Internet Appendix to "Liquidity, Volume, and Volatility"

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- Section 1 solves the Glosten (1989) one-period model and computes comparative statics of liquidity and volume. The model is a standard one-period Kyle-type model, but it allows for risk-averse insiders and replaces noise traders with endowment shocks of the risk-averse trader.
- Section 2 solves the standard inventory model of Campbell, Grossman, and Wang (1993) with endogenous entry of liquidity providers
- Section 3 reports additional robustness checks mentioned in the paper
- Section 4 shows that the main results are robust to using dollar volume instead of market capitalization to form the quintiles portfolios

1 Glosten (1989) Kyle-type one-period model: volume-spread comparative statics

- Asset value $V \sim N(\mu, \Sigma_v)$.
- The agent observes $s = V + \epsilon$. $\epsilon \sim N(0, \Sigma_\epsilon)$.
- The agent endowed with ω of asset. $\omega \sim N(0, \Sigma_\omega)$.
- The agent faces the price schedule $P(X)$ if she submits an order X it will be filled at $P(X)$.

- Agent Maximizes $E^i[(\omega + x)V - xP(x)] - \frac{\gamma}{2}(\omega + x)^2 \text{Var}^i[V]$.

- We look for linear equilibrium $P(X) = \mu + \lambda X$.

- FOC of the agent gives

$$X = \frac{\mathbb{E}^i[V] - \gamma \text{Var}^i[V]\omega - \mu}{2\lambda + \gamma \text{Var}^i[V]}$$

- The second order condition is

$$2\lambda + \gamma \text{Var}^i[V] > 0$$

- Updating based on the agent's signal gives:

$$\mathbb{E}^i[V] = \mu + \frac{\Sigma_v}{\Sigma_v + \Sigma_\epsilon}(s - \mu)$$
$$\text{Var}^i[V] = \frac{\Sigma_v \Sigma_\epsilon}{\Sigma_v + \Sigma_\epsilon}$$

- it follows that agents demand is

$$X = \beta(s - \gamma \Sigma_\epsilon \omega - \mu)$$
$$\beta = \frac{\Sigma_v}{2\lambda(\Sigma_v + \Sigma_\epsilon) + \gamma \Sigma_\epsilon \Sigma_v}$$

- Now, we see that the market maker's break-even price is indeed of the form $P(X) = \mathbb{E}[V \mid X] = \mu + \lambda X$ with

$$\lambda = \frac{\text{Cov}(V, \beta(s - \gamma \Sigma_\epsilon \omega)}{\text{Var}[\beta(s - \gamma \Sigma_\epsilon \omega - \mu)]} = \frac{\Sigma_v}{\beta(\Sigma_v + \Sigma_\epsilon + \gamma^2 \Sigma_\epsilon^2 \Sigma_\omega)}$$

- We can then solve the fixed point for λ. This gives:

$$\lambda = \frac{\gamma \Sigma_\epsilon \Sigma_v}{\Sigma_\epsilon(\gamma^2 \Sigma_\epsilon \Sigma_\omega - 1) - \Sigma_v}$$

- We plug into SOC and find that Second order condition for optimum becomes:

$$\Sigma_\epsilon + \Sigma_v < \gamma^2 \Sigma_\epsilon^2 \Sigma_\omega$$

- Then we can compute the expected volume in the model as $\Theta = \mathbb{E}[|X|] = \sqrt{\frac{2}{\pi}\text{Var}[X]}$, using the fact that

$$\text{Var}[X] = \beta^2(\Sigma_v + \Sigma_\epsilon + \gamma^2\Sigma_\epsilon^2\Sigma_\omega) = \frac{(\Sigma_\epsilon + \Sigma_v - \gamma^2\Sigma_\epsilon^2\Sigma_\omega)^2}{\gamma^2\Sigma_\epsilon^2(\Sigma_\epsilon + \Sigma_v + \gamma^2\Sigma_\epsilon^2\Sigma_\omega)}$$

- Then we can do the comparative statics with respect to all parameters $\Sigma_V, \Sigma_\epsilon, \Sigma_\omega, \gamma$ and we find (see the attached mathematica file for the proofs), that if the Second order condition is satisfied we have:

  1. $\frac{\partial\Theta}{\partial\Sigma_\omega} > 0$ and $\frac{\partial\lambda}{\partial\Sigma_\omega} < 0$
  2. $\frac{\partial\Theta}{\partial\Sigma_\epsilon} > 0$ and $\frac{\partial\lambda}{\partial\Sigma_\epsilon} < 0$
  3. $\frac{\partial\Theta}{\partial\Sigma_v} < 0$ and $\frac{\partial\lambda}{\partial\Sigma_\omega} > 0$
  4. $\frac{\partial\Theta}{\partial\gamma} > 0$ and $\frac{\partial\lambda}{\partial\gamma} < 0$

- So in the end the model always delivers the same comparative statics that volume and spreads are negatively related.

2 Campbell-Grossman-Wang (1993) with Endogenous Entry of Liquidity Providers

2.1 Without Entry

- One risky asset that pays dividend $d_t \sim N(\bar{d}, \sigma_d)$
- one risk-free exogenous asset that pays a gross return R
- M risk-averse traders who maximize expected utility over next period wealth $\max_{x_{i,t}} -\mathbb{E}_t e^{-\gamma W_{t+1}}$, where $W_{t+1} = RW_t + x_{i,t}(p_{t+1} + d_{t+1} - Rp_t)$
- Liquidity traders submit supply shock $\theta_t \sim N(0, \sigma_\theta)$ (in the original version of the model the liquidity providers have exogenous time-varying risk aversion)
- Market clears: $\sum_i^M x_{i,t} = \theta_t$

- Let $q_{t+1} = p_{t+1} + d_{t+1} - Rp_t$, then $x_{i,t} = \frac{\mathbb{E}_t[q_{t+1}]}{\gamma \text{Var}_t[q_{t+1}]}$
- In equilibrium $p_t = \bar{p} - \lambda\theta_t$, where $R\lambda = \frac{\gamma}{M}(\sigma_d^2 + \lambda^2\sigma_\theta^2)$, in what follows we focus on the positive root (stable equilibrium) of the price impact λ

2.2 With Entry

- A market maker pays a fixed cost c to participate, in equilibrium the last market maker to enter has to be indifferent between entering or not (we ignore the fact that M is discrete)

$$-\mathbb{E}\left[e^{-\gamma(R(W_t - c) + x_{i,t}(p_{t+1} + d_{t+1} - Rp_t))}\right] = -\mathbb{E}\left[e^{-\gamma R W_t}\right]$$

- Using the fact that all market makers are identical $\frac{M}{\gamma}\frac{\mathbb{E}_t[q_{t+1}]}{\gamma \text{Var}_t[q_{t+1}]} = \theta_t$
- Plug that in and simplify to obtain $\mathbb{E}\left[e^{-\frac{\gamma}{M}\theta_t q_{t+1}}\right] = e^{-\gamma Rc}$
- We have $q_{t+1}|\theta_t \sim N(-R\lambda\theta_t, \lambda^2\sigma_\theta^2 + \sigma_d^2)$
- By the law of iterated expectations this can be used to obtain $\mathbb{E}\left[e^{-\frac{1}{2}\frac{\gamma}{M}R\lambda\theta_t^2}\right] = e^{-\gamma Rc}$
- Use the moment generating function of the Chi-Squared distribution: $\mathbb{E}[e^{tX^2}] = \frac{1}{\sqrt{1-2t}}$, where $X \sim N(0,1)$
- Hence, $\frac{1}{\sqrt{1 + R\frac{\gamma\lambda\sigma_\theta^2}{M}}} = e^{-\gamma Rc}$, where $\lambda = \frac{1}{2\sigma_\theta^2}\left(\frac{RM}{\gamma} - \sqrt{(\frac{RM}{\gamma})^2 - 4\sigma_t^2\sigma_d^2)}\right)$
- $\frac{1}{\left(1 + R^2/2 - R(\frac{R^2}{4} - \frac{\sigma_\theta^2\sigma_d^2\gamma^2}{M^2})\right)^{(}1/2)} = e^{-\gamma Rc}$
- An increase in σ_θ must be directly offset by an increase in M in equilibrium so that σ_θ/M is constant. The price impact then decreases with σ_θ since $\lambda = \frac{1}{2\sigma_\theta}\left(\frac{R}{\gamma}\frac{M}{\sigma_\theta} - \sqrt{(\frac{R}{\gamma}\frac{M}{\sigma_\theta})^2 - 4\sigma_d^2)}\right)$

3 Additional Tables

Table 1. Effective spread regressed on turnover and average absolute return across size quintiles in the time series.
Panel regression: $\log s_{i,t} = \alpha_i + \beta_\tau \log \tau_{i,t} + \beta_\sigma \log \sigma_{i,t} + \text{controls} + \epsilon_{i,t}$ for stock i on day t, where $\tau_{i,t}$ is the daily intraday turnover and $\sigma_{i,t}$ is the average absolute return over the past five trading days (including the current day). Controls are (log) market capitalization, (log) price, and day-of-the-week and month-of-the-year indicators. The regression includes stock fixed effects and is estimated on a year-by-year basis for stocks in a given size quintile. At the beginning of each month, stocks are sorted by their average daily market capitalization over the past 250 trading days (a minimum of 100 observations is required). The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than \$5 and lower than \$1,000 and a market capitalization greater than \$100 million. Effective spreads are winsorized at 0.05% and 99.95% each year. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level.

	Size quintile					
	Small		Mid (3)		Large	
Year	β_τ	β_σ	β_τ	β_σ	β_τ	β_σ
2002	-0.05*** (-7.37)	0.24*** (14.98)	0.02*** (3.68)	0.14*** (25.50)	0.11*** (14.13)	0.11*** (19.48)
2003	-0.07*** (-14.53)	0.23*** (31.27)	0.01** (2.13)	0.11*** (6.91)	0.15*** (12.70)	0.07*** (15.20)
2004	-0.08*** (-18.93)	0.20*** (20.94)	0.01** (2.03)	0.11*** (17.04)	0.15*** (19.56)	0.05*** (11.34)
2005	-0.07*** (-16.32)	0.16*** (10.74)	0.02 (1.62)	0.10*** (11.76)	0.16*** (19.18)	0.05*** (9.28)
2006	-0.08*** (-21.17)	0.16*** (15.99)	0.03** (2.36)	0.09*** (9.03)	0.14*** (16.68)	0.06*** (10.78)
2007	-0.06*** (-13.72)	0.15*** (9.40)	0.04*** (2.80)	0.12*** (13.81)	0.21*** (16.00)	0.08*** (8.32)
2008	-0.08*** (-6.64)	0.18*** (8.04)	0.02 (0.68)	0.14*** (8.27)	0.12*** (7.68)	0.13*** (9.05)
2009	-0.11*** (-11.25)	0.13*** (6.40)	-0.01 (-1.28)	0.07*** (7.34)	0.10*** (8.87)	0.04*** (4.42)
2010	-0.09*** (-8.92)	0.17*** (14.21)	-0.03** (-2.29)	0.06*** (4.81)	0.11*** (8.89)	0.03*** (2.62)
2011	-0.08*** (-9.04)	0.15*** (11.57)	-0.02 (-1.38)	0.11*** (8.60)	0.11*** (9.61)	0.05*** (4.14)
2012	-0.15*** (-14.17)	0.19*** (17.81)	-0.04*** (-2.99)	0.10*** (9.76)	0.13*** (9.92)	0.02*** (3.38)
2013	-0.13*** (-17.54)	0.16*** (8.01)	-0.04*** (-3.57)	0.09*** (10.56)	0.12*** (9.46)	0.04*** (3.60)
2014	-0.12*** (-18.13)	0.17*** (23.20)	-0.09*** (-7.93)	0.11*** (12.66)	0.07*** (4.57)	0.05*** (5.89)
2015	-0.10*** (-15.84)	0.11*** (6.49)	-0.09*** (-7.01)	0.09*** (10.34)	0.02 (1.62)	0.08*** (7.10)
2016	-0.12*** (-15.44)	0.16*** (15.91)	-0.07*** (-4.39)	0.09*** (8.66)	0.02 (1.57)	0.06*** (5.28)
2017	-0.11*** (-14.18)	0.08*** (5.84)	-0.03** (-2.34)	0.05*** (4.19)	0.07*** (5.06)	0.04*** (5.24)
$\bar{R}^2$(%)	12.25		12.60		14.78	

Table 2. Effective spread regressed on turnover and average absolute return (all stocks).
Panel regression: $\log s_{i,t} = \alpha + \beta_\tau \log \tau_{i,t} + \beta_\sigma \log \sigma_{i,t} + \text{controls} + \epsilon_{i,t}$ for stock i on day t, where $\tau_{i,t}$ is the daily intraday turnover and $\sigma_{i,t}$ is the average absolute return over the past five trading days (including the current day). Controls are (log) market capitalization, (log) price, and day-of-the-week and month-of-the-year indicators (the calendar indicators are excluded with day fixed effects). Left (right) panel: the regression includes stock (date) fixed effects and is estimated on a year-by-year basis for stocks in a given size quintile. The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than \$5 and lower than \$1,000, a market capitalization greater than \$100 million, and at least 100 days of prior trading. Effective spreads are winsorized at 0.05% and 99.95% each year. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level.

