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Liquidity and dynamic leverage: the moderating impacts of leverage deviation and target instability

Ly Ho
University of Economics, The University of Da Nang, Da Nang, Vietnam

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Abstract

Purpose – We explore the impact of equity liquidity on a firm's dynamic leverage adjustments and the moderating impacts of leverage deviation and target instability on the link between equity liquidity and dynamic leverage in the UK market.

Design/methodology/approach – In applying the two-step system GMM, we estimate our model by exploring suitable instruments for the dynamic variable(s), i.e. lagged values of the dynamic term(s).

Findings – Our analyses document that a firm's equity liquidity has a positive impact on the speed of adjustment (SOA) of its leverage ratio back to the target ratio in the UK market. We also demonstrate that the positive relationship between liquidity and SOA is more pronounced for firms whose current position is relatively close to their target leverage ratio and whose target ratio is relatively stable.

Practical implications – This study provides important implications for both firms' managers and investors. Particularly, firms' managers who wish to increase the leverage SOA to enhance firms' value need to give great attention to their equity liquidity. Investors who want to evaluate firms' performance could also consider their equity liquidity and leverage SOA.

Originality/value – We are the first to enrich the literature on leverage adjustments by identifying equity liquidity as a new determinant of SOA in a single developed country with many differences in the structure and development of capital markets, ownership concentration and institutional characteristics. We also provide new empirical evidence of the joint effect of equity liquidity, leverage deviation and target instability on leverage SOA.

Keywords Equity liquidity, Leverage adjustment, Dynamic trade-off theory, Leverage deviation, Target leverage instability

Paper type Research paper

1. Introduction

The managerial decision on corporate capital structure is one of the most debated topics by modern finance scholars and practitioners around the world. While the static trade-off theory of capital structure suggests that the value of a firm can be maximized by targeting a leverage ratio that minimizes its cost of capital (Fischer *et al.*, 1989), more recently, dynamic trade-off models argue that firms have incentives to adjust their actual debt/equity ratio towards the optimal (target) ratio (Hovakimian and Li, 2011). However, if the adjustment is costly, then the speed of adjustment (hereafter SOA) tends to be slowed. Myers (1984) points out that where the costs of leverage adjustment are high, one might expect to see firms to deviate from their target debt-equity ratios by large amounts for extended periods. Hence, an essential task is to explain the cross-sectional differences in the dynamics of corporate capital structure decisions, rather than only concentrating on purifying the traditional static trade-off models

JEL Classification — C23, C51, G32, G33

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(Graham and Leary, 2011). In this paper, we investigate the impact of equity liquidity on leverage SOA in the UK equity market.

Previous literature provides evidence that firms with greater liquidity face lower transaction costs, lower levels of information asymmetry, stronger corporate governance, lower costs of issuing both debt and equity financing, and ultimately lower costs of adjustment to the target leverage (Berkman and Nguyen, 2010; Dang *et al.*, 2015). Stoll and Whaley (1983) and Amihud and Mendelson (1986) first suggest that illiquid firms have higher stock transaction costs, and thus a higher required rate of return from investors. Butler *et al.* (2005) show that investment banking fees are lower for more liquid firms. Hennessy and Whited (2005) confirm that firms with high liquidity are more likely to have lower transaction costs, and thus lower cost of equity. Cheung *et al.* (2019) indicate that firms with high liquidity not only have easier access to the equity market, but also have lower costs of debt financing. Hence, one might expect that equity liquidity would reduce the cost of leverage adjustment, resulting in a faster SOA.

Consistent with this argument, a recent study by Ho *et al.* (2021) investigates that firms with high liquidity have significantly higher leverage SOA. The results of this study are based on an international sample that mixes firms from developed and emerging markets. It is not obvious whether or not these results can be applied to a single country with differences in the structure and development of capital markets, ownership concentration, and the severe of information asymmetry. In particular, emerging countries have less developed capital market financing, less sophisticated bond markets, higher concentrated corporate ownership, and higher asymmetric information than developed markets, that significantly affect liquidity (Saleh *et al.*, 2020, 2022). These differences potentially enhance or moderate the role of liquidity in leverage SOA decisions. The differing market structure of the UK and other countries also leads to large differences in liquidity characteristics (Huang and Stoll, 2001). For these reasons, it is not clear whether the results based on international studies can be readily applied to firms in a single country. Furthermore, the UK is considered a major worldwide economic market. It is large and has grown rapidly in recent years (IMF, 2011). The London Stock Exchange has a huge daily volume of transactions, competing with the major US stock exchanges, such as the NYSE and NASDAQ (Charitou *et al.*, 2004). The UK provides a financial environment "ideal" for the examination of issues of equity liquidity and corporate capital structure decision-making. Therefore, in this study, we take a step in this direction by investigating the impact of liquidity on leverage SOA in the UK.

The findings of our study contribute to corporate finance literature. First, while a prior study has documented the impact of equity liquidity on firms' leverage SOA using international data that mixes firms from countries with different market structures, market development, and national institutions (Ho *et al.*, 2021), we focus on a single country that is one of the most developed economies outside the US, that is the UK While the UK has a developed capital market that pronounces the positive impact of liquidity on leverage SOA, it has a low-leverage policy that may moderate this relationship. The UK also has good institutional characteristics with better governance that may reduce the role of firm-level determinants of SOA including liquidity. Corporate ownership is much less concentrated in the UK than in emerging markets that also have significant impact on liquidity (Heflin and Shaw, 2000; Rubin, 2007). For these reasons, it is not clear whether or not the results of an international study can be applied to a single country such as the UK.

Second, our study sheds new light on the literature to explain firms' financial policy and provides the first evidence on the association between equity liquidity and firms' capital structure adjustment in the UK market. Although several studies have examined the capital structure choices of UK firms, for example, Bevan and Danbolt (2002, 2004) suggest the determinants of capital structures, Dang (2013) examine the zero-leverage phenomenon, Ezeani *et al.* (2023) suggest the association between corporate board and capital structure, they do not investigate the association between liquidity and dynamic capital structure. Our study thus fills this important gap in the literature by examining the important role of equity liquidity in dynamic leverage adjustments in the UK.

