

Abstract: We test market microstructure invariance of bet hypothesis and its implications using the tick-by-tick transaction data from the Tokyo Stock Exchange (TSE). The pooled regression coefficients of the log of arrival rate on the log of trading activity which range from 0.620 to 0.679 are close to the theoretical value of two-thirds implied by invariance of bet hypothesis. During our sample period, these coefficients vary more cross-sectionally than time-serially suggesting the invariance of bet is affected by different market frictions imposed on different stocks. With the TSE's unique trading features, we calibrate the order-splitting ratios among different minimum tick size groups. The order-splitting ratio of the smallest minimum ticksize group is about 4.17 times of that for the largest minimum ticksize group. However, these order-splitting ratios are close to each other across different volume groups. These findings confirm previous studies that the increase of order-splitting activities due to the market frictions lead to the coefficients deviating from the theoretical value implied by market invariance hypothesis.

Table I: Panel A Descriptive Statistics for All Stocks

VARIABLES	N	mean	sd	p1	p50	p99
nprints	417,297	648.976	1,398.538	2.000	194.000	6,598.000
avg_price	417,297	2,003.577	2,868.717	97.250	1,404.952	10,082.456
avg_printsize	417,297	1,024.947	27,216.395	100.000	251.429	3,543.902
d_med_tw_size	417,297	164.043	2,152.858	100.000	100.000	600.000
d_med_vw_size	417,297	24,578.456	851,987.223	100.000	400.000	47,800.000
volatility	417,297	0.017	0.010	0.004	0.015	0.054
dollarvol_in_1000	417,297	8,036.155	33,074.950	3.058	629.311	125,301.352

Panel B: Descriptive Statistics for Ticksize Groups

VARIABLES	ticksiz 1	ticksiz 5	ticksiz 10	ticksiz 50	ticksiz 100
	mean	mean	mean	mean	mean
nprints	591	768	1,209	3,895	2,768
avg_price	1,283.051	3,797.550	7,991.081	40,742.975	64,763.626
avg_printsize	1,160.687	316.201	360.689	212.296	180.887
d_med_tw_size	168.675	125.133	169.995	100.000	100.000
d_med_vw_size	28,720.539	3,531.043	3,188.153	292.260	672.638
volatility	0.017	0.016	0.016	0.018	0.014
dollarvol_in_1000	4,646.658	14,976.849	36,380.023	357,454.161	329,110.764
N	349,074	44,110	23,483	323	307

Panel C: Descriptive Statistics for Volume Groups

VARIABLES	1	2	3	4	5	6	7	8	9	10
	mean	mean	mean	mean	mean	mean	mean	mean	mean	mean
nprints	44	163	326	514	736	851	1,028	1,344	1,961	4,420
avg_price	1,221.639	1,435.623	1,579.472	1,950.272	2,163.494	2,523.116	2,695.131	2,903.012	3,432.067	6,189.153
avg_printsize	414.721	399.514	437.745	798.495	319.544	523.559	467.314	11,112.206	746.357	856.631
d_med_tw_size	140.815	148.865	164.433	146.955	142.332	205.641	164.996	237.029	229.317	238.457
d_med_vw_size	2,505.309	2,279.971	2,591.859	27,636.443	2,064.609	3,650.505	4,159.958	368,216.590	10,065.915	21,527.615
volatility	0.014	0.018	0.020	0.020	0.020	0.020	0.018	0.018	0.017	0.016
dollarvol_in_1000	102.094	465.362	1,116.658	2,132.176	3,482.005	5,054.238	7,799.110	13,009.282	24,584.997	96,498.814
N	124,244	84,921	41,800	41,906	20,788	20,297	20,386	20,681	21,097	21,177

Table II Pooled Least Square Estimates of Number of Prints

VARIABLES	(1)	(2)	(3)	(4)
	OLS	LSDV	LSDV	LSDV
Log Adj-Trading Activity (α_1)	0.679*** (0.009)	0.625*** (0.005)	0.679*** (0.009)	0.620*** (0.005)
Constant (α_0)	5.101*** (0.019)	5.103*** (0.000)	5.101*** (0.019)	5.059*** (0.008)
Observations	417,228	417,228	417,228	417,228
Adjusted R-squared	0.911	0.968	0.913	0.970
Stock FE	NO	YES	NO	YES
Day FE	NO	NO	YES	YES
Coef Equal 2/3 p-val	0.146	0.000	0.154	0.000

Robust (Industry-clustered) standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

