

Conditional stock liquidity premium: is Warsaw stock exchange different?

Conditional
stock liquidity
premium

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Abstract

Purpose – This paper aims to empirically indicate the factors influencing stock liquidity premium (i.e. the relationship between liquidity and stock returns) in one of the leading European emerging markets, namely, the Polish one.

Design/methodology/approach – Various firms' characteristics and market states are analysed as potentially affecting liquidity premiums in the Polish stock market. Stock returns are regressed on liquidity measures and panel models are used. Liquidity premium has been estimated in various subsamples.

Findings – The findings vividly contradict the common sense that liquidity premium raises during the periods of stress. Liquidity premium does not increase during bear markets, as investors lengthen the investment horizon when market liquidity decreases. Liquidity premium varies with the firm's size, book-to-market value and stock risk, but these patterns seem to vanish during a bear market.

Originality/value – This is one of the first empirical papers considering conditional stock liquidity premium in an emerging market. Using a unique methodological design it is presented that liquidity premium in emerging markets behaves differently than in developed markets.

Keywords Liquidity premium, Warsaw stock exchange, Drivers of liquidity premium, Liquidity costs, Pricing of liquidity

Paper type Research paper

1. Introduction

Liquidity premium may be defined as an additional expected return on stock required by investors to compensate for the potential loss of expected utility of his/her terminal wealth caused by incurred liquidity costs. To claim the existence of such a premium, less liquid stocks should outperform more liquid ones, i.e. negative liquidity-return relationship has to occur. As the seminal papers of [Amihud and Mendelson \(1986\)](#) and [Constantinides \(1986\)](#),

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JEL classification – G11, G12

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liquidity premium in the markets around the world is widely investigated, both in theoretical, as well as empirical research [1].

The fact that less liquid shares outperform more liquid ones is quite well documented in the US and other developed stock markets, while similar studies carried out on relatively less developed capital markets still yield ambiguous results. Most of the empirical research is focussed on indicating the unconditional, i.e. constant over time and equal to all stocks, liquidity premiums. However, as pointed out by some authors (Jensen and Moorman, 2010; Ben-Rephael *et al.*, 2015; Chiang and Zheng, 2015) liquidity premium may vary depending on some stock characteristics and/or market conditions. There is still a lack of comprehensive answer to the question about the factors determining such a premium.

The main objective of this paper is to empirically indicate the factors influencing stock liquidity premium (i.e. the relationship between liquidity and stock returns) in one of the leading European emerging markets. Using a unique methodological design, various firms' characteristics and market states are analysed as potentially affecting this premium in the Polish stock market.

The contribution of the paper is at least threefold. At first, the paper contributes to the literature as this is one of the first empirical papers considering conditional stock liquidity premium. Recently, Jang *et al.* (2015) analysed state-dependent liquidity premiums in the Korean stock market. They found that liquidity premium differs significantly in different market states. In particular, they found that realised liquidity premium is significantly higher in the expansive state rather than in the recessive state. Jang *et al.* (2017) have analysed state-dependent variations in the expected liquidity premium and found that it displays strong state-dependent, countercyclical variations. Grillini *et al.* (2019) have applied conditional L-CAPM by Acharya and Pedersen (2005) to indicate the time-variant pricing of various liquidity risks within the Eurozone countries.

Chiang and Zheng (2015), in turn, analysed the liquidity conditional on various stock characteristics. They found that the relationship between liquidity factor and stock returns is stronger for larger, lower book-to-market value and more liquid stocks. On the contrary, the relationship between unexpected liquidity and stock returns is stronger for smaller, higher book-to-market and less liquid stocks.

However, there is a lack of research that merges two abovementioned approaches, namely, the variance of liquidity premium across market states and across stocks with different characteristics. There is also a scarcity of research on conditional liquidity premiums in emerging stock markets. This study contributes to the literature as it presents liquidity premium conditional on both market states and firms' characteristics in an emerging market.

The second important contribution emerges from the empirical approach in investigating liquidity premium. This is the first study in which the relationship between liquidity and returns is analysed on a single stock level (rather than on a portfolio level) with the use of panel data. The use of the data on a single stock is justified by the fact that liquidity costs are undiversifiable (Amihud and Mendelson, 1986) and the use of portfolios instead of single stocks may lead to the loss of some important information. Moreover, in regressions carried out, liquidity measure is amortised similarly as done by Chalmers and Kadlec (1998) and unexpected stock liquidity is included.

Finally, this study contributes to the literature as it uses data on stocks listed on the Polish stock exchange, still considered an emerging market. While studies on liquidity premium in the USA and other developed stock markets give coherent results, similar studies carried out on less developed markets prove the liquidity-return relationship being far from obvious. For instance, Bekaert *et al.* (2007) have found significant liquidity premiums across 19 emerging markets. Similarly, Amihud *et al.* (2015) found liquidity premiums being higher in emerging than in developed markets. On the contrary,

Stereńczak *et al.* (2020) have studied liquidity premium in frontier markets and found it insignificantly negative. The same was found by Batten and Vo (2015), who have analysed the Vietnamese stock market.

