경영학석사 학위논문

The Effect of Stock Liquidity on Corporate Cash Holdings

– Evidence from Korea –

주식유동성이 기업의 현금보유에 미치는 영향

–한국 시장에서의 실증 연구–

2022년 8월

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이 논문을 경영학석사 학위논문으로 제출함

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Abstract

The Effect of Stock Liquidity on Corporate Cash Holdings

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Firms hold cash for stock repurchases and higher stock liquidity strengthens this motive. Therefore, higher stock liquidity increases a firm's propensity to hold cash. Consistent with this, I find in the Korean stock market that firms with more liquid stocks increase cash holdings relatively more when restrictions to repurchases are eased. This is consistent evidence with the findings in the U.S. and is contrary to common view, in which the ease of financial constraints offered by stock liquidity is predicted to lower corporate cash holding.

Keyword : Stock liquidity, Repurchase, Cash holdings, Undervaluation

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Table of Contents

1. Introduction

A firm's cash ratio has been said to be affected by an abundance of factors in corporate literature. Those most commonly mentioned, however, have been corporate variables. A firm's stock and its characteristics had yet to be studied in relation with cash ratio. This was changed by Nyborg and Wang (2021), where the authors provided evidence that enhanced stock liquidity increases a firm's propensity to increase its cash holdings.

The authors attributed this finding to the repurchase motive, a new motive for cash holdings that projects firms take advantage of stock repurchases in times of high stock liquidity hold cash to do so. Thus, there exists a positive relation between a firm's stock liquidity and its cash holdings. This motive is contrary to the previously studied motives of cash holdings in firms: the precautionary motive and the agency motive.

The precautionary motive states that firms hold cash to hedge from the dangers of external capital expenditures (Opler et al., 1999). The agency motive states that the firms hold cash so that managers could use funds freely (Jensen and Meckling, 1976). The repurchase motive as proposed by Nyborg and Wang (2021) is different from the former traditional explanations as it relates to financial activity of firms, not their real investments. The former two explanations also necessitate that firms are likely to hold less cash when stocks are liquid, as financial constraints are less strict in times of high stock liquidity. The repurchase motive is fit to explain the actual positive relation between firms' cash holdings and their stock liquidity shown

in Nyborg and Wang (2021). In other words, the authors were able to provide evidence that the repurchase dominates the precautionary and agency motives, and thus leads to increased cash holdings firms during times of high stock liquidity.

The mechanism behind the repurchase motive is simple. Firms repurchase stocks with cash holdings (Dittmar, 2000). These repurchases are usually made in times of stock price undervaluation to take advantage of undervalued stock prices (Brav et al., 2005; Peyer and Vermaelen, 2009) or to match stock prices relative to their fundamentals (Hong et al., 2008). Firms with more liquid stocks are likely to repurchase more in both cases, as increased liquidity requires more cash to achieve either goal. As such, when firms have a motive to repurchase, higher liquidity will lead to higher cash holdings by firms.

Nyborg and Wang (2021) showed evidence of the positive relation between stock liquidity and corporate cash holdings as well as the existence of the repurchase motive in the US firms. I test the same theory in the Korean market.

Repurchase activity in the Korean market has yet to be extensively studied. Repurchase was first allowed for Korean firms in 1992, and the size of repurchases has been smaller compared to the U.S. market. However, the motivation for repurchases in Korean firms has been shown to share some similarities with U.S. firms as indicated by previous literature. Park et al. (2018) showed that managers try to time the market in repurchase activities in order to buy back shares when they are relatively undervalued. Kim et al. (2005) proposed undervaluation as a motive for firms to repurchase shares.

As such, I hypothesize that there will be a positive relation between a firm's stock

liquidity and its cash holdings, which is at least partially attributed to firms' repurchase activities. In order to test this theory, I primarily employ the methodology used by Nyborg and Wang (2021).

The first part of my analysis shows there is a positive relation between a firm's stock liquidity and its cash holdings and supports the main hypothesis that enhanced stock liquidity strengthens the propensity for firms to hold cash in Korea. In the second part of my analysis, I try to explain the former results using firms' repurchase activity. I use an event of external shock to repurchase activity in Korea to show that Korean firms with higher liquidity hold relatively more cash when there is an external pressure to repurchase stock. I perform a DiD regression around this event to show that firms with liquid stock indeed move to hold more cash than their less liquid counterparts in this event. This also acts to rule out endogeneity, as an external shock to repurchases causes an increase in the cash ratio.