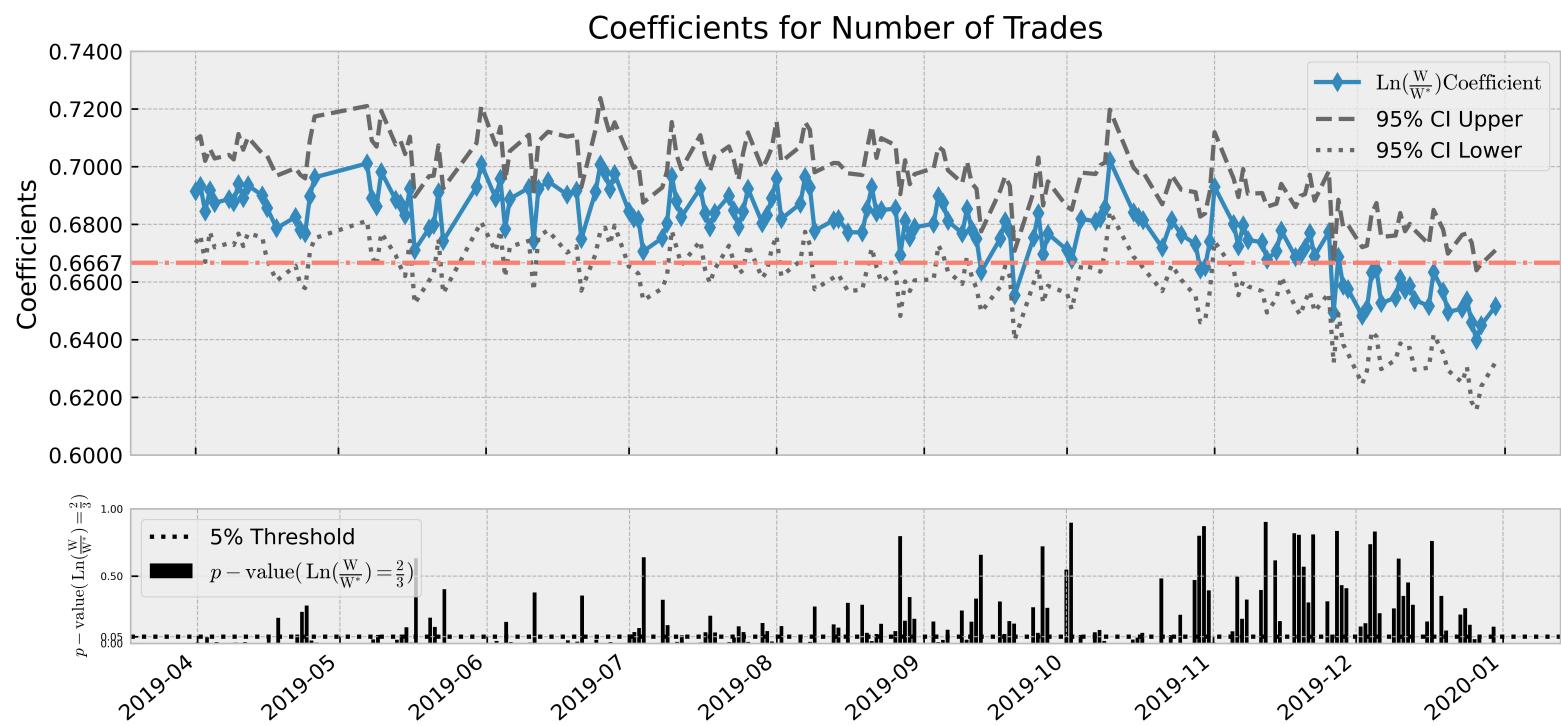


Table III OLS Estimates of Number of Prints for Ticksize Groups

VARIABLES	$Ln(N_{it}) = \alpha_0 + \alpha_1 Ln(\frac{W_{it}}{W_*}) + \epsilon_{it}$				
	(1) Ticksize 1	(2) Ticksize 5	(3) Ticksize 10	(4) Ticksize 50	(5) Ticksize 100
Log Adj-Trading Activity (α_1)	0.624*** (0.004)	0.657*** (0.006)	0.638*** (0.011)	0.652*** (0.027)	0.689*** (0.022)
Constant (α_0)	5.207*** (0.001)	4.597*** (0.008)	4.424*** (0.028)	4.018*** (0.165)	3.657*** (0.133)
Observations	349,005	44,110	23,483	323	307
Adjusted R-squared	0.967	0.978	0.973	0.932	0.808
Stock FE	YES	YES	YES	YES	YES
Day FE	NO	NO	NO	NO	NO
Coef Equal 2/3 p-val	0.000	0.112	0.012	0.633	0.417

Robust (Industry-clustered) standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table IV OLS Estimates of Number of Prints for Volume Groups

