.002)
Risk controls	YES	YES	YES	YES	YES	YES
Vlm correlations	YES	YES	YES	YES	YES	YES
Observations	5,026	4,681	5,026	4,681	5,026	4,681
R^2	0.398	0.417	0.030	0.036	0.108	0.106

Note: *p<0.1; **p<0.05; ***p<0.01

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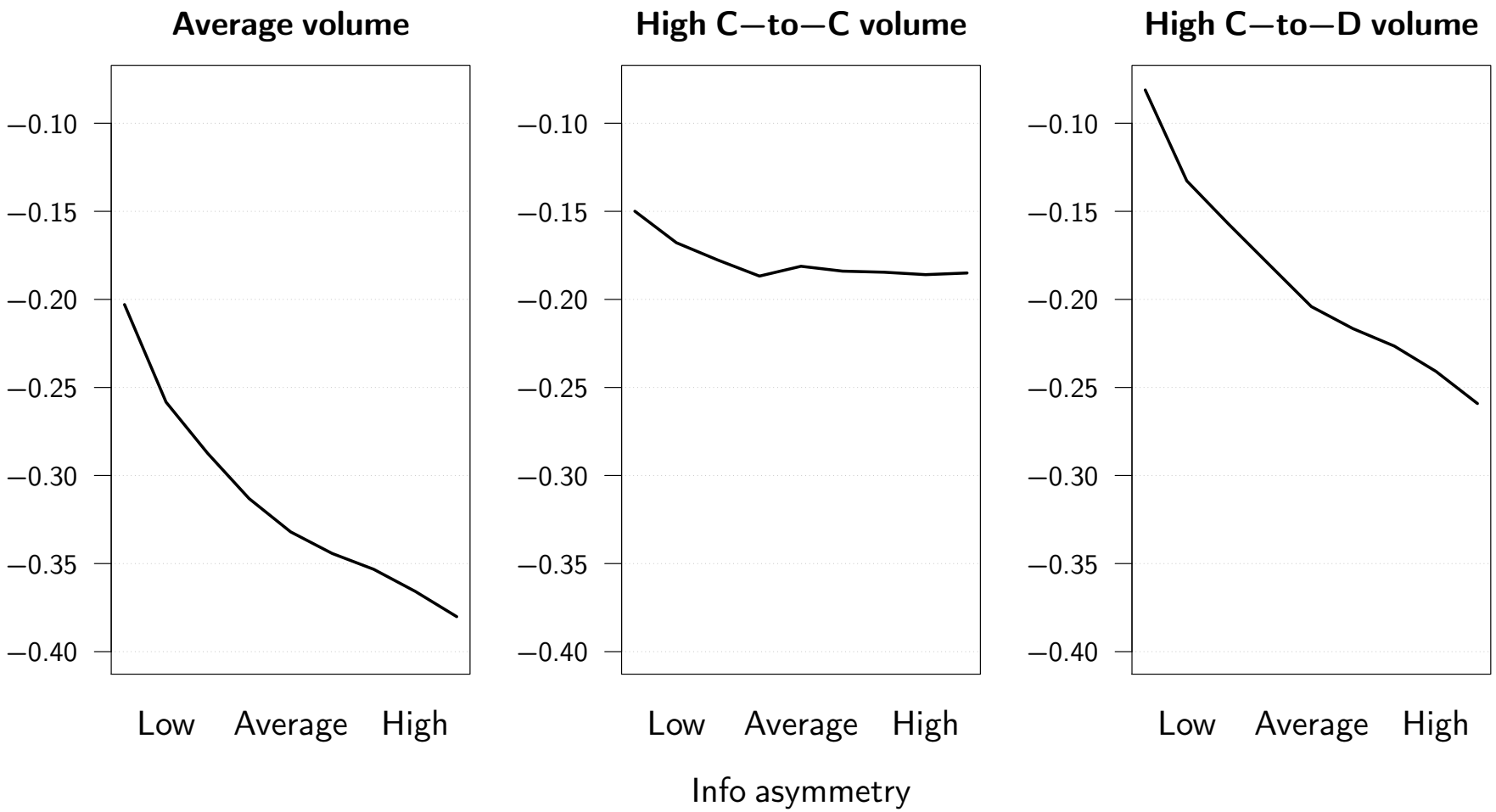
Appendix: predicted reversals under changing information asymmetry



Deciles of information asymmetry proxies are on x-axes. Controls are fixed at the median levels.

First return autocorrelation is on y-axes.