Warsaw Stock Exchange (WSE) provides an interesting setting for studying liquidity premium as it differs significantly from the US stock markets. The market is dominated by long-term investors such as state treasury, open pension funds, institutions (including SOEs) and families. WSE is also densely populated by small and medium entities and trading is highly concentrated within the small number of blue chips. The smallest 290 companies (60% of total listed stocks) account for only 2.19% of total capitalisation, compared to 13% in the US market. The most thinly traded 290 companies (60% of all listed stocks) accounts for only 0.55% of total turnover, and 80% of the turnover is concentrated in 11 most heavily traded stocks (2.28% of all companies).

WSE is an order-driven market, which means that its trading mechanism differs from the hybrid quote-driven mechanism displayed in the US stock markets. Liquidity concerns may be of less importance in order-driven markets than in the quote-driven ones, as the order imbalance spreads between a large number of liquidity providers rather than concentrates on one market maker. Hence, the study contributes to the literature on liquidity premiums in non-US order-driven markets. However, the Polish stock market is far less developed and less liquid than most developed markets around the world. Thus, stock liquidity should play a more important role in asset pricing than in the US.

The abovementioned differences between Polish and US stock markets may cause the results of the studies carried out on the Polish stock market that is different than the respective results of the studies carried out on the US stock market. On the one hand, as the WSE is a less developed and less liquid market, stock liquidity should influence the stock returns more severely than in the US. On the other hand, the fact that WSE is an order-driven market should attenuate this relationship. Equally important, studies carried out so far do not allow to indicate clearly if there exists a stock liquidity premium in the Polish capital market. Previous research is scarce [2] and their results varied. This is the first such extensive study on the liquidity premium in the Polish stock market.

The obtained results indicate that liquidity premium exists in the WSE and is in part captured by the return on the market portfolio, market risk premium and by the factor premiums related to the firm's size and value. Interestingly, our findings vividly contradict the common sense that liquidity premium increases during the market downturns. In the periods of a bear market, when the overall level of liquidity decreases, investors lengthen the investment horizon, thus making an increase in liquidity premium insignificant. Liquidity premium varies with the firm's book-to-market value, stock capitalisation and its risk, but these patterns seem to appear only in the bull market.

The rest of the paper is organised as follows. Section 2 is devoted to the methodological design of the study, it describes the methods applied, variables and the sources of data. Section 3 provides the empirical results and the series of robustness tests are presented in Section 4. Section 5 concludes the paper.

2. Methodology and data

2.1 Empirical design

The effect of stock liquidity on returns (liquidity premium) arises from the costs related to liquidity. At the moment of buying, the investor is able to forecast the level of liquidity (and, thus liquidity costs) at the moment he wants to sell. Hence, when purchasing the shares, an investor makes such a valuation, which ensures that he/she will obtain the required return,

taking into account liquidity costs incurred presently and in the future (Eleswarapu and Reinganum, 1993).

According to previous research (among others Amihud and Mendelson, 1986; Chalmers and Kadlec, 1998; Florackis *et al.*, 2011), the effect of liquidity on stock returns depends not only on the number of liquidity costs but also on the frequency of transactions. Liquidity costs are incurred only when buying and selling, which means that the longer the holding period is, into more periods liquidity costs can be divided. Therefore, the required compensation in rates of return (liquidity premium) per one period should decrease with an increase in the investment horizon.

Taking into account the above considerations, the following research framework is set. A marginal investor takes an investment decision at the end of the month $t-1$. Based on the level of liquidity in month $t-1$ he/she forecasts the level of liquidity in the future and makes a decision regarding the investment horizon [3]. Taking into account the return he/she requires and the incurred liquidity costs amortised over the investment horizon, specifies the maximum price he/she is willing to pay for that stock. This valuation is observable directly at the end of the month $t-1$. The expected rate of return is observable indirectly, by analysing the stock price at the end of the month t . Also, the decision of the marginal investor about the investment horizon is directly unobservable. Indirectly, one can conclude his/her choice by observing the turnover ratio in month t – the longer the investment horizon, the lower the turnover ratio in that month.

The expected rate of return is a function of stock characteristics, i.e. liquidity costs at the beginning (month $t-1$) and the end of the investment. The expected return is observable only indirectly through the realised return in the month following the beginning of the investment (month t). Realised return may be a biased estimate of expected return as liquidity level in month t may differ from the predicted one. As stock liquidity is time-varying, predicted by an investor's future level of stock liquidity is charged with an estimation error. This causes the need to include the unexpected level of liquidity in an empirical model to analyse the effect of stock liquidity on expected returns. If unexpected liquidity would not be taken into account in a model, the estimated liquidity premium could be biased downwards. This is in line with Amihud (2002), who has proved that ex ante returns are an increasing function of expected illiquidity, and unexpected illiquidity has a negative effect on contemporaneous stock returns.

Taking into account this setting, the relationship between stock liquidity and returns may be verified by the estimation of the following model:

$$r_{it} - rf_t = a + b_1Liq_{it-1} + b_2Liq_{it}^U + \beta' X_{it} + \varepsilon_{it} \quad (1)$$

where rf_t is the risk-free rate of return in month t (proxied by the one month Warsaw Inter-Bank Offered Rate – WIBOR 1 M), Liq_{it} denotes the value of liquidity measure for i -th stock in month t , Liq_{it}^U is an i -th stock unexpected liquidity in month t and X_{it} is a vector of control variables. The estimate of the coefficient b_1 reflects the liquidity premium required for the unit of liquidity costs (hereafter “per unit liquidity premium”) and is of the greatest interest taking into account the aim of the paper. To obtain the amount of total liquidity premium in terms of percentage points, one should multiply the estimated coefficient b_1 by the value of amortised liquidity costs.