VARIABLES	(1) Volume 1	(2) Volume 2	(3) Volume 3	(4) Volume 4	(5) Volume 5	(6) Volume 6	(7) Volume 7	(8) Volume 8	(9) Volume 9	(10) Volume 10
Log Adj-Trading Activity	0.618*** (0.006)	0.650*** (0.004)	0.635*** (0.006)	0.623*** (0.014)	0.618*** (0.010)	0.622*** (0.010)	0.620*** (0.009)	0.567*** (0.039)	0.599*** (0.009)	0.585*** (0.010)
Constant	4.853*** (0.017)	5.129*** (0.003)	5.242*** (0.002)	5.295*** (0.016)	5.328*** (0.018)	5.235*** (0.021)	5.223*** (0.022)	5.311*** (0.112)	5.237*** (0.031)	5.437*** (0.048)
Observations	124,209	84,887	41,800	41,906	20,788	20,297	20,386	20,681	21,097	21,177
Adjusted R-squared	0.889	0.864	0.861	0.842	0.836	0.852	0.832	0.835	0.851	0.868
Stock FE	YES									
Day FE	NO									
Coef Equal 2/3 p-val	0.000	0.001	0.000	0.005	0.000	0.000	0.000	0.016	0.000	0.000

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table IIIc Restricted Specifications of Number of Prints for Ticksizes Groups

Order-splitting Multiplier Calibration

VARIABLES	$Ln(N_{it}) = Ln(\mu_0) + \frac{2}{3}Ln(W_{it}) + \epsilon_{it}$				
	(1) Ticksize 1	(2) Ticksize 5	(3) Ticksize 10	(4) Ticksize 50	(5) Ticksize 100
$Ln(\mu_0)$	-0.895*** (0.018)	-1.529*** (0.019)	-1.766*** (0.033)	-2.189*** (0.153)	-2.322*** (0.053)
Observations	349,005	44,110	23,483	323	307
R-squared	0.924	0.945	0.928	0.860	0.735
$\delta_{it} \times \underbrace{\left(\frac{\zeta}{2} E \left[\frac{\zeta}{2} \tilde{I} \right]^{-\frac{2}{3}} \right)}_{\text{Constant}}$	0.409	0.217	0.171	0.112	0.098
rmse	0.484	0.417	0.427	0.274	0.221

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table Va Restricted Specifications of Print Size for Ticksizes Groups
 Order-splitting Multiplier Calibration

VARIABLES	$\ln\left(\frac{ \tilde{X}_{it} }{V_{it}}\right) = \ln(\mu_x) - \frac{2}{3}\ln(W_{it}) + \epsilon_{it}$				
	(1)	(2)	(3)	(4)	(5)
	Ticksizes 1	Ticksizes 5	Ticksizes 10	Ticksizes 50	Ticksizes 100
$\ln(\mu_x)$	0.060* (0.032)	0.675*** (0.033)	0.837*** (0.051)	1.449*** (0.269)	1.739*** (0.124)
Observations	349,005	44,110	23,483	323	307
$\delta_{it}^{-1} \times \underbrace{E\left[\frac{\zeta}{2} \tilde{I} \right]^{-\frac{1}{3}}}_{\text{Constant}}$	1.062	1.963	2.309	4.260	5.690
rmse	0.683	0.636	0.615	0.384	0.252

Robust standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table IIIc Restricted Specifications of Number of Prints for Volume Groups
Order-splitting Multiplier Calibration

VARIABLES	$\ln(N_{it}) = \ln(\mu_0) + \frac{2}{3}\ln(W_{it}) + \epsilon_{it}$									
	(1) Volume 1	(2) Volume 2	(3) Volume 3	(4) Volume 4	(5) Volume 5	(6) Volume 6	(7) Volume 7	(8) Volume 8	(9) Volume 9	(10) Volume 10
$\ln(\mu_0)$	-1.125*** (0.042)	-0.975*** (0.012)	-0.884*** (0.024)	-0.868*** (0.018)	-0.869*** (0.037)	-0.969*** (0.027)	-1.004*** (0.047)	-1.093*** (0.047)	-1.118*** (0.053)	-1.056*** (0.078)
Observations	124,209	84,887	41,800	41,906	20,788	20,297	20,386	20,681	21,097	21,177
$\delta_{it} \times \underbrace{\left(\frac{\zeta}{2} E \left[\frac{\zeta}{2} \tilde{I} \right]^{-\frac{2}{3}} \right)}_{\text{Constant}}$	0.325	0.377	0.413	0.420	0.419	0.379	0.366	0.335	0.327	0.348
rmse	0.629	0.475	0.446	0.462	0.466	0.509	0.470	0.607	0.526	0.582

