

Internet Appendix

The effect of stock liquidity on cash holdings:
The repurchase motive¹

Kjell G. Nyborg
University of Zurich,
Swiss Finance Institute,
and CEPR

Zexi Wang
Lancaster University

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¹Nyborg: Department of Banking and Finance, University of Zurich, Plattenstrasse 14, 8032 Zurich, Switzerland. Email: kjell.nyborg@bf.uzh.ch. Wang: Management School, Lancaster University, Lancaster LA1 4YX, United Kingdom. Email: z.wang41@lancaster.ac.uk.

Table A1

Panel regressions of Cash ratio on liquidity measures and controls over different time periods (with coefficients on control variables)

This table presents the results from panel regressions with the general specification $\text{Cash ratio}_{i,t} = \beta_0 + \beta_1 \text{Liquidity}_{i,t-1} + \mathbf{\Gamma}' \mathbf{Z}_{i,t} + \varepsilon_{i,t}$, where Liquidity is *ILLIQ*_res, *ILLIQ*, *Log_resprd_res*, or *Log_resprd*, \mathbf{Z} is a vector of control variables, and $\mathbf{\Gamma}$ is a vector of coefficients. The sample period varies with the availability of Liquidity and control variables, as indicated in the top row. Industry (Fama-French 48 sectors) fixed effects and year fixed effects are included in Columns 1 to 10. Firm fixed effects and year fixed effects are included in Columns 11 and 12. Variables (except dummies) are winsorized at the 1st and 99th percentiles. *t*-statistics are based on firm-clustered standard errors and displayed in parentheses. Statistical significance at the 1%, 5% and 10% level is indicated by **a**, **b**, and **c** respectively. A * indicates that coefficients are multiplied by 100.