I also study the repurchase motive further by looking at the relation between stock liquidity and stock repurchases. I use a tobit panel regression to look at whether this relationship is stronger for undervalued firms, proxied by firms with low market-to-book ratios(MTB). I find that firms with undervalued stock show a much stronger relation between stock liquidity and repurchases, signaling that firms with undervalued stocks engage in repurchases when liquidity is higher. Because higher liquidity causes repurchases by undervalued firms to be more profitable, this result lends support to this new motive for holding cash.

The rest of the paper is organized as follows: Section 2 describes the data and variables used and displays the basic statistics and correlations of the variables.

Section 3 contains the main analysis of the relation between cash holdings and stock liquidity, and then examines the possibility of the repurchase motive through a DiD regression regarding the 1994 Amendment to the Korean Securities and Exchange Act. I also examine undervaluation in this section to strengthen the robustness of the theory. Section 4 concludes.

2. Data and Summary Statistics

This section lists the data, variables, and their sources, as well as the basic statistics and correlation of the variables.

2.1 Data

Daily and monthly stock data and corporate data are collected from FN DataGuide. The sample period is 1992 to 2021, and includes all firms listed on the Korean Stock Exchange(KSE) and Kosdaq. From this sample, I only keep firm-year data with positive total assets, positive sales, and positive ratio of total debt to total assets.

I also remove firms in the finance sector (industry code K) and those with less than 100 trading days during a year for consistency. Following Acharya et al.(2007), I remove data with yearly asset or sales growth larger than 100% and those with market-to-book ratios larger than 10. With these restrictions, I am left with 26,801 total firm-year observations over the 30-year period. Some variables exist in shorter time periods, as explained in the next section.

Table 1
Variable descriptions
All variables are collected from FN DataGuide. Variables exist in varying time periods.

Variable	Description
Analyst coverage	Monthly average number of analyst coverage of a firm
Cash flow	[EBITDA-interest-taxes-dividends] divided by total assets
Capex	Capital expenditure divided by total assets
Cash ratio	Ratio of cash holdings to total assets
Dividend	Ratio of cash dividends to net income
Dividend dummy	Dummy equaling one if dividend is more than 0 in that year
Beta	12-month beta of a stock
Firm age	logarithm of one plus the number of months since the stock's IPO
Firm size	logarithm of total assets
Industry sigma	Industry mean of firm-level cash flow standard deviations for the past 10 years
ILLIQ	Amihud(2002)'s illiquidity measure, modified
IPO2-IPO5	Dummy equaling one if the number of years since a stock's IPO is 2 to 5 respectively and zero otherwise
Leverage	Ratio of total debt to total assets
MTB	[Total assets - book value of equity + market value of equity] divided by total assets
Net debt issuance	Annual total debt issuance divided by total assets
Net equity issuance	Annual total equity sales divided by total assets
Net working capital	Net working capital divided by total assets
R&D	Research and development expense divided by total assets
Rep	Ratio of repurchase value to market capitalization

2.2 Main Variables

The main dependent variable in this study is the Cash Ratio, defined by the total cash holdings of a company divided by its total assets in Korean won. This variable is available for the full sample period, and acts as the main dependent variable for most analyses of my study.

The independent variable of stock liquidity is represented by ILLIQ, a variable defined in Amihud (2002)'s paper. ILLIQ_Amihud is defined by the following equation:

$$ILLIQ\_Amihud_{i,t} = \frac{1}{N_{i,t}} \sum_{d=1}^{N_{i,t}} \frac{|r_{i,t,d}|}{DVol_{i,t,d}},$$

where $N_{i,t}$ is the number of trading days of stock i in year t, $r_{i,t,d}$ is the daily stock return on day d of year t, and $DVol_{i,t,d}$ is the corresponding dollar volume in one million US dollars. I modify the above equation to the following to adjust for data using Korean Won.

$$ILLIQ_{i,t} = \frac{1}{N_{i,t}} \sum_{d=1}^{N_{i,t}} \frac{|r_{i,t,d}|}{WVol_{i,t,d}}$$

Here, $WVol_{i,t,d}$ is the daily trading volume of stock *i* on day *d* of year *t* in one million Korean won. All other definitions are equal to the original ILLIQ_Amihud equation. Returns and volume data are collected from FN DataGuide. ILLIQ is available for the full sample period.