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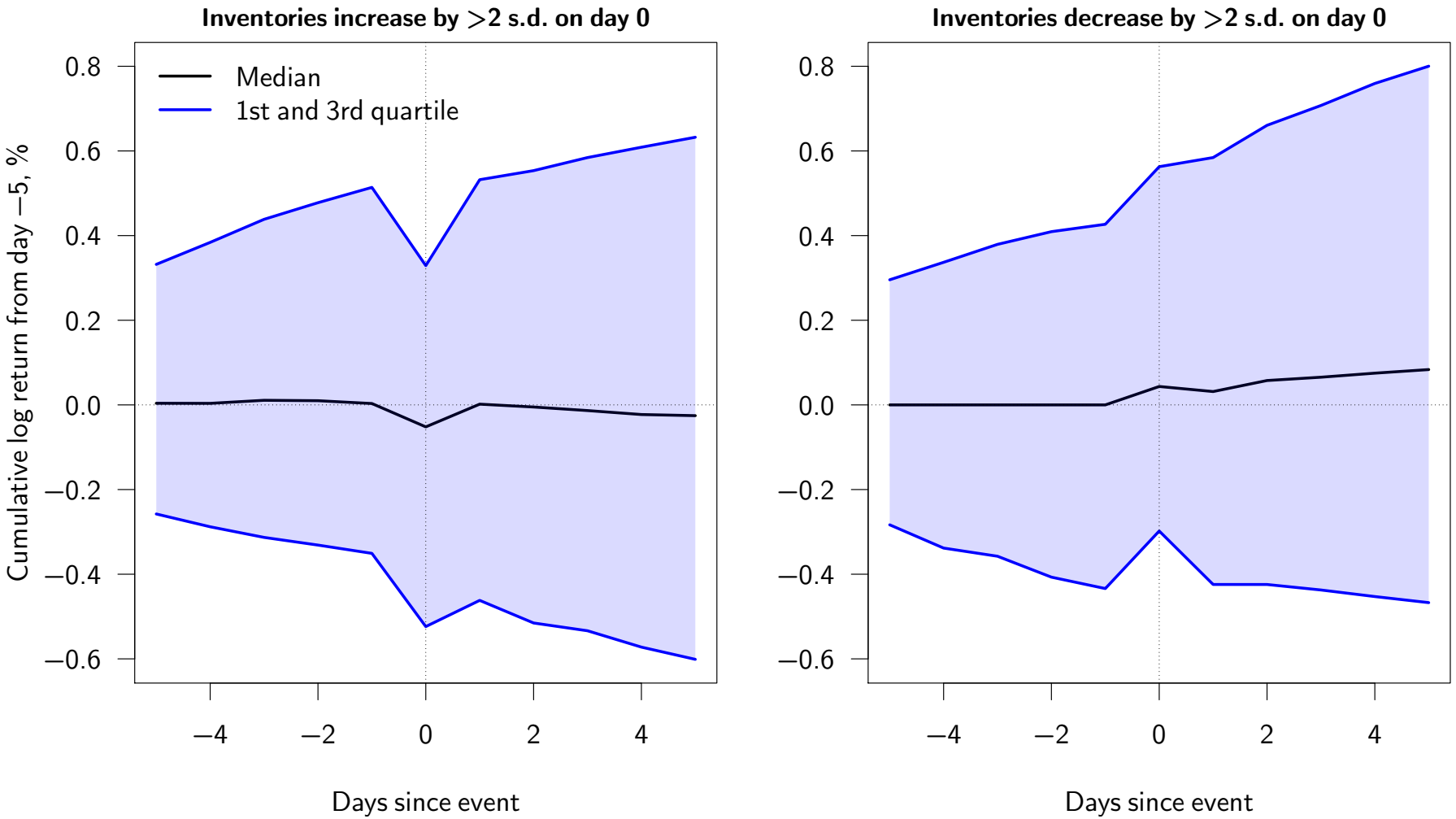
Appendix: event study on high C-to-D volume days

Examine how bond prices behave around days with high C-to-D vlm and zero C-to-C vlm



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Appendix: pre/post-crisis differences [preliminary]

A: **Jan 2005 – Jun 2008**

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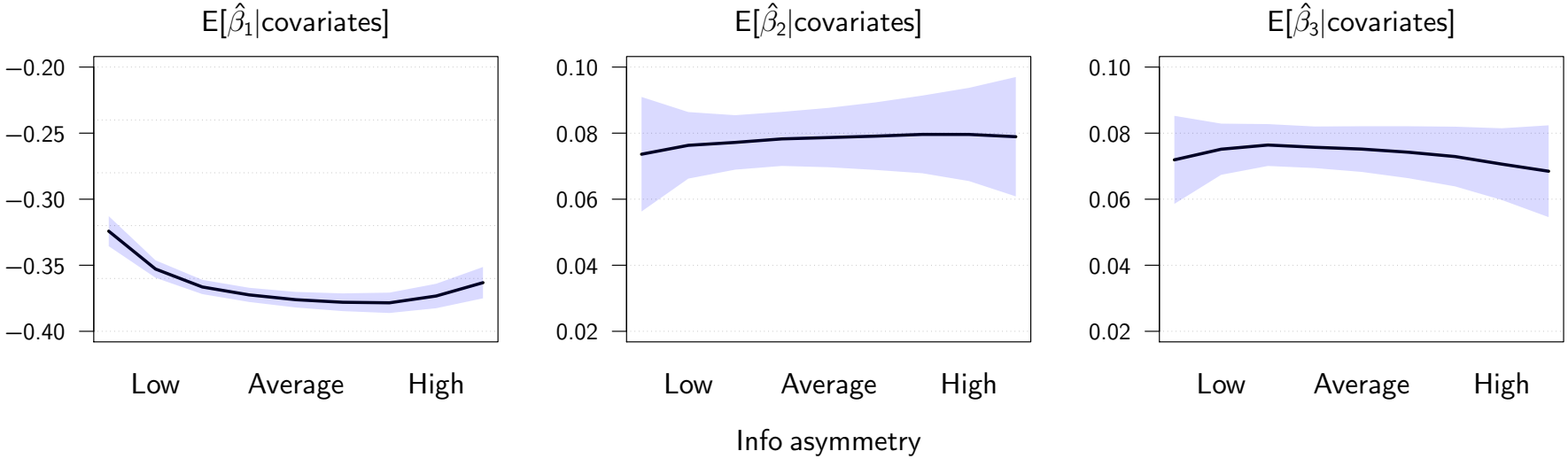
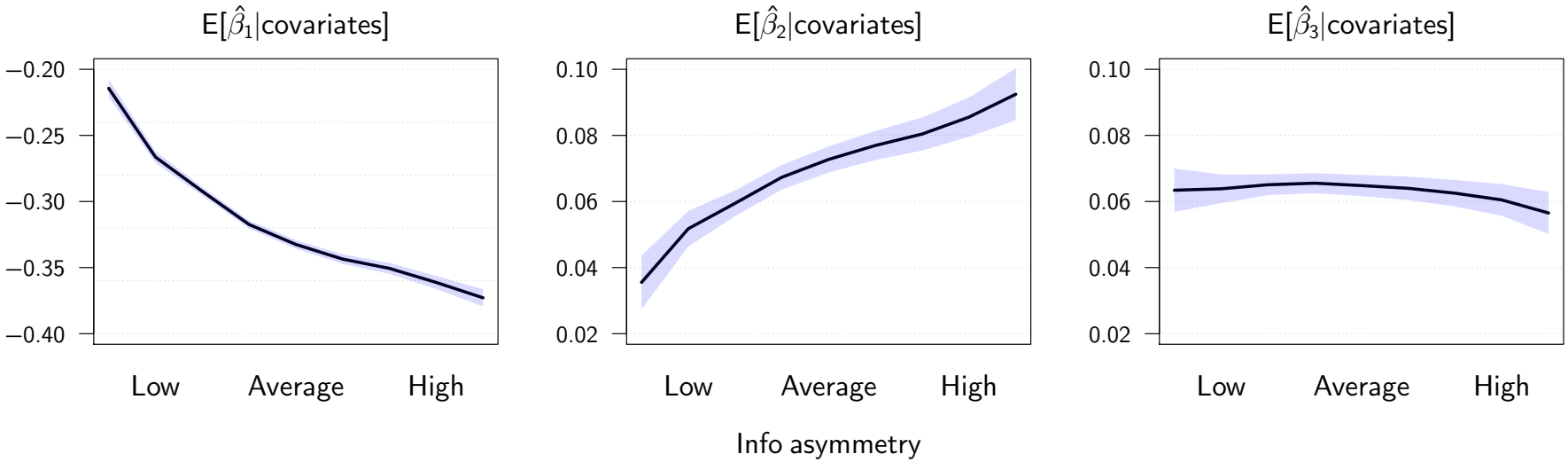