To estimate model (3) panel regression approach is used instead of conventional Fama and MacBeth (1973) cross-sectional regressions. Fama-MacBeth procedures are subject to statistical biases (Petersen, 2009), in particular, they account only for cross-sectional

correlations, neglecting serial correlations. Thus, to account for both, cross-sectional and serial correlations, panel regression is used as suggested by Petersen (2009).

2.2 Variables

For the purpose of measuring liquidity, Amihud's (2002) illiquidity ratio has been applied. It has been indicated as the best measure of liquidity in both developed and emerging markets (Goyenko *et al.*, 2009; Fong *et al.*, 2017; Ahn *et al.*, 2018). However, as indicated by Stereńczak (2019a), Amihud's measure reflects stock liquidity in the WSE better if the return in the numerator is replaced with the log of the daily price range. Such a modification allows also to capture the short-term price pressure that disappears before the end of the trading day. Liquidity measure $ILLIQ_{it}^R$ is, thus, computed as follows (Stereńczak, 2019a):

$$ILLIQ_{it}^R = \frac{1}{D_{it}} \sum_{d=1}^{D_{it}} \frac{|\ln(p_{itd}^H / p_{itd}^L)|}{Vol_{itd}} \quad (2)$$

where p^H , p^L and Vol denote the maximum daily price, minimum daily price and trading volume denominated in thousands of PLN, respectively.

To minimise the influence of outliers on the analysed relationship, values of liquidity measures have been cross-sectionally winsorised at 2.5 and 97.5 percentile of the distribution. Next, computed and winsorised values of $ILLIQ^R$ have been "amortised" to reflect the number of liquidity costs per month. Amortisation is done by dividing the value of liquidity measure by the average investment holding period in months. An inverse of turnover ratio has been used as a proxy for the investment horizon. Amortised $ILLIQ^R$ is, thus, computed similarly as done by Chalmers and Kadlec (1998) and given as follows:

$$amILLIQ_{it-1}^R = \frac{ILLIQ_{it-1}^R}{HP_{it}} = ILLIQ_{it-1}^R \frac{V_{it}}{NoS_{it}} \quad (3)$$

where V_{it} denotes the volume of i -th shares traded in month t and NoS_{it} is the number of outstanding shares of stock i in month t .

The unexpected level of liquidity is calculated as a residual from the following AR(1) model estimated based on the data from the previous 36 months:

$$ILLIQ_{it}^R = \varphi_0 + \varphi_1 ILLIQ_{it-1}^R + \varepsilon_{it} \quad (4)$$

To avoid the identification of a spurious relationship between liquidity and stock return, also control variables are included in the estimated models. These variables are to take into account the effect of various stock characteristics on the rates of return. The set of control variables includes:

- natural logarithm of the market value of equity ($\ln(MV)$) – to take into account the size effect (Fama and French, 1992, 1993)
- book-to-market value of equity (BMV) – to take into account the effect of the company's value (Fama and French, 1992, 1993)
- dividend yield (DY) – to control for the effect of liquidity on dividend policy (Banerjee *et al.*, 2007; Jiang *et al.*, 2017)

- cumulative return from the past 12 months ($r_{t-12:t-1}$) – reflecting the momentum effect (Jegadeesh and Titman, 1993; Carhart, 1997) and
- standard deviation of monthly returns in the past 36 months (σ) – reflecting stock risk.

2.3 Data

The study covers all common stocks listed on the WSE in the period from 2001 to 2016, which means that it is carried out on the unbalanced panel of companies. The exclusion of the earlier period is dictated by the fact that in November 2000 WARSET trading system has been introduced. Prior to the introduction of WARSET, WSE was poorly developed and its liquidity was very low, which could negatively influence the quality of obtained results.

As some of the explanatory and control variables are calculated based on the data on 36 months, the research sample has been confined to stocks with data available for at least 37 consecutive months. Thus, newly listed shares are included in the sample from the 37th month after the start of the listing. Similarly, it happened when the listing was suspended for a time longer than one month: in such case, the stock has returned to the research sample from the 37th month after the end of the suspension period.

Raw data on daily quotations have been downloaded from InfoStrefa service and adjusted for corporate actions. Data on companies' capitalisations, book values of equity, the number of outstanding shares and dividend yields were obtained from the Official Quotations of the Warsaw Stock Exchange (Cedula GPW).

3. Empirical results

3.1 Liquidity premium in the Warsaw stock exchange

To indicate the most appropriate estimator for the equation (3) a series of panel diagnostic tests have been carried out. Welch's t -test indicates that panel units differ in the intercepts; the Breusch-Pagan test reveals unit-specific variances of residuals and the Hausman test claims the inconsistency of GLS estimator with random effects. Hence, to claim the existence of stock liquidity premium in the WSE fixed effects estimator is used. As the Breusch-Pagan test indicates the existence of heteroskedasticity, heteroskedasticity and autocorrelation (HAC) robust standard errors are estimated with the Arellano's (1987) approach. The results of the estimation are presented in Panel A of Table 1. In the first column parameters of the one-way model with fixed effects for the panel, units are delivered, while in columns (2)–(6) parameters of two-way models with fixed effects for both panel units and time units are presented.