	Stock fixed effects		Day fixed effects	
Year	β_τ	β_σ	β_τ	β_σ
2002	-0.02*** (-5.19)	0.18*** (35.64)	-0.18*** (-33.65)	0.29*** (39.55)
2003	-0.01*** (-3.20)	0.17*** (26.82)	-0.22*** (-38.88)	0.33*** (32.65)
2004	-0.02*** (-5.98)	0.15*** (35.46)	-0.26*** (-49.99)	0.31*** (47.16)
2005	-0.01*** (-2.68)	0.12*** (23.76)	-0.26*** (-53.64)	0.27*** (33.47)
2006	-0.02*** (-4.00)	0.12*** (26.36)	-0.27*** (-55.79)	0.27*** (38.18)
2007	0.00 (0.47)	0.14*** (21.09)	-0.27*** (-49.29)	0.25*** (30.88)
2008	-0.03 (-1.60)	0.17*** (12.52)	-0.34*** (-46.44)	0.32*** (24.19)
2009	-0.05*** (-5.85)	0.10*** (14.10)	-0.31*** (-38.09)	0.29*** (24.23)
2010	-0.04*** (-4.49)	0.10*** (12.07)	-0.29*** (-37.21)	0.25*** (24.71)
2011	-0.03*** (-3.69)	0.12*** (15.02)	-0.29*** (-37.56)	0.27*** (31.84)
2012	-0.07*** (-6.98)	0.13*** (21.68)	-0.31*** (-40.29)	0.28*** (35.05)
2013	-0.07*** (-9.03)	0.12*** (17.49)	-0.29*** (-41.76)	0.26*** (25.09)
2014	-0.09*** (-12.08)	0.12*** (24.40)	-0.31*** (-48.16)	0.31*** (40.24)
2015	-0.09*** (-11.67)	0.11*** (14.73)	-0.28*** (-42.74)	0.27*** (20.22)
2016	-0.09*** (-9.95)	0.12*** (17.24)	-0.30*** (-45.97)	0.27*** (34.15)
2017	-0.07*** (-7.45)	0.08*** (10.96)	-0.27*** (-36.06)	0.21*** (14.03)
$\bar{R}^2$(%)	12.61		71.01	

Table 3. Effective spread regressed on turnover and volatility across size quintiles (changes) in the time series.
The following panel regression is estimated: $\Delta s_{i,t} = \alpha_i + \beta_\tau \Delta\tau_{i,t} + \beta_\sigma \Delta\sigma_{i,t} + \text{controls} + \epsilon_{i,t}$ for stock i on day t, where $\Delta x_t \equiv \log(\frac{x_t}{x_{t-1}})$, and $\tau_{i,t}$ is the daily intraday turnover and $\sigma_{i,t}$ is the average absolute return over the past five trading days (including the current day). Controls are (log) market capitalization, (log) price, and day-of-the-week and month-of-the-year indicators. The regression includes stock fixed effects and is estimated on a year-by-year basis for stocks in a given size quintile. At the beginning of each month, stocks are sorted by their average daily market capitalization over the past 250 trading days (a minimum of 100 observations is required). The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than \$5 and lower than \$1,000 and a market capitalization greater than \$100 million. Effective spreads are winsorized at 0.05% and 99.95% each year. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level.

	Size quintile					
	Small		Mid (3)		Large	
Year	β_τ	β_σ	β_τ	β_σ	β_τ	β_σ
2002	-0.02*** (-5.10)	0.09*** (4.46)	0.08*** (13.94)	0.12*** (17.00)	0.16*** (17.11)	0.08*** (8.73)
2003	-0.00 (-0.57)	0.14*** (21.94)	0.09*** (10.22)	0.07*** (5.70)	0.22*** (13.43)	0.05*** (4.89)
2004	-0.01*** (-3.07)	0.10*** (6.80)	0.09*** (11.76)	0.06*** (8.22)	0.23*** (26.13)	0.04*** (5.42)
2005	-0.01** (-1.99)	0.09*** (6.90)	0.12*** (10.68)	0.03*** (3.45)	0.25*** (24.49)	0.02*** (2.85)
2006	-0.01*** (-3.73)	0.06*** (4.67)	0.13*** (10.15)	0.02** (2.20)	0.24*** (25.05)	0.01 (1.49)
2007	-0.01* (-1.89)	0.07*** (5.19)	0.15*** (8.08)	0.03** (2.35)	0.34*** (17.29)	0.01 (0.72)
2008	0.00 (0.05)	0.06*** (4.00)	0.16*** (4.30)	0.02 (1.01)	0.25*** (11.36)	0.01 (0.54)
2009	-0.02* (-1.71)	0.04*** (2.88)	0.07*** (3.97)	0.02 (1.26)	0.20*** (12.77)	-0.03 (-1.23)
2010	0.01 (0.77)	0.01 (0.85)	0.08*** (5.35)	-0.02 (-1.50)	0.22*** (14.82)	-0.04*** (-2.90)
2011	0.01 (1.08)	0.02 (1.64)	0.09*** (6.77)	-0.02 (-1.22)	0.20*** (16.77)	-0.04*** (-2.72)
2012	-0.04*** (-3.73)	0.07*** (5.14)	0.07*** (3.60)	0.02* (1.72)	0.23*** (9.10)	-0.03*** (-2.59)
2013	-0.04*** (-6.28)	0.08*** (6.07)	0.06*** (5.03)	0.05*** (4.23)	0.21*** (14.08)	0.00 (0.04)
2014	-0.04*** (-6.29)	0.07*** (9.12)	0.02 (1.59)	0.02** (2.12)	0.17*** (7.96)	-0.03** (-2.30)
2015	-0.04*** (-6.18)	0.04*** (4.10)	0.02 (1.04)	0.04*** (2.97)	0.12*** (8.23)	0.02 (1.17)
2016	-0.04*** (-5.06)	0.05*** (3.50)	0.05** (2.48)	0.02 (0.85)	0.12*** (7.95)	-0.02 (-1.03)
2017	-0.03*** (-4.32)	0.02*** (4.42)	0.06*** (2.79)	0.01 (0.96)	0.16*** (8.66)	-0.01 (-0.50)
$\bar{R}^2$(%)	1.27		3.84		5.21	

Table 4. Effective spread regressed on turnover and average absolute return in the time-series. The following time-series regression is estimated for each stock each year: $\log s_t = \alpha + \beta_\tau \log \tau_t + \beta_\sigma \log \sigma_t + \text{controls} + \epsilon_t$, where s_t is the effective spread on day t, τ_t is the turnover, and σ_t is the average absolute return over the past five trading days (including the current day). Controls are (log) price and day-of-the-week and month-of-the-year indicators. The table reports statistics about the distribution of β_τ and β_σ among stocks in the bottom and top size quintiles. $\% > 0^*$ ($\% < 0^*$) indicates the percentage of betas significantly greater (lower) than zero at a level of significance of 10%. At the beginning of January, stocks are sorted by their average daily market capitalization over the past 250 trading days (a minimum of 100 observations is required). The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than \$5 and lower than \$1,000 and a market capitalization greater than \$100 million. Standard errors in the individual regressions are Newey-West adjusted with five lags.

	Turnover beta				Volatility beta				
Year	median β_τ	$\% > 0$	$\% > 0^*$	$\% < 0^*$	median β_τ	$\% > 0$	$\% > 0^*$	$\% < 0^*$	$\bar{R}^2_{\text{adj}}$
Small stocks									
2002	-0.05	28.4	7.0	38.3	0.19	94.1	72.2	0.9	0.18
2003	-0.05	29.8	9.1	38.7	0.17	95.1	71.5	0.4	0.17
2004	-0.05	34.5	12.8	39.7	0.15	93.7	64.8	0.7	0.14
2005	-0.04	33.6	11.4	37.8	0.13	91.6	57.0	0.5	0.14
2006	-0.05	31.9	12.9	39.5	0.14	91.6	58.6	0.6	0.15
2007	-0.04	33.8	7.8	32.2	0.15	92.2	64.4	1.3	0.14
2008	-0.05	32.8	9.1	34.1	0.22	92.2	66.4	1.5	0.21
2009	-0.06	26.0	5.1	40.0	0.15	90.3	65.5	1.8	0.20
2010	-0.03	37.2	8.6	27.6	0.12	88.7	55.5	0.8	0.14
2011	-0.02	40.9	10.7	28.0	0.16	91.4	64.2	0.8	0.19
2012	-0.09	14.2	1.7	53.8	0.12	87.3	50.8	0.6	0.14
2013	-0.09	16.0	3.5	56.0	0.12	91.6	57.7	0.6	0.14
2014	-0.10	15.5	1.5	53.3	0.13	87.2	54.7	1.7	0.12
2015	-0.08	18.0	2.1	45.3	0.13	85.6	52.4	1.9	0.11
2016	-0.09	19.3	2.9	47.6	0.15	88.3	56.9	1.4	0.14
2017	-0.09	18.6	2.2	48.3	0.09	82.6	44.4	2.0	0.15
Large stocks									
2002	0.13	90.9	65.8	1.6	0.10	89.3	50.7	1.5	0.25
2003	0.17	91.6	67.3	0.4	0.09	88.2	46.0	0.2	0.21
2004	0.20	93.9	75.3	1.5	0.04	70.7	22.3	2.9	0.12
2005	0.19	94.9	75.8	1.6	0.03	70.6	21.0	2.4	0.11
2006	0.15	92.1	67.6	1.6	0.06	78.8	33.7	1.6	0.12
2007	0.23	97.2	86.1	0.9	0.07	79.1	34.7	1.9	0.16
2008	0.16	91.0	66.7	1.7	0.14	91.7	63.3	0.5	0.37
2009	0.13	92.1	64.7	1.6	0.05	77.5	40.0	2.9	0.29
2010	0.14	96.9	77.3	0.6	0.03	69.3	27.4	4.3	0.14
2011	0.13	94.1	72.8	0.2	0.05	78.8	40.7	2.7	0.23
2012	0.14	93.0	71.0	2.1	0.02	60.3	14.4	6.0	0.11
2013	0.14	89.0	63.9	1.8	0.01	60.2	16.1	4.7	0.11
2014	0.09	79.6	42.6	4.6	0.04	74.0	28.4	2.9	0.08
2015	0.06	65.4	37.8	9.0	0.07	78.7	40.3	1.5	0.12
2016	0.07	68.8	36.2	10.9	0.04	72.2	32.6	2.1	0.13
2017	0.09	78.0	44.0	6.5	0.02	65.0	18.5	3.9	0.07

Table 5. Effective spread regressed on common turnover, idiosyncratic turnover, common volatility, and idiosyncratic volatility across size quintiles in the time series.
Panel regression: $\log s_{i,t} = \alpha_i + \beta_{\tau,C}\tau^C_{i,t} + \beta_{\tau,I}\tau^I_{i,t} + \beta_{\sigma,C}\sigma^C_{i,t} + \beta_{\sigma,I}\sigma^I_{i,t} + \epsilon_{i,t}$ for stock i on day t, where the subscripts C and I denote common and idiosyncratic quantities computed as described in the text. Controls are (log) market capitalization, (log) price, and day-of-the-week and month-of-the-year indicators. The regression includes stock fixed effects and is estimated on a year-by-year basis for stocks in a given size quintile. At the beginning of each month, stocks are sorted by their average daily market capitalization over the past 250 trading days (a minimum of 100 observations is required). The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than \$5 and lower than \$1,000 and a market capitalization greater than \$100 million. Effective spreads are winsorized at 0.05% and 99.95% each month. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1%.

	Small stocks				Large stocks			
Year	$\beta_{\tau,C}$	$\beta_{\tau,I}$	$\beta_{\sigma,C}$	$\beta_{\sigma,I}$	$\beta_{\tau,C}$	$\beta_{\tau,I}$	$\beta_{\sigma,C}$	$\beta_{\sigma,I}$
2002	-0.05**	-0.05***	0.01	0.24***	0.34***	0.10***	0.01	0.07***
	(-2.18)	(-7.08)	(0.38)	(23.25)	(8.55)	(15.04)	(0.87)	(11.89)
2003	-0.08**	-0.07***	0.00	0.21***	0.14**	0.16***	0.01	0.04***
	(-2.43)	(-14.96)	(0.31)	(27.82)	(2.38)	(21.08)	(0.87)	(9.24)
2004	-0.10***	-0.08***	0.03**	0.20***	0.23***	0.16***	0.00	0.02***
	(-4.23)	(-18.81)	(2.43)	(30.06)	(6.42)	(23.53)	(0.27)	(6.37)
2005	-0.06*	-0.08***	0.01	0.19***	0.34***	0.15***	-0.01	0.03***
	(-1.76)	(-18.76)	(0.59)	(32.18)	(6.87)	(23.20)	(-0.76)	(6.62)
2006	-0.09***	-0.08***	0.01	0.19***	0.26***	0.14***	0.02	0.02***
	(-3.91)	(-22.63)	(0.64)	(29.27)	(7.02)	(19.89)	(1.32)	(4.21)
2007	-0.03	-0.06***	0.09***	0.18***	0.46***	0.17***	0.03	0.03***
	(-1.00)	(-16.18)	(5.10)	(31.26)	(10.65)	(18.84)	(1.18)	(4.71)
2008	0.12	-0.09***	0.09**	0.21***	0.37***	0.08***	0.07**	0.06***
	(1.65)	(-10.55)	(2.21)	(26.92)	(7.52)	(7.69)	(2.09)	(8.14)
2009	0.12**	-0.12***	-0.00	0.12***	0.23***	0.09***	-0.01	0.01
	(2.25)	(-15.50)	(-0.24)	(17.21)	(5.97)	(10.58)	(-0.20)	(1.57)
2010	0.16***	-0.11***	-0.06**	0.13***	0.27***	0.10***	-0.01	-0.00
	(3.17)	(-13.05)	(-2.23)	(15.85)	(6.82)	(10.83)	(-0.84)	(-0.38)
2011	0.15***	-0.10***	0.05**	0.11***	0.26***	0.10***	0.01	0.01
	(3.17)	(-15.13)	(2.28)	(16.84)	(9.41)	(11.81)	(0.99)	(1.18)
2012	-0.00	-0.17***	0.03	0.16***	0.39***	0.12***	0.03	0.00
	(-0.03)	(-20.72)	(1.06)	(16.27)	(5.12)	(11.86)	(1.63)	(0.05)
2013	-0.02	-0.14***	0.00	0.15***	0.29***	0.11***	0.00	0.01
	(-0.60)	(-22.19)	(0.34)	(21.86)	(6.60)	(11.06)	(0.26)	(1.62)
2014	0.00	-0.12***	-0.00	0.14***	0.29***	0.05***	0.02*	0.01***
	(0.07)	(-19.66)	(-0.12)	(21.79)	(5.35)	(4.71)	(1.79)	(2.72)
2015	0.09*	-0.11***	0.03*	0.15***	0.29***	0.01	0.03***	0.02***
	(1.89)	(-20.27)	(1.92)	(19.72)	(4.96)	(0.96)	(2.96)	(3.21)
2016	0.01	-0.12***	-0.03**	0.16***	0.15***	0.02	0.02	0.02***
	(0.28)	(-17.06)	(-2.01)	(19.65)	(4.13)	(1.43)	(1.15)	(2.68)
2017	0.11*	-0.12***	-0.02*	0.14***	0.37***	0.05***	-0.00	0.01**
	(1.68)	(-18.85)	(-1.66)	(19.19)	(5.83)	(5.04)	(-0.24)	(1.98)
$\bar{R}^2$(%)	11.83				15.27			