ILLIQ is highly negatively correlated with firm size(-0.34), which is also one of the key determinants of cash ratio. As such, I performed size orthogonalization on ILLIQ, using an OLS regression of the following equation:

$$ILLIQ_{i,t} = \gamma_0 + \gamma_1 Firm\ Size_{i,t} + \varepsilon_{i,t}$$

The residuals $\varepsilon_{i,t}$ from this estimation are denoted as ILLIQ_res, and are used

Table 2

Descriptive statistics.
This table displays the summary statistics of the main and control variables. The period column displays the years in which the variables were available. The Unit column shows the units used for the respective variables, where applicable. The last column displays the number of observations for each variable. All variables are in firm-years.

Name	Period	Unit	Mean	Median	Std. Dev.	Min.	Max.	N
Panel A: Main								
Cash ratio	'92-'21		0.08	0.06	0.08	0.00	0.43	26,801
	'00-'21		0.09	0.06	0.08	0.00	0.43	23,411
ILLIQ	'92-'21	million won	0.20	0.01	1.14	0.00	11.38	26,801
	'00-'21	million won	0.19	0.01	1.16	0.00	11.38	23,411
Panel B: Control								
Firm size	'94-'21	log(TA)	26.07	25.79	1.43	23.40	31.30	26,801
Leverage	'94-'21		0.45	0.45	0.21	0.01	0.99	26,801
MTB	'94-'21		1.31	0.92	1.25	0.03	9.98	26,801
Firm age	'94-'21	log(month)	6.05	6.12	0.51	3.50	7.31	26,801
Net working capital	'94-'21		0.12	0.10	0.14	-0.22	0.55	23,897
Dividend dummy	'94-'21		0.61	1.00	0.49	0.00	1.00	26,801
R&D	'94-'21		0.01	0.00	0.02	0.00	0.49	25,876
Capex	'94-'21		0.03	0.02	0.09	0.00	0.23	25,876
Cash flow	'94-'21		0.06	0.05	0.08	-1.40	0.85	26,801
Industry sigma	'94-'21		0.05	0.06	0.08	0.00	0.43	26,801
Equity beta	'94-'21		0.82	0.82	0.39	-1.45	2.52	26,701
IPO2	'94-'21		0.02	0.00	0.15	0.00	1.00	26,801
IPO3	'94-'21		0.05	0.00	0.22	0.00	1.00	26,801
IPO4	'94-'21		0.05	0.00	0.22	0.00	1.00	26,801
IPO5	'94-'21		0.05	0.00	0.21	0.00	1.00	26,801
Net equity issuance	'94-'21		0.01	0.00	0.04	-0.04	0.38	26,801
Net debt issuance	'94-'21		0.01	0.00	0.07	-0.26	0.32	26,801
Analyst coverage	'00-'21	log(coverage)	2.00	2.00	1.00	0.00	5.00	23,273

along with ILLIQ as the main liquidity variables in this study. The correlation between ILLIQ and ILLIQ_res is 0.77, suggesting that orthogonalization leaves the liquidity variable well-intact.

2.3 Control Variables

Following Opler et al. (1999), I use firm size, market-to-book ratio(MTB), firm leverage(total debt over total assets), net working capital, R&D expenditure, capital expenditure(Capex), cash flow, industry sigma, and a dividend dummy as controls for the cash ratio. All numeral control variables are scaled by the firm's total assets. Following Bates et al. (2009), I also control for net equity issuance, net debt issuance, and dummies for the number of years past IPO, specifically for years 2 to 5. Finally, I use analyst coverage information as control for a firm's cash ratio.

All variables excluding analyst coverage data is available for the entire sample period. Analyst coverage data is available from 2000.

2.4 Descriptive Statistics and Correlations

Table 2 displays the descriptive statistics of the main variables (Panel A) and the control variables (Panel B). The different time periods reflect the availability of the control variables. The average cash ratio is stable over time, while ILLIQ decreases significantly over time periods.

Table 3 displays the correlations of all variables. They are calculated pairwise for their respective interlapping periods. The control variables with the largest positive correlation with cash ratio are MTB(0.19), R&D(0.17), and Industry sigma(0.23).