Third, our study contributes to the empirical literature on the joint relationship among equity liquidity, leverage deviation, target stability and leverage SOA. Prior literature suggests that firms with greater leverage deviation or target instability confront higher financial risks, pay even higher costs of equity and have low equity liquidity (Ippolito *et al.*, 2012; Zhou *et al.*, 2016), while equity liquidity has been documented to have impacts on leverage adjustments. Given that there is evidence that equity liquidity, leverage deviation, target stability and leverage adjustments are associated, how the first three factors jointly influence leverage adjustments is still unexplored. Our study unveils this gap.

The paper proceeds as follows. Section 2 provides the literature and hypotheses development. Section 3 describes the sample, data collection and variable construction. The empirical methods are reported in Section 4 and the results are presented in Section 5. The study is concluded in Section 6.

2. Literature review and hypotheses development

Previous literature has shown the important role of liquidity in making corporate finance decisions. For example, the prior studies examine the impacts of stock liquidity on firm value (Batten and Vo, 2019; Pham *et al.*, 2020) and various corporate policies, such as innovation (Fang *et al.*, 2014), payout policy (Jiang *et al.*, 2017; Nguyen, 2020), stock repurchase (Brockman *et al.*, 2008), trade credit (Shang, 2020), risk-taking (Hsu *et al.*, 2020) and corporate governance (Edmans *et al.*, 2013).

Meanwhile, there has been a stream of literature that documents the role of equity liquidity in firms' capital structure decisions. Brennan and Subrahmanyam (1996) and Brennan *et al.* (1998) provide important evidence of the negative relationship between equity liquidity and the cost of capital, that is, higher equity liquidity means lower cost of capital. Market microstructure literature shows that stock liquidity can alleviate agency problems (Edmans *et al.*, 2013) and information asymmetry (Subrahmanyam and Titman, 2001). Companies with high stock liquidity would have better credit ratings and lower credit risk compared to illiquid firms (Brogaard *et al.*, 2017). Cheung *et al.* (2019) further highlight that more liquid firms are more likely to access debt financing and have lower debt costs compared to their counterparties. In sum, firms with higher liquidity have lower capital costs and are easier to access external financing sources.

Liquidity can also influence the transaction costs associated with raising new external equity capital. First, an illiquid firm has to offer a discount on the current share price to attract the capital that it requires. This discount is reflected by the magnitude of the bid-ask spread and price impact of issuing new equity (Bundgaard and Ahm, 2012). Thereby, illiquid stocks tend to be traded at a discount. Second, when a firm raises new equity capital, it incurs the issuance fees that an issuer will have to pay institutions that assist it in the fund-raising process (Butler *et al.*, 2005). The bottom line is that firms with higher equity liquidity will have lower transaction costs associated with issuing new equity and thus have greater incentives to rapidly correct any deviation of their actual leverage level from their target.

In addition, information is likely to be another important channel between equity liquidity and leverage SOA. This argument suggests that greater liquidity facilitates more informed trading and produces more information about the firm (Friewald *et al.*, 2016; Fulghieri and Lukin, 2001). Consequently, stock liquidity helps to reduce adverse selection and equity mispricing, thus lowering the agency costs, and thereby, reducing leverage adjustment costs and increasing the speed of leverage adjustment (Öztekin, 2015; Öztekin and Flannery, 2012).

We propose the first hypothesis as follows:

H1. Equity liquidity has a positive impact on leverage SOA.

It is argued that due to the far deviation from or high instability of its target leverage ratio, it is possible that a firm should pay a penalty in the form of higher cost of equity capital. Specifically, a firm with higher deviation from or higher instability in its target level will confront higher financial risks, which influence the required rate of return on corporate equity capital, and hence, leave greater costs of equity capital and lower equity liquidity for the firm. Consistent with this argument, Zhou *et al.* (2016) derive a theoretical link between leverage deviation and costs of equity and confirm that the firm's cost of equity positively relates to the deviation from its target level of leverage. Ippolito *et al.* (2012) also suggest a significantly positive association between the deviation from target and the expected equity return (then, cost of equity capital). Investors require a higher expected equity return for firms that deviate further from the target leverage. These firms consequently confront greater cost of equity that leads to lower equity liquidity. Accordingly, the question that we raise here is whether the magnitude of the positive relationship between equity liquidity and leverage SOA will be impacted by the extent of the deviation between the actual and the target ratios and/or the stability of the target ratios of firms.

Building on the above discussion, we investigate the following hypotheses:

H2. The positive impact of equity liquidity on leverage SOA is less pronounced for firms that deviate further from target ratios.

H3. The positive impact of equity liquidity on leverage SOA is less pronounced for firms that have higher instability in target ratios.

3. Data and variable construction

3.1 Data

The annual firm-level and industry-level accounting data are retrieved from World scope via the Datastream database. To estimate liquidity measures, we collect daily data (e.g. bid/ask price, trading volume and stock return) from this database. Only data for firms with common securities are collected, whereas those with distinct characters, for instance warrants, trusts, funds, and non-equity stocks, are excluded. Financial and utility corporations are also eliminated from the sample since these corporations are subject to special regulations on financing policies. The final sample contains 20,090 firm-year observations for the UK market during the period from 1996 to 2016. Finally, to reduce the possible impacts of extreme values, we minorized both the dependent and independent variables at the 1st and 99th percentiles.

3.2 Variable construction

3.2.1 Leverage measurements. Based on existing studies (An *et al.*, 2015; Halling *et al.*, 2016), we use both the book ratio ($BLEV$) and the market ratio ($MLEV$) of leverage as dependent variables.

3.2.2 Equity liquidity. In the main analysis, we use the Amihud illiquidity score, which is the most popular measure of liquidity (Nadarajah *et al.*, 2018). Specifically, the Amihud (2002) illiquidity measure is defined as the average ratio of the daily absolute stock return divided by the dollar value of volume:

$$LIQ_{i,t,d} = \frac{|R_{i,t,d}|}{DVOL_{i,t,d}} \quad (1)$$

where R_{itd} is the stock return of firm i on day d in year t, $DVOL_{itd}$ is the daily volume in dollars of firm i on day d in year t.