Table 6. Effective spread regressed on common turnover, idiosyncratic turnover, common volatility, and idiosyncratic volatility across size quintiles in the time series.
Panel regression: $\Delta s_{i,t} = \alpha_i + \beta_{\tau,C}\Delta\tau^C_{i,t} + \beta_{\tau,I}\Delta\tau^I_{i,t} + \beta_{\sigma,C}\Delta\sigma^C_{i,t} + \beta_{\sigma,I}\Delta\sigma^I_{i,t} + \epsilon_{i,t}$ for stock i on day t, where the subscripts C and I denote common and idiosyncratic quantities computed as described in the text and $\Delta x_t = \log(\frac{x_t}{x_{t-1}})$. Controls are (log) market capitalization, (log) price, and day-of-the-week and month-of-the-year indicators. The regression includes stock fixed effects and is estimated on a year-by-year basis for stocks in a given size quintile. At the beginning of each month, stocks are sorted by their average daily market capitalization over the past 250 trading days (a minimum of 100 observations is required). The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than \$5 and lower than \$1,000 and a market capitalization greater than \$100 million. Effective spreads are winsorized at 0.05% and 99.95% each month. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1%.

	Small stocks				Large stocks			
Year	$\beta_{\tau,C}$	$\beta_{\tau,I}$	$\beta_{\sigma,C}$	$\beta_{\sigma,I}$	$\beta_{\tau,C}$	$\beta_{\tau,I}$	$\beta_{\sigma,C}$	$\beta_{\sigma,I}$
2002	0.01	-0.02***	-0.02	0.15***	0.36***	0.14***	-0.02	0.05***
	(0.49)	(-5.90)	(-1.36)	(22.18)	(6.06)	(19.58)	(-1.02)	(7.31)
2003	-0.04	0.00	-0.03	0.13***	0.15***	0.23***	-0.02	0.03***
	(-1.15)	(0.13)	(-1.65)	(19.20)	(2.78)	(27.02)	(-0.76)	(4.32)
2004	0.00	-0.01***	-0.00	0.13***	0.36***	0.22***	0.01	0.02***
	(0.09)	(-3.48)	(-0.05)	(20.09)	(7.70)	(29.38)	(0.76)	(2.83)
2005	0.09**	-0.01**	-0.02	0.11***	0.46***	0.24***	-0.04**	0.02***
	(2.44)	(-2.51)	(-1.58)	(18.54)	(7.49)	(32.03)	(-1.99)	(3.08)
2006	0.01	-0.01***	-0.02	0.11***	0.40***	0.23***	-0.07***	-0.00
	(0.41)	(-4.09)	(-1.34)	(17.06)	(9.71)	(28.44)	(-2.86)	(-0.12)
2007	0.06*	-0.01**	0.04*	0.11***	0.66***	0.30***	0.02	-0.00
	(1.82)	(-2.58)	(1.72)	(15.98)	(9.41)	(24.55)	(0.49)	(-0.42)
2008	0.37***	-0.01	-0.01	0.09***	0.60***	0.18***	0.00	-0.00
	(4.83)	(-1.37)	(-0.23)	(9.23)	(7.26)	(16.51)	(0.09)	(-0.06)
2009	0.21***	-0.03***	-0.03	0.07***	0.40***	0.17***	-0.08	-0.00
	(4.70)	(-5.31)	(-0.63)	(8.24)	(5.66)	(16.83)	(-1.63)	(-0.40)
2010	0.27***	-0.01	-0.19***	0.05***	0.43***	0.19***	-0.06***	-0.02***
	(6.04)	(-1.61)	(-4.54)	(6.25)	(7.84)	(19.72)	(-2.65)	(-3.31)
2011	0.23***	-0.01	-0.15***	0.06***	0.36***	0.18***	-0.08***	-0.01
	(5.07)	(-1.25)	(-3.91)	(7.12)	(9.18)	(19.16)	(-3.51)	(-1.41)
2012	0.07	-0.05***	-0.00	0.08***	0.54***	0.20***	-0.05*	-0.02***
	(1.41)	(-8.20)	(-0.05)	(11.83)	(4.28)	(15.80)	(-1.80)	(-2.60)
2013	0.06**	-0.05***	0.01	0.09***	0.37***	0.19***	-0.02	-0.01
	(2.57)	(-9.49)	(0.24)	(13.61)	(6.51)	(17.00)	(-0.83)	(-0.98)
2014	0.07*	-0.05***	-0.01	0.07***	0.49***	0.13***	-0.04*	-0.01
	(1.95)	(-7.86)	(-0.35)	(11.54)	(5.55)	(9.65)	(-1.69)	(-1.62)
2015	0.14**	-0.04***	-0.01	0.08***	0.45***	0.09***	-0.04	0.00
	(2.56)	(-8.01)	(-0.31)	(11.57)	(5.93)	(8.48)	(-1.25)	(0.58)
2016	0.17***	-0.04***	-0.06*	0.08***	0.41***	0.09***	-0.11***	0.01
	(3.29)	(-7.29)	(-1.68)	(11.67)	(6.56)	(8.30)	(-3.25)	(0.80)
2017	0.28***	-0.05***	-0.02	0.07***	0.61***	0.13***	-0.07*	-0.00
	(4.54)	(-7.52)	(-0.88)	(9.43)	(6.08)	(10.31)	(-1.93)	(-0.28)
$\bar{R}^2(\%)$		1.79				5.91		

Table 7. Effective spread regressed on common turnover, idiosyncratic turnover, common volatility, and idiosyncratic volatility in the time series.
The following time-series regression is estimated for each stock each year: $\log s_t = \alpha + \beta_{\tau,C}\tau_t^C + \beta_{\tau,I}\tau_t^I + \beta_{\sigma,C}\sigma_t^C + \beta_{\sigma,I}\sigma_t^I + \epsilon_t$, where the subscripts C and I denote common and idiosyncratic quantities computed as described in the text. Controls are (log) price and day-of-the-week and month-of-the-year indicators. The table reports statistics about the distribution of $\beta_{\tau,C}$ and $\beta_{\tau,I}$ among stocks in the bottom and top size quintiles. $\% > 0^*$ ($\% < 0^*$) indicates the percentage of β_τ significantly greater (lower) than zero at a level of significance of 10%. At the beginning of January, stocks are sorted by their average daily market capitalization over the past 250 trading days (a minimum of 100 observations is required). The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than $5 and lower than $1,000 and a market capitalization greater than $100 million. Standard errors in the individual regressions are Newey-West adjusted with five lags.

	Common turnover beta				Idiosyncratic turnover beta				
Year	median β_τ	$\% > 0$	$\% > 0^*$	$\% < 0^*$	median β_τ	$\% > 0$	$\% > 0^*$	$\% < 0^*$	$\bar{R}^2_{\text{adj}}$
Small stocks									
2002	-0.08	39.7	9.3	22.2	-0.04	33.2	8.2	34.8	0.18
2003	-0.10	33.5	8.7	26.3	-0.04	35.8	11.3	33.3	0.17
2004	-0.06	42.4	11.5	21.0	-0.04	36.4	15.0	33.3	0.15
2005	-0.06	43.9	6.8	15.9	-0.04	34.5	11.9	35.0	0.14
2006	-0.07	44.2	11.1	18.7	-0.04	34.5	14.4	36.6	0.16
2007	-0.05	43.0	9.3	17.5	-0.03	38.4	9.9	32.0	0.15
2008	0.15	61.8	25.8	12.1	-0.06	31.2	8.0	38.0	0.24
2009	0.15	64.9	27.0	9.9	-0.08	21.9	3.7	46.0	0.21
2010	0.33	87.3	55.7	3.1	-0.07	23.6	4.6	43.0	0.17
2011	0.18	71.1	36.2	5.0	-0.05	30.8	7.6	31.6	0.22
2012	0.06	60.0	16.6	8.6	-0.12	13.4	1.5	59.1	0.15
2013	0.05	59.8	18.9	10.7	-0.10	14.5	2.7	58.2	0.14
2014	0.08	60.4	17.5	11.9	-0.11	14.2	1.9	57.5	0.12
2015	0.02	51.5	14.5	12.0	-0.08	19.2	2.1	45.7	0.12
2016	0.15	61.2	26.3	11.9	-0.10	16.2	2.9	52.4	0.16
2017	0.10	59.6	18.5	9.6	-0.09	17.3	3.0	47.6	0.16
Large stocks									
2002	0.37	95.8	75.7	1.1	0.11	85.9	50.5	3.3	0.26
2003	0.13	76.7	26.9	2.2	0.18	92.2	71.7	1.2	0.22
2004	0.35	92.7	60.2	0.9	0.19	92.2	70.2	1.7	0.13
2005	0.40	93.2	57.2	0.8	0.17	92.4	70.4	1.9	0.11
2006	0.25	86.2	41.1	1.8	0.16	92.8	65.7	1.4	0.12
2007	0.47	98.4	86.4	0.5	0.19	94.5	70.1	1.2	0.18
2008	0.46	99.3	93.2	0.0	0.06	69.0	31.8	6.6	0.41
2009	0.31	95.5	72.4	0.9	0.10	84.3	45.4	3.4	0.30
2010	0.34	97.1	85.3	0.2	0.10	87.7	52.4	1.6	0.17
2011	0.29	97.9	81.1	0.2	0.10	83.7	52.8	3.6	0.26
2012	0.36	94.0	66.6	0.8	0.11	88.5	57.5	2.9	0.13
2013	0.25	90.2	51.2	1.8	0.13	85.5	59.8	2.4	0.11
2014	0.35	96.6	72.5	0.2	0.05	62.7	30.4	12.6	0.12
2015	0.43	95.7	76.2	0.4	0.01	52.8	25.8	18.0	0.16
2016	0.31	91.2	58.9	1.1	0.02	56.2	23.4	17.3	0.17
2017	0.33	90.8	51.7	1.8	0.06	68.6	35.4	9.2	0.09

Table 8. Price filter (large stocks). Effective spread regressed on turnover and average absolute return for large stocks in the time series.

Panel regression: $\log s_{i,t} = \alpha_i + \beta_\tau \log \tau_{i,t} + \beta_\sigma \log \sigma_{i,t} + \text{controls} + \epsilon_{i,t}$ for stock i on day t, where $\tau_{i,t}$ is the daily intraday turnover and $\sigma_{i,t}$ is the average absolute return over the past five trading days (including the current day). Controls are (log) market capitalization, (log) price, and day-of-the-week and month-of-the-year indicators. The regression includes stock fixed effects and is estimated on a year-by-year basis for stocks in a given size quintile. At the beginning of each month, stocks are sorted by their average daily market capitalization over the past 250 trading days (a minimum of 100 observations is required). The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than \$X and lower than \$1,000 and a market capitalization greater than \$100 million. Effective spreads are winsorized at 0.05% and 99.95% each year. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level.