Signs of the estimated parameters for control variables are consistent with the expectations with the estimated parameter for stock riskiness (σ) being an exception. These estimates are negative and statistically significant at level 0.01. Negative signs of the estimates of the parameters for stock risk may result from model misspecification. Liquidity and volatility may not be independent variables (Będowska-Sójka and Kliber, 2018). Secondly, the research sample correlation between risk and size exceeds 0.4. To omit these problems, the following modifications have been applied to the model's specification:

- risk has been orthogonalised versus liquidity:
- risk has been orthogonalised versus size:
- risk has been omitted and
- liquidity has been omitted.

Variable	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: estimates of the models' parameters</i>						
Intercept	0.160*** (15.33)	0.115*** (10.37)	0.104*** (9.657)	0.098*** (8.905)	0.099*** (8.993)	0.121*** (10.93)
$\ln MV$	-0.029*** (15.63)	-0.020*** (10.92)	-0.020*** (10.92)	-0.019*** (10.22)	-0.018*** (9.891)	-0.021*** (11.46)
BMV	0.0001 (0.561)	0.0001 (0.557)	0.0001 (0.557)	0.0001 (0.557)	0.0002 (0.874)	0.00001 (0.463)
DY	0.015 (1.326)	0.001 (0.060)	0.001 (0.060)	0.001 (0.060)	0.001 (0.119)	0.00001 (0.006)
$r_{t-12:t-1}$	0.020*** (11.69)	0.007*** (2.930)	0.007*** (2.930)	0.007*** (2.930)	0.006*** (2.723)	0.006*** (3.119)
σ	-0.103*** (4.924)	-0.079*** (3.268)	-0.079*** (3.268)	-0.079*** (3.268)	-0.079*** (3.268)	-0.072*** (3.238)
$\sigma^{orthog_amILLIQ}$						
σ^{orthog_lnMV}						
$amILLIQ^R$	9.473*** (4.094)	8.899*** (3.923)	8.461*** (3.707)	8.899*** (3.923)	8.905*** (3.893)	
$ILLIQ^{RU}$	-0.214*** (4.092)	-0.134*** (2.675)	-0.134*** (2.675)	-0.134*** (2.675)	-0.126*** (2.546)	
Stocks effects	Yes	Yes	Yes	Yes	Yes	Yes
Months effects	No	Yes	Yes	Yes	Yes	Yes
n	40,879	40,879	40,879	40,879	41,265	42,893
R^2	0.026	0.204	0.204	0.204	0.204	0.194
F	61.974	24.529	24.529	24.529	21.269	26.813
$D-W$	1.876	1.989	1.989	1.989	1.990	1.985
AIC	-47,260.12	-55,194.79	-55,194.79	-55,194.79	-55,637.80	-56,083.83
<i>Panel B: total liquidity premium</i>						
Value [%]	0.115 [0.007]	0.108 [0.006]	0.103 [0.006]	0.108 [0.006]	0.108 [0.006]	n/a
Fraction of returns [%]	13.35 [0.79]	12.54 [0.74]	11.93 [0.71]	12.54 [0.74]	12.55 [0.75]	n/a

Notes: Panel A presents estimated parameters of the model given with the equation (3) with various specifications of explanatory variables. Dependent variables are stock return in month t , $\ln MV$ is the natural logarithm of stock market capitalisation at the end of the month $t - 1$; BV/MV is the ratio of last known at the end of the month $t - 1$ book value of equity to the market value of equity at the end of the month $t - 1$; DY is the last known at the end of month $t - 1$ dividend yield; $r_{t-12:t-1}$ is the cumulated return from the months from $t - 12$ to $t - 1$; σ is the standard deviation of monthly returns in past 36 months; $amILLIQ^R$ is the value of FHT measure in month $t - 1$ amortised by the expected holding period, approximated by the reciprocal of the turnover ratio in month t ; $ILLIQ^{RU}$ is the residual from AR(1) model of $ILLIQ^R$ measure. t -statistics are given in the parentheses and asterisks denote the statistical significance at the 0.1 (*), 0.05 (**), and 0.01 (***) level. Panel B presents the total liquidity premium together with the fraction of returns it constitutes. The result for median $amILLIQ^R$ is presented in square brackets

Table 1.
The results of the estimation of the liquidity premium

Estimates of the modified model are provided in Panel A of [Table 1](#), Columns 3–6. Change in the specification of the model does not change the results.

Next, to test whether the effects of liquidity on stock returns survive after adjusting for risk, four different rates of return have been applied as dependent variables, namely, market excess ($r_{it} - r_{Mt}$), CAPM-adjusted ($r_{it} - r_{it}^{CAPM}$), FF3-adjusted ($r_{it} - r_{it}^{FF3}$) and Carhart-adjusted ($r_{it} - r_{it}^{Carhart}$). Risk-adjusted returns are computed as the difference between the actual return realisation and the pricing model-implied return. Estimated liquidity premiums after adjusting returns for risk are delivered in Panel A of [Table 3](#). After adjusting for risk liquidity premium remains positive and statistically significant.

