Liquidity Dynamics and Stock Market Automation

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Motivation - Effects of Automation on Liquidity

1. Trade-offs between lower operating costs and higher adverse selection costs.
2. Trade-offs between execution costs, quantities and speeds.
3. More information may allow discretionary traders to cluster, resulting in greater liquidity spikes and droughts. Admati & Pfleiderer [1988], Coppejans Domowitz & Madhaven [2001]

A Selective Summary of Findings in the Literature

Single Exchange Event Studies - Mixed Evidence

Lower costs: Israel & France - Amihud, Mendelson & Lauterbach [1997], Kalay, Wei & Wohl [2002], Muscarella & Piwowar

Higher costs: US & Germany - Theissen [1999] & Henderschott Moulton [2008]

Cross-sectional Studies - Mixed Samples

Hard to compare one exchange to another

Lower costs: 51 exchanges - Jain [2005]

Higher costs: NYSE v. Paris - Venkatamaran [2001]

Liquidity Dynamics - No Evidence

Persistence, Volatility and Cross-moments of Liquidity (AP Liquidity Betas)

Data

Daily data available 49 countries
Bid-Ask spreads are typically not available until after automation.

Countries Excluded from the Event Study

Reason	Number	Countries Affected
(1) Not automated by 2005	3	Ghana, Kenya and Zimbabwe
(2) Price availability coincides with Automation	11	Brazil, Bulgaria, Chile, China, Estonia, Jamaica Jordan, Latvia, Luxembourg, Romania and Saudi Arabia
(3) Price availability more than 1 year after Automation	9	Iceland, Kuwait, Lithuania, Nigeria, Oman, Russia, Slovakia, Taiwan and Tunisia

Plan

1. Pre/post analysis with Bootstrap Errors
2. Speed of Information Incorporation
3. Firm-level Panel Regressions
4. Persistence and Volatility of Systematic Liquidity
5. Acharya Pedersen [2005] Liquidity CAPM (with GMM Structural Break Tests)

Liquidity Proxies

LOT - Lesmond Ogden Trzcinka [1999]

ZEROS - As used in Bekaert, Harvey Lundblad [2007]

$$ZEROS = T^{-1} \sum_{t=1}^{T} I_{(R_t=0)}$$

ILLIQ - The Amihud [2002] illiquidity measure

$$ILLIQ = T^{-1} \sum_{t=1}^{T} \frac{|R_t|}{VO_{dol,t}}, \quad VO_{dol,t} > 0$$

LCF is a latent common factor representation of **LOT**, **ZEROS** and, where available, **ILLIQ.**

Liquidity Before and After Automation

Panel A. All Countries (49 countries)				
Statistic	**LOT**	**ZEROS**	**ILLIQ**	**LCF**
Pre-Automation	5.7	34.0	11.1	-0.39
Post-Automation	2.7	25.5	10.0	-0.68
Proportion Falling	71%	76%	82%	86%
Average Change	**-2.6***	**-8.1*****	**-1.0*****	**-0.27*****
Wilcoxon Mann-Whitney	(0.040)	(0.002)	(0.045)	(0.001)
Bootstrap P-value	(0.066)	(0.001)	(0.002)	(0.003)
Median Change	**-0.51***	**-5.1*****	**-0.77****	**-0.19****
Bootstrap P-value	(0.079)	(0.005)	(0.037)	(0.011)