B: **Jan 2010 – Jun 2017**



Appendix: not only firm-level but also bond-level information matters

Restrict the sample to issuers with $\geqslant 15$ bonds outstanding and control for issuer FE

	$\hat{\beta}_1$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_2$	$\hat{\beta}_3$	$\hat{\beta}_3$
Average bid-ask	-0.066^{***}	-0.075^{***}	0.005	0.007	-0.006	-0.004
	(0.010)	(0.010)	(0.011)	(0.010)	(0.008)	(0.008)
No. funds	0.009^{***}	0.010^{***}	-0.008^{**}	-0.008^{**}	0.002	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
CDS dummy	0.012	-0.004	0.001	-0.003	0.001	-0.005
	(0.010)	(0.009)	(0.010)	(0.010)	(0.008)	(0.008)
Issue size	0.029^{***}	0.023^{***}	-0.00003	-0.001	-0.002	-0.002
	(0.005)	(0.005)	(0.004)	(0.004)	(0.003)	(0.003)
No. dealers	0.016^{***}	0.026^{***}	-0.011^{***}	-0.013^{***}	-0.011^{***}	-0.009^{**}
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Issuer size		0.044^{***}		0.008		-0.009
		(0.008)		(0.010)		(0.009)
–Equity volatility		0.026^{***}		-0.013^{*}		0.023^{***}
		(0.006)		(0.007)		(0.006)
Issuer FE	YES	YES	YES	YES	YES	YES
Risk controls	YES	YES	YES	YES	YES	YES
Vlm correlations	YES	YES	YES	YES	YES	YES
Observations	1,927	1,837	1,927	1,837	1,927	1,837
R^2	0.553	0.568	0.115	0.131	0.217	0.204

Note: *p<0.1; **p<0.05; ***p<0.01

Caveat: covariates are standardized, each has a standard deviation of 1 (different from a corresponding table in the paper).

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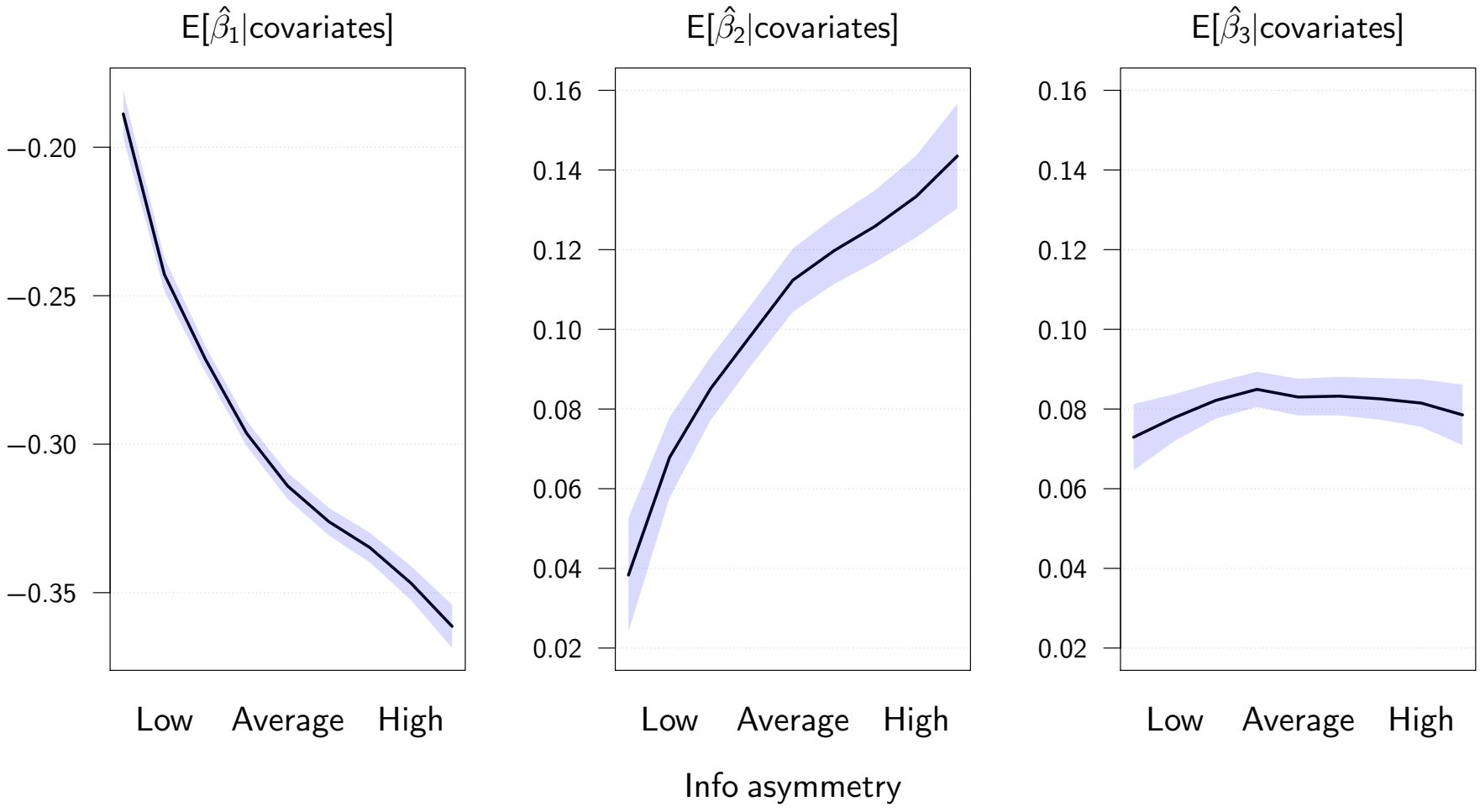
Appendix: robustness to inclusion of volumes in the 1st stage