The liquidity premium is partially captured by the return on a market portfolio, market risk premium and size and value factor premiums. This is evidenced by the decreasing values of per unit liquidity premium with an increase in the number of factors in the model. However, the inclusion of the momentum factor causes the opposite – liquidity premium increases. Also, the effect of the unexpected changes in liquidity on contemporaneous stock return is significantly negative, however, risk factors do not account for that effect.

Regardless of the model specification, the estimated parameter for the amortised liquidity measure is positive and statistically significant at the 0.01 level. This means that there exists a statistically significant liquidity premium in the WSE. The estimate ranges from 8.461 to 9.473 with mean value of 8.927. This estimated parameter reflects the per unit liquidity premium, not the total one. To determine the economic relevance of liquidity premium in the WSE, total liquidity premium has been computed.

The average total liquidity premium is computed as the estimated parameter for amortised liquidity measure multiplied by the median value of amortised $ILLIQ^R$ measure. A similar approach was presented by [An et al. \(2019\)](#). The use of median instead of mean is a result of high liquidity concentration in the WSE. Due to that, there are huge disproportions in the average holding periods between various shares. The use of the mean value of $amLLLIQ^R$ instead of the median, would result in the overestimation of average total liquidity premium being the effect of the outliers.

The average total liquidity premium in the WSE is presented in Panel B of [Table 1](#). Based on the median value of $amLLLIQ^R$ average total liquidity premium is equal to 0.006–0.007 p.p. monthly, which constitutes 0.71–0.79% of the average rate of return in the WSE in the analysed period. The estimated total liquidity premium is significantly lower than that reported e.g. by [Amihud et al. \(2015\)](#) for emerging markets. The mean liquidity premium reported in their study ranges from 0.741 to 1.161 p.p. monthly.

If one would use the mean value of $amLLLIQ^R$ instead of the median, the average total liquidity premium would be significantly higher and equal to 0.103–0.115 p.p. monthly, which constitutes 11.93–13.35% of the average return on the WSE in the analysed period. Nevertheless, these values are still much lower than those presented e.g. by [Amihud et al. \(2015\)](#) for emerging markets and cannot be considered highly economically relevant.

WSE is considered an illiquid market, thus it is quite surprising that liquidity premium consists of only a small fraction of returns. This may result from several reasons. At first, due to low integration with the global economy, WSE may still offer some diversification benefits that offset stock illiquidity ([Batten and Vo, 2015](#); [Stereńczak et al., 2020](#)). Although emerging markets have become markedly more integrated with the global economy ([Carriero et al., 2007](#)), WSE is densely populated with small capitalisation firms with relatively low participation of institutional investors concerned with the possibility to quickly enter or exit the market. Secondly, small liquidity premiums may be a result of investors' awareness of illiquidity. If investors are aware of liquidity costs, they may lengthen the investment horizon or rebalance their portfolios less frequently to avoid

frequent occurring liquidity costs. As most of the outstanding shares on the WSE is held by long-term investors, illiquidity concerns may be of less importance in that market.

3.2 Liquidity premium during the bull and the bear market

Liquidity premium may be time-varying, and some of the research carried out so far indicate some factors affecting the time-variance of liquidity premium. Based on theoretical models, liquidity premium increases with market or return volatility (Constantinides, 1986; Longstaff, 1995, 2001; Jang *et al.*, 2007; Pereira and Zhang, 2010), liquidity volatility (Pereira and Zhang, 2010) and expected return (Jang *et al.*, 2007; Stereńczak, 2019b). These factors are closely related to bull and bear market phases, which can be distinguished based on two of the three abovementioned factors, namely, return volatility (risk) and expected return.

To identify bullish and bearish market periods, a state-dependent variance Markov-switching model has been applied. This model allows us to estimate parameters for different market states and assign to each observation the probability of belonging to one of the K market states. The model is given as follows (Maheu and McCurdy, 2000):

$$\begin{aligned} r_t &= \mu(S_t) + \phi_1 r_{t-1} + \sigma(S_t) v_t \\ v_t &\sim NID(0, 1) \\ S_t &= 1, 2 \end{aligned} \quad (5)$$

where r_t denotes the return on a market portfolio, v_t is return variance and S_t refers to one of the market states bull or bear market.

Once the model (7) is estimated, each month of the study period is assigned to one of the two states based on the probabilities of belonging to these states; the month is assigned to the state it belongs more probably. The bull market period is characterised by higher expected return and lower return volatility than the bear market period. Therefore, state i is labelled the bull market if two following conditions are jointly satisfied: $\mu(S_t = i) > \mu(S_t = j)$ and $\sigma(S_t = i) < \sigma(S_t = j)$. In such a situation state j is labelled the bear market state. Periods of the bullish and bearish market are plotted jointly with the values of the WSE index (WIG) in Figure 1.

Next, to investigate the effects of liquidity on stock returns during bull and bear markets, two dummy variables are created: H and B . Those variables reflect the market states and H_t takes the value of 1 if month t belongs to a bull market state and 0 otherwise. On the contrary, B_t equals 1 if month t belongs to the bear market state and 0 otherwise. Dummy variables reflecting market states are then used to construct interactive variables included in the following model:

$$\begin{aligned} r_{it} - rf_t &= \tilde{a} + b_1^H Liq_{it-1} \times H_t + b_1^B Liq_{it-1} \times B_t + b_2^H Liq_{it}^U \times H_t + b_2^B Liq_{it}^U \times B_t + \beta' X_{it} \\ &+ \varepsilon_{it} \end{aligned} \quad (6)$$

Thus, b_1^H (b_1^B) reflects per unit liquidity premium during the bull (bear) market phase, and b_2^H (b_2^B) reflects the effect of unexpected liquidity on stock returns during the bullish (bearish) market. One should expect b_1^B being higher than b_1^H and b_2^B being more negative than b_2^H . Estimated parameters are delivered in Panel A of Table 2.