	1964-2015		1971-2015		1981-2015		1998-2015					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
<i>ILLIQ</i> _res* _{<i>t</i>-1}	-0.087 ^a		-0.085 ^a		-0.064 ^a		-0.064 ^a				-0.043 ^a	
	(-15.33)		(-15.07)		(-10.53)		(-6.95)				(-5.13)	
<i>ILLIQ</i> * _{<i>t</i>-1}		-0.077 ^a		-0.079 ^a		-0.059 ^a		-0.055 ^a				
		(-15.96)		(-16.29)		(-11.03)		(-6.88)				
<i>Log_resprd_res</i> _{<i>t</i>-1}									-0.024 ^a			-0.011 ^a
									(-9.00)			(-5.45)
<i>Log_resprd</i> _{<i>t</i>-1}										-0.018 ^a		
										(-8.19)		
Firm size	-0.009 ^a	-0.013 ^a	-0.009 ^a	-0.013 ^a	-0.011 ^a	-0.013 ^a	-0.011 ^a	-0.015 ^a	-0.012 ^a	-0.020 ^a	-0.012 ^a	-0.012 ^a
	(-14.17)	(-18.58)	(-12.87)	(-17.45)	(-13.24)	(-15.81)	(-9.82)	(-11.72)	(-9.98)	(-13.13)	(-3.07)	(-3.10)
Leverage	-0.292 ^a	-0.300 ^a	-0.308 ^a	-0.317 ^a	-0.316 ^a	-0.323 ^a	-0.300 ^a	-0.305 ^a	-0.295 ^a	-0.302 ^a	-0.202 ^a	-0.200 ^a
	(-45.13)	(-50.81)	(-45.29)	(-50.66)	(-42.07)	(-47.09)	(-29.84)	(-32.99)	(-29.26)	(-32.56)	(-16.46)	(-16.31)
MTB	0.018 ^a	0.019 ^a	0.017 ^a	0.017 ^a	0.016 ^a	0.015 ^a	0.016 ^a	0.016 ^a	0.014 ^a	0.015 ^a	0.008 ^a	0.007 ^a
	(14.60)	(16.84)	(13.44)	(15.09)	(11.24)	(12.41)	(9.23)	(10.27)	(8.28)	(9.75)	(4.75)	(4.65)
Industry sigma	0.174 ^a	0.201 ^a	0.173 ^a	0.194 ^a	0.164 ^a	0.177 ^a	0.083 ^a	0.086 ^a	0.082 ^a	0.084 ^a	0.027	0.028
	(7.23)	(8.41)	(6.91)	(7.86)	(6.02)	(6.71)	(2.74)	(2.96)	(2.69)	(2.87)	(1.18)	(1.21)
Net Work. Cap.	-0.276 ^a	-0.269 ^a	-0.299 ^a	-0.290 ^a	-0.309 ^a	-0.300 ^a	-0.315 ^a	-0.305 ^a	-0.312 ^a	-0.302 ^a	-0.311 ^a	-0.310 ^a
	(-37.26)	(-38.79)	(-38.24)	(-39.76)	(-35.87)	(-37.29)	(-25.92)	(-26.75)	(-25.67)	(-26.52)	(-21.15)	(-21.00)
R&D	0.484 ^a	0.499 ^a	0.467 ^a	0.480 ^a	0.432 ^a	0.438 ^a	0.488 ^a	0.474 ^a	0.488 ^a	0.475 ^a	-0.246 ^a	-0.253 ^a
	(17.74)	(20.71)	(16.93)	(19.66)	(15.17)	(17.51)	(12.62)	(13.88)	(12.61)	(13.87)	(-4.35)	(-4.46)
Capex	-0.449 ^a	-0.417 ^a	-0.589 ^a	-0.550 ^a	-0.638 ^a	-0.600 ^a	-0.691 ^a	-0.648 ^a	-0.694 ^a	-0.649 ^a	-0.508 ^a	-0.511 ^a
	(-28.06)	(-28.84)	(-32.94)	(-33.90)	(-32.33)	(-33.81)	(-23.37)	(-23.91)	(-23.49)	(-24.01)	(-18.33)	(-18.49)
Div. dummy	-0.009 ^a	-0.013 ^a	-0.010 ^a	-0.014 ^a	-0.007 ^b	-0.009 ^a	-0.008 ^b	-0.007 ^c	-0.010 ^b	-0.009 ^b	0.005	0.005
	(-3.95)	(-5.88)	(-4.09)	(-5.89)	(-2.45)	(-3.25)	(-2.09)	(-1.92)	(-2.55)	(-2.36)	(1.40)	(1.22)
Cash flow	-0.057 ^a	-0.066 ^a	-0.012	-0.020 ^b	-0.024 ^b	-0.033 ^a	-0.033 ^b	-0.044 ^a	-0.033 ^b	-0.040 ^a	0.021	0.019
	(-5.82)	(-7.86)	(-1.21)	(-2.36)	(-2.27)	(-3.66)	(-2.15)	(-3.37)	(-2.19)	(-3.04)	(1.47)	(1.34)
Acquisition			-0.453 ^a	-0.439 ^a	-0.477 ^a	-0.464 ^a	-0.562 ^a	-0.547 ^a	-0.567 ^a	-0.542 ^a	-0.422 ^a	-0.424 ^a
			(-30.99)	(-32.69)	(-31.03)	(-32.92)	(-27.23)	(-28.57)	(-27.30)	(-28.45)	(-28.22)	(-28.26)

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Table A1 – continued from previous page