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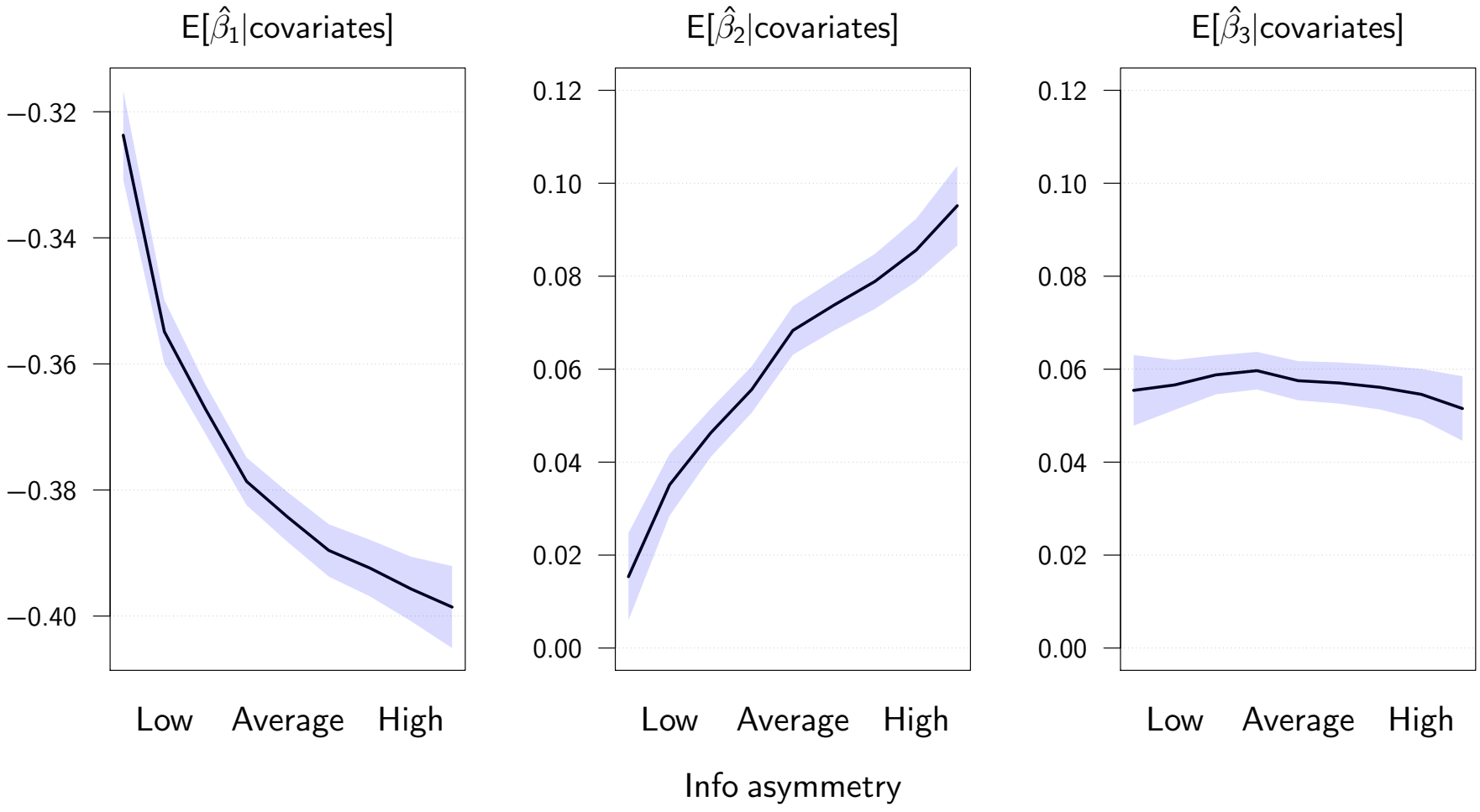
Appendix: robustness to inclusion of market return in the 1st stage