Estimated per unit liquidity premium during periods of a bear market is quantitatively higher than during periods of the bull market, though statistically insignificant. Similarly,

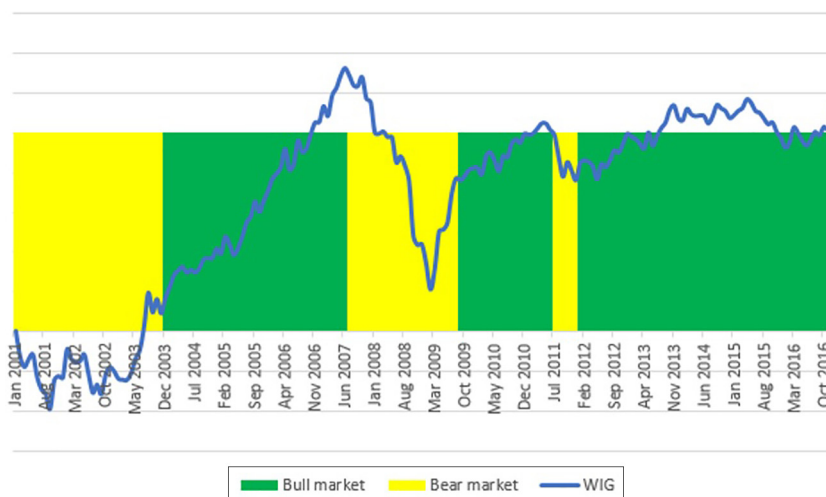


Figure 1.
Bull and bear market
phases on the WSE
identified with the
use of AR(1) Markov
switching model

the parameter for unexpected liquidity during the bear market is quantitatively more negative than during the bull market, although statistically insignificant. Thus, although estimated parameters suggest the effect of liquidity on stock returns being stronger during bear markets, these differences should be considered insignificant.

The above evidence contradicts previous studies on state-dependent liquidity premium in developed markets. Extant research presents a strong time-variance of stock liquidity premium conditional on the market state. This is evidenced by [Jang *et al.* \(2017\)](#) and [Grillini *et al.* \(2019\)](#). Our study reports insignificant time-variance in liquidity premium conditional on the market state in an emerging market. Such inconsistency should encourage further research in this field.

Observed higher liquidity premium during bear markets does not clearly hold when risk-adjusted returns are taken into consideration (results are delivered in Panel B of [Table 2](#)). One should point out that estimated parameters for $amILLIQ^R$ during the bull and bear market are quantitatively similar when returns are adjusted for risk, although during the bear market estimated liquidity premium is indistinguishably different from zero. This may indicate that common risk factors included in pricing models (CAPM, FF3 and Carhart) capture the time-variance of liquidity premium resulting from the changes in market state. However, once the returns are adjusted for risk, the effect of unexpected liquidity on stock returns during bear markets becomes significant and more negative than during the bull market phase. Thus, the effects of liquidity on stock returns during bear markets arise mostly as a result of unexpected changes in liquidity.

The average liquidity premium during bull markets equals 0.006% and during a bear market is equal to 0.022%. However, one should consider these differences statistically insignificant; taking into account statistical significance, the total liquidity premium should be considered being zero. Hence, the total liquidity premium during the bull market should be considered higher than during the bear market, supporting the previous results of [Jang *et al.* \(2015\)](#) for the Korean stock market. [Jang *et al.* \(2015\)](#) found that an expansion-expansive state (good economic conditions) generates a huge liquidity premium, while such a premium does not exist in the recession-restrictive state (bad economic conditions).

The average value of amortised $ILLIQ^R$ is higher in the bull market phase rather than during the bear market, indicating that investors incur higher liquidity costs amortised over