	1964-2015		1971-2015		1981-2015		1998-2015					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Net equity issu.			0.063 ^a	0.061 ^a	0.053 ^a	0.048 ^a	0.030	0.029 ^c	0.041 ^b	0.044 ^a	0.132 ^a	0.135 ^a
			(4.84)	(5.83)	(3.94)	(4.42)	(1.50)	(1.78)	(2.10)	(2.70)	(8.45)	(8.69)
Net debt issu.			0.261 ^a	0.245 ^a	0.275 ^a	0.254 ^a	0.309 ^a	0.284 ^a	0.297 ^a	0.282 ^a	0.244 ^a	0.241 ^a
			(29.03)	(29.50)	(27.79)	(27.84)	(20.66)	(20.19)	(19.99)	(20.07)	(19.59)	(19.41)
Firm age					-0.005 ^b	-0.009 ^a	-0.001	-0.006 ^a	-0.002	-0.007 ^a	-0.016 ^a	-0.018 ^a
					(-2.57)	(-6.09)	(-0.40)	(-2.67)	(-0.70)	(-2.99)	(-3.39)	(-3.89)
Equity beta					0.006 ^a	0.008 ^a	0.010 ^a	0.013 ^a	0.012 ^a	0.015 ^a	0.002	0.003
					(3.85)	(6.03)	(4.18)	(5.91)	(4.81)	(6.60)	(1.35)	(1.58)
Analyst coverage_res					0.004 ^a	0.006 ^a	0.006 ^a	0.009 ^a	0.003	0.007 ^a	0.002	0.001
					(2.71)	(4.17)	(2.61)	(4.24)	(1.34)	(3.10)	(0.77)	(0.54)
Blocks					0.037 ^a	0.045 ^a	0.050 ^a	0.057 ^a	0.055 ^a	0.065 ^a	0.034 ^a	0.030 ^b
					(4.11)	(5.27)	(4.29)	(5.26)	(4.79)	(6.05)	(2.84)	(2.50)
Non-blocks_res					0.033 ^a	0.031 ^a	0.057 ^a	0.056 ^a	0.030 ^b	0.035 ^a	0.076 ^a	0.066 ^a
					(3.72)	(3.65)	(4.78)	(5.01)	(2.44)	(3.09)	(6.72)	(5.79)
Inst_turn					0.193 ^a	0.190 ^a	0.222 ^a	0.201 ^a	0.280 ^a	0.264 ^a	0.139 ^a	0.164 ^a
					(6.63)	(7.24)	(4.47)	(4.43)	(5.60)	(5.79)	(3.43)	(4.08)
Fluidity							0.004 ^a	0.005 ^a	0.004 ^a	0.005 ^a	0.000	0.000
							(6.22)	(7.42)	(6.38)	(7.55)	(0.78)	(0.80)
IPO2			0.012 ^a	0.017 ^a	0.007 ^c	0.003	0.022 ^a	0.015 ^a	0.024 ^a	0.016 ^a	0.011 ^b	0.011 ^b
			(4.49)	(7.18)	(1.68)	(1.05)	(3.44)	(2.86)	(3.74)	(2.97)	(2.06)	(2.06)
IPO3			0.007 ^a	0.006 ^a	0.003	-0.005 ^c	0.011 ^b	0.000	0.012 ^b	-0.000	0.009 ^c	0.008 ^c
			(3.01)	(2.80)	(0.78)	(-1.92)	(2.06)	(0.06)	(2.18)	(-0.04)	(1.86)	(1.78)
IPO4			0.003	0.003	-0.001	-0.006 ^b	0.006	-0.001	0.006	-0.002	0.001	0.001
			(1.26)	(1.50)	(-0.35)	(-2.34)	(1.30)	(-0.18)	(1.29)	(-0.35)	(0.33)	(0.26)
IPO5			0.003	-0.000	0.000	-0.008 ^a	0.006	-0.002	0.006	-0.002	-0.001	-0.002
			(1.48)	(-0.03)	(0.10)	(-3.34)	(1.30)	(-0.46)	(1.34)	(-0.58)	(-0.44)	(-0.51)
Observations	74,032	91,166	68,868	84,315	55,241	68,562	25,091	31,007	25,090	31,058	25,141	25,140
Adjusted R^2	0.476	0.489	0.492	0.502	0.501	0.513	0.552	0.564	0.552	0.563	0.211	0.210

Table A2

The effect on cash holding of different variables: our paper vs. the literature

This table reports the signs of the regression coefficients in this paper as compared with the literature. The column labelled “Sign Us” lists the signs of coefficients in Column 9 of Table A1; the column labelled “Sign Lit.” provides the signs in the relevant literature. *NS* stands for not significant at conventional levels (10% or better). The symbol + (–) indicates that the coefficient is positive (negative) and statistically significant at least at the 10% level.