In this study, we use the annual average of this daily liquidity measure for each stock i:

$$LIQ_{i,t} = 1 \Big/ D_{i,t} \sum_{1}^{D_{i,t}} \frac{|R_{i,t,d}|}{DVOL_{i,t,d}} \tag{2}$$

where $D_{i,t}$ is the number of days for which the volume of stock i in year t is positive:

We also employ other three measures of liquidity including zero-return proportion ($Propzero_{i,t}$) (Goyenko *et al.*, 2009), daily closing percent quoted spread ($Spread_{i,t}$) (Fong *et al.*, 2017), and turnover ($Turnover_{i,t}$) (Berkman and Nguyen, 2010) [1].

3.2.3 Target leverage. The current literature on capital structure suggests that the target level of a firm's leverage is a function of time-varying firm characteristics and industrial elements (An *et al.*, 2015; Devos *et al.*, 2017):

$$LEV_{i,t+1} = \alpha_i + \beta X_{i,t} + \mu_{i+1}, LEV \in \{BLEV, MLEV\} \tag{3}$$

where each firm is indexed by i and time by t. $X_{i,t}$ is a vector of firm and industry variables associated with the operation costs and benefits with different leverage levels including SIZE, TANG, MTB, PROF, DEP, RD, RDDum, and INDMED [2]. The trade-off hypothesis predicts that $\beta \neq 0$, and the variation in $LEV_{i,t+1}$ is nontrivial. We also note that by modeling optimal capital structure in period t+1 as a function of determinants observed in period t, then the endogeneity concerns are somewhat mitigated.

We measure the target leverage ratio of each firm as the fitted value obtained from Equation (3):

$$LEV^*_{i,t+1} = \widehat{\beta^\wedge} X_{i,t} \tag{4}$$

3.2.4 Leverage deviation. The deviation from the target level is measured as the absolute difference between the target and the observed leverage ratio:

$$Lev\_Dev_{i,t} = \left| LEV^*_{i,t} - LEV_{i,t} \right| \tag{5}$$

where $LEV^*_{i,t}$ is the target leverage ratio defined above and $LEV_{i,t}$ is the observed leverage ratio of firm i at time t.

3.2.5 Target instability. Based on Kayhan and Titman (2007), the instability in the target ratio of leverage is measured as

$$\Delta Target_{i,t} = LEV^*_{i,t} - LEV^*_{i,t-1} \tag{6}$$

where $LEV^*_{i,t}$ and $LEV^*_{i,t-1}$ are the target leverage ratios of firm i at time t and t-1, respectively. The higher level of $\Delta Target_{i,t}$ is, the more unstable the target leverage is.

4. Empirical methods

The standard partial adjustment model measures the rate at which the firm converges its leverage to the target ratio:

$$LEV_{i,t+1} - LEV_{i,t} = \alpha_0 + \partial\left(LEV^*_{i,t+1} - LEV_{i,t}\right) + \omega_{i,t+1} \tag{7}$$

where ∂ is a measure of aggregate leverage SOA of firms that diverge away from the target of next period. The target leverage estimated from Equation (4) is substituted into Equation (7) and rearranged to yield the model as follows:

$$LEV_{i,t+1} = \alpha_0 + (1 - \partial)LEV_{i,t} + \partial\beta X_{i,t} + \omega_{i,t+1} \quad (8)$$

We follow previous literature (e.g. Devos *et al.*, 2017; Zhou *et al.*, 2016) and augment Equation (8) with an equity liquidity variable ($LIQ_{i,t}$) and an interaction term to test the significance of $LIQ_{i,t}$ on the leverage SOA (H1). In particular, $LIQ_{i,t}$ is proxied by Amihud illiquidity measure. The interaction term is the product of $LIQ_{i,t}$ and the first lag of the firm's actual leverage ratio. We model this economic relation as follows:

$$LEV_{i,t+1} = \alpha_0 + (1 - \partial)LEV_{i,t} + \beta_1 LIQ_{i,t} + \beta_2 \left(LIQ_{i,t}\, x\, LEV_{i,t}\right) + \partial\beta X_{i,t} + \omega_{i,t+1} \quad (9)$$

In Equation (9), our main focus is the coefficient of the interaction term $LIQ_{i,t}\, x\, LEV_{i,t}$. Since we hypothesize that equity liquidity has a positive impact on the SOA (H1), and the variable $LIQ_{i,t}$ is proxied by the Amihud illiquidity measure, we expect the coefficient on the interaction term, β_2, to be positive [3]. This implies that the coefficient on the lagged leverage is smaller for firms with higher equity liquidity and hence, they exhibit a faster SOA (∂).

Our next hypotheses (H2 and H3) relate to how the relationship between equity liquidity and SOA is conditional on leverage deviation and target stability. To examine this issue, following Devos *et al.* (2017), we include the triple interaction terms among equity liquidity, actual leverage ratio and leverage deviation/target stability in the SOA regression (Equation (9)). Specifically, the augmented models take the following forms:

$$\begin{aligned} LEV_{i,t+1} = {} & \alpha_0 + (1 - \partial_0)LEV_{i,j,t} + \beta_1 LIQ_{i,j,t} + \beta_2\left(LIQ_{i,t}\, x\, LEV_{i,t}\right) + \beta_3 LevDev_{i,t} \\ & + \beta_4\left(LIQ_{i,t}\, x\, LevDev_{i,t}\right) + \beta_5(LevDev_{i,t}\, x\, LEV_{i,t}) \\ & + \beta_6\left(LIQ_{i,t}\, x\, LEV_{i,t}\, x\, LevDev_{i,t}\right) + \partial_j\beta X_{i,t} + \omega_{i,t+1} \end{aligned} \quad (10)$$

$$\begin{aligned} LEV_{i,t+1} = {} & \alpha_0 + (1 - \partial_0)LEV_{i,j,t} + \beta_1 LIQ_{i,j,t} + \beta_2\left(LIQ_{i,t}\, x\, LEV_{i,t}\right) + \beta_3 \Delta Target_{i,t} \\ & + \beta_4\left(LIQ_{i,t}\, x\, \Delta Target_{i,t}\right) + \beta_5\left(\Delta Target_{i,t}\, x\, LEV_{i,t}\right) \\ & + \beta_6\left(LIQ_{i,t}\, x\, LEV_{i,t}\, x\, \Delta Target_{i,t}\right) + \partial_j\beta X_{i,t} + \omega_{i,t+1} \end{aligned} \quad (11)$$