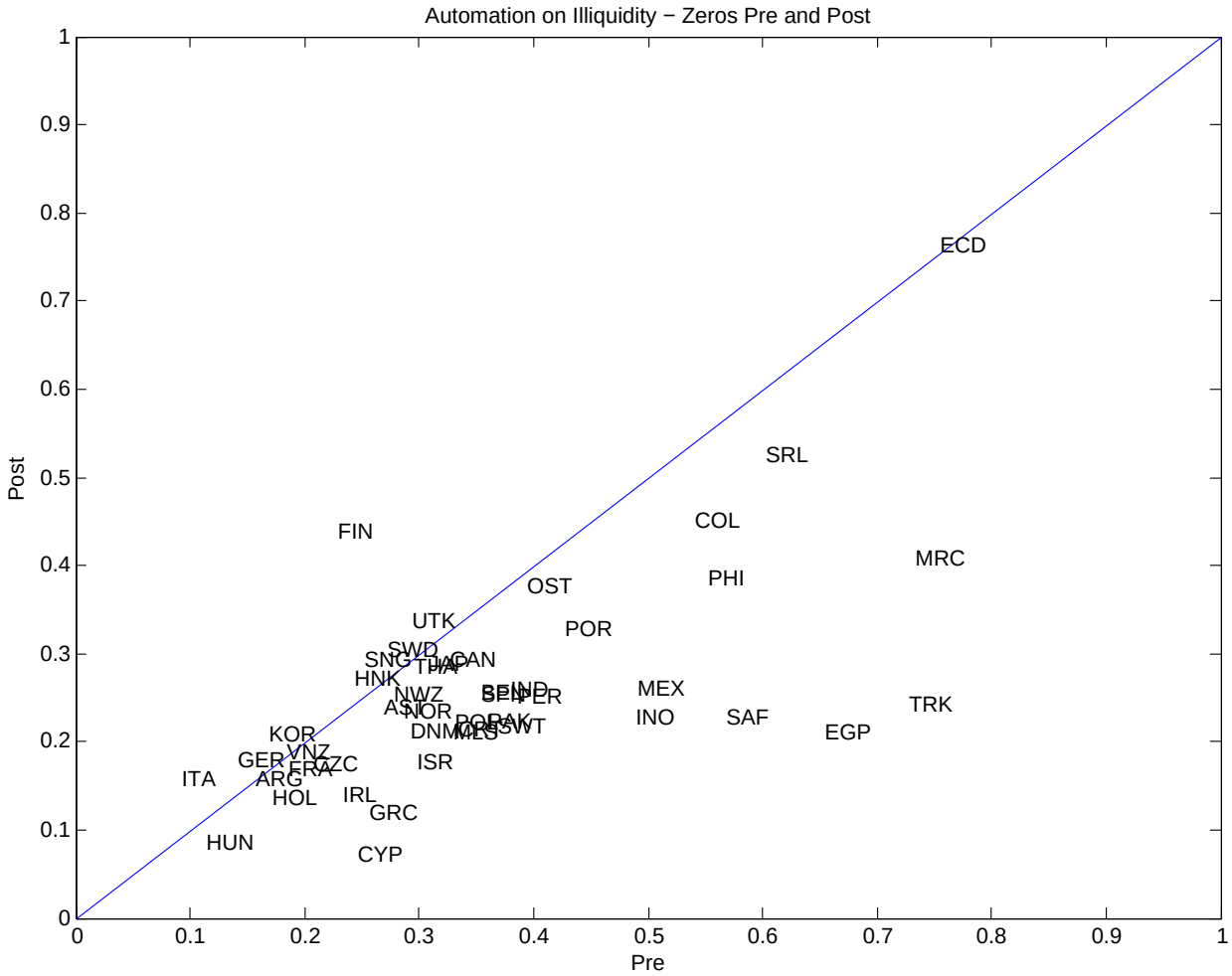
Robustness: Results similar at 6 months, 1 year, 2 years and 4 year windows.