Variable	Sign Us	Sign Lit.	Literature
<i>Panel A: in the extant literature and this paper</i>			
Firm size	–	–	Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009)
Leverage	–	–	Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009)
MTB	+	+	Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009)
Industry sigma	+	+	Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009), Han and Qiu (2007)
Net working capital	–	–	Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009)
R&D	+	+	Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009), Brown and Petersen (2011)
Capex	–	–	Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009)
Acquisition	–	–	Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009)
Dividend dummy	–	–	Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009)
Cash flow	<i>NS</i>	mixed	Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009), Riddick and Whited (2009)
Net equity issuance	+	+	Bates, Kahle, and Stulz (2009), McLean (2011)
Net debt issuance	+	+	Bates, Kahle, and Stulz (2009)
IPO2	+	+	Bates, Kahle, and Stulz (2009)
IPO3	<i>NS</i>	+	Bates, Kahle, and Stulz (2009)
IPO4	<i>NS</i>	+	Bates, Kahle, and Stulz (2009)
IPO5	<i>NS</i>	+	Bates, Kahle, and Stulz (2009)
Inst_turn	+	+	Brown, Chen and Shekhar (2011)
Fluidity	+	+	Hoberg, Phillips, and Prabhala (2014), Morellec, Nikolov, and Zucchi (2013)
Analyst coverage	+	+	Chang (2012)
<i>Panel B: in this paper</i>			
Stock liquidity	+		
Firm age	–		
Equity beta	+		
Blocks	+		
Non-blocks_res	+		

Table A3

Robustness tests using alternative matching variables: matching estimator for the DiD analysis based on tick-size decimalization in 2001

This table reports on the Abadie and Imbens (2011) bias-corrected matching estimator for the DiD analysis based on tick-size decimalization with an alternative set of matching variables. We estimate the average treatment effect on treated firms by comparing changes (with the bias correction) in Cash ratio (ΔCash , the year after minus the year before the event) of treated and control firms. Firms whose stocks are in the top tercile by number of trades in the year before the event are classified as treated. Matched controls are picked from nontreated firms within the same industry (Fama-French twelve) with replacement using a nearest-neighbor approach and the Mahalanobis metric. The matching variables are: Cash flows, change in Net working capital, Capex, Acquisition, Net equity issuance, Net debt issuance, Firm size, Leverage, Firm age, R&D, Inst_turn, Fluidity, Analyst coverage_res, Blocks, and Non-blocks_res in the year before the event. Abadie and Imbens (2006) robust standard errors are used. Statistical significance at the 1%, 5% and 10% level is indicated by **a**, **b**, and **c**, respectively.

ΔCash	Coef.	Std. err.	z	$P > z $	[95% Conf. Interval]	
Treatment	0.028 ^b	0.011	2.54	0.011	0.006	0.049

Table A4

Decimalization DiD tests controlling for financial constraints

This table presents the DiD regressions for tick-size decimalization controlling for financial constraints. The specification is as follows: $\text{Cash ratio}_{it} = \beta_0 + \beta_1 \cdot \text{Treat}_i \times \text{Post}_t + \beta_2 \cdot \text{Post}_t + \mathbf{\Gamma}'\mathbf{Z}_{i,\tau(t)} + \varepsilon_{i,t}$, where i refers to firm i , t refers to year t , the dummy variable Treat equals 1 (0) for treated (control) firms using the matched sample as in the matching estimator, the dummy variable Post equals 1 if a year is in or after the event year and 0 otherwise, $\mathbf{Z}_{i,\tau(t)}$ is a vector of control variables (as in Table 6), $\tau(t)$ equals t in years before the event and -1 (the year before the event) in years in or after the event, $\mathbf{\Gamma}$ is a vector of coefficients. The coefficient β_1 is the DiD estimator. Financial constraint is measured by widely used dummy variables: i) Small, which equals one if book assets are below the median in a year and zero otherwise, ii) SAI, which equals one if a firm's size-and-age index (Hadlock and Pierce, 2010) is above the median in a year and zero otherwise, iii) WWI, which equals one if a firm's Whited and Wu index (Whited and Wu, 2006) is above the median in a year and zero otherwise, iv) Bond rating, which equals one if a firm does not have a rating and zero otherwise (Whited, 1992; Denis and Sibilkov, 2010), and v) Paper rating, which equals one if a firm does not have a commercial paper rating and zero otherwise (Almeida, Campello, and Weisbach, 2004). Ratings data is from Compustat. The event window is $[-2, +2]$. Firm and year fixed effects are included in all columns. t -statistics are based on firm-clustered standard errors and displayed in parentheses. Statistical significance at the 1%, 5% and 10% level is indicated by **a**, **b**, and **c**, respectively.