$$\begin{aligned} LEV_{i,t+1} = {} & \alpha_0 + (1 - \partial_0)LEV_{i,j,t} + \beta_1 LIQ_{i,j,t} + \beta_2\left(LIQ_{i,t}\, x\, LEV_{i,t}\right) + \beta_3 LevDev_{i,t} \\ & + \beta_4\left(LIQ_{i,t}\, x\, LevDev_{i,t}\right) + \beta_5(LevDev_{i,t}\, x\, LEV_{i,t}) \\ & + \beta_6\left(LIQ_{i,t}\, x\, LEV_{i,t}\, x\, LevDev_{i,t}\right) + \beta_7 \Delta Target_{i,t} + \beta_8\left(LIQ_{i,t}\, x\, \Delta Target_{i,t}\right) \\ & + \beta_9\left(\Delta Target_{i,t}\, x\, LEV_{i,t}\right) + \beta_{10}\left(LIQ_{i,t}\, x\, LEV_{i,t}\, x\, \Delta Target_{i,t}\right) + \partial_j\beta X_{i,t} + \omega_{i,t+1} \end{aligned} \quad (12)$$

where Equation (10) is used to examine the hypothesis H2, Equation (11) is used to examine the hypothesis H3, and Equation (12) is the combination of both hypotheses.

We propose that firms with greater leverage deviation and/or target instability would have higher financial risks and pay penalties in the form of higher costs of equity capital and thus have lower equity liquidity. Hence, we might expect a positive sign on the interaction term $LIQ_{i,t}\, x\, LEV_{i,t}$ and negative signs on the triple interaction terms $LIQ_{i,t}\, x\, LEV_{i,t}\, x\, LevDev_{i,t}$ and $LIQ_{i,t}\, x\, LEV_{i,t}\, x\, \Delta Target_{i,t}$. We use leverage deviation and target instability as dummy variables by assigning "1" for high leverage deviation (high target instability), and "0" for low leverage deviation (low target instability) based on the median value. To further confirm the results, we also examine these relationships for over- and under-levered firms by re-estimating Equation (12) for the two sub-samples.

4.1 Econometric method

Since all the main specifications in this paper are dynamic panel data models, traditional pooled OLS or firm fixed effects estimators would result in biased and inconsistent estimates (Baltagi and Baltagi, 2008). Specifically, whereas the pooled OLS estimator is likely to overestimate the coefficient of the dynamic variable $(1-\partial)$ and thus underestimating the level of SOA (∂), the firm fixed effects model underestimates the coefficient of the dynamic variable, hence, overestimates the SOA (Nickell, 1981). The inconsistence is more likely to occur in the case of relatively short period of sample data (Flannery and Hankins, 2013).

Due to the limitations of the pooled OLS and firm fixed effects models and the dynamic nature of our panel models, we follow the recent research and use Blundell and Bond (1998)'s two-step system GMM. This is the most reliable method to estimate the dynamic short panels with the lagged-dependent variable and endogenous independent variables (Zhou *et al.*, 2016). In applying the two-step system GMM, we estimate our model by exploring suitable instruments for the dynamic variable(s) (e.g. leverage ratios, interaction terms between leverage ratios and main variables), i.e., lagged values of the dynamic term(s).

5. Empirical results

5.1 Descriptive statistics

The summary statistics for the entire sample are presented in Table 1, which includes descriptive statistics (Panel A) and correlation coefficients of the determinants of the target leverage (Panel B). In our sample, the mean book leverage ratio is 0.1793, and the mean market leverage is 0.1981. The extent of the cross-sectional variation is illustrated by the difference between the first quartile of the book (market) leverage ratio of 0.0211 (0.0138) and the third quartile at 0.2805 (0.3099). In terms of the liquidity measure, the means of Amihud, zero-return day's proportion, turnover and daily quoted spread measures are 23.1187, 0.3495, 0.2820 and 0.0531, respectively. The mean book leverage deviation (0.1102) is lower than the mean market leverage deviation (0.1349). On average, the absolute change in target market leverage (0.0085) is higher than that in target book leverage (0.0031). In our sample, the average value of asset tangibility-total assets ratio is 27.35%, market-to-book ratio is 2.528, profitability-total assets ratio is 6.55%, depreciation-total assets ratio is 4.57% and R&D-total assets ratio is 2.22%. Panel B reports the correlations among the determinants of the target leverage ratio. We see that these correlations are low, suggesting that there is little concern with multicollinearity.

5.2 Equity liquidity and SOA: baseline results

We present the results from the baseline regression (Equation 9), which determines the equity liquidity – SOA relationship (H1), in Table 2. All these regressions were estimated using the two-step system GMM method. The results are presented for both $BLEV_{i,t}$ and $MLEV_{i,t}$ separately. The variables of interest in this regression are the interaction terms between $LEV_{i,t}$ and $LIQ_{i,t}$ (Columns 1–2).

The coefficient on $LIQ_{i,t}{*}LEV_{i,t}$ are positive and highly significant at the 1% level for both book and market leverage regressions. This suggests that firms with high (low) liquidity have lower (higher) overall adjustment costs, which results in higher (lower) SOA. Regarding the economic significance, a standard deviation increase of one in liquidity increases the SOA by 1.18–4.11%, compared with an average adjustment speed of 24.1% for book leverage and 17.9% for market leverage [4]. In other words, an average firm takes about 2.5–3.5 years to adjust half of the deviation between the actual and the target leverage. This duration decreases to about 2–3 years for firms with high liquidity [5]. In general, the results support our first hypothesis that liquidity boosts the leverage SOA. Firms with high liquidity are charged lower transaction costs in issuing financial capital and have lower asymmetric