Table 3
Correlation Matrix.
The table below shows the correlation matrix of all variables. The sample period is 1992 to 2021 for all variables excluding Analyst coverage(2000-2021). All variables are winsorized at the 1st and 99th percentiles.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) Cash ratio	1															
(2) ILLIQ	-0.05	1														
(3) Firm size	-0.16	-0.34	1													
(4) Leverage	-0.29	0.06	0.25	1												
(5) MTB	0.19	-0.08	-0.15	-0.01	1											
(6) Firm age	-0.27	0.06	0.26	0.21	-0.29	1										
(7) NWC	-0.09	0.04	-0.28	-0.05	-0.02	0.02	1									
(8) Div. Dummy	-0.03	-0.02	0.27	-0.21	-0.18	0.12	-0.03	1								
(9) R&D	0.17	-0.04	-0.13	-0.18	0.25	-0.27	0.07	-0.05	1							
(10) Capex	-0.08	-0.01	0.03	0.06	-0.01	-0.02	-0.04	-0.03	0.01	1						
(11) Cash flow	0.02	0.06	0.02	-0.08	0.02	0.07	0.10	0.30	-0.08	0.06	1					
(12) Ind. Sigma	0.23	0.03	-0.03	-0.09	0.27	0.00	-0.19	-0.16	0.22	-0.08	-0.15	1				
(13) Equity beta	0.08	-0.19	0.06	0.06	0.20	-0.16	0.03	-0.15	0.14	0.02	-0.06	0.02	1			
(14) NEI	0.08	-0.02	-0.12	0.01	0.15	-0.07	0.02	-0.2	0.03	0.00	-0.13	0.07	0.07	1		
(15) NDI	0.01	0.01	-0.01	0.15	0.07	-0.02	0.07	-0.04	0.00	0.11	-0.07	0.01	0.05	-0.01	1	
(16) Coverage	-0.05	-0.06	0.62	0.07	0.11	0.02	-0.15	0.19	0.01	0.04	0.19	0.09	0.11	-0.06	-0.02	1

The variables with the largest negative correlation to cash ratio are Leverage(-0.29), Firm age(-0.27), and Firm size(-0.16).

3. Main Results

This chapter observes the relation of the stock liquidity and corporate cash holdings and tries to explain it through firms' repurchase activities.

3.1 Liquidity and the Cash Ratio

In this subsection, I observe the relationship between a firm's cash ratio and its stock liquidity. I perform a panel regression using the below equation:

$$Cash\ ratio_{i,t} = \beta_0 + \beta_1 Liquidity_{i,t-1} + \Gamma Z_{i,t} + \varepsilon_{i,t},$$

where Liquidity is either ILLIQ or ILLIQ_res. Z is a vector of control variables and Γ is the vector of their regression coefficients.

3.1.1 Panel Regression

Table 4 shows the results of this regression. Panel regressions are performed in 3 periods, reflecting the availability of control variables. The full sample period(1992-2021) excludes the analyst coverage data(available from 2000). The shortest period, covering the year 2000 to 2021, represents the result with all control variables. Year fixed effects are included in all specifications, and industry and firm fixed effects are used interchangeably.

For all specifications of both liquidity variables, the coefficients are negative and

significant at the 5% level. Since the liquidity variables represent the level of illiquidity, the negative coefficients show that there is a positive relation between a firm's stock liquidity and its cash ratio in the following year. In other words, a firm with more liquid stocks in one year hold more cash in the following year. Evidence here shows that higher stock liquidity is associated with higher cash holdings in firms.

3.2 DiD Analysis of Repurchase Shock

In this subsection, I examine the mechanism behind the effect of liquidity on cash holdings. I try to explain the positive association of stock liquidity and cash examined in the previous section through the idea of share repurchasing. The main test of this idea is performed through a difference-in-difference analysis around the first allowance of repurchase activity for Korean firms in 1994. This is an exogenous shock to repurchase activity, and allows me to examine the change of cash holdings for firms around this shock to repurchases.

3.2.1 Stock repurchase regulation in Korea

Stock repurchases were initially banned in Korea for the reasons of the principal of equality among shareholders and risk of unfair trading. In 1992, the first repurchase activity in the form of repurchase funds(indirect purchase) was made possible. In 1994, the Korean Securities and Exchange Act was amended to allow for repurchases up to 5% of a firm's outstanding shares. This was later expanded to 10% in 1996 and unlimited in 1998.