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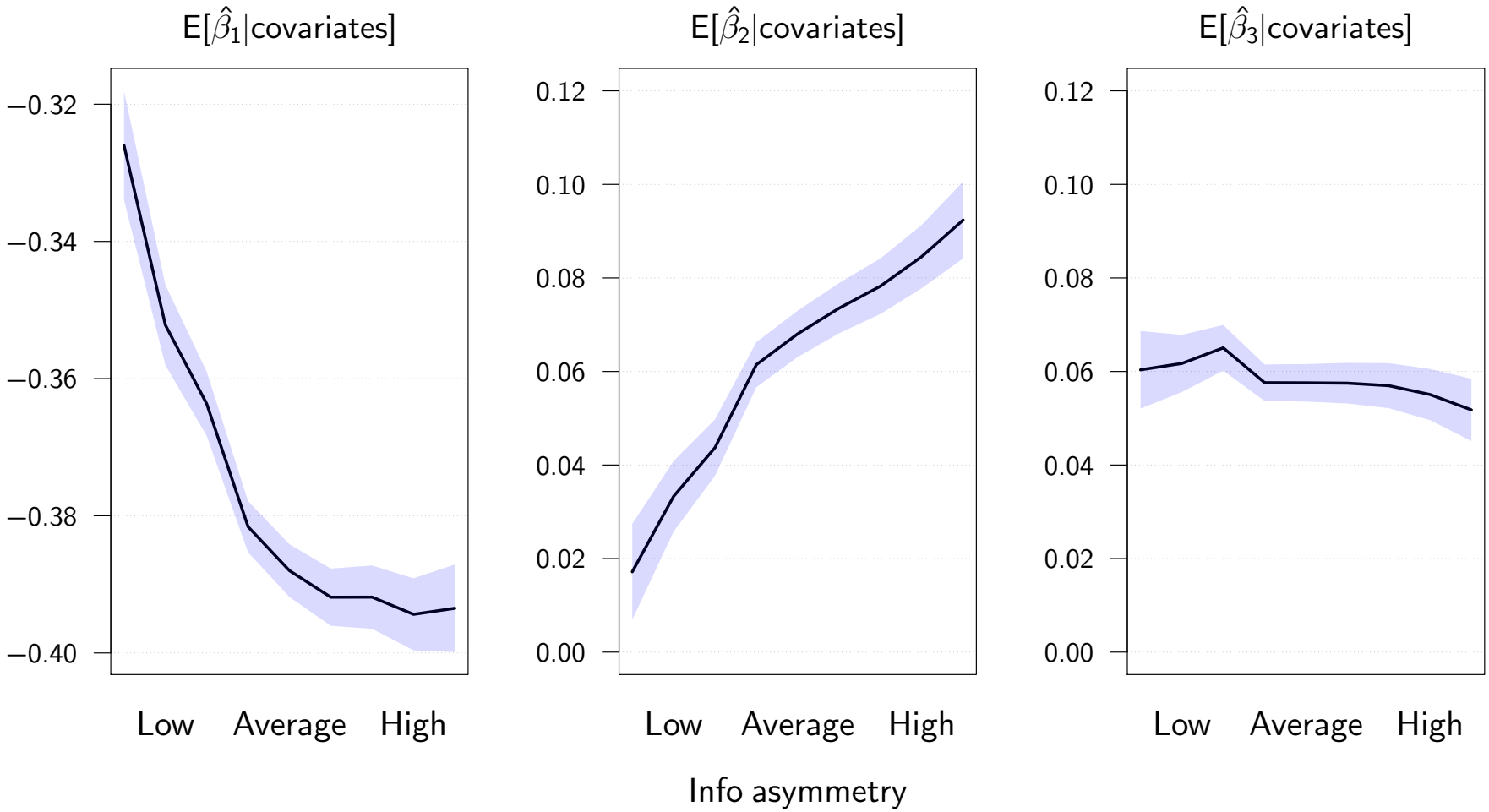
Appendix: robustness to initial values of info asymmetry proxies



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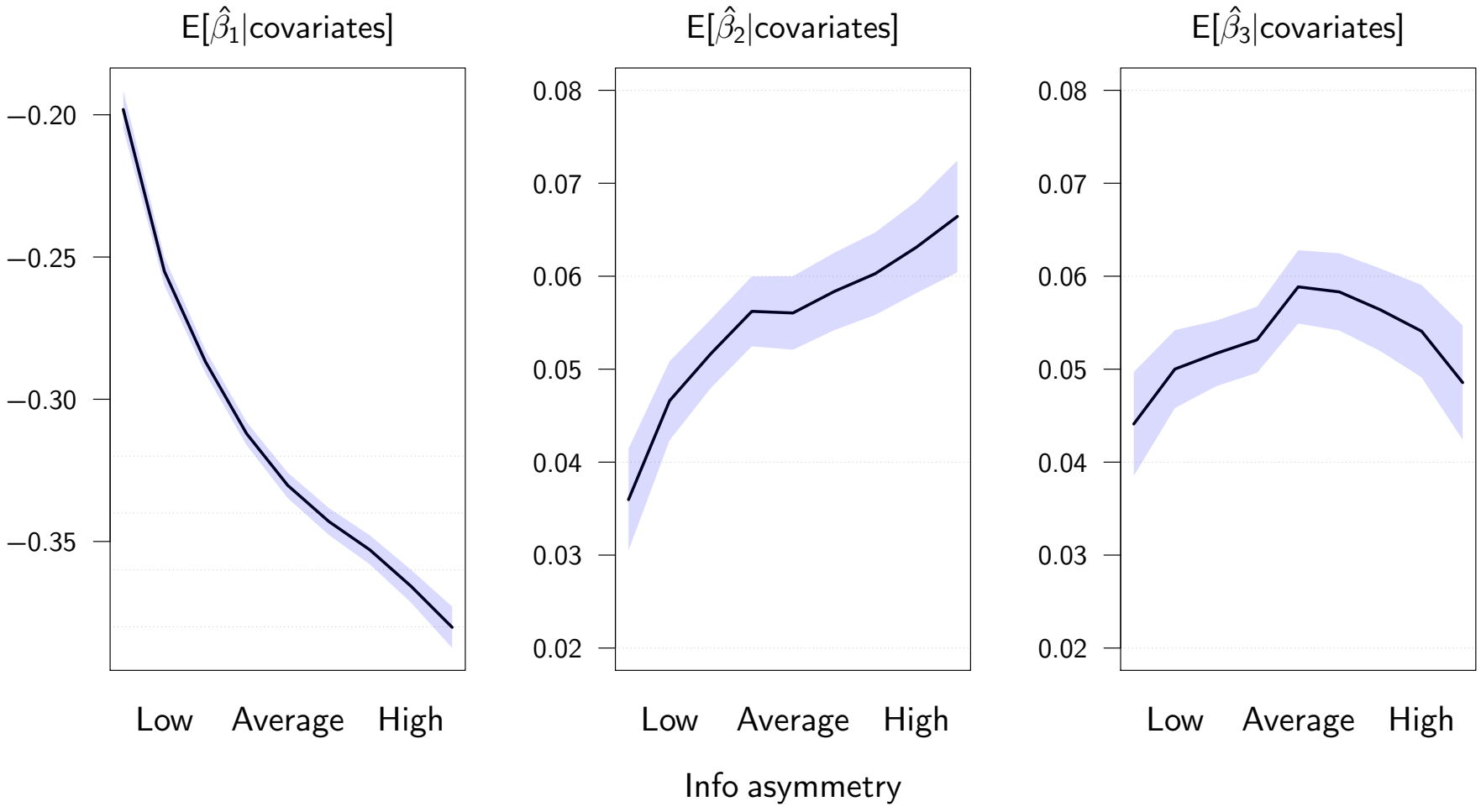
Appendix: robustness to weighted LS on the 2nd stage