Table 1. Summary statistics

Panel A. Descriptive statistics

Variables	N	Mean	Std. Dev	Min	Max	p25	Median	p75
BLEV	20,090	0.1793	0.1725	0.0000	0.7615	0.0211	0.1472	0.2805
MLEV	20,090	0.1981	0.2085	0.0000	0.8648	0.0138	0.1405	0.3099
Amihud	18,132	23.1187	58.7806	0.0010	407.2400	0.3287	3.3604	16.1732
PropZero	18,780	0.3495	0.3594	0.0040	2.5000	0.0711	0.3320	0.4941
Turnover	18,102	0.2820	0.2799	0.0115	1.7022	0.1094	0.1998	0.3490
Spread	19,957	0.0531	0.0565	0.0006	0.3036	0.0157	0.0361	0.0698
LevDev (BLEV)	16,545	0.1102	0.0894	0.0000	0.7024	0.0489	0.0947	0.1444
LevDev (MLEV)	16,545	0.1349	0.1151	0.0000	0.8283	0.0550	0.1075	0.1765
ΔTarget (BLEV)	13,825	0.0031	0.0288	−0.2119	0.3128	−0.0109	0.0029	0.0165
ΔTarget (MLEV)	13,825	0.0085	0.0513	−0.3079	0.3178	−0.0220	0.0068	0.0355
SIZE	20,090	11.4956	1.8997	8.7321	17.0757	10.0095	11.1488	12.6488
TANG	20,023	0.2735	0.2558	0.0004	0.9385	0.0566	0.1981	0.4227
MTB	19,967	2.5282	2.3529	0.3000	9.5700	0.9600	1.7100	3.1300
PROF	19,849	0.0655	0.1904	−0.8162	0.4525	0.0209	0.0995	0.1638
DEP	20,015	0.0457	0.0435	0.0001	0.3004	0.0202	0.0367	0.0572
RD	20,090	0.0222	0.0786	−0.0084	2.9404	0.0000	0.0000	0.0059
RDDum	20,090	0.3142	0.4642	0.0000	1.0000	0.0000	0.0000	1.0000
INDMED (BLEV)	20,090	0.1529	0.1381	0.0000	0.7308	0.0441	0.1260	0.2251
INDMED (MLEV)	20,090	0.1570	0.1540	0.0000	0.6875	0.0266	0.1167	0.2395

Panel B. Correlation coefficients of determinants of target leverage

	SIZE	*TANG*	*MTB*	*PROF*	*DEP*	*RD*	*RDDum*	*INDMED (BLEV)*	*INDMED (MLEV)*
SIZE	1								
TANG	0.1598*	1							
MTB	0.0138	−0.0889*	1						
PROF	0.2488*	0.1555*	0.0996*	1					
DEP	−0.0787*	0.2097*	0.1685*	0.0725*	1				
RD	−0.1411*	−0.1340*	0.1800*	−0.2602*	0.1121*	1			
RDDum	0.0470*	−0.1879*	0.1049*	−0.0563*	0.0603*	0.4170*	1		
INDMED (BLEV)	0.1866*	0.3139*	0.0702*	0.1568*	0.2296*	−0.1077*	−0.1175*	1	
INDMED (MLEV)	0.2143*	0.2617*	−0.2073*	0.0572*	−0.0013	−0.1850*	−0.1450*	0.7143*	1

Note(s): This table reports the descriptive statistics including the mean, standard deviation, minimum, maximum, first quantile, median, and third quantile of firm-level and industry-level variables for the entire sample in Panel A, and correlation coefficients in Panel B. The study period is from 1996 to 2016. The variable definitions are in Appendix
Source(s): The table is created by authors

Variable	$BLEV_{t+1}$ (1)	$MLEV_{t+1}$ (2)
LEV	0.6460***	0.8330***
	(0.000)	(0.000)
LIQ	−0.0001***	−0.0001***
	(−0.000)	(−0.000)
LIQ × *LEV*	*0.0007****	*0.0002****
	(0.000)	*(0.001)*
SIZE	0.0051***	0.0004
	(0.000)	(0.525)
TANG	0.0618***	0.0864***
	(0.000)	(0.000)
MTB	0.0031***	0.0049***
	(0.000)	(0.000)
PROF	0.0358***	0.0327***
	(0.000)	(0.000)
DEP	0.2140***	−0.0422
	(0.000)	(0.366)
RD	−0.0112	−0.0667***
	(0.621)	(0.000)
RDDUM	−0.0051*	−0.0077***
	(0.061)	(0.001)
INDMED	0.0662***	−0.0818***
	(5.456)	(0.000)
Constant	−0.0308***	0.0843***
	(0.004)	(0.000)
Year FE	Yes	Yes
Observations	14,925	14,925
Number of id	2,260	2,260
AR(2)	0.4406	0.6778
p-value Hansen test	0.3796	0.3121

Note(s): This table reports the regression results for the effect of liquidity on the speed of adjustment using the two-step system GMM estimator for the baseline model. The variable definitions are contained in Appendix. ***, **, * indicate significance at the 1, 5, and 10% levels, respectively. The *p*-values are in parenthesis
Source(s): The table is created by authors

Table 2. Effects of liquidity on the speed of leverage adjustment – baseline results

information that leads to lower agency costs. Consequently, such firms have a higher leverage SOA. This result is consistent with Öztekin (2015), Cheung *et al.* (2019) and Ho *et al.* (2021) suggesting that stock liquidity helps firms to reduce transaction costs, lower agency costs, easier access to external financing sources and thereby, reduce leverage adjustment costs and increase the speed of leverage adjustment.

We also present results of two diagnostic tests, including the AR(2) second-order serial correlation test and the Hansen J test of over-identifying restriction. Specifically, AR(2) tests show the *p*-values of 0.4406 and 0.6778 for the book and market leverage regressions, respectively. These results imply that our system GMM specifications do not suffer from the second-order serial correlation. Further, the *p*-values of Hansen J tests of 0.3796 and 0.3121 for book and market leverage regressions, respectively, confirm the validity of all our instruments. In sum, the results of these specifications imply that the dynamic system GMM model specification is appropriate [6].