	Price filter						
	$p \geq \$80$		$p \geq \$100$		$p \geq \$120$		
Year	β_τ	β_σ	β_τ	β_σ	β_τ	β_σ	obs.
2002	0.12*** (2.74)	0.13*** (5.63)	0.09 (1.04)	0.16*** (4.44)	-0.04 (-0.37)	0.17*** (4.14)	746
2003	0.12*** (3.49)	0.08*** (4.57)	0.03 (0.45)	0.14*** (3.14)	-0.03 (-0.36)	0.10*** (4.14)	572
2004	0.10*** (2.85)	0.10*** (4.21)	0.04 (0.63)	0.09*** (3.19)	-0.09* (-1.94)	0.12*** (3.60)	974
2005	0.11*** (3.78)	0.09*** (8.11)	0.04 (0.85)	0.10*** (5.52)	-0.03 (-0.64)	0.14*** (8.05)	2,235
2006	0.08*** (3.28)	0.08*** (6.27)	0.01 (0.36)	0.10*** (6.57)	-0.03 (-0.65)	0.09*** (5.14)	2,940
2007	0.18*** (7.44)	0.09*** (5.75)	0.13*** (3.82)	0.10*** (4.89)	0.07 (1.55)	0.12*** (4.94)	4,952
2008	0.07*** (2.75)	0.12*** (6.39)	0.05 (1.54)	0.12*** (5.77)	0.03 (0.69)	0.13*** (5.23)	3,730
2009	-0.01 (-0.28)	0.12*** (3.00)	0.03 (0.96)	0.06** (2.25)	0.03 (0.85)	0.08** (2.49)	2,442
2010	0.09*** (4.56)	0.05** (2.48)	0.07*** (2.82)	0.03* (1.93)	0.05* (1.65)	0.04** (2.33)	3,791
2011	0.03 (0.87)	0.14*** (3.29)	-0.00 (-0.09)	0.17*** (2.58)	0.06** (2.43)	0.06*** (3.19)	5,850
2012	0.10*** (4.50)	0.04*** (3.06)	0.07*** (3.36)	0.04*** (3.06)	0.05** (2.34)	0.06*** (3.76)	6,795
2013	0.07*** (3.38)	0.06*** (3.36)	0.05** (2.54)	0.07*** (3.54)	0.03 (1.40)	0.08*** (3.29)	11,479
2014	0.04** (2.06)	0.07*** (5.35)	0.02 (0.98)	0.07*** (5.73)	0.01 (0.60)	0.07*** (5.68)	16,629
2015	-0.02 (-1.13)	0.13*** (6.22)	-0.04* (-1.83)	0.15*** (5.59)	-0.04* (-1.83)	0.15*** (4.38)	20,865
2016	0.00 (0.19)	0.08*** (4.52)	-0.01 (-0.39)	0.08*** (3.92)	0.00 (0.02)	0.08*** (3.24)	20,253
2017	0.06*** (3.38)	0.05*** (6.02)	0.06*** (3.36)	0.05*** (5.43)	0.06*** (3.67)	0.05*** (4.89)	29,480
$\bar{R}^2$(%)	12.52		13.88		14.94		
$\bar{\text{obs}}$	22,279		12,943		-		

Table 9. Price filter (large stocks): decomposition. Effective spread regressed on common turnover, idiosyncratic turnover, common volatility, and idiosyncratic volatility for large stocks in the time series.
Panel regression: $\log s_{i,t} = \alpha_i + \beta_{\tau,C}\tau^C_{i,t} + \beta_{\tau,I}\tau^I_{i,t} + \beta_{\sigma,C}\sigma^C_{i,t} + \beta_{\sigma,I}\sigma^I_{i,t} + \epsilon_{i,t}$ for stock i on day t, where the subscripts C and I denote common and idiosyncratic quantities computed as described in the text. Controls are (log) market capitalization, (log) price, and day-of-the-week and month-of-the-year indicators. The regression includes stock fixed effects and is estimated on a year-by-year basis for stocks in a given size quintile. At the beginning of each month, stocks are sorted by their average daily market capitalization over the past 250 trading days (a minimum of 100 observations is required). The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than \$X and lower than \$1,000 and a market capitalization greater than \$100 million. Effective spreads are winsorized at 0.05% and 99.95% each month. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1%.

	Price filter					
	$p \geq$ \$80		$p \geq$ \$100		$p \geq$ \$120	
Year	$\beta_{\tau,C}$	$\beta_{\tau,I}$	$\beta_{\tau,C}$	$\beta_{\tau,I}$	$\beta_{\tau,C}$	$\beta_{\tau,I}$
2002	0.30*** (3.99)	0.13*** (3.19)	0.17 (1.05)	0.12 (1.47)	0.08 (0.42)	0.00 (0.03)
2003	0.16*** (2.64)	0.14*** (3.62)	0.10 (1.05)	0.05 (0.61)	-0.03 (-0.32)	-0.02 (-0.24)
2004	0.17*** (4.50)	0.11*** (3.04)	0.21** (2.53)	0.03 (0.58)	0.01 (0.19)	-0.09* (-1.95)
2005	0.25*** (4.89)	0.10*** (3.47)	0.15** (2.02)	0.04 (0.76)	0.01 (0.07)	-0.03 (-0.58)
2006	0.24*** (5.41)	0.07*** (3.10)	0.18*** (3.03)	0.01 (0.27)	0.12** (2.57)	-0.03 (-0.73)
2007	0.50*** (9.40)	0.13*** (6.18)	0.44*** (7.64)	0.08*** (2.67)	0.40*** (5.51)	0.03 (0.65)
2008	0.39*** (5.83)	0.03 (1.02)	0.31*** (4.55)	0.02 (0.47)	0.25*** (3.53)	0.01 (0.21)
2009	0.26*** (4.93)	-0.02 (-0.69)	0.22*** (4.23)	0.01 (0.27)	0.22*** (4.27)	0.01 (0.26)
2010	0.32*** (6.85)	0.07*** (3.35)	0.30*** (5.57)	0.04* (1.82)	0.29*** (4.04)	0.01 (0.50)
2011	0.40*** (9.23)	0.01 (0.33)	0.36*** (7.15)	-0.02 (-0.39)	0.36*** (7.34)	0.03 (1.09)
2012	0.51*** (4.67)	0.07*** (4.27)	0.43*** (4.64)	0.06*** (2.86)	0.37*** (4.59)	0.04* (1.79)
2013	0.30*** (5.13)	0.06*** (3.33)	0.28*** (4.88)	0.04** (2.42)	0.25*** (5.03)	0.03 (1.36)
2014	0.40*** (5.53)	0.01 (0.64)	0.38*** (5.45)	-0.02 (-0.81)	0.38*** (5.11)	-0.03 (-1.28)
2015	0.40*** (6.12)	-0.04** (-2.43)	0.40*** (6.27)	-0.05*** (-2.85)	0.39*** (6.67)	-0.04** (-2.43)
2016	0.22*** (4.34)	0.00 (0.16)	0.20*** (4.21)	-0.01 (-0.47)	0.21*** (3.94)	-0.00 (-0.08)
2017	0.42*** (5.75)	0.03*** (2.67)	0.42*** (5.74)	0.03*** (2.59)	0.41*** (5.45)	0.04*** (2.64)
$\bar{R}^2$(%)	13.41		14.65		15.97	
obs	22,277		12,942		8,403	

Table 9. (continued.)

	Price filter					
	$p \geq \$80$		$p \geq \$100$		$p \geq \$120$	
Year	$\beta_{\sigma,C}$	$\beta_{\sigma,I}$	$\beta_{\sigma,C}$	$\beta_{\sigma,I}$	$\beta_{\sigma,C}$	$\beta_{\tau,I}$
2002	0.02 (0.87)	0.06*** (3.07)	0.03 (0.82)	0.06* (1.68)	-0.03 (-0.71)	0.01 (0.14)
2003	0.01 (0.44)	0.03* (1.73)	0.04 (0.79)	0.04 (1.29)	-0.02 (-0.30)	0.07*** (4.44)
2004	0.01 (0.58)	0.06*** (3.99)	0.04 (1.08)	0.05* (1.69)	0.06 (1.44)	0.08** (2.52)
2005	0.01 (0.95)	0.07*** (5.62)	0.00 (0.08)	0.09*** (3.99)	-0.01 (-0.42)	0.14*** (6.35)
2006	0.04* (1.95)	0.05*** (4.06)	0.05* (1.89)	0.07*** (4.53)	0.06* (1.94)	0.06*** (3.53)
2007	0.05 (1.59)	0.04*** (3.42)	0.04 (1.26)	0.06*** (3.46)	0.04 (1.26)	0.07*** (2.77)
2008	0.12*** (3.43)	0.05*** (4.18)	0.12*** (3.43)	0.06*** (4.26)	0.12*** (3.41)	0.06*** (3.20)
2009	0.03 (1.29)	0.03* (1.69)	0.03 (1.46)	0.03 (1.46)	0.03 (1.35)	0.03 (1.58)
2010	0.01 (0.65)	-0.00 (-0.25)	0.02 (1.05)	-0.01 (-0.95)	0.03 (1.36)	0.01 (0.76)
2011	0.01 (0.85)	0.02 (1.64)	0.02 (1.03)	0.03*** (2.59)	0.02 (0.86)	0.01 (0.53)
2012	0.05* (1.85)	-0.00 (-0.07)	0.04* (1.72)	-0.00 (-0.37)	0.05** (2.19)	0.01 (0.36)
2013	0.03* (1.70)	0.02* (1.76)	0.04** (2.34)	0.02** (2.25)	0.04** (2.38)	0.03** (2.07)
2014	0.03** (1.98)	0.02*** (2.98)	0.03** (2.39)	0.03*** (3.57)	0.05*** (3.52)	0.03*** (3.76)
2015	0.06*** (4.20)	0.03*** (3.22)	0.06*** (4.44)	0.03*** (3.21)	0.06*** (4.37)	0.03*** (2.84)
2016	0.04** (1.97)	0.01 (1.18)	0.06*** (2.79)	0.01 (0.91)	0.06*** (3.00)	0.01 (0.90)
2017	0.00 (0.07)	0.02*** (2.93)	0.00 (0.24)	0.02*** (2.66)	0.01 (0.42)	0.03*** (2.64)
$\bar{R}^2(\%)$	13.41		14.65		15.97	
obs	22,277		12,942		8,403	

Table 10. Price filter (large stocks): order imbalance volatility. Effective spread regressed on turnover, realized volatility, and order imbalance volatility for large stocks in the time series.
Levels: $\log s_{i,t} = \alpha_i + \beta_\tau \log \tau_{i,t} + \beta_{\text{RVol}} \log \text{RVol}_{i,t} + \beta_{\sigma(\text{OI})} \log \sigma(\text{OI})_{i,t} + \text{controls} + \epsilon_{i,t}$ for stock i on day t, where $\tau_{i,t}$ is the daily intraday turnover and $\text{RVol}_{i,t}$ is the realized volatility computed using five-minute intraday midquote returns and $\sigma(\text{OI})_{i,t}$ is the volatility of order imbalance computed using five-minute order imbalances over the trading day. Controls are (log) market capitalization, (log) price, and day-of-the-week and month-of-the-year indicators. The regression includes stock fixed effects and is estimated on a year-by-year basis for stocks in the top size quintile. At the beginning of each month, stocks are sorted by their average daily market capitalization over the past 250 trading days (a minimum of 100 observations is required). The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than \$X and lower than \$1,000 and a market capitalization greater than \$100 million. Effective spreads are winsorized at 0.05% and 99.95% each year. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level.

	Price filter					
	$p \geq \$80$		$p \geq \$100$		$p \geq \$120$	
Year	β_τ	$\beta_{\sigma(\text{OI})}$	β_τ	$\beta_{\sigma(\text{OI})}$	β_τ	$\beta_{\sigma(\text{OI})}$
2002	-0.27*** (-5.20)	0.26*** (6.80)	-0.28*** (-3.28)	0.23*** (4.28)	-0.41*** (-7.69)	0.29*** (16.25)
2003	-0.30*** (-5.19)	0.33*** (9.26)	-0.27*** (-2.63)	0.32*** (4.07)	-0.44*** (-7.21)	0.35** (2.44)
2004	-0.36*** (-11.50)	0.32*** (16.98)	-0.38*** (-11.84)	0.32*** (9.41)	-0.39*** (-10.38)	0.24*** (6.40)
2005	-0.33*** (-12.17)	0.30*** (16.22)	-0.39*** (-12.63)	0.30*** (9.71)	-0.42*** (-23.95)	0.26*** (5.62)
2006	-0.32*** (-16.20)	0.29*** (19.26)	-0.35*** (-12.27)	0.27*** (11.09)	-0.35*** (-11.38)	0.25*** (6.42)
2007	-0.31*** (-14.11)	0.32*** (15.96)	-0.32*** (-13.43)	0.31*** (15.28)	-0.36*** (-13.89)	0.31*** (12.49)
2008	-0.43*** (-12.99)	0.37*** (11.47)	-0.38*** (-10.83)	0.33*** (9.46)	-0.36*** (-8.52)	0.31*** (6.46)
2009	-0.38*** (-14.62)	0.30*** (16.24)	-0.38*** (-13.35)	0.30*** (15.61)	-0.37*** (-11.86)	0.30*** (13.94)
2010	-0.34*** (-17.03)	0.29*** (16.71)	-0.33*** (-12.52)	0.28*** (12.30)	-0.34*** (-9.89)	0.27*** (9.56)
2011	-0.35*** (-23.02)	0.26*** (16.03)	-0.33*** (-17.87)	0.23*** (11.56)	-0.30*** (-11.66)	0.22*** (9.23)
2012	-0.38*** (-15.93)	0.32*** (10.72)	-0.38*** (-14.65)	0.31*** (10.45)	-0.38*** (-10.27)	0.30*** (7.59)
2013	-0.38*** (-25.17)	0.29*** (18.01)	-0.40*** (-21.94)	0.29*** (14.19)	-0.38*** (-18.75)	0.26*** (13.19)
2014	-0.49*** (-20.62)	0.34*** (11.51)	-0.50*** (-18.75)	0.32*** (9.82)	-0.49*** (-18.09)	0.30*** (8.46)
2015	-0.47*** (-30.09)	0.28*** (16.02)	-0.46*** (-28.57)	0.25*** (13.69)	-0.46*** (-25.17)	0.25*** (12.35)
2016	-0.49*** (-28.83)	0.30*** (15.74)	-0.48*** (-28.16)	0.28*** (14.72)	-0.46*** (-24.33)	0.27*** (12.61)
2017	-0.45*** (-24.48)	0.29*** (11.62)	-0.45*** (-22.87)	0.28*** (11.07)	-0.45*** (-21.35)	0.28*** (9.93)
$\bar{R}^2$(%)	33.31		35.78		37.96	
$\bar{\text{obs}}$	22,149		12,859		8,358	

Table 11. Effective spread regressed on turnover and realized volatility across size quintiles in the time series.
Panel regression: $\log s_{i,t} = \alpha_i + \beta_\tau \log \tau_{i,t} + \beta_\sigma \log \sigma_{i,t} + \text{controls} + \epsilon_{i,t}$ for stock i on day t, where $\tau_{i,t}$ is the daily intraday turnover and $\sigma_{i,t}$ is the realized volatility estimated using five-minute returns over the current day. Controls are (log) market capitalization, (log) price, and day-of-the-week and month-of-the-year indicators. The regression includes stock fixed effects and is estimated on a year-by-year basis for stocks in a given size quintile. At the beginning of each month, stocks are sorted by their average daily market capitalization over the past 250 trading days (a minimum of 100 observations is required). The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than \$5 and lower than \$1,000 and a market capitalization greater than \$100 million. Effective spreads are winsorized at 0.05% and 99.95% each year. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level.