	(1)	(2)	(3)	(4)	(5)
	Cash	Cash	Cash	Cash	Cash
Treat \times Post	0.016 ^b	0.016 ^b	0.016 ^b	0.016 ^b	0.015 ^b
	(2.38)	(2.38)	(2.38)	(2.30)	(2.18)
Post	0.031 ^a	0.031 ^a	0.031 ^a	0.034 ^a	0.034 ^a
	(3.81)	(3.83)	(3.73)	(4.15)	(4.22)
Fin. constr. dummy	Small	SAI	WWI	Bond rating	Paper rating
Controls	All	All	All	All	All
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	2,531	2,531	2,531	2,215	2,196
Adjusted R^2	0.102	0.102	0.102	0.122	0.122

Table A5

Robustness tests using alternative matching variables: matching estimator for the DiD analysis based on the adoption of SEC Rule 10b-18 in 1982

This table reports the matching estimator for the DiD analysis based on the the adoption of SEC Rule 10b-18. The matching estimator estimates the average treatment effect on treated firms by comparing changes in Cash ratio (ΔCash , the year after minus the year before the event) of treated and control firms. The treated (control) firms are those with ILLIQ_res below (above) the bottom tercile in the year before the event, i.e. with relatively lower (higher) trading costs. Nearest-neighbor matching pairs the closest match by the Mahalanobis distance metric. The matching with replacement is across Cash flows, change in Net working capital, Capex, Acquisition, Net equity issuance, Net debt issuance, Firm size, Leverage, Firm age, and R&D in the year before the decimalization and a matched pair is required to be in the same industry (Fama-French 12). Robust heteroskedastic errors are allowed and bias is adjusted using the matching variables. Statistical significance at the 5% level is indicated by **b**.

ΔCash	Coef.	Std. err.	z	$P > z $	[95% Conf. Interval]	
Treatment	0.019 ^b	0.010	1.97	0.048	0.000	0.038

Table A6

Repurchases, stock liquidity, and market-to-book ratio (showing coefficients of control variables)

This table presents results from the following tobit model: $\text{Rep}_{i,t} = \beta_0 + \beta_1 \text{Liquidity}_{i,t-1} + \mathbf{\Gamma}' \mathbf{Z}_{i,t-1} + \varepsilon_{i,t}$, where Liquidity is ILLIQ_res, or Log_resprd_res, \mathbf{Z} is a vector of control variables, and $\mathbf{\Gamma}$ is a vector of coefficients. The lower bound of Rep is zero. Industry (Fama-French, 48 sectors) fixed effects and year fixed effects are controlled. The sample period is from 1972 (1994) to 2015 for tests using ILLIQ_res (Log_resprd_res). The label Low (High) MTB is for the sub-sample with MTB below (above) median in a year. *p-value* is for the equality test of the stock illiquidity coefficients in the two sub-samples. *t* (*z*)-statistics in parentheses are based on firm-clustered standard errors. Statistical significance at the 1%, 5% and 10% level is indicated by **a**, **b**, and **c**, respectively. A * indicates that coefficients are multiplied by 100.