This 1994 amendment gave firms rights to repurchase their own stock for the first time, and firms were quick to respond. In 1994, almost 14% of listed firms

Table 4

Panel regressions of Cash ratio on liquidity variables with controls over time periods. This table displays results from panel regression of the following equation: $Cash\ ratio_{i,t} = \beta_0 + \beta_1 Liquidity_{i,t-1} + \Gamma Z_{i,t} + \varepsilon_{i,t}$,where Liquidity is ILLIQ_res or ILLIQ. Z is a vector of control variables and Γ is a vector of their coefficients. The sample period is divided by the availability of control variables. Industry fixed effects and year fixed effects are used in columns 1 to 6. Firm fixed effects and year fixed effects are used in columns 7 and 8. All variables excluding dummies are winsorized at the 1st and 99th percentiles. t-statistics are based on firm-clustered standard errors and are displayed in parentheses. The significance of the coefficients at the 10%, 5%, and 1% levels are marked by ***, **, and * next to the coefficients respectively. A * in the variable names indicate that the coefficients are multiplied by 100 for clarity.

	1992-2021		2000-2021			
	(1)	(2)	(3)	(4)	(5)	(6)
ILLIQ_res*	-0.15***		-0.15***		-0.09**	
	(-3.73)		(-3.57)		(-2.48)	
ILLIQ*		-0.14***		-0.14***		-0.10**
		(-3.43)		(-3.32)		(-2.23)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	No	No
Firm fixed effects	No	No	No	No	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26,800	26,800	23,411	23,411	23,411	23,411
Adjusted R^2	0.239	0.238	0.242	0.242	0.567	0.544

repurchased stock, which increased to over 20% in 1995.

In this subsection, I will use the amendment event in 1994 as an exogenous shock to repurchase activity and examine whether the firms with more liquid stock increase cash holding relatively more after this event. From my hypothesis, I expect this to hold true, as liquid stocks would engage in relatively more repurchase activity with this shock.

3.2.2 Matching Procedure

The main idea of this procedure is to compare the effect of a repurchase allowance on treated firms to matched control firms. Treated firms are defined as those with the most liquid stocks in the year before the event. More specifically, the treatment group is consisted of all firms in the bottom tercile of ILLIQ_res in 1993. Control firms are matched with individual firms in the treatment group according to their Cash flow, Change in net working capital, Capex, Net equity issuance, and Net debt issuance. The matching process was carried out by the 'greedy nearest neighbor matching method'.

Table 5 shows the summary statistics of the matching variables of treated firms and matched controls in the pre-event year. Although the sample of firms in each group are small, the statistics of variables are largely similar. Figure 1 shows the average cash ratio of treated firms and control firms from the years around the 1994 event. The graph shows parallel movement until the event year, when the treated firms show increase in average cash ratio while the matched control firms show a decrease. This signals that the firms with more liquid stocks began to hold more cash after the event year as a way to repurchase more stocks. This gives strength to the repurchase motive and explains the positive association of cash and liquidity shown in the previous section.

3.2.3 Regression results

I perform DiD regressions on the treated and matched control firms in order to

Table 5

Descriptive statistics of treated firms and matched control firms
Summary statistics of treated firms and their matched controls are displayed below. The data used is those of firms one year before the event of the 1994 Amendment to the Korean Securities and Exchange Act. The variables of interest are factors known to impact cash ratio, used in the matching process.

Variables	Mean	Median	Std. Dev.	Min.	Max.	N
Panel A: Treated firms						
Cash flow	0.10	0.09	0.05	-0.01	0.29	90
Change in NWC	-0.01	0.00	0.06	-0.32	0.12	90
Capex	0.04	0.03	0.08	-0.15	0.40	90
Net equity issuance	0.02	0.00	0.05	-0.01	0.28	90
Net debt issuance	0.03	0.02	0.08	-0.13	0.23	90
Panel B: Matched controls						
Cash flow	0.10	0.09	0.06	-0.03	0.33	90
Change in NWC	-0.01	0.00	0.08	-0.54	0.18	90
Capex	0.04	0.03	0.08	-0.25	0.35	90
Net equity issuance	0.02	0.00	0.03	-0.01	0.23	90
Net debt issuance	0.03	0.02	0.08	-0.16	0.24	90