Liquidity Before and After Automation by Development

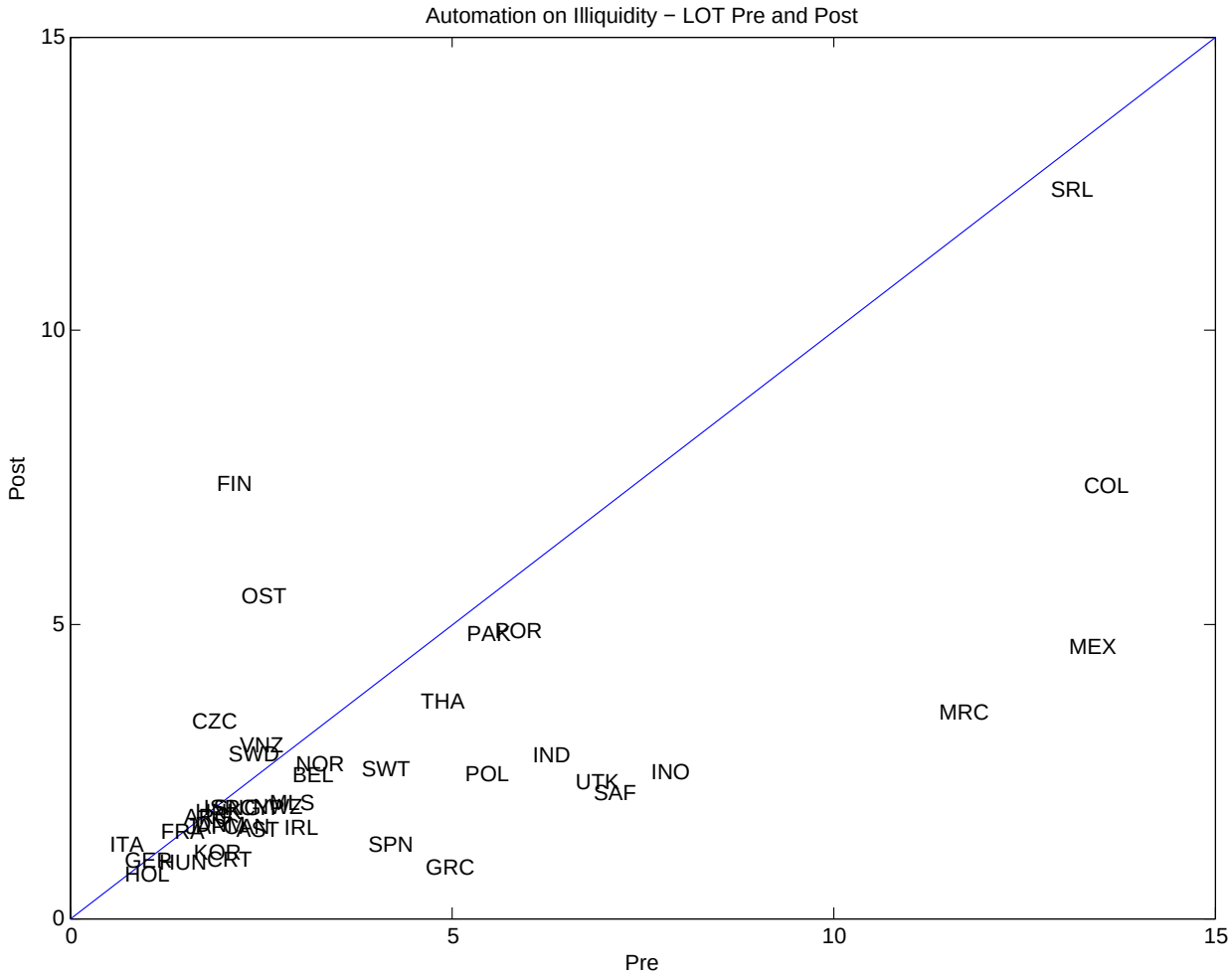
Panel B. Developed Countries (20 countries) Statistic	LOT	ZEROS	ILLIQ	LCF
Pre-Automation	2.2	26.5	10.5	-0.44
Post-Automation	2.2	24.2	9.7	-0.58
Proportion Falling	60%	75%	93%	80%
Average Change	0.00	-2.3	-0.9	-0.14
Median Change	-0.2	-2.7	-0.6	-0.14

Panel C. Emerging Markets (29 countries) Statistic	LOT	ZEROS	ILLIQ	LCF
Pre-Automation	8.3	39.5	11.4	-0.35
Post-Automation	3.1	26.5	10.3	-0.75
Proportion Falling	79%	76%	72%	90%
Average Change	-4.4	-12.0	-1.1	-0.36
Median Change	-0.8	-11.8	-1.0	-0.28