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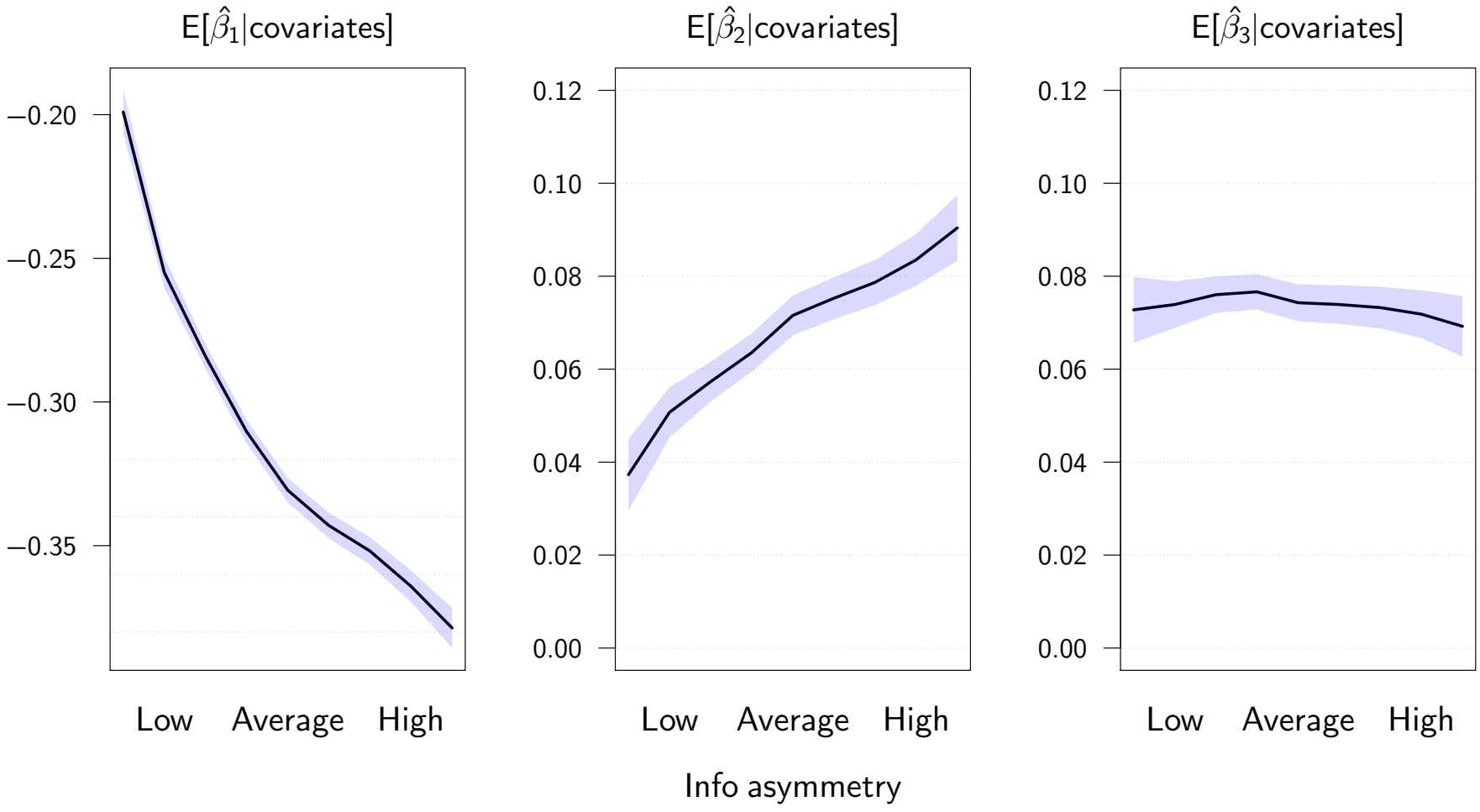
Appendix: robustness to trading volumes in logs