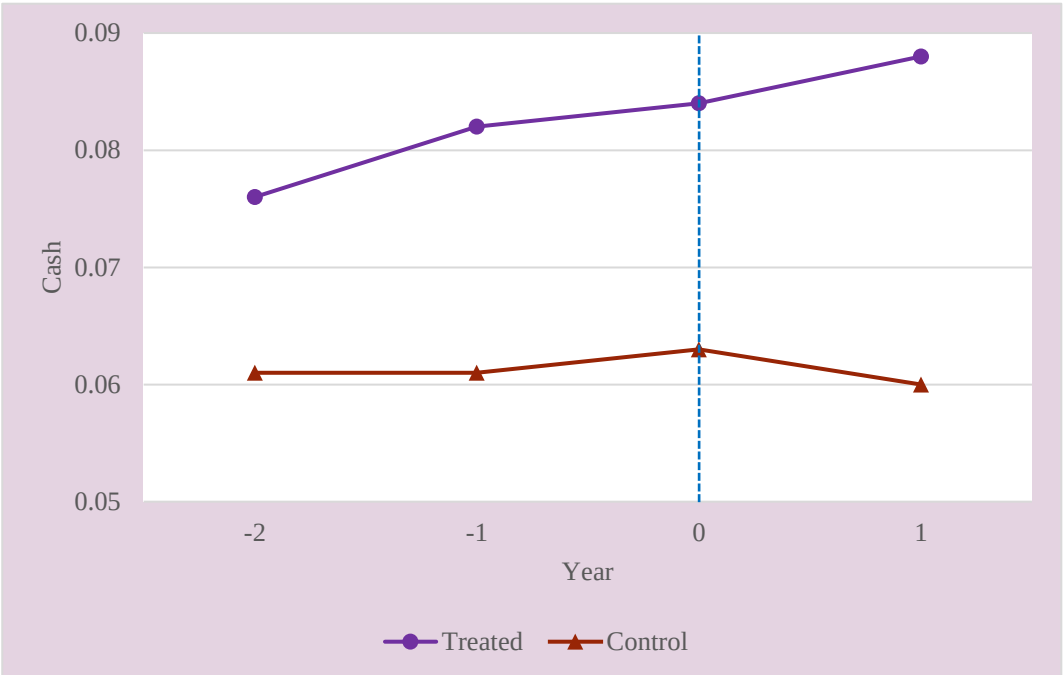
numerically examine the effect of the external shock to repurchases to firms' cash ratio. I use a regression approach to control for variables that can impact the cash ratio, which are the set of variables used in the matching process. The regression is performed with the below equation:

$$Cash\ ratio_{i,t} = \beta_0 + \beta_1 * Treat_i \times Post_t + \beta_2 * Post_t + \Gamma Z_{i,\tau(t)} + \varepsilon_{i,t},$$

where *i* denotes a firm and *t* denotes a year. $Post_t$ is an indicator variable, having a value of one for the year of the event and afterwards, and zero otherwise. *Z* is a set of control variables, and Γ is a vector of their coefficients.

Figure 1

Mean cash ratio, 1994 amendment to the Korean Securities and Exchange Act.
The figure shows the average cash ratio for treated firms and matched controls around the years of the Securities and Exchange Act amendment in 1994. Matched control firms are matched from nontreated firms within the same industry using the nearest neighbor matching method. Cash flow, change in net working capital, Capex, Net equity issuance, and Net debt issuance were used as matching variables. The years listed in the x-axis represent years relative to the event year, 1994.



The main event window is [-2, +2], and I show six versions of this calculation. The first does not include any controls. The second adds controls excluding the variables used in the matching process. The third and fourth versions show results with all controls, with the fourth including industry x year fixed effects. The fifth excludes the event year, and the last version is obtained using a [-3,3] event window.

Results are displayed in table 6. The DiD estimator is positive and statistically significant at the 5% level in all columns. This indicates that treated firms' cash ratio increased proportionately more after the event years compared to the matched

controls. The coefficient for ‘Post’ shows that the average cash ratio of all sample firms fell after the event year, albeit insignificantly. The results show that for firms with stock that were high in liquidity the past year, the cash ratio increased.

3.3 Repurchase and Undervaluation

In this subsection, I will further explore the relation between stock liquidity and repurchases using the undervaluation hypothesis. Many scholars, including Dittmar (2000) and Brav et al. (2005) have shown that firms tend to repurchase stocks when their shares are undervalued, as they are able to purchase more stocks at a cheaper price and earn a profit. This ‘undervaluation hypothesis’ has become consistently studied since, even yielding results in Korea as displayed in Kim (2005) and Lim et al. (2018).