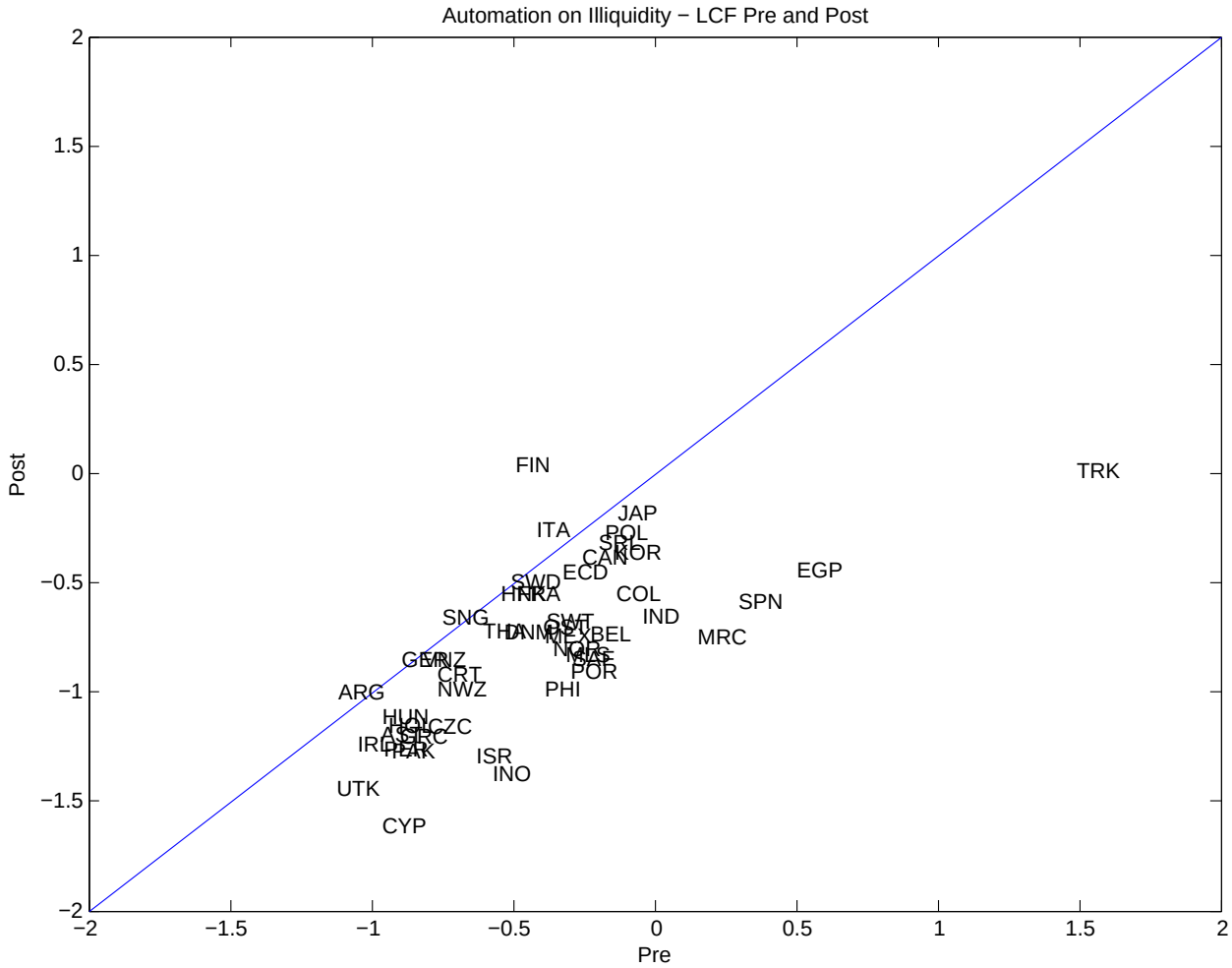
Automation on Illiquidity: Country-by-Country Results (Zeros)



Automation on Illiquidity: Country-by-Country Results (LOT)



Automation on Illiquidity: Country-by-Country Results (LCF)



Speed of Information Transmission

Delay Measures from Mech [1993], Hou & Moskowitz [2005]

$$Delay = max(0, \overline{R}^2_{SW} - \overline{R}^2_{MM})$$

where $\overline{R}^2_{SW}$ is the adjusted R^2 from a Scholes-Williams [1977]/Dimson [1979] type regression and $\overline{R}^2_{MM}$ is the adjusted R^2 from the typical market model regression.

We also compute variance ratios, $VR(q)$ at $q = \{2,\ 5,\ 10\}$ trading days for individual securities and for market indices,

$$VR(q) = 1 + 2\sum_{k=1}^{q-1}\left(1 - \frac{k}{q}\right)\hat{\rho}(k),$$

following Campbell, Lo & MacKinlay [1997].

Changes in Speed of Information Incorporation

For Individual Securities.

All Countries (49 countries) **Statistic**	**Delay**	**VR(2)**	**VR(5)**	**VR(10)**
Pre-Automation	0.055	1.001	0.896	0.688
Post-Automation	0.051	0.987	0.857	0.648
Proportion Falling	65%	69%	78%	76%
Average Change	-0.004	**-0.015***	**-0.043*****	**-0.044*****
Wilcoxon Mann-Whitney	(0.226)	(0.034)	(0.006)	(0.019)
Bootstrap P-value	(0.510)	(0.064)	(0.003)	(0.002)
Median Change	**-0.006****	**-0.016****	**-0.039*****	**-0.036*****
Bootstrap P-value	(0.035)	(0.046)	(0.002)	(0.004)

Small-Large Portfolio Cross-correlations will be in the next draft.