	Size quintile					
	Small		Mid (3)		Large	
Year	β_τ	β_σ	β_τ	β_σ	β_τ	β_σ
2002	-0.13*** (-22.05)	0.40*** (40.60)	-0.06*** (-13.58)	0.48*** (46.93)	0.03** (2.56)	0.43*** (14.15)
2003	-0.14*** (-27.69)	0.48*** (62.24)	-0.05*** (-7.79)	0.51*** (31.41)	0.07*** (5.76)	0.43*** (42.35)
2004	-0.14*** (-39.35)	0.46*** (60.49)	-0.06*** (-9.95)	0.49*** (59.50)	0.07*** (9.83)	0.37*** (37.47)
2005	-0.14*** (-36.97)	0.43*** (62.11)	-0.05*** (-5.14)	0.44*** (50.17)	0.08*** (10.23)	0.35*** (30.73)
2006	-0.14*** (-38.22)	0.41*** (61.24)	-0.03*** (-2.72)	0.40*** (47.74)	0.08*** (9.88)	0.31*** (31.07)
2007	-0.13*** (-30.35)	0.41*** (47.25)	-0.04*** (-3.09)	0.40*** (28.64)	0.11*** (8.35)	0.36*** (18.90)
2008	-0.14*** (-12.48)	0.46*** (27.94)	-0.06** (-2.24)	0.52*** (18.14)	0.01 (1.19)	0.45*** (17.51)
2009	-0.16*** (-15.97)	0.43*** (35.71)	-0.06*** (-4.58)	0.32*** (17.83)	0.04*** (3.08)	0.25*** (12.90)
2010	-0.14*** (-14.52)	0.44*** (37.08)	-0.08*** (-7.03)	0.34*** (15.66)	0.04*** (3.45)	0.28*** (12.19)
2011	-0.15*** (-16.34)	0.43*** (37.09)	-0.08*** (-7.96)	0.39*** (20.96)	0.02* (1.91)	0.31*** (19.18)
2012	-0.20*** (-20.03)	0.44*** (34.44)	-0.10*** (-7.93)	0.41*** (22.82)	0.05*** (3.32)	0.29*** (16.90)
2013	-0.18*** (-23.31)	0.40*** (25.47)	-0.11*** (-10.55)	0.41*** (30.01)	0.02* (1.89)	0.32*** (17.12)
2014	-0.17*** (-24.68)	0.35*** (32.09)	-0.17*** (-14.24)	0.46*** (30.35)	-0.05*** (-2.92)	0.36*** (22.64)
2015	-0.17*** (-27.12)	0.35*** (32.81)	-0.18*** (-14.62)	0.47*** (25.73)	-0.10*** (-8.84)	0.43*** (18.66)
2016	-0.17*** (-21.68)	0.35*** (33.82)	-0.14*** (-9.58)	0.41*** (25.79)	-0.10*** (-7.75)	0.39*** (18.81)
2017	-0.16*** (-19.19)	0.30*** (16.15)	-0.11*** (-7.26)	0.34*** (18.00)	-0.09*** (-5.34)	0.41*** (24.53)
$\bar{R}^2$(%)	23.90		23.23		20.38	

Table 12. Effective spread regressed on turnover and realized volatility across size quintiles (changes) in the time series.
The following panel regression is estimated: $\Delta s_{i,t} = \alpha_i + \beta_\tau \Delta\tau_{i,t} + \beta_\sigma \Delta\sigma_{i,t} + \text{controls} + \epsilon_{i,t}$ for stock i on day t, where $\Delta x_t \equiv \log(\frac{x_t}{x_{t-1}})$, and $\tau_{i,t}$ is the daily intraday turnover and $\sigma_{i,t}$ is the realized volatility estimated using five-minute returns over the current day. Controls are (log) market capitalization, (log) price, and day-of-the-week and month-of-the-year indicators. The regression includes stock fixed effects and is estimated on a year-by-year basis for stocks in a given size quintile. At the beginning of each month, stocks are sorted by their average daily market capitalization over the past 250 trading days (a minimum of 100 observations is required). The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than \$5 and lower than \$1,000 and a market capitalization greater than \$100 million. Effective spreads are winsorized at 0.05% and 99.95% each year. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level.

	Size quintile					
	Small		Mid (3)		Large	
Year	β_τ	β_σ	β_τ	β_σ	β_τ	β_σ
2002	-0.08***(-22.82)	0.27***(34.61)	-0.01**(-2.44)	0.43***(40.50)	0.07***(5.64)	0.35***(10.29)
2003	-0.08***(-17.37)	0.37***(45.37)	-0.00(-0.52)	0.45***(28.18)	0.12***(7.68)	0.40***(35.98)
2004	-0.09***(-23.86)	0.37***(44.13)	0.00(0.70)	0.44***(52.03)	0.13***(16.38)	0.36***(36.53)
2005	-0.08***(-20.78)	0.34***(46.49)	0.03***(2.81)	0.39***(40.09)	0.16***(15.67)	0.32***(28.65)
2006	-0.08***(-21.70)	0.32***(46.12)	0.05***(3.79)	0.34***(34.16)	0.17***(16.54)	0.27***(27.56)
2007	-0.07***(-17.81)	0.33***(36.31)	0.07***(3.77)	0.30***(24.00)	0.25***(11.58)	0.28***(15.78)
2008	-0.06***(-5.61)	0.34***(21.98)	0.06*(1.80)	0.41***(16.51)	0.13***(8.13)	0.35***(14.06)
2009	-0.08***(-7.57)	0.35***(34.72)	0.02(1.23)	0.27***(15.46)	0.13***(7.47)	0.20***(9.79)
2010	-0.06***(-4.54)	0.32***(27.66)	0.01(0.67)	0.30***(15.25)	0.14***(9.11)	0.22***(9.84)
2011	-0.06***(-5.15)	0.32***(27.09)	0.01(0.76)	0.31***(19.31)	0.11***(8.67)	0.24***(18.80)
2012	-0.10***(-8.69)	0.30***(28.76)	-0.00(-0.09)	0.30***(14.60)	0.16***(6.04)	0.20***(11.46)
2013	-0.09***(-13.36)	0.28***(24.99)	-0.03**(-2.10)	0.34***(25.21)	0.12***(7.13)	0.25***(17.11)
2014	-0.09***(-12.24)	0.24***(23.16)	-0.07***(-4.57)	0.36***(24.41)	0.05**(2.34)	0.29***(17.83)
2015	-0.09***(-13.48)	0.23***(21.64)	-0.09***(-4.35)	0.37***(18.11)	-0.00(-0.10)	0.34***(13.12)
2016	-0.09***(-10.04)	0.23***(22.80)	-0.04*(-1.72)	0.32***(19.72)	-0.02(-1.10)	0.35***(21.63)
2017	-0.08***(-7.81)	0.19***(9.48)	-0.04(-1.51)	0.30***(15.47)	0.02(0.77)	0.34***(19.77)
$\bar{R}^2$(%)	8.51		10.20		8.48	

Table 13. Effective spread regressed on turnover and realized volatility for large stocks in the time series.
(a) Levels: $\log s_{i,t} = \alpha_i + \beta_{\tau,C}\tau^C_{i,t} + \beta_{\tau,I}\tau^I_{i,t} + \beta_{\text{RVol}} \log \text{RVol}_{i,t} + \text{controls} + \epsilon_{i,t}$ for stock i on day t, where $\tau_{i,t}$ $\text{RVol}_{i,t}$ is the realized volatility computed using five-minute intraday midquote returns and the subscripts C and I denote common and idiosyncratic quantities computed as described in the text. (b) Changes: $\Delta s_{i,t} = \alpha_i + \beta_{\tau,C}\Delta\tau^C_{i,t} + \beta_{\tau,I}\Delta\tau^I_{i,t} + \beta_\sigma \Delta\text{RVol}_{i,t} + \text{controls} + \epsilon_{i,t}$, where $\Delta x_t \equiv \log(\frac{x_t}{x_{t-1}})$. Controls are (log) market capitalization, (log) price, and day-of-the-week and month-of-the-year indicators. The regression includes stock fixed effects and is estimated on a year-by-year basis for stocks in the top size quintile. At the beginning of each month, stocks are sorted by their average daily market capitalization over the past 250 trading days (a minimum of 100 observations is required). The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than \$5 and lower than \$1,000 and a market capitalization greater than \$100 million. Effective spreads are winsorized at 0.05% and 99.95% each year. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level.

	(a) Levels			(b) Changes		
Year	$\beta_{\tau,C}$	$\beta_{\tau,I}$	β_{RVol}	$\beta_{\tau,C}$	$\beta_{\tau,I}$	β_{RVol}
2002	0.12** (2.46)	0.02** (2.47)	0.42*** (13.22)	0.18*** (2.68)	0.06*** (6.10)	0.35*** (10.06)
2003	-0.05 (-1.05)	0.08*** (11.45)	0.45*** (42.76)	0.00 (0.02)	0.14*** (16.32)	0.41*** (35.94)
2004	0.01 (0.29)	0.07*** (11.23)	0.38*** (39.58)	0.15*** (3.10)	0.13*** (18.16)	0.36*** (39.17)
2005	0.16*** (3.18)	0.07*** (11.79)	0.34*** (28.41)	0.29*** (4.30)	0.16*** (19.68)	0.31*** (27.00)
2006	0.11*** (2.77)	0.08*** (11.05)	0.30*** (29.47)	0.23*** (4.96)	0.16*** (18.66)	0.26*** (25.61)
2007	0.25*** (5.45)	0.09*** (8.98)	0.33*** (16.58)	0.52*** (6.81)	0.22*** (14.90)	0.25*** (13.52)
2008	0.12*** (2.64)	0.00 (0.18)	0.42*** (17.93)	0.37*** (4.75)	0.10*** (9.23)	0.31*** (15.01)
2009	0.09** (1.99)	0.03*** (3.28)	0.24*** (11.07)	0.28*** (3.64)	0.12*** (9.35)	0.19*** (9.09)
2010	0.10*** (2.70)	0.03*** (3.40)	0.27*** (11.77)	0.29*** (5.14)	0.13*** (10.37)	0.21*** (9.33)
2011	0.06** (1.96)	0.02* (1.73)	0.30*** (17.04)	0.19*** (4.51)	0.10*** (9.62)	0.23*** (16.73)
2012	0.27*** (3.12)	0.03*** (3.23)	0.27*** (16.69)	0.43*** (3.28)	0.13*** (9.07)	0.19*** (10.59)
2013	0.13*** (2.68)	0.02 (1.52)	0.31*** (16.16)	0.24*** (3.94)	0.11*** (8.10)	0.25*** (16.15)
2014	0.08 (1.19)	-0.06*** (-4.30)	0.34*** (17.54)	0.32*** (3.30)	0.03* (1.79)	0.28*** (15.30)
2015	-0.00 (-0.01)	-0.11*** (-9.76)	0.41*** (19.61)	0.20*** (3.22)	-0.02 (-1.24)	0.32*** (14.16)
2016	-0.07* (-1.96)	-0.11*** (-8.53)	0.39*** (18.30)	0.16** (2.39)	-0.03*** (-2.64)	0.34*** (20.53)
2017	0.11 (1.52)	-0.10*** (-7.36)	0.40*** (20.47)	0.39*** (3.58)	-0.01 (-0.44)	0.32*** (18.53)
$\bar{R}^2$(%)		20.59			8.84	

Table 14. Effective spread regressed on turnover and realized volatility for large stocks in the time series.
(a) Levels: $\log s_{i,t} = \alpha_i + \beta_\tau \log \tau_{i,t} + \beta_{\text{RVol}} \log \text{RVol}_{i,t} + \beta_{|\text{OI}|} \log |\text{OI}|_{i,t} + \text{controls} + \epsilon_{i,t}$ for stock i on day t, where $\tau_{i,t}$ is the daily intraday turnover and $\text{RVol}_{i,t}$ is the realized volatility computed using five-minute intraday midquote returns and $|\text{OI}|_{i,t}$ is the absolute value of the daily order imbalance as a fraction of shares outstanding. (b) Changes: $\Delta s_{i,t} = \alpha_i + \beta_\tau \Delta\tau_{i,t} + \beta_\sigma \Delta\text{RVol}_{i,t} + \beta_{|\text{OI}|} \Delta|\text{OI}| + \text{controls} + \epsilon_{i,t}$, where $\Delta x_t \equiv \log(\frac{x_t}{x_{t-1}})$. Controls are (log) market capitalization, (log) price, and day-of-the-week and month-of-the-year indicators. The regression includes stock fixed effects and is estimated on a year-by-year basis for stocks in the top size quintile. At the beginning of each month, stocks are sorted by their average daily market capitalization over the past 250 trading days (a minimum of 100 observations is required). The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than \$5 and lower than \$1,000 and a market capitalization greater than \$100 million. Effective spreads are winsorized at 0.05% and 99.95% each year. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level.