<i>Tobit regressions</i>	Low MTB	High MTB	Low MTB	High MTB
	(1)	(2)	(3)	(4)
ILLIQ_res*	-0.027 ^a (-5.26)	-0.008 ^c (-1.89)		
Log_resprd_res			-0.014 ^a (-8.42)	-0.010 ^a (-8.87)
MTB	-0.010 ^b (-2.18)	-0.004 ^a (-8.30)	-0.007 ^c (-1.76)	-0.005 ^a (-9.08)
Free cash flow	0.148 ^a (11.96)	0.114 ^a (15.84)	0.100 ^a (8.82)	0.103 ^a (13.26)
ROE	0.009 ^a (4.02)	0.004 ^a (3.69)	0.005 ^b (2.50)	0.004 ^a (3.25)
Firm size	0.007 ^a (12.70)	0.007 ^a (18.48)	0.008 ^a (14.38)	0.008 ^a (21.32)
Leverage, industry adjusted	-0.070 ^a (-11.69)	-0.021 ^a (-3.99)	-0.051 ^a (-8.50)	-0.041 ^a (-6.51)
Non-operating profit	0.429 ^a (7.94)	0.391 ^a (9.89)	0.299 ^a (5.13)	0.347 ^a (7.60)
Stock return, market adjusted	0.005 ^a (3.16)	-0.006 ^a (-7.63)	0.003 ^c (1.92)	-0.005 ^a (-5.47)
Dividend	-0.000 (-0.02)	0.003 ^b (2.46)	0.001 (0.93)	0.001 (0.86)
<i>p-value</i>		0.00		0.01
<i>N</i>	31,044	30,257	17,267	16,936

References

- Abadie, A., Imbens, G.W., 2006. Large sample properties of matching estimators for average treatment effects. *Econometrica* 74, 235-267.
- Abadie, A., Imbens, G.W., 2011. Bias-corrected matching estimators for average treatment effects. *Journal of Business & Economic Statistics* 29, 1-11.
- Almeida, H., Campello, M., Weisbach, M.S., 2004. The cash flow sensitivity of cash. *Journal of Finance* 59, 1777-1804.
- Bates, T.W., Kahle, K.M., Stulz, R.M., 2009. Why do U.S. firms hold so much more cash than they used to? *Journal of Finance* 64, 1985-2021.
- Brown, C., Chen, Y., Shekhar, C., 2011. Institutional ownership and firm cash holdings. Unpublished working paper. Monash University.
- Brown, J.R., Petersen, B.C., 2011. Cash holdings and R&D smoothing. *Journal of Corporate Finance* 17, 694-709.
- Chang, C.H., 2012. Analysts and corporate liquidity policy. Unpublished working paper. Arizona State University.
- Denis, D.J., Sibilkov, V., 2010. Financial constraints, investment, and the value of cash holdings. *Review of Financial Studies* 23, 247-269.
- Hadlock, C.J., Pierce, J.R., 2010. New evidence on measuring financial constraints: moving beyond the KZ index. *Review of Financial Studies* 23, 1909-1940.
- Han, S., Qiu, J., 2007. Corporate precautionary cash holdings. *Journal of Corporate Finance* 13, 43-57.
- Hoberg, G., Phillips, G., Prabhala, N., 2014. Product market threats, payouts, and financial flexibility. *Journal of Finance* 69, 293-324.
- McLean, R.D., 2011. Share issuance and cash savings. *Journal of Financial Economics* 99, 693-715.
- Morellec, E., Nikolov, B., Zucchi, F., 2013. Competition, cash holdings, and financing decisions. Unpublished working paper. Swiss Finance Institute.
- Opler, T., Pinkowitz, L., Stulz, R.M., Williamson, R., 1999. The determinants and implications of corporate cash holdings. *Journal of Financial Economics* 52, 3-46.
- Riddick, L.A., Whited, T.M., 2009. The corporate propensity to save. *Journal of Finance* 64, 1729-1766.
- Whited, T.M., 1992. Debt, liquidity constraints, and corporate investment: evidence from

panel data. *Journal of Finance* 47, 1425-1460.

Whited, T.M., Wu, G., 2006. Financial constraints risk. *Review of Financial Studies* 19, 531-559.