5.3 Robustness checks

5.3.1 Two-step approach. In baseline regression, following previous literature (Devos *et al.*, 2017; Zhou *et al.*, 2016), we use an interaction term between liquidity and leverage ratio to test the significance of liquidity on SOA. However, given that both liquidity and the first lag of the firm's actual leverage ratio have highly significant impacts on the leverage ratio, this method may not fully assess whether including the interaction variable improves the model. In this session, we check the robustness of our baseline results using the two-step approach (Çolak *et al.*, 2018; Dang *et al.*, 2019).

To examine the relationship between liquidity and leverage SOA, we include liquidity in the regression which determines a firm's SOA. Öztekin and Flannery (2012) also suggest that firm accounting variables may affect both target leverage and SOA. We use a set of covariates that are used in the target leverage estimation (vector $X_{i,t,j}$). Thus, ∂ varies with liquidity and control variables:

$$\partial = \partial_0 + \beta_1 LIQ_{i,t,j} + \Theta X_{i,t,j} \tag{13}$$

Substituting Equation (13) back to Equation (7) yields the equation for a partial adjustment model with heterogeneity in the leverage SOA:

$$\Delta LEV_{i,t+1,j} = \alpha_0 + \left(\partial_0 + \beta_1 LIQ_{i,t,j} + \Theta X_{i,t,j}\right)\left(Dist_{i,t,j}\right) + \omega_{i,t+1,j} \tag{14}$$

where $\Delta LEV_{i,t+1,j} = LEV_{i,t+1,j} - LEV_{i,t,j}$.

Equation (14) includes a pooled OLS regression of leverage changes on the product of $Dist_{i,t,j}$ and liquidity and control variables with bootstrapped standard errors to account for the generated regressors (Çolak *et al.*, 2018; Faulkender *et al.*, 2012; Pagan, 1984).

Table 3 reports the results. The coefficients of interaction between liquidity and distance from the target are positive and statistically significant across models, implying a positive relationship between liquidity and leverage SOA. This is consistent with our baseline findings.

5.3.2 Alternative measures of leverage. We test the robustness of our key findings by including two other definitions of corporate leverage ratio: long-term debt to the book value of assets (LDA) and long-term debt to market value of assets (LDM) (Devos *et al.*, 2017; Zhou *et al.*, 2016).

We tabulate the robustness test for our baseline results in Table 4. For brevity, only the main coefficients of interest in examining our hypotheses are presented. With various measures of financial leverage, Table 4 presents the regression results in the association between equity liquidity and leverage SOA (H1). Compared with the key findings from Table 2, the regression results in Table 4 confirm the significantly positive relationship (at the 1% level) between equity liquidity and leverage SOA for book leverage regression, but insignificant for the market leverage model.

5.3.3 Alternative measures of liquidity. In this subsection, we examine the robustness of our main finding using alternative measures of equity liquidity, including zero return proportion (*PropZero*), turnover (*Turnover*) and daily closing percent quoted spread (*Spread)*. Results are reported in Table 5.

Columns 1–2, 3–4 and 5–6 report the results for *PropZero*, *Turnover*, and *Spread*, respectively. We find consistent results as in Table 2. Specifically, in columns 1–2, the coefficients of the interaction term $LEV_{i,t} \times PropZero_{i,t}$ are positive and statistically significant at the 1% level for both book and market leverage regressions. As *PropZero* is an illiquidity measure, these results confirm that liquidity has a positive impact on leverage SOA. Next, as a liquidity measure, the negative coefficients of the interaction term $LEV_{i,t} \times Turnover_{i,t}$ also suggest a statistically significant relationship at the 1% level between equity liquidity and leverage SOA (columns 3–4) for both book and market leverage models. The results on *Spread* are similar, which indicate a significantly positive liquidity – leverage SOA relation (columns 5–6) at the 1% level. These results further support our baseline finding (H1).

Variables	BLEV $_{t+1}$ (1)	MLEV $_{t+1}$ (2)
Dist	0.4198***	0.4181***
	(8.2016)	(10.1673)
*LIQ*Dist*	*0.0005****	*0.0009****
	(2.8741)	*(12.897)*
*SIZE*DIST*	−0.0174***	−0.0194***
	(−4.5114)	(−5.7574)
*TANG*DIST*	−0.0544*	−0.0749***
	(−1.9463)	(−2.6512)
*MTB*DIST*	0.0059**	0.0008
	(1.9725)	(0.1930)
*PROF*DIST*	0.1466**	−0.1156**
	(2.3782)	(−2.1450)
*DEP*DIST*	−0.1978	0.3542
	(−0.9407)	(1.4117)
*RD*DIST*	−0.1771	−0.4759***
	(−1.4627)	(−4.6397)
*RDDUM*DIST*	−0.0070	−0.0238
	(−0.4121)	(−1.5764)
*INDMED*DIST*	−0.1196**	0.1341**
	(−2.5058)	(2.2862)
Constant	−0.3225***	0.1307***
	(−9.8335)	(5.9600)
Year FE	Yes	Yes
Observations	15,202	15,202
R-square	0.1480	0.1173

Note(s): This table reports the regression results for the effect of liquidity on the leverage speed of adjustment using two-step approach. ***, **, * indicate significance at the 1, 5, and 10% levels, respectively. Standard errors are bootstrapped. *t*-statistics are reported in parenthesis. The variable definitions are in Appendix
Source(s): The table is created by authors

Table 3.
Robustness check: two-step approach

Variables	LDA$_{t+1}$ (1)	LDM $_{t+1}$ (2)
LEV	0.7190***	0.7040***
	(0.000)	(0.000)
LIQ	−0.0001***	−0.0000
	(0.006)	(0.992)
LIQ × *LEV*	*0.0009****	*−0.0002*
	(0.000)	*(0.832)*
Control	Yes	Yes
Year fixed effects	Yes	Yes
Observations	10,938	10,938
Number of id	1,609	1,609

Note(s): This table reports the regression results for the effect of liquidity on the speed of adjustment using the two-step system GMM estimator. The variable definitions are in Appendix. ***, ** and * indicate significance at the 1, 5 and 10% levels, respectively. The *p*-values are in parenthesis
Source(s): The table is created by authors

Table 4.
Alternative leverage measures

5.4 Effect of liquidity on SOA: conditional on leverage deviation and target change

Next, we investigate whether the positive relationship between equity liquidity and leverage SOA varies conditional on the low and high levels of leverage deviation (H2), and low and high levels of target instability (H3). Estimation results for Equations (10–12) are reported in Table 6.