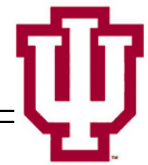
Changes in Speed of Information Incorporation by Development

Developed Countries (20 countries)

Statistic	Delay	VR(2)	VR(5)	VR(10)
Pre-Automation	0.057	0.995	0.884	0.671
Post-Automation	0.052	0.975	0.846	0.640
Proportion Falling	80%	80%	75%	75%
Average Change	-0.002	-0.019	-0.037	-0.024
Median Change	-0.006	-0.019	-0.035	-0.028

Emerging Markets (29 countries)

Statistic	Delay	VR(2)	VR(5)	VR(10)
Pre-Automation	0.053	1.004	0.905	0.701
Post-Automation	0.051	0.996	0.865	0.655
Proportion Falling	55%	62%	79%	76%
Average Change	-0.001	-0.019	-0.031	-0.038
Median Change	-0.006	-0.012	-0.041	-0.049



Systematic Liquidity Persistence and Volatility

The persistence of systematic liquidity are from the autoregression

$$LCF_{*W,t} = \psi + \rho LCF_{*W,t-1} + \varepsilon_t$$

where $LCF_{*W,t}$ is the illiquidity proxy aggregated up by $*W \in \{EW,\ VW\}$ method in time, t. ρ is the autoregressive coefficient.

$$\sigma_L = \sqrt{T^{-1} \sum_{t=1}^{T} e_t^2}$$

where T is the total number of time series observations and e_t is the estimate residual at time t from above.

Persistence & Volatility of Systematic Liquidity

All Countries (49 countries) **Statistic**	$\rho_{LCF,EW}$	$\rho_{LCF,VW}$	$\sigma_{LCF,EW}$	$\sigma_{LCF,VW}$
Average	0.21	0.16	-35.4	-19.4
Median	0.19	0.10	-39.6	-25.7
Proportion Falling	24%	33%	88%	74%
Wilcoxon Mann-Whitney	0.00	0.00	0.00	0.00

Results stronger in emerging markets than in developed ones. To do: Structural break tests...

Liquidity Risks

Acharya-Pedersen [2005] liquidity-CAPM that captures the following covariances

1. Sharpe-Lintner Beta, β_{MKT}, Asset Returns and Market Returns (Market Beta)
2. Chordia-Roll-Subrahmanyam Beta, β_{CRS}, Asset Liquidity and Market Liquidity (Commonality)
3. Pastor-Stambaugh Beta, β_{PS}, Asset Returns and Market Liquidity
4. Acharya-Pedersen Beta, β_{AP}, Asset Liquidity and Market Returns

$$
\begin{aligned}
COV_{MKT,*W} &= cov(R_{i,t},\ R_{t,*W} - E_{t-1}R_{t,*W}),\\
COV_{CRS,*W} &= cov(L_{i,t} - E_{t-1}L_{i,t},\ L_{t,*W} - E_{t-1}L_{t,*W}),\\
COV_{PS,*W} &= cov(R_{i,t},\ L_{t,*W} - E_{t-1}L_{t,*W}),\\
COV_{AP,*W} &= cov(L_{i,t} - E_{t-1}L_{i,t},\ R_{t,*W} - E_{t-1}R_{t,*W}),
\end{aligned}
$$

Liquidity Risks

All Countries (39 countries)

	COV_{MKT}			COV_{CRS}		
Statistic	PRE	POST	DIFF	PRE	POST	DIFF
Average	0.90	0.55	**-0.35**	0.58	0.37	**-0.21**
Median	0.62	0.41	-0.18	0.47	0.29	-0.17
Proportion Falling			77%			82%
Wilcoxon Mann-Whitney			0.01			0.01

	COV_{PS}			COV_{AP}		
Statistic	PRE	POST	DIFF	PRE	POST	DIFF
Average	-0.58	-0.36	**0.22**	-0.34	-0.27	**0.07**
Median	-0.39	-0.16	0.09	-0.37	-0.12	0.10
Proportion Falling			41%			28%
Wilcoxon Mann-Whitney			0.16			0.07

Summary of Findings and Extensions

1. Automation appears to reduce transactions costs by 3% over the whole sample
   - Mixed results in the literature may be dependent on the initial liquidity of the market. Developed, efficient floor-trading markets may not have much room for improvement.
   - Automation may make emerging markets more accessible to foreign traders, improving liquidity but opening the market up to global liquidity crises.
2. Automation is consistent with more frequent trading and faster incorporation of information
3. Automation appears to reduce liquidity risk
   - Are liquidity crises a peso problem?
4. A few more things to do