<i>Panel A: estimates for bull and bear markets</i>			
Variable	All	Bull market	Bear market
$amILLIQ^k$	8.899*** (3. 923)	8.711*** (3. 904)	28.176 (1.507)
$ILLIQ^{kU}$	-0.134*** (2. 675)	-0.133*** (2. 600)	-0.165 (0.771)
<i>Level of liquidity (multiplied by 10³)</i>	0.121 [0.0072]	0.127 [0.0074]	0.112 [0.0077]
<i>Total liquidity premium [%]</i>	0.108 [0.006]	0.111 [0.006]	0.317/0.000 [0.022/0.000]
<i>Panel B: Estimates for stocks with different capitalisations</i>			
Variable	Low MV	2	3
$amILLIQ^k$	8.741*** (3. 871)	19.143*** (2. 842)	67.136*** (2. 839)
$ILLIQ^{kU}$	-0.082 (1.121)	-0.267*** (3. 631)	-0.105 (1.121)
<i>Level of liquidity (multiplied by 10³)</i>	0.377 [0.053]	0.055 [0.013]	0.019 [0.0046]
<i>Total liquidity premium</i>	0.329 [0.047]	0.105 [0.026]	0.127 [0.031]
<i>Panel C: estimates for stocks with different book-to-market values</i>			
Variable	Low B-MV	2	3
$amILLIQ^k$	7.981** (2. 077)	26.446** (2. 332)	12.188*** (4. 087)
$ILLIQ^{kU}$	-0.109 (0.734)	-0.036 (0.259)	-0.175** (2. 404)
<i>Level of liquidity (multiplied by 10³)</i>	0.140 [0.0047]	0.047 [0.0050]	0.090 [0.0073]
<i>Total liquidity premium</i>	0.112 [0.004]	0.124 [0.013]	0.110 [0.009]
<i>Panel D: estimates for stocks with different levels of risk</i>			
Variable	Low risk	2	3
$amILLIQ^k$	28.133*** (3. 382)	19.800*** (3. 529)	17.057*** (2. 766)
$ILLIQ^{kU}$	-0.113 (1.428)	-0.042 (0.702)	-0.202*** (3. 279)
<i>Level of liquidity (multiplied by 10³)</i>	0.030 [0.0018]	0.069 [0.0063]	0.097 [0.011]
<i>Total liquidity premium</i>	0.085 [0.005]	0.137 [0.013]	0.166 [0.019]

Notes: The table presents estimated parameters for $amILLIQ^k$ and $ILLIQ^{kU}$, as well as the level of liquidity and total liquidity premium in various subsamples. Panel A presents the results for bull and bear markets identified with the use of Markov-switching state-dependent variance AR(1) model; Panel B presents the estimates for stocks of different size as measured by market capitalisation (MV); Panel C presents the results for stocks with different book-to-market values ($B-MV$) and Panel D contains estimates for stocks with different levels of return volatility. t -statistics are given in the parentheses and asterisks denote the statistical significance at the 0.1 (*), 0.05 (**), and 0.01 (***) level

Table 2.
The results of the estimation of the liquidity premium in various subsamples

their investment horizon when economic conditions are quite good. As liquidity is procyclical, ILLIQ^R (unamortised) takes higher values during bear markets (Sterenczak, 2018). Hence, the difference arises from the difference in the average holding period between bull and bear market periods. Figure 2 plots the market liquidity and average investment horizon on the WSE in the analysed period. It is quite well visible that the holding period lengthens when liquidity decreases. This is confirmed by the high coefficients of correlation between the level of liquidity and average holding period. Correlation coefficients, namely, Pearson's r , Spearman's ρ and Kendall's τ equal 0.7402, 0.8052 and 0.6159, respectively.

3.3 Companies' characteristics and liquidity premium

As pointed out by Chiang and Zheng (2015), liquidity premium depends on a firm's size, book-to-market value, stock liquidity and idiosyncratic volatility. Thus, in this section, differences in liquidity premium between firms with different capitalisations, book-to-market values and return volatilities are analysed. To do so, in each month stocks are sorted based on the quartiles of the cross-sectional distribution of a given characteristic. Then, for each characteristic four dummy variables reflecting each quartile of distribution are created. These dummy variables (denoted as D^q , $q = 1, 2, 3, 4$) are used to create interactive variables included in the following model:

$$r_{it} - rf_t = \tilde{a} + \sum_{q=1}^4 b_1^q Liq_{it-1} \times D_{it}^q + \sum_{q=1}^4 b_2^q Liq_{it}^U \times D_{it}^q + \mathbf{b}' \mathbf{X}_{it} + \varepsilon_{it} \quad (7)$$

Thus, b_1^q and b_2^q denote, respectively, per unit liquidity premium and the effect of unexpected liquidity on stock returns for firms in q -th quartile of the distribution of given characteristics. Estimated liquidity premiums for stocks with different characteristics are delivered in Panel B (for capitalisation), Panel C (for book-to-market value) and Panel D (for stock risk) of Table 2.

In line with the findings of Chiang and Zheng (2015), per unit liquidity premium increases with the stock capitalisation. However, taking into account that bigger companies are characterised by the lower values of amortised liquidity costs, one should notice that total liquidity premium decreases as the stock capitalisation increases. Unlike the results of

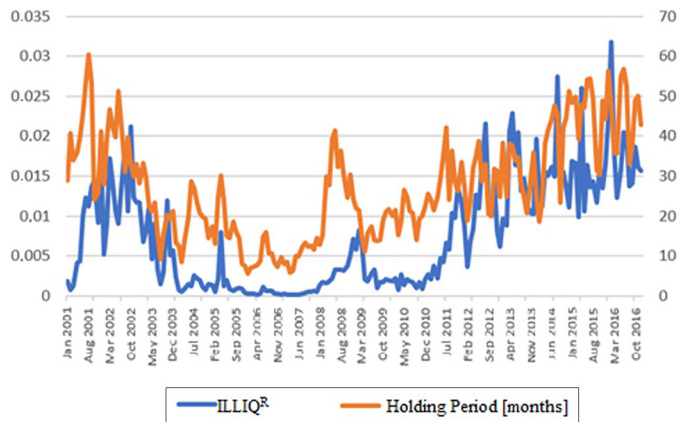


Figure 2.
Liquidity of WSE and
the average holding
period

Chiang and Zheng (2015), there is no clear relationship between stock size and the strength of the effect of unexpected liquidity on stock returns.