Variables	PropZero BLEV $_{t+1}$ (1)	PropZero MLEV $_{t+1}$ (2)	Turnover BLEV $_{t+1}$ (3)	Turnover MLEV $_{t+1}$ (4)	Spread BLEV $_{t+1}$ (5)	Spread MLEV $_{t+1}$ (6)
LEV	0.840***	0.732***	0.853***	0.884***	0.774***	0.840***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PropZero	−0.0406	−0.0250*				
	(0.144)	(0.066)				
PropZero × *LEV*	*0.284****	*0.183****				
	(0.008)	*(0.001)*				
Turnover			−0.0081**	−0.0037		
			(0.016)	(0.328)		
Turnover × *LEV*			*0.0436****	*0.0541****		
			(0.000)	*(0.000)*		
Spread					−0.156***	−0.176***
					(0.002)	(0.000)
Spread × *LEV*					*1.168****	*0.453****
					(0.000)	*(0.000)*
Control	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,469	15,469	14,925	14,925	16,457	16,457
Number of id	2,298	2,298	2,260	2,260	2,400	2,400

Note(s): This tables reports the regression results for the effects of other liquidity measures including proportion of zero-return days, turnover, and daily quoted spread to test the association between equity liquidity and leverage using two-step system GMM. The variable definition are in Appendix. ***, ** and * indicate significance at the 1, 5 and 10% levels, respectively. The *p*-values are in parenthesis
Source(s): The table is created by authors

Table 5. Alternative liquidity measures

Panel A presents the results for the full sample. The coefficients of the interaction term ($LIQ_{i,t} \times LEV_{i,t}$) are positive and highly significantly (at the 1% level) in the case of both book and market leverages in all regressions (columns 1–6), implying that the equity liquidity has a positive effect on the leverage SOA. Columns 1 and 2 test hypothesis 2 by including the triple interaction term $LIQ_{i,t} \times LEV_{i,t} \times LevDev_{i,t}$. The results show that the coefficients on this triple interaction term are negative and highly significant at the 1% level, indicating that leverage deviation has a negative impact on the positive association between equity liquidity and SOA. Hypothesis 3 is tested in columns 3 and 4. Specifically, the coefficients of the triple interaction term $LIQ_{i,t} \times LEV_{i,t} \times \Delta Target_{i,t}$ are negative and statistically significant at the 1% level, which implies that the positive relation between equity liquidity and leverage SOA is less pronounced for firms with higher target instability. To further confirm these findings, we include both triple interaction terms, $LIQ_{i,t} \times LEV_{i,t} \times LevDev_{i,t}$ and $LIQ_{i,t} \times LEV_{i,t} \times \Delta Target_{i,t}$, in columns 5 and 6. The results confirm that both coefficients are significantly negative, suggesting that the impact of equity liquidity on SOA is greater for firms with a smaller deviation from the target and a more stable target leverage ratio. These results are consistent with previous literature suggesting that larger leverage deviation and greater target instability result in higher adjustment costs and higher uncertainty associated with adjusting back to the target and consequently lower the leverage speed of adjustment (Zhou *et al.*, 2016) [7].

6. Conclusion

In this study, we investigate how equity liquidity, along with the deviation from the target leverage ratio and the instability in that target, affects the behavior of a firm's SOA. Based on a sample of more than 2,000 UK firms over the period from 1996 to 2016, we find a positive

Variables	Hypothesis 3 BLEV $_{t+1}$ (1)	Hypothesis 3 MLEV $_{t+1}$ (2)	Hypothesis 4 BLEV $_{t+1}$ (3)	Hypothesis 4 MLEV $_{t+1}$ (4)	Both hypotheses BLEV $_{t+1}$ (5)	Both hypotheses MLEV $_{t+1}$ (6)
LEV	0.7380***	0.8020***	0.6920***	0.6560***	0.8000***	0.6210***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LIQ	−0.0005***	−0.0002***	−0.0001	−0.0004***	−0.0002***	−0.0024***
	(0.000)	(0.000)	(0.122)	(0.000)	(0.000)	(0.000)
LIQ × LEV	*0.0024****	*0.0005****	*0.0007****	*0.0004****	*0.0012****	*0.0063****
	(0.000)	*(0.000)*	*(0.000)*	*(0.006)*	*(0.000)*	*(0.000)*
LevDev	−0.0260***	0.0176***			−0.0056***	0.0303***
	(0.000)	(0.000)			(0.000)	(0.000)
LEV × LevDev	0.0806***	−0.111***			0.0133***	−0.102***
	(0.000)	(0.000)			(0.000)	(0.000)
LIQ × LevDev	0.0003***	0.0001***			0.0002***	0.0019***
	(0.000)	(0.000)			(0.000)	(0.000)
LIQ × LEV × LevDev	*−0.0018****	*−0.0004****			*−0.0008****	*−0.0048****
	(0.000)	*(0.000)*			*(0.000)*	*(0.000)*
ΔTarget			−0.0040***	−0.0007	0.0135***	−0.0085**
			(0.000)	(0.818)	(0.000)	(0.016)
LEV × ΔTarget			−0.0149***	0.0642***	−0.0638***	0.0765***
			(0.000)	(0.000)	(0.000)	(0.000)
LIQ × ΔTarget			−0.0000	0.0005***	0.0000***	0.0005***
			(0.789)	(0.000)	(0.000)	(0.000)
LIQ × LEV × ΔTarget			*−0.0002****	*−0.0008****	*−0.0004****	*−0.0016****
			(0.000)	*(0.000)*	*(0.000)*	*(0.000)*
Control	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,938	10,938	4,645	4,037	6,293	6,901
Number of id	1,609	1,609	1,088	1,081	1,206	1,257
AR(2)	0.0894	0.0137	0.4931	0.9131	0.2339	0.3835
p-value Hansen test	0.7275	0.5068	0.3835	0.2722	0.1699	0.2211

Note(s): This tables reports the regression results for the effects of liquidity measures on the leverage SOA in high and low leverage deviation firms, and high and low instability in target, based on whether the firm's leverage deviation position/instability in target is above or below the median for full sample using two-step system GMM. The variable definition are in Appendix. ***, ** and * indicate significance at the 1, 5 and 10% levels, respectively. The *p*-values are in parenthesis
Source(s): The table is created by authors

Table 6. Effects of liquidity on the speed of leverage adjustment – conditional on leverage deviation and target instability

association between equity liquidity and leverage SOA, indicating that firms with high equity liquidity adjust more quickly to their targets. This important finding proves to be robust to a battery of checks, including alternative empirical methods, alternative samples without data adjustment, and alternative proxies for leverage ratios and equity liquidity. We further observe that both the leverage deviation and the target instability have a negative impact on the strength of the relationship between equity liquidity and the SOA. Indeed, for firms with both a large leverage deviation and a large target change, any positive impact that equity liquidity has on their SOA is almost eliminated.