Furthermore, liquidity adds to the firms’ profit, which is the main driver of the undervaluation hypothesis. When firms have more liquid stocks, it is easier for them repurchase more stocks easily, as liquidity enables them to buy much more stocks at a cheaper price. Illiquid stocks will deter firms from taking advantage of undervalued shares. Thus, if the repurchase motive is to hold true, we would likely see that there is a stronger correlation between repurchase activity and liquidity for stocks that are undervalued.

Based on such conjecture, I plan to see whether the relationship between stock liquidity and the amount of repurchases is stronger when the firm’s stock is undervalued. If there is a strong positive correlation between illiquidity and repurchases when there is undervaluation, it signals the fact that firms with undervalued stock are more likely to engage in repurchases when their stocks are

Table 6
Did regressions of the 1994 Securities and Exchange Act Amendment Event.
Results of the Did regressions using the amendment event of 1994 are displayed in the table. The equation is:
$Cash\ ratio_{i,t} = \beta_0 + \beta_1 * Treat_i \times Post_t + \beta_2 * Post_t + \Gamma Z_{i,\tau(t)} + \varepsilon_{i,t}$, where *i* denotes firm *i* and *t* denotes year *t*. The main event window is [-2,2]. The dummy variable treat equals one for treated firms and zero for matched controls. The dummy variable post equals one for data on or after the event year and zero otherwise. $Z_{i,\tau(t)}$ is a vector of control variables, where $\tau(t)$ equals t in years before the event and 1993(the year before the event) on the years on or after the event. Control variables included in column 2 are all control variables in table 1 excluding matching variables. Control variables used in columns 3-6 are all control variables listed in table 1. Industry fixed effects are included in all results. Year fixed effects are included in all results except column 4. Firm x year fixed effects are included in column 4. Column 5 shows results excluding the event year, and column 6 shows results with an extended window [-3,3].

	(1) Cash	(2) Cash	(3) Cash	(4) Cash	(5) Cash	(6) Cash
Treat x Post	0.026***	0.013**	0.015***	0.010**	0.019***	0.011**
	(4.60)	(2.45)	(2.78)	(1.99)	(3.05)	(2.41)
Post	-0.01	-0.01	-0.01	0.00	-0.01	0.00
	(-1.75)	(-1.14)	(-1.21)	(-0.82)	(-1.52)	(-0.10)
Controls	No	Partial	All	All	All	All
Year fixed effects	Yes	Yes	Yes	No	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm x Year fixed effects	No	No	No	Yes	No	No
Observations	780	776	776	776	604	983
Adjusted R^2	0.085	0.216	0.257	0.718	0.251	0.241

liquid, giving support to the repurchase motive. To see if this is true, I divided the sample firm-year data into high and low MTB based on medians of each year. Market-to-book ratio, or MTB, was used as a proxy for stock undervaluation. As *rep* is always larger than 0(bounded), I used a tobit regression on the two groups based on MTB levels. The equation used for this analysis is:

$$Rep_{i,t} = \beta_0 + \beta_1 * ILLIQ\_res_{i,t-1} + \Gamma Z_{i,t-1} + \varepsilon_{i,t},$$

Table 7
Repurchases and liquidity with undervaluation.
This table shows results from the following tobit model:
$Rep_{i,t} = \beta_0 + \beta_1 * ILLIQ\_res_{i,t-1} + \Gamma Z_{i,t-1} + \varepsilon_{i,t}$, where Z is a vector of control variables and Γ is a vector of their coefficients. The two columns below display the coefficients of the tobit regression. Low and high MTB groups are formed yearly based on yearly medians of market-to-book ratios(MTB). T values are based on firm-clustered standard errors and are displayed in parentheses. The significance of the coefficients at the 10%, 5%, and 1% levels are marked by ***, **, and * next to the coefficients respectively. A * in the variable name indicates that the coefficients were multiplied by 100.The p-value is from the equality test of the two coefficients from the two groups.

Tobit regressions	Low MTB		High MTB
	(1)		(2)
ILLIQ_res*	-0.0009***		0.00002
	(-5.89)		(0.26)
Controls	Yes		Yes
Equality test *p-value*		*0.000*	
N	13,534		12,711

where *i* denotes firm *i* and *t* denotes year *t.* Rep is the ratio of repurchase to market capitalization in the previous year. Z is the vector of control variables and includes firm size, MTB, stock returns, cash flow, and Return on Equity(ROE), leverage, and dividend following Dittmar(2000).