Robust standard errors in parentheses

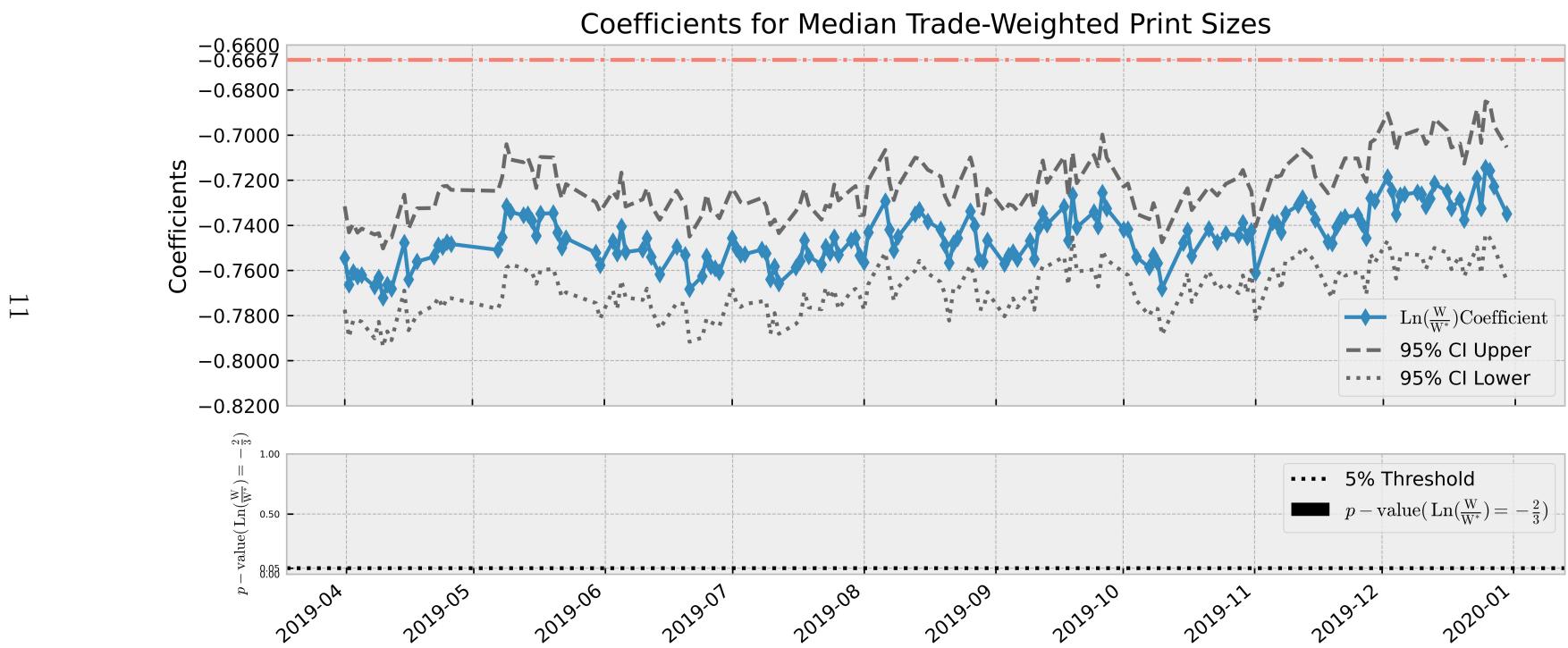
*** p<0.01, ** p<0.05, * p<0.1

Table V Pooled Least Square Estimates of Quantile Print Sizes

VARIABLES	$f(\ln(\frac{ \tilde{X}_{it} }{V_{it}})) = \alpha_0 + \alpha_1 \ln(\frac{W_{it}}{W^*}) + \epsilon_{it}$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
\tilde{X}_{it} is the print size of a trade for stock i at day t. $f(\cdot)$ is a function (TW or VW) of the 50th percentiles of these distributions. V_{it} is the trading volume for stock i at day t.								
Log Adj-Trading Activity (α_1)	-0.610*** (0.008)	-0.746*** (0.011)	-0.501*** (0.012)	-0.611*** (0.008)	-0.504*** (0.012)	-0.705*** (0.007)	-0.745*** (0.011)	-0.699*** (0.007)
Constant (α_0)	-4.541*** (0.022)	-5.939*** (0.031)	-4.546*** (0.001)	-4.541*** (0.022)	-4.608*** (0.015)	-5.941*** (0.000)	-5.939*** (0.031)	-5.854*** (0.014)
Observations	417,228	417,228	417,228	417,228	417,228	417,228	417,228	417,228
Adjusted R-squared	0.761	0.885	0.850	0.770	0.859	0.965	0.887	0.967
Stock FE	NO	NO	YES	NO	YES	YES	NO	YES
Day FE	NO	NO	NO	YES	YES	NO	YES	YES
Coef Equal -2/3 p-val	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Robust (Industry-clustered) standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1



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