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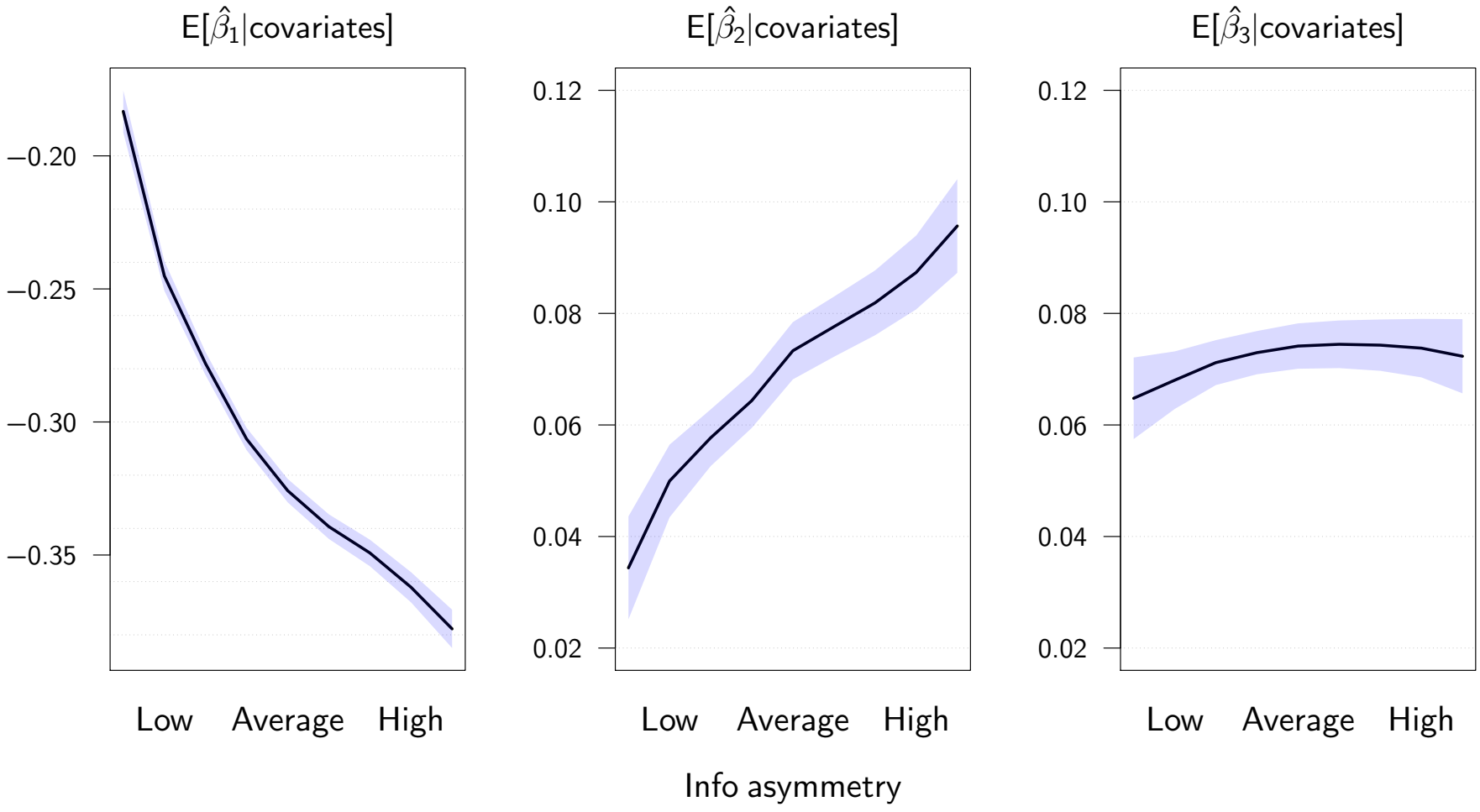
Appendix: robustness to volume-weighted mid price



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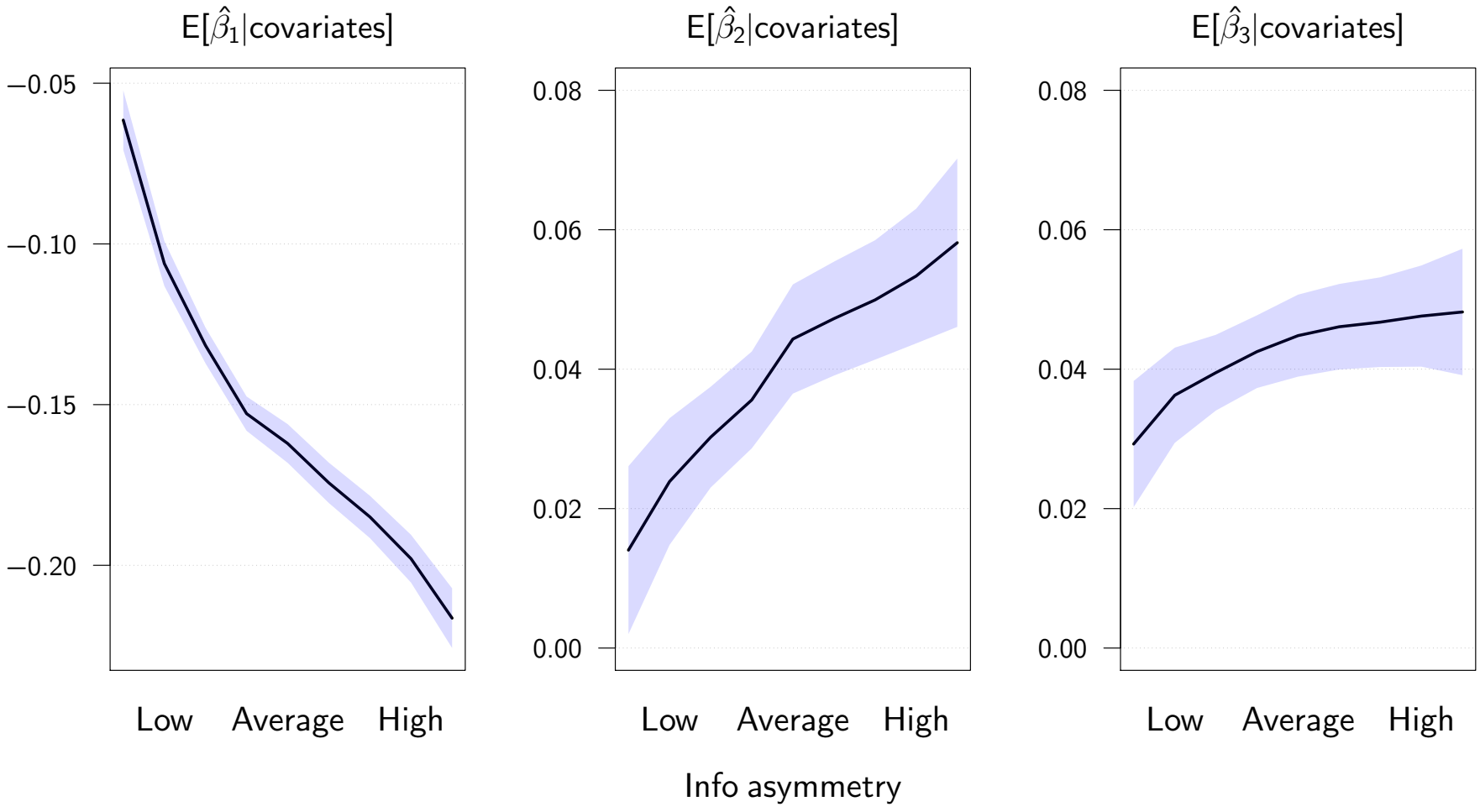
Appendix: robustness to exclusion of small trades