	(a) Levels			(b) Changes		
Year	β_τ	β_{RVol}	$\beta_{\|\text{OI}\|}$	β_τ	β_{RVol}	$\beta_{\|\text{OI}\|}$
2002	0.02* (1.82)	0.43*** (14.16)	0.01*** (3.33)	0.06*** (5.01)	0.35*** (10.30)	0.01*** (4.70)
2003	0.06*** (4.90)	0.44*** (42.76)	0.01*** (3.82)	0.11*** (7.25)	0.40*** (36.14)	0.00*** (2.77)
2004	0.06*** (9.03)	0.38*** (37.45)	0.01*** (3.72)	0.13*** (16.36)	0.36*** (36.34)	0.00** (2.48)
2005	0.06*** (8.98)	0.36*** (31.79)	0.02*** (6.28)	0.14*** (15.99)	0.32*** (29.48)	0.02*** (7.16)
2006	0.05*** (7.65)	0.31*** (33.32)	0.02*** (8.45)	0.14*** (16.28)	0.27*** (29.21)	0.02*** (8.89)
2007	0.07*** (7.26)	0.37*** (21.18)	0.04*** (6.87)	0.21*** (11.93)	0.29*** (17.51)	0.03*** (9.38)
2008	-0.03*** (-3.34)	0.46*** (18.40)	0.04*** (6.98)	0.08*** (6.52)	0.37*** (14.96)	0.03*** (8.47)
2009	0 (-0.03)	0.26*** (15.10)	0.03*** (6.28)	0.09*** (6.56)	0.21*** (11.18)	0.03*** (8.16)
2010	0 (0.32)	0.29*** (13.59)	0.03*** (7.91)	0.10*** (8.32)	0.24*** (11.03)	0.03*** (9.72)
2011	-0.01* (-1.65)	0.32*** (21.33)	0.03*** (9.25)	0.08*** (7.74)	0.25*** (21.28)	0.02*** (10.27)
2012	0.01 (0.62)	0.30*** (18.33)	0.03*** (6.75)	0.12*** (5.51)	0.22*** (12.76)	0.03*** (8.19)
2013	-0.02* (-1.85)	0.33*** (18.62)	0.04*** (11.84)	0.07*** (5.43)	0.26*** (18.83)	0.03*** (13.67)
2014	-0.09*** (-8.06)	0.38*** (25.24)	0.04*** (6.51)	0.01 (0.49)	0.30*** (20.00)	0.03*** (8.49)
2015	-0.14*** (-14.66)	0.44*** (19.90)	0.03*** (9.49)	-0.04*** (-2.77)	0.35*** (13.92)	0.03*** (11.01)
2016	-0.14*** (-12.21)	0.40*** (19.71)	0.03*** (9.02)	-0.05*** (-4.12)	0.36*** (22.84)	0.03*** (9.84)
2017	-0.13*** (-11.19)	0.43*** (27.72)	0.04*** (7.32)	-0.03 (-1.51)	0.35*** (21.71)	0.03*** (9.19)
$\bar{R}^2$(%)		21.15			9.22	

Table 15. Effective spread regressed on turnover and average absolute return across size quintiles in the cross-section.
Panel regression: $\log s_{i,t} = \alpha_t + \beta_\tau \log \tau_{i,t} + \beta_\sigma \log \sigma_{i,t} + \text{controls} + \epsilon_{i,t}$ for stock i on day t, where $\tau_{i,t}$ is the daily intraday turnover and $\sigma_{i,t}$ is the average absolute return over the past five trading days (including the current day). Controls are (log) market capitalization and (log) price. The regression includes date fixed effects and is estimated on a year-by-year basis for stocks in a given size quintile. At the beginning of each month, stocks are sorted by their average daily market capitalization over the past 250 trading days (a minimum of 100 observations is required). The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than \$5 and lower than \$1,000 and a market capitalization greater than \$100 million. Effective spreads are winsorized at 0.05% and 99.95% each year. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level.

	Size quintile					
	Small		Mid (3)		Large	
Year	β_τ	β_σ	β_τ	β_σ	β_τ	β_σ
2002	-0.15*** (-17.15)	0.33*** (18.48)	-0.13*** (-10.85)	0.24*** (18.09)	-0.02 (-1.08)	0.21*** (10.52)
2003	-0.18*** (-27.06)	0.35*** (33.39)	-0.18*** (-15.62)	0.26*** (8.25)	0.00 (0.17)	0.17*** (7.52)
2004	-0.21*** (-33.43)	0.33*** (23.14)	-0.22*** (-17.24)	0.28*** (24.06)	-0.04 (-1.28)	0.20*** (8.05)
2005	-0.22*** (-32.13)	0.27*** (12.02)	-0.22*** (-17.37)	0.27*** (25.35)	-0.04 (-1.03)	0.19*** (9.56)
2006	-0.23*** (-36.96)	0.27*** (18.65)	-0.20*** (-14.60)	0.24*** (12.65)	-0.06 (-1.50)	0.22*** (8.91)
2007	-0.24*** (-33.05)	0.23*** (10.88)	-0.22*** (-14.97)	0.25*** (26.64)	-0.03 (-0.75)	0.20*** (10.15)
2008	-0.32*** (-32.45)	0.28*** (11.96)	-0.25*** (-14.82)	0.29*** (17.40)	-0.07 (-1.61)	0.31*** (11.83)
2009	-0.30*** (-22.06)	0.29*** (10.71)	-0.24*** (-12.11)	0.20*** (8.96)	0.03 (1.09)	0.17*** (7.79)
2010	-0.29*** (-23.92)	0.27*** (17.24)	-0.21*** (-11.68)	0.18*** (6.62)	0.06*** (2.94)	0.15*** (9.36)
2011	-0.31*** (-25.93)	0.27*** (14.27)	-0.20*** (-14.92)	0.25*** (18.02)	0.05** (2.18)	0.21*** (11.08)
2012	-0.35*** (-28.48)	0.28*** (23.09)	-0.20*** (-13.33)	0.24*** (16.42)	-0.01 (-0.11)	0.21*** (5.12)
2013	-0.30*** (-28.00)	0.25*** (9.54)	-0.22*** (-16.06)	0.25*** (16.30)	-0.01 (-0.24)	0.20*** (5.72)
2014	-0.28*** (-28.69)	0.30*** (26.72)	-0.27*** (-22.47)	0.28*** (19.38)	-0.01 (-0.48)	0.21*** (8.98)
2015	-0.25*** (-21.18)	0.20*** (7.74)	-0.25*** (-18.01)	0.28*** (17.02)	-0.03 (-1.42)	0.25*** (10.80)
2016	-0.28*** (-25.99)	0.26*** (18.48)	-0.23*** (-16.43)	0.25*** (16.81)	-0.03 (-0.99)	0.21*** (9.26)
2017	-0.26*** (-21.84)	0.18*** (6.29)	-0.22*** (-13.02)	0.16*** (4.85)	0.00 (0.05)	0.18*** (10.27)
$\bar{R}^2$(%)	39.68		27.82		29.66	

Table 16. Effective spread regressed on turnover and average absolute return across size deciles in the cross-section.
Panel regression: $\log s_{i,t} = \alpha_t + \beta_\tau \log \tau_{i,t} + \beta_\sigma \log \sigma_{i,t} + \text{controls} + \epsilon_{i,t}$ for stock i on day t, where $\tau_{i,t}$ is the daily intraday turnover and $\sigma_{i,t}$ is the average absolute return over the past five trading days (including the current day). Controls are (log) market capitalization and (log) price. The regression includes date fixed effects and is estimated on a year-by-year basis for stocks in a given size decile. At the beginning of each month, stocks are sorted by their average daily market capitalization over the past 250 trading days (a minimum of 100 observations is required). The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than \$5 and lower than \$1,000 and a market capitalization greater than \$100 million. Effective spreads are winsorized at 0.05% and 99.95% each year. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level.

	Size decile					
	Small		Mid (3)		Large	
Year	β_τ	β_σ	β_τ	β_σ	β_τ	β_σ
2002	-0.18*** (-22.27)	0.39*** (21.87)	-0.02*** (-5.19)	0.18*** (35.64)	0.05*** (3.55)	0.16*** (17.09)
2003	-0.17*** (-21.93)	0.38*** (30.17)	-0.01*** (-3.20)	0.17*** (26.82)	0.07*** (3.50)	0.13*** (12.80)
2004	-0.20*** (-24.37)	0.34*** (16.77)	-0.02*** (-5.98)	0.15*** (35.46)	0.09*** (6.38)	0.11*** (9.29)
2005	-0.22*** (-23.25)	0.28*** (7.88)	-0.01*** (-2.68)	0.12*** (23.76)	0.11*** (5.73)	0.12*** (9.86)
2006	-0.23*** (-30.82)	0.27*** (13.96)	-0.02*** (-4.00)	0.12*** (26.36)	0.12*** (8.64)	0.11*** (10.24)
2007	-0.22*** (-24.07)	0.25*** (8.04)	0.00 (0.47)	0.14*** (21.09)	0.10*** (5.77)	0.16*** (11.04)
2008	-0.29*** (-24.39)	0.29*** (8.21)	-0.03 (-1.60)	0.17*** (12.52)	0.06** (2.28)	0.25*** (10.40)
2009	-0.28*** (-14.84)	0.29*** (6.63)	-0.05*** (-5.85)	0.10*** (14.10)	0.11*** (4.18)	0.12*** (5.15)
2010	-0.29*** (-20.42)	0.28*** (12.97)	-0.04*** (-4.49)	0.10*** (12.07)	0.14*** (5.03)	0.12*** (5.61)
2011	-0.32*** (-20.82)	0.29*** (12.03)	-0.03*** (-3.69)	0.12*** (15.02)	0.15*** (4.82)	0.15*** (6.36)
2012	-0.35*** (-20.90)	0.30*** (16.83)	-0.07*** (-6.98)	0.13*** (21.68)	0.18*** (6.02)	0.13*** (4.99)
2013	-0.28*** (-19.44)	0.24*** (5.54)	-0.07*** (-9.03)	0.12*** (17.49)	0.18*** (6.65)	0.11*** (3.93)
2014	-0.28*** (-25.44)	0.32*** (22.57)	-0.09*** (-12.08)	0.12*** (24.40)	0.08*** (2.86)	0.19*** (5.17)
2015	-0.24*** (-21.61)	0.20*** (5.52)	-0.09*** (-11.67)	0.11*** (14.73)	0.07** (2.31)	0.21*** (5.72)
2016	-0.26*** (-22.49)	0.29*** (14.43)	-0.09*** (-9.95)	0.12*** (17.24)	0.07** (2.11)	0.19*** (6.14)
2017	-0.25*** (-18.43)	0.18*** (5.90)	-0.07*** (-7.45)	0.08*** (10.96)	0.09*** (2.84)	0.15*** (5.65)
$\bar{R}^2$(%)	39.68		27.82		29.66	

Table 17. Effective spread regressed on turnover, realized volatility, and order imbalance volatility for large stocks in the cross-section. Panel regression: $\log s_{i,t} = \alpha_i + \beta_\tau \log \tau_{i,t} + \beta_{\text{RVol}} \log \text{RVol}_{i,t} + \beta_{\sigma(\text{OI})} \log \sigma(\text{OI})_{i,t} + \text{controls} + \epsilon_{i,t}$ for stock i on day t, where $\tau_{i,t}$ is the daily intraday turnover and $\text{RVol}_{i,t}$ is the realized volatility computed using five-minute intraday midquote returns and $\sigma(\text{OI})_{i,t}$ is the volatility of order imbalance computed using five-minute order imbalances over the trading day. Controls are (log) market capitalization and (log) price. The regression includes date fixed effects and is estimated on a year-by-year basis for stocks in the top size quintile. At the beginning of each month, stocks are sorted by their average daily market capitalization over the past 250 trading days (a minimum of 100 observations is required). The sample consists of NYSE, Amex, and NASDAQ common stocks. To be included in a given month, a stock is required to have at the beginning of the month a price greater than \$5 and lower than \$1,000 and a market capitalization greater than \$100 million. Effective spreads are winsorized at 0.05% and 99.95% each year. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level.

	without σ(OI)		with σ(OI)		
Year	β_τ	β_{RVol}	β_τ	β_{RVol}	$\beta_{\sigma(\text{OI})}$
2002	-0.08*** (-4.35)	0.51*** (12.70)	-0.37*** (-12.15)	0.60*** (13.15)	0.34*** (17.67)
2003	-0.07*** (-3.39)	0.55*** (14.57)	-0.37*** (-10.55)	0.65*** (17.56)	0.34*** (15.07)
2004	-0.12*** (-4.16)	0.57*** (12.72)	-0.44*** (-10.20)	0.67*** (16.26)	0.37*** (13.15)
2005	-0.10*** (-2.94)	0.51*** (13.15)	-0.45*** (-9.02)	0.63*** (16.79)	0.39*** (12.78)
2006	-0.11*** (-3.10)	0.47*** (12.81)	-0.46*** (-9.81)	0.59*** (17.35)	0.39*** (14.35)
2007	-0.08** (-2.19)	0.45*** (15.70)	-0.43*** (-10.84)	0.57*** (23.96)	0.39*** (17.69)
2008	-0.13*** (-3.05)	0.56*** (15.61)	-0.47*** (-11.69)	0.65*** (23.88)	0.40*** (18.48)
2009	-0.04 (-1.51)	0.42*** (9.07)	-0.39*** (-10.81)	0.53*** (12.99)	0.39*** (17.31)
2010	-0.02 (-0.77)	0.43*** (12.73)	-0.37*** (-11.11)	0.52*** (16.82)	0.38*** (17.21)
2011	-0.02 (-1.04)	0.45*** (18.62)	-0.37*** (-14.76)	0.53*** (24.32)	0.37*** (24.63)
2012	-0.09* (-1.80)	0.54*** (8.93)	-0.42*** (-8.84)	0.61*** (13.78)	0.37*** (19.58)
2013	-0.10* (-1.70)	0.53*** (8.42)	-0.45*** (-8.62)	0.59*** (12.55)	0.39*** (16.26)
2014	-0.13*** (-5.44)	0.60*** (16.50)	-0.53*** (-17.81)	0.67*** (22.14)	0.42*** (22.96)
2015	-0.14*** (-6.53)	0.60*** (22.16)	-0.54*** (-19.45)	0.69*** (28.21)	0.41*** (25.22)
2016	-0.14*** (-5.07)	0.56*** (14.98)	-0.55*** (-16.24)	0.65*** (20.58)	0.44*** (22.22)
2017	-0.14*** (-5.88)	0.61*** (17.60)	-0.51*** (-16.08)	0.69*** (22.62)	0.38*** (22.46)
$\bar{R}^2$(%)	37.15		47.16		

Table 18. Order imbalance volatility, turnover, and stock returns. Every week, portfolios are formed by sequentially sorting stocks using NYSE breakpoints. The table reports portfolios' value-weighted average return. Panel (a): sort on turnover then on order imbalance volatility. Panel (b): sort on order imbalance volatility then on turnover. Turnover is the average turnover over previous five trading days. Order imbalance volatility is an exponentially-weighted moving average of prior order imbalance with a half-life of one day. To be included in a portfolio, a stock must have a price greater than \$5 on the formation date. The sample consists of NYSE, Amex, and NASDAQ common stocks over 2002-2017 (797 weekly observations). t-statistics are reported in parentheses and computed using Newey-West standard errors with 3 lags. *, **, and *** denote significance at the 10%, 5%, and 1% level.