The results for the tobit regression can be found in Table7. While the coefficient for low MTB is negative and statistically significant, the coefficient for high MTB is positive. The p-value of the coefficient equality test is 0.000, signaling a significant different between them. This means that while firms with low MTB repurchase more stocks when the liquidity is higher, those with higher MTB do not do so. This is likely due to firms with low MTB, which are those with undervalued stocks, having more motivation to repurchase stocks while those without undervalued stocks not

necessarily engaging in repurchase activity, even when there is high liquidity. Thus, this result supports the repurchase motive my showing that stock liquidity has an effect on repurchase activity of firms that could gain more from repurchasing undervalued stock. When liquidity is higher, firms that can gain from repurchases engage in buybacks, and thus need to hold more cash.

This result also shows that the relationship between cash ratio and illiquidity shown in the previous section is likely to be attributed to activity by firms with undervalued stocks. The firms with undervalued stocks are shown to engage in repurchases when liquidity is high, while those without undervalued stocks are without such significant activity. As such, the repurchase motive is stronger for firms with undervalued stock.

5. Conclusion

The main point of this study is that increased stock liquidity has a positive effect on corporate cash holdings in Korean firms. This result is surprising because higher liquidity has traditionally has been thought reduce financial constraints in firms. With this reasoning, firms would need to hold less cash in times of higher stock liquidity. However, the empirical results show the opposite of these predictions.

There is robust evidence that there is a positive relation between stock liquidity and cash ratio. The evidence withstands firm, industry, and year controls as well as size orthogonalization. Endogeneity is addressed using matching and regression DiD of the exogenous shock to repurchases in 1994. In short, firms hold more cash when

stock liquidity is higher.

The second part of this paper dealt with the reasons behind this positive association. I test the Repurchase Motive proposed by Nyborg and Wang(2021) in Korean firms to see whether the positive relation may be caused by firms' repurchases increasing when liquidity is higher. Firms may engage in repurchase activity to take advantage of undervalued stock or to stabilize stock prices to their appropriate level. In either case, higher liquidity is likely to cause firms to repurchase more stocks. If the repurchase motive is true, firms are more likely to hold cash in order to repurchase stocks when liquidity is high. This may be the reason behind the positive correlation between cash and liquidity we observed in the earlier sections.

The evidence for the Repurchase Motive in Korean firms is strong. By examining the 1994 exogenous shock to repurchases, I was able to see that when firms experience this external shock, the more liquid firms increased their cash ratio compared to their matched counterparts. In other words, firms with more liquid stocks tended to increase their average cash holdings when there was a shock to repurchases compared to their matched controls. This strengthened the existence of the Repurchase Motive in Korean firms, as firms that have liquid stocks were seen to hold more cash when repurchases became mainstream.

From here, I also looked at the Undervaluation Theory and how it relates to the repurchase motive. With a tobit regression, I was able to see that firms with lower MTB showed a stronger association between liquidity and repurchases than those with higher MTB. In other words, firms with undervalued stocks tend to repurchase more stocks given the same level of liquidity, signaling that they are leading the

Repurchase Motive and its effects.

Although a large body of literature regarding liquidity and cash ratios independently exist in Korea, there has yet to be a study connecting these two variables. This paper is also the first in Korea to show evidence of a Repurchase Motive for cash holdings. As such, I believe there is much more room to be researched on the implications of this new motive for corporate cash holdings.

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국문초록

기업들은 자사주 매입을 위해 현금을 보유하고 있으며 주식 유동성이 높아지면 자사주 매입을 위한 동기가 강화된다. 이에 따라 주식 유동성이 높아지면 기업의 현금 보유 경향이 높아진다. 이와 일관되게 한국시장에서는 자사주 매입에 대한 규제가 완화되면 유동성이 높은 기업이 상대적으로 현금 보유를 더 많이 늘린다는 것이 나타난다. 이는 미국시장에서의 결과와 일관된 증거로 주식 유동성이 제공하는 금융제약 완화로 기업의 현금보유 필요성이 낮아질 것을 예측하는 일반적인 시각과 대치된다.

주요어 : 주식 유동성, 자사주 매입, 현금보유, 저평가

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