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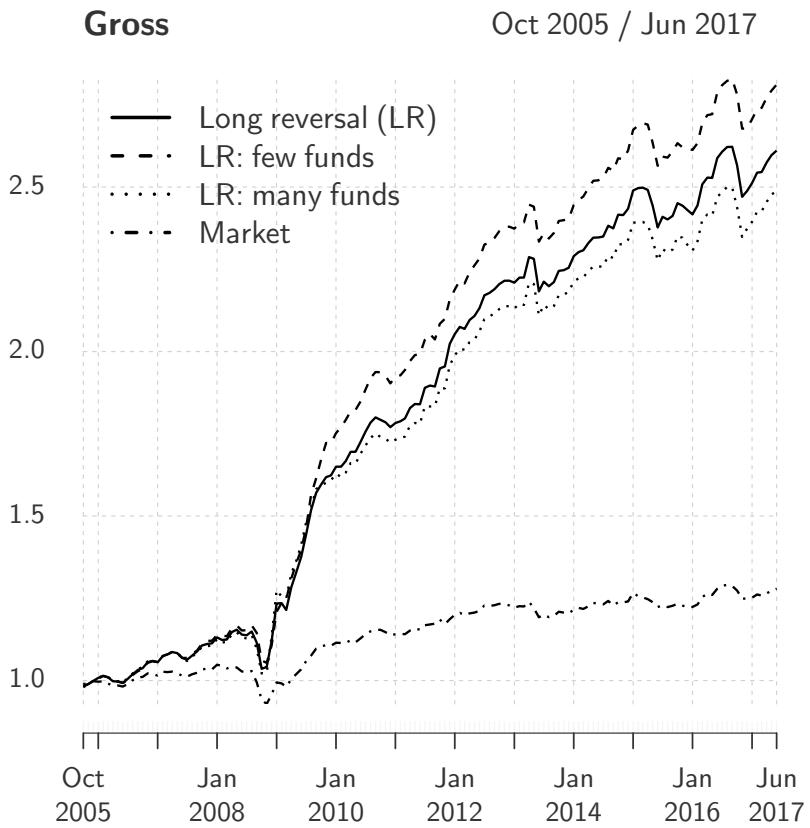
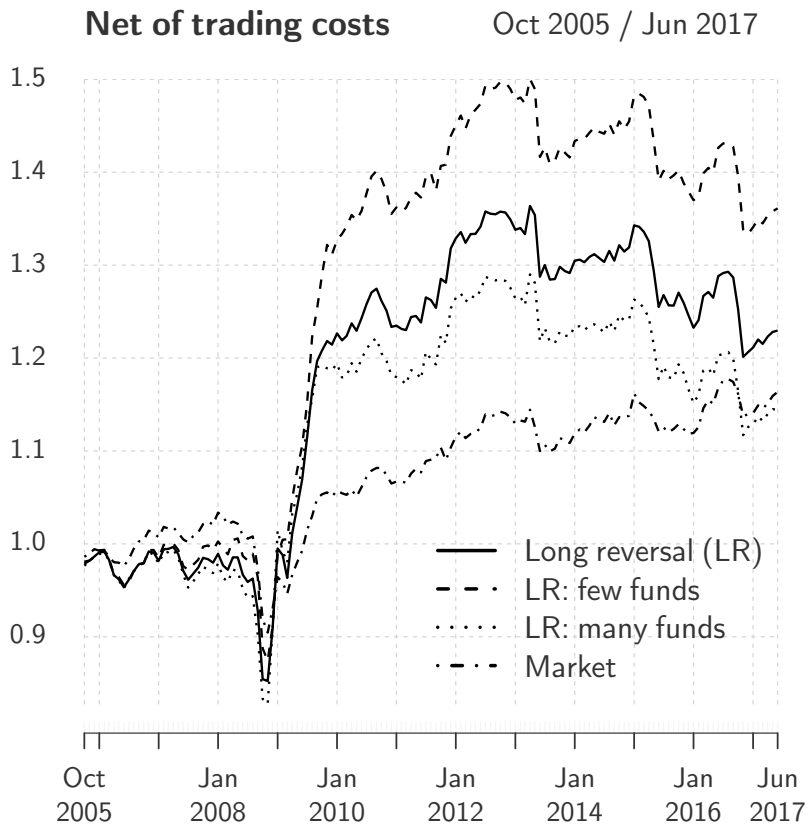
Appendix: cumulative performance of reversal portfolios



(a) Before trading cost adjustment



(b) After trading cost adjustment

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