(a) raw value-weighted return (turnover then order imbalance volatility)

	low σ(OI)	2	3	4	high σ(OI)	H-L
low turn.	0.10	0.17**	0.19**	0.20**	0.26***	0.16***
	(1.60)	(2.24)	(2.30)	(2.39)	(3.12)	(2.69)
2	0.15**	0.21***	0.17**	0.20**	0.24***	0.09*
	(1.97)	(2.72)	(2.06)	(2.25)	(2.79)	(1.86)
3	0.18**	0.20**	0.24***	0.28***	0.30***	0.12***
	(2.13)	(2.42)	(2.89)	(3.18)	(3.35)	(2.69)
4	0.12	0.21**	0.22**	0.17*	0.31***	0.19***
	(1.20)	(2.19)	(2.22)	(1.67)	(3.41)	(4.01)
high turn.	0.18	0.18	0.28**	0.19	0.30***	0.12*
	(1.54)	(1.47)	(2.26)	(1.62)	(2.76)	(1.77)

(b) raw value-weighted return (order imbalance volatility then turnover)

	low turn	2	3	4	high turn	H-L
low σ(OI)	0.14*	0.13**	0.13*	0.17**	0.14	-0.00
	(1.77)	(2.06)	(1.94)	(2.20)	(1.53)	(-0.09)
2	0.19**	0.17**	0.18**	0.22**	0.15	-0.03
	(2.18)	(2.21)	(2.22)	(2.55)	(1.53)	(-0.61)
3	0.24***	0.21**	0.23***	0.24**	0.22**	-0.02
	(2.72)	(2.41)	(2.79)	(2.54)	(2.00)	(-0.35)
4	0.23***	0.29***	0.24**	0.20*	0.16	-0.07
	(2.71)	(3.35)	(2.49)	(1.88)	(1.29)	(-0.99)
high σ(OI)	0.28***	0.27***	0.27***	0.32***	0.21	-0.07
	(3.28)	(2.92)	(2.64)	(2.97)	(1.54)	(-0.87)

4 Robustness: Dollar Volume Quintiles

At the beginning of each month, stocks are sorted into quintiles by their average dollar volume over the past 250 trading days. We require a stock to have a minimum of 100 observations. On average

each quintile contains 269 stocks, with a minimum of 191 and a maximum of 355. The median daily dollar volume of a stock in the lowest (highest) dollar volume quintile is \$0.13 (\$15.69) million in 1994 and grows to \$2.08 (\$195.97) million in 2017. The median market capitalization of a stock in the lowest (highest) dollar volume quintile is \$0.21 (\$5.84) billion in 1994 and grows to \$0.50 (\$29.50) billion in 2017.

Table 19. Descriptive statistics for stocks sorted in dollar volume quintiles for a sample of years. The spread is the percent effective spread, turnover is the intraday turnover, and avg$|r|$ is the average absolute return over the past five trading days including the current day. The within standard deviation (σ (within)) is computed as the standard deviation of the deviations from the time-mean of each stock. The variables are winsorized at 0.05% and 99.95% each year.

		1996	1998	2000	2002	2004	2006	2008	2010	2012	2014	2016
Low Dollar Volume												
spread [bp]	mean	96.72	95.77	103.24	55.71	38.33	35.30	41.62	25.21	27.78	30.01	28.67
	median	85.74	80.75	88.60	44.16	28.88	24.36	27.39	19.40	20.00	21.25	20.44
	σ (within)	42.20	50.00	49.70	29.41	19.87	20.44	28.86	11.11	13.12	13.93	15.31
turnover [%]	mean	0.13	0.13	0.14	0.19	0.26	0.36	0.54	0.44	0.35	0.42	0.44
	median	0.06	0.07	0.08	0.11	0.16	0.23	0.38	0.32	0.24	0.29	0.31
	σ (within)	0.22	0.22	0.23	0.26	0.31	0.40	0.54	0.42	0.39	0.42	0.43
volatility [%]	mean	1.23	1.51	1.78	1.84	1.43	1.43	2.72	1.90	1.56	1.49	1.69
	median	1.04	1.24	1.48	1.56	1.24	1.23	2.16	1.67	1.38	1.29	1.42
	σ (within)	0.70	0.95	1.09	1.03	0.73	0.77	1.85	0.94	0.77	0.78	0.94
Mid Dollar Volume (Third Quintile)												
spread [bp]	mean	63.31	54.55	53.99	21.24	11.12	9.33	12.00	6.67	7.01	7.24	7.50
	median	53.62	43.82	44.96	17.31	9.16	7.66	9.32	5.74	5.74	5.89	6.10
	σ (within)	23.51	29.71	24.20	12.49	6.63	6.11	9.62	3.21	3.98	4.13	4.60
turnover [%]	mean	0.32	0.37	0.45	0.56	0.69	0.88	1.37	1.06	0.96	0.97	1.00
	median	0.19	0.24	0.31	0.40	0.50	0.66	1.07	0.78	0.70	0.68	0.73
	σ (within)	0.35	0.37	0.40	0.46	0.51	0.60	0.86	0.72	0.67	0.69	0.72
volatility [%]	mean	1.38	1.92	2.31	1.94	1.28	1.30	2.83	1.58	1.39	1.27	1.55
	median	1.16	1.57	1.97	1.65	1.11	1.10	2.20	1.37	1.17	1.04	1.26
	σ (within)	0.74	1.11	1.21	1.05	0.62	0.66	1.80	0.76	0.69	0.68	0.87
High Dollar Volume												
spread [bp]	mean	33.95	26.09	27.09	14.89	7.52	5.80	7.70	4.54	4.05	3.75	3.83
	median	29.07	21.59	23.03	11.56	5.90	4.73	5.77	3.67	3.19	2.94	3.02
	σ (within)	11.40	13.40	11.71	10.72	5.14	4.30	7.03	2.30	2.35	2.54	2.46
turnover [%]	mean	0.38	0.47	0.57	0.69	0.68	0.85	1.60	1.22	1.00	0.87	0.91
	median	0.25	0.31	0.41	0.49	0.45	0.55	1.08	0.84	0.68	0.57	0.60
	σ (within)	0.30	0.34	0.37	0.45	0.42	0.49	0.94	0.68	0.59	0.56	0.58
volatility [%]	mean	1.31	1.92	2.49	2.06	1.14	1.19	2.94	1.40	1.19	1.07	1.28
	median	1.14	1.62	2.18	1.71	1.00	1.01	2.19	1.22	1.03	0.90	1.02
	σ (within)	0.63	1.02	1.16	1.11	0.52	0.55	2.00	0.65	0.55	0.57	0.74

Table 20. Effective spread (log) regressed on turnover (log) and average absolute return (log) across dollar volume quintiles (time-series: stock fixed effects).
Panel regression: $s_{i,t} = \alpha_i + \beta_\tau \tau_{i,t} + \beta_\sigma \sigma_{i,t} + \epsilon_{i,t}$ for stock i on day t. $\sigma_{i,t}$ is the logarithm of the average absolute return over the past five trading days (including the current day). The regression includes stock fixed effects and is estimated on a year by year basis for stocks in a given dollar volume quintile. At the beginning of each month, stocks are sorted by their average dollar volume (computed from CRSP) over the past 250 trading days (a minimum of 100 observations is required). The sample includes all NYSE and Amex common stocks with a price greater than \$5 and lower than \$1,000 at the beginning of each month, a market capitalization greater than \$100 million at the beginning of each month, and at least 100 days of prior trading. The variables are winsorized at 0.05% and 99.95% each year. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level.

	Dollar Volume Quintile					
	Low		3		High	
Year	β_τ	β_σ	β_τ	β_σ	β_τ	β_σ
1994	0.03***	0.14***	-0.00	0.08***	0.02*	0.07***
	(5.86)	(21.74)	(-1.24)	(15.58)	(1.65)	(8.49)
1996	0.03***	0.11***	0.00	0.08***	0.03***	0.05***
	(8.75)	(17.81)	(1.05)	(15.72)	(5.52)	(9.70)
1998	0.02***	0.21***	0.02***	0.21***	0.04***	0.22***
	(5.72)	(30.28)	(3.91)	(21.11)	(3.57)	(18.39)
2000	0.02***	0.17***	0.02***	0.13***	0.10***	0.14***
	(4.45)	(19.72)	(4.30)	(20.49)	(10.94)	(14.77)
2002	-0.06***	0.21***	0.06***	0.19***	0.20***	0.23***
	(-8.50)	(19.39)	(6.27)	(16.84)	(14.98)	(21.86)
2004	-0.06***	0.16***	0.04***	0.10***	0.20***	0.07***
	(-9.04)	(20.24)	(5.56)	(13.19)	(18.65)	(8.07)
2006	-0.07***	0.15***	0.04***	0.13***	0.17***	0.12***
	(-8.09)	(17.78)	(3.92)	(10.24)	(14.34)	(10.82)
2008	-0.06***	0.34***	0.05***	0.35***	0.20***	0.33***
	(-6.04)	(20.95)	(2.77)	(22.24)	(7.88)	(20.10)
2010	-0.08***	0.17***	0.05***	0.10***	0.17***	0.07***
	(-5.86)	(8.85)	(4.57)	(9.06)	(11.41)	(5.70)
2012	-0.13***	0.13***	0.02	0.08***	0.16***	0.03***
	(-12.05)	(11.07)	(1.35)	(6.11)	(12.13)	(4.44)
2014	-0.12***	0.13***	-0.01	0.11***	0.15***	0.05***
	(-13.18)	(13.02)	(-1.16)	(11.72)	(11.15)	(6.61)
2016	-0.12***	0.18***	-0.00	0.15***	0.15***	0.08***
	(-8.25)	(12.49)	(-0.23)	(11.75)	(10.87)	(6.06)
$\bar{R}^2$(%)	5.43		5.63		9.18	

Table 21. Effective spread regressed on turnover and volatility (all expressed in percentage change) across dollar volume quintiles .

Panel regression: $\Delta s_{i,t} = \alpha_i + \beta_\tau \Delta\tau_{i,t} + \beta_\sigma \Delta\sigma_{i,t} + u_{i,t}$, for stock i on day t. $\Delta x_t = \frac{x_t - x_{t-1}}{x_{t-1}}$. The regression includes stock fixed effects and is estimated on a year by year basis for stocks in a given dollar volume quintile. At the beginning of each month, stocks are sorted by their average dollar volume (computed from CRSP) over the past 250 trading days (a minimum of 100 observations is required). The sample includes all NYSE and Amex common stocks with a price greater than \$5 and lower than \$1,000 at the beginning of each month, a market capitalization greater than \$100 million at the beginning of each month, and at least 100 days of prior trading. The variables are winsorized at 0.05% and 99.95% each year. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level.

	Dollar Volume Quintile					
	Low		3		High	
Year	β_τ	β_σ	β_τ	β_σ	β_τ	β_σ
1994	0.03***	0.29***	0.01***	0.12***	0.03**	0.11***
	(4.68)	(4.47)	(3.63)	(5.95)	(2.44)	(8.10)
1996	0.01***	0.21***	0.02***	0.09***	0.02	0.07***
	(4.18)	(5.31)	(6.21)	(9.02)	(1.43)	(6.35)
1998	0.01***	0.24***	0.03***	0.13***	0.02	0.14***
	(3.77)	(13.97)	(3.79)	(9.67)	(1.10)	(7.92)
2000	0.01***	0.16***	0.04***	0.11***	0.13***	0.09***
	(4.59)	(6.36)	(5.62)	(9.10)	(10.05)	(7.03)
2002	0.01***	0.20***	0.12***	0.15***	0.25***	0.09***
	(3.51)	(7.68)	(11.79)	(7.41)	(15.31)	(4.03)
2004	0.01*	0.16***	0.11***	0.08***	0.25***	0.05***
	(1.92)	(6.48)	(8.12)	(4.62)	(12.09)	(3.24)
2006	0.01**	0.06***	0.14***	0.05***	0.30***	-0.01
	(2.10)	(4.32)	(9.76)	(3.28)	(10.75)	(-0.32)
2008	-0.00*	0.10***	0.15***	0.09***	0.24***	0.03
	(-1.84)	(4.24)	(6.40)	(3.00)	(6.99)	(0.66)
2010	0.01*	0.05***	0.11***	0.04**	0.27***	-0.06***
	(1.70)	(3.01)	(9.02)	(2.25)	(9.10)	(-2.64)
2012	0.01	0.08***	0.11***	0.01	0.26***	-0.03**
	(1.46)	(5.82)	(6.71)	(0.65)	(6.93)	(-2.25)
2014	0.01*	0.08***	0.12***	0.04***	0.24***	-0.05**
	(1.80)	(7.38)	(6.37)	(2.68)	(8.84)	(-2.37)
2016	0.02*	0.07***	0.11***	0.02	0.21***	-0.04*
	(1.92)	(3.29)	(4.65)	(0.74)	(8.78)	(-1.82)
$\bar{R}^2$(%)	0.41		1.68		2.66	