We contribute to the existing literature in several ways. First, given the theoretical prediction and empirical evidence on the relationship between liquidity and leverage SOA, we are the first to enrich the literature on leverage adjustments by identifying equity liquidity as a new determinant of SOA in a single developed country with many differences on the structure and development of capital market, the ownership concentration, and institutional characteristics that vary the relationship between liquidity and a firm's dynamic capital structure decisions. Moreover, although several studies have examined the capital structure choices of UK firms but do not investigate the dynamic leverage adjustments, our study contributes to the empirical literature on the association between equity liquidity and firms' capital structure decisions in the UK Next, we provide new empirical evidence of the joint effect of equity liquidity, leverage deviation and target instability on leverage SOA. The positive impact on equity liquidity on the SOA is greater for firms that are relatively close to their target and whose target is relatively stable.

Our study has important implications at both firm and country levels. Specifically, firm managers who wish to access easier to various financing sources and fasten the speed of adjustment toward the target capital structure to enhance firm value need to pay more attention to drive up equity liquidity. From the policy makers perspective, when establishing regulation frameworks, policy makers should consider the impact of stock liquidity and financial market development on firms' financial policy, especially during the periods of high uncertainty and volatility; while firms with high liquidity could have a higher chance to access to external sources, low liquidity firms experience more financial difficulties. In such cases, policy makers should consider multiple assistant programs for these constrained firms. Furthermore, investors need to take into account the significant impacts of liquidity on firm financial policy. This might assist investors in choosing the proper investment strategies. Our current research has a potential limitation with regard to the data period. The sample period is 2002–2016 in this study [8]. It is interesting to know whether our documented results would still remain valid in recent years, especially after the COVID-19 pandemic. Future studies may extend our sample period to more recent years and examine whether the pandemic irregularity has any impact on the relationship between CSP and equity liquidity. This interesting question awaits further examination.

Notes

1. Note that while turnover is a measure of liquidity, Amihud, zero-return proportion, and daily closing percent quoted spread provide inverse measures of liquidity (or illiquidity).
2. Please refer to Appendix for the definition of variables.
3. As ∂ indicates the leverage SOA, a positive β_2 indicates a negative relationship between Amihud score ($LIQ_{i,t}$) and leverage SOA. However, as Amihud score ($LIQ_{i,t}$) is an illiquidity measure (Amihud and Mendelson, 1986), a positive β_2 implies a positive relationship between equity liquidity and leverage SOA.
4. To compute the economic significance of liquidity on leverage SOA, we take the product of the coefficients and sample standard deviation of liquidity measure (An *et al.*, 2015; Colak *et al.*, 2018).
5. The half-life time is calculated as Ln(0.5)/Ln(1-SOA).
6. In unreported tables, we also check the impact of liquidity on SOA for under- and over-levered firms. The results are consistent with Ho *et al.* (2021) that equity liquidity positively affects the SOA of over-levered firms but has no impact for under-levered firms.
7. In unreported tables, we further consider the impact of leverage deviation and target stability on the equity liquidity-SOA relationship for over- and under-levered subsamples. We find that equity liquidity has a positive effect on leverage SOA for over-levered firms. This relationship, though, is weaker for firms with higher leverage deviation and/or higher instability in target levels. The results also show that equity liquidity has no significant effect on leverage SOA of under-levered firms.
8. We thank an anonymous reviewer for raising this concern. We have to stop in 2016 because the authors only have legal access to the required databases up to then, due to graduation and change of affiliations. Moreover, even if we have data available up to 2023 the most recent year, it is inappropriate to include the pandemic and recession years of 2020–2023 into the sample due to the unusual Covid-19 impacts. Thus, the best possible sample period could be 2002–2019, which is only three years longer than our current one. Given that our sample period covers 15 years already, we believe that an additional three years might not have any material impact on our findings.

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Appendix

Table A1. Variable definitions

Variables	Description	Data source
BLEV	Book value of total debt divided by book value of total assets	WorldScope
MLEV	Book value of total debt divided by the sum of the market value of equity and the book value of total debt	WorldScope
LIQ	Ratio of the daily absolute stock return to its dollar volume averaged over the number of positive volume days	Datastream
PropZero	Proportion of trading days in the year that had zero price changes (zero return) from the previous day	Datastream
Turnover	The number of shares traded on a day, divided by the total number of shares outstanding. The turnover for each stock, for each year, is calculated as the average turnover across all trading days in a year	Datastream
Spread	Daily-closing bid-ask spread divided by the midpoint spread averaged over the number of positive volume days	Datastream
SIZE	Natural logarithm of book value of total assets	WorldScope
TANG	Net property, plant and equipment dividend by book value of assets	WorldScope
MTB	Ratio of book value of assets less book value of equity plus market value of equity to book value of assets	WorldScope
PROF	Earning before interests, taxes, depreciation and amortization divided by the book value of assets	WorldScope
DEP	Depreciation and amortization divided by the book value of assets	WorldScope
RD	Research and development expenses divided by the book value of assets	WorldScope
RDDUM	Dummy variable that equals to one if research and development expenses are not reported and zero otherwise	WorldScope
INDMED	The median leverage ratio of an industry to which a firm belongs	WorldScope

Source(s): The table is created by authors

Corresponding author
Ly Ho can be contacted at: lyhth@due.edu.vn