Table 22. Effective spread regressed on turnover and average absolute return in the time-series. The following time-series regression is estimated for each stock each year: $s_t = \alpha + \beta_\tau \tau_t + \beta_\sigma \sigma_t + \epsilon_t$, where s_t is the logarithm of effective spread on day t, τ_t is the logarithm of turnover, and σ_t is the logarithm of the average absolute return over the past five trading days (including the current day). The table reports statistics about the distribution of β_τ among stocks in the low (L) and high (H) dollar volume quintiles. $\% > 0^*$ ($\% < 0^*$) indicates the percentage of β_τ significantly greater (lower) than zero at a level of significance of 10%. At the beginning of January, stocks are sorted by their average dollar volume (computed from CRSP) over the past 250 trading days (a minimum of 100 observations is required). The sample includes all NYSE and Amex common stocks with a price greater than \$5 and lower than \$1,000 at the beginning of each month, a market capitalization greater than \$100 million at the beginning of each month, and at least 100 days of prior trading. The variables are winsorized at 0.05% and 99.95% each year. Standard errors in the individual regressions are Newey-West adjusted with five lags.

year	quintile	mean β_τ	median	$\% > 0$	$\% > 0^*$	$\% < 0^*$	$\bar{R}^2_{\text{adj}}$
1994	L	0.02	0.01	58.39	20.07	9.85	0.04
	H	0.03	0.03	66.42	30.29	6.20	0.04
1996	L	0.03	0.02	66.44	24.83	8.05	0.04
	H	0.04	0.04	77.26	40.80	6.35	0.04
1998	L	0.02	0.02	61.58	22.29	7.33	0.08
	H	0.05	0.05	73.62	38.55	9.28	0.16
2000	L	0.01	0.02	58.88	22.04	11.18	0.07
	H	0.11	0.11	87.99	59.42	4.87	0.14
2002	L	-0.05	-0.05	28.52	4.94	34.98	0.08
	H	0.21	0.21	93.21	75.47	0.75	0.21
2004	L	-0.07	-0.07	25.36	3.62	39.86	0.06
	H	0.22	0.20	95.27	77.82	0.73	0.08
2006	L	-0.06	-0.06	31.12	7.69	38.46	0.07
	H	0.17	0.17	93.03	66.20	0.70	0.08
2008	L	-0.01	-0.03	40.00	17.09	22.18	0.19
	H	0.21	0.20	93.09	69.09	1.45	0.29
2010	L	-0.06	-0.04	32.58	6.79	39.37	0.09
	H	0.18	0.18	96.05	81.58	0.88	0.10
2012	L	-0.09	-0.09	17.52	6.41	55.98	0.09
	H	0.18	0.17	94.47	75.74	1.28	0.07
2014	L	-0.12	-0.10	12.86	2.07	60.17	0.08
	H	0.15	0.13	95.06	62.14	1.23	0.08
2016	L	-0.10	-0.09	28.26	3.91	48.26	0.09
	H	0.14	0.13	87.50	57.08	0.83	0.10

Table 23. Effective spread (log) regressed on turnover (log) and average absolute return (log) across dollar volume quintiles (cross-section: date fixed effects).
Panel regression: $s_{i,t} = \alpha_t + \beta_\tau \tau_{i,t} + \beta_\sigma \sigma_{i,t} + \epsilon_{i,t}$ for stock i on day t. $\sigma_{i,t}$ is the logarithm of the average absolute return over the past five trading days (including the current day). The regression includes date fixed effects and is estimated on a year by year basis for stocks in a given dollar volume quintile. At the beginning of each month, stocks are sorted by their average dollar volume (computed from CRSP) over the past 250 trading days (a minimum of 100 observations is required). The sample includes all NYSE and Amex common stocks with a price greater than \$5 and lower than \$1,000 at the beginning of each month, a market capitalization greater than \$100 million at the beginning of each month, and at least 100 days of prior trading. The variables are winsorized at 0.05% and 99.95% each year. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level.

	Dollar Volume Quintile					
	Low		3		High	
Year	β_τ	β_σ	β_τ	β_σ	β_τ	β_σ
1994	0.02*	0.32***	0.03***	0.28***	0.02	0.27***
	(1.87)	(24.14)	(3.05)	(13.82)	(1.13)	(12.76)
1996	0.01	0.28***	0.03***	0.26***	0.10***	0.18***
	(1.12)	(20.59)	(2.89)	(16.42)	(4.73)	(9.22)
1998	-0.01	0.32***	0.04***	0.37***	0.16***	0.20***
	(-1.30)	(25.02)	(3.36)	(25.67)	(9.11)	(11.19)
2000	-0.05***	0.33***	-0.00	0.31***	0.14***	0.18***
	(-5.67)	(21.11)	(-0.37)	(19.01)	(6.43)	(8.73)
2002	-0.18***	0.33***	0.01	0.39***	0.03*	0.49***
	(-14.87)	(18.61)	(0.94)	(21.45)	(1.71)	(20.43)
2004	-0.24***	0.30***	0.03*	0.28***	0.07***	0.28***
	(-18.34)	(16.19)	(1.94)	(14.88)	(3.22)	(11.76)
2006	-0.27***	0.27***	0.06***	0.28***	0.12***	0.15***
	(-19.05)	(14.13)	(2.94)	(16.15)	(7.59)	(9.78)
2008	-0.26***	0.18***	0.05**	0.39***	0.15***	0.31***
	(-21.76)	(10.16)	(2.52)	(22.74)	(7.12)	(15.42)
2010	-0.26***	0.30***	0.11***	0.25***	0.18***	0.19***
	(-17.45)	(15.23)	(6.83)	(12.46)	(6.20)	(7.24)
2012	-0.31***	0.29***	0.07***	0.31***	0.29***	0.13***
	(-18.44)	(11.45)	(3.40)	(15.30)	(11.01)	(5.68)
2014	-0.38***	0.32***	0.02	0.31***	0.28***	0.16***
	(-16.36)	(12.83)	(0.94)	(12.52)	(9.24)	(4.65)
2016	-0.38***	0.33***	0.05*	0.30***	0.32***	0.11***
	(-12.61)	(12.59)	(1.71)	(14.28)	(13.23)	(4.35)
$\bar{R}^2$(%)	19.17		15.40		18.75	

Table 24. Effective spread (log) regressed on common turnover (log), idiosyncratic turnover (log), common volatility (log), and idiosyncratic volatility (log) for the bottom two dollar volume quintiles (time-series: stock fixed effects).
Panel regression: $s_{i,t} = \alpha_i + \beta_{\tau,C}\tau^C_{i,t} + \beta_{\tau,I}\tau^I_{i,t} + \beta_{\sigma,C}\sigma^C_{i,t} + \beta_{\sigma,I}\sigma^I_{i,t} + \epsilon_{i,t}$ for stock i on day t, where $\sigma^C_{i,t}$ is the common volatility and $\sigma^I_{i,t}$ is the idiosyncratic volatility. For each stock, common and idiosyncratic turnover (volatilities) are computed as described in the text. The regression includes stock fixed effects and is estimated on a year by year basis for stocks in a given dollar volume quintile. At the beginning of each month, stocks are sorted by their average dollar volume (computed from CRSP) over the past 250 trading days (a minimum of 100 observations is required). The sample includes all NYSE and Amex common stocks with a price greater than \$5 and lower than \$1,000 at the beginning of each month, a market capitalization greater than \$100 million at the beginning of each month, and at least 100 days of prior trading. The variables are winsorized at 0.05% and 99.95% each year. Standard errors are double-clustered by date and stock, and t-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level.

	Dollar Volume Quintile							
	Quintile 1 (Low)				Quintile 2			
Year	$\beta_{\tau,C}$	$\beta_{\tau,I}$	$\beta_{\sigma,C}$	$\beta_{\sigma,I}$	$\beta_{\tau,C}$	$\beta_{\tau,I}$	$\beta_{\sigma,C}$	$\beta_{\sigma,I}$
1994	0.06***	0.03***	0.03***	0.15***	0.02	-0.00	0.03***	0.10***
	(3.15)	(5.74)	(3.62)	(20.86)	(0.83)	(-0.82)	(5.01)	(16.48)
1996	0.01	0.03***	-0.01	0.12***	0.01	-0.00	0.02***	0.09***
	(0.30)	(8.69)	(-1.33)	(18.58)	(0.39)	(-0.88)	(3.28)	(18.16)
1998	-0.10***	0.03***	0.07***	0.19***	0.03	0.00	0.07***	0.18***
	(-3.28)	(7.05)	(7.19)	(29.01)	(0.63)	(0.95)	(6.96)	(24.15)
2000	0.03	0.02***	-0.00	0.17***	0.06***	-0.00	-0.00	0.12***
	(1.39)	(4.26)	(-0.47)	(18.69)	(2.64)	(-0.71)	(-0.30)	(19.78)
2002	-0.25***	-0.05***	0.02	0.19***	-0.02	-0.01	0.08***	0.14***
	(-7.97)	(-6.69)	(1.13)	(19.90)	(-0.51)	(-1.18)	(5.50)	(19.56)
2004	-0.06**	-0.06***	0.05***	0.13***	0.06	-0.04***	0.06***	0.08***
	(-2.08)	(-8.49)	(3.78)	(17.59)	(1.41)	(-5.70)	(3.57)	(9.76)
2006	0.03	-0.08***	0.02	0.13***	0.34***	-0.01	0.07***	0.06***
	(0.53)	(-9.24)	(0.93)	(15.79)	(3.75)	(-0.87)	(3.67)	(8.35)
2008	0.15**	-0.07***	0.23***	0.20***	0.52***	-0.04***	0.24***	0.11***
	(2.40)	(-10.42)	(11.00)	(17.70)	(4.34)	(-2.86)	(10.58)	(8.73)
2010	0.04	-0.09***	0.05***	0.10***	0.28***	-0.05***	0.06***	0.04***
	(1.06)	(-6.71)	(3.71)	(8.81)	(5.73)	(-5.68)	(3.58)	(5.62)
2012	-0.07	-0.13***	-0.00	0.10***	0.10	-0.05***	-0.01	0.07***
	(-1.36)	(-13.15)	(-0.23)	(14.01)	(1.36)	(-5.28)	(-0.83)	(11.32)
2014	0.22***	-0.14***	0.04**	0.08***	0.30***	-0.09***	0.06***	0.06***
	(5.45)	(-15.55)	(2.51)	(10.11)	(5.66)	(-10.02)	(3.59)	(9.27)
2016	0.21***	-0.15***	0.06**	0.13***	0.47***	-0.07***	0.04	0.09***
	(2.63)	(-12.58)	(1.99)	(10.23)	(3.97)	(-5.27)	(1.19)	(8.05)
$\bar{R}^2$(%)	5.24				5.87			

(Table 24 continued.)

	Dollar Volume Quintile							
	Quintile 4				Quintile 5 (High)			
Year	$\beta_{\tau,C}$	$\beta_{\tau,I}$	$\beta_{\sigma,C}$	$\beta_{\sigma,I}$	$\beta_{\tau,C}$	$\beta_{\tau,I}$	$\beta_{\sigma,C}$	$\beta_{\sigma,I}$
1994	-0.04*	0.02***	0.04***	0.06***	-0.09**	0.04***	0.04***	0.06***
	(-1.69)	(4.34)	(4.69)	(12.64)	(-2.26)	(3.32)	(5.03)	(7.91)
1996	0.02	0.02***	0.04***	0.05***	0.01	0.04***	0.04***	0.04***
	(0.81)	(4.52)	(6.01)	(10.57)	(0.45)	(7.70)	(5.96)	(8.92)
1998	0.07	0.02***	0.11***	0.14***	0.07	0.03***	0.17***	0.12***
	(0.98)	(4.24)	(7.12)	(14.67)	(1.06)	(4.30)	(10.06)	(14.17)
2000	0.20***	0.06***	0.02***	0.09***	0.20***	0.10***	0.05***	0.09***
	(7.11)	(8.58)	(3.37)	(12.71)	(5.63)	(11.57)	(7.06)	(12.47)
2002	0.31***	0.09***	0.11***	0.11***	0.39***	0.19***	0.17***	0.10***
	(8.56)	(11.78)	(7.31)	(12.23)	(7.94)	(16.53)	(10.51)	(9.69)
2004	0.20***	0.12***	0.02	0.06***	0.38***	0.19***	-0.01	0.04***
	(7.09)	(16.24)	(1.52)	(9.59)	(9.62)	(20.18)	(-0.61)	(6.75)
2006	0.22***	0.11***	0.08***	0.05***	0.16***	0.19***	0.15***	0.04***
	(5.28)	(15.49)	(3.96)	(7.41)	(2.96)	(19.00)	(5.63)	(5.29)
2008	0.33***	0.06***	0.25***	0.10***	0.38***	0.13***	0.22***	0.11***
	(4.56)	(6.02)	(13.06)	(10.63)	(5.17)	(8.54)	(9.46)	(8.55)
2010	0.24***	0.09***	0.05***	0.01*	0.31***	0.14***	0.03***	0.01
	(7.00)	(11.41)	(3.99)	(1.94)	(7.63)	(14.43)	(2.61)	(0.96)
2012	0.13***	0.08***	0.04***	0.03***	0.28***	0.16***	0.03**	0.00
	(3.53)	(6.80)	(3.37)	(4.05)	(5.83)	(12.61)	(2.47)	(0.23)
2014	0.25***	0.02***	0.04***	0.03***	0.28***	0.13***	0.04***	0.02***
	(6.94)	(2.67)	(3.43)	(5.17)	(6.86)	(10.96)	(3.09)	(3.15)
2016	0.22***	0.02	0.12***	0.05***	0.30***	0.11***	0.08***	0.01*
	(5.54)	(1.45)	(6.30)	(6.41)	(8.80)	(8.17)	(4.99)	(1.71)
$\bar{R}^2$(%)		7.98				10.42		