An inverse U-shape may be observed in per unit liquidity premium for stocks with various book-to-market values. Chiang and Zheng (2015) report that it is higher for stocks with low rather than with high book-to-market value. The highest per unit liquidity premium is observed for stocks in the second quartile of B-MV. Again, if one considers total liquidity premium, a little bit different pattern is observable: total liquidity premium decreases with B-MV, however not monotonically. As the parameters for unexpected liquidity in two lower quartiles of book-to-market value are statistically insignificant, one may claim that the relationship between unexpected liquidity and returns is stronger for stock with higher B-MV values, similarly as in Chiang and Zheng (2015).

Surprisingly, per unit liquidity premium is lower for stocks with higher return volatility, as evidenced in panel D of Table 2. Highly risky stocks are also more vulnerable to unexpected liquidity than less risky stocks. More risky stocks are also characterised by higher amortised liquidity costs, which results in the fact that total liquidity premium increases with the riskiness of the stock. These findings empirically support the findings of Constantinides (1986) and Stereńczak (2019b), who found that the liquidity premium associated with transaction costs and temporary price impact [4], respectively, increases with the stock return volatility.

3.4 Joint effect of market state and firm's characteristics on liquidity premium

So far, all analyses on conditional liquidity premiums were carried out regarding only various market states or various stock characteristics. Thus, it is natural to join two approaches presented in Sections 3.2 and 3.3. To do so, the following model with triple interactive variables has to be estimated:

$$r_{it} - rf_t = \tilde{a} + \sum_{q=1}^4 b_1^{Hq} Liq_{it-1} \times D_{it}^q \times H_t + \sum_{q=1}^4 b_1^{Bq} Liq_{it-1} \times D_{it}^q \times B_t + \sum_{q=1}^4 b_2^{Hq} Liq_{it}^U \times D_{it}^q \times H_t + \sum_{q=1}^4 b_2^{Bq} Liq_{it}^U \times D_{it}^q \times B_t + \beta' \mathbf{X}_{it} + \varepsilon_{it} \quad (8)$$

Estimated parameters b_1^{Hq} and b_1^{Bq} reflect per unit liquidity premium for stocks in q -th quartile of the distribution of a given characteristic in bull and bear market phase, respectively. Similarly, estimated parameters b_2^{Hq} and b_2^{Bq} reflect the effect of unexpected liquidity on contemporaneous stock returns for stocks in q -th quartile of distribution during bull and bear market, respectively.

The estimates of the per-unit liquidity premium based on the model (9) are presented in Panels C, D and E of Table 3. In general, the relationships between stock capitalisation, book-to-market value, stock risk and liquidity premium presented in Section 3.3 hold only during the bull market, while during the bear market phase such clear relationships do not appear. Findings presented in Section 3.2 hold only partially, as not in all cases estimated per unit liquidity premium during bear markets is quantitatively higher than during bull markets, though statistically insignificant. The only exemptions where these results do not hold are the cases of low capitalisation stocks and highly risky stocks. For these groups of stocks, liquidity premium during bear markets is both statistically significant and quantitatively higher than during bull markets.

Table 3.
Estimate of the per-unit liquidity premium with various modifications

<i>Panel A: estimates for the entire sample</i>					
Variable	$r_{it} - r_{Mt}$	$r_{it} - r_{CAPM}$	$r_{it} - r_{FF3}$	$r_{it} - r_{Carhart}$	
$amLLIQ^R$	8.136*** (3.829)	8.066*** (3.890)	7.725*** (3.232)	7.971*** (4.556)	
$ILLIQ^{RU}$	-0.180*** (3.201)	-0.195*** (3.750)	-0.156*** (2.961)	-0.170*** (3.322)	
<i>Panel B: estimates for bull and bear markets</i>					
Variable	$r_{it} - r_{Mt}$	$r_{it} - r_{CAPM}$	$r_{it} - r_{FF3}$	$r_{it} - r_{Carhart}$	
Bull market - $amLLIQ^R$	8.093*** (3.811)	8.057*** (3.841)	7.749*** (3.190)	7.973*** (4.492)	
Bear market - $amLLIQ^R$	12.661 (0.846)	8.259 (0.922)	5.682 (0.649)	7.324 (0.768)	
Bull market - $ILLIQ^{RU}$	-0.175*** (3.051)	-0.187*** (3.508)	-0.147*** (2.729)	-0.161*** (3.053)	
Bear market - $ILLIQ^{RU}$	-0.350 (1.511)	-0.500** (2.027)	-0.467*** (2.022)	-0.500** (2.148)	
<i>Panel C: estimates for stocks with different capitalisations</i>					
Variable	Low MV	2	3	High MV	
Bull market - $amLLIQ^R$	8.499*** (3.859)	28.365*** (4.224)	62.191** (2.548)	209.009** (2.372)	
Bear market - $amLLIQ^R$	37.652** (2.167)	-48.704 (1.543)	116.564 (1.545)	453.186 (1.388)	
<i>Panel D: estimates for stocks with different book-to-market values</i>					
Variable	Low B-MV	2	3	High B-MV	
Bull market - $amLLIQ^R$	7.985** (2.071)	25.793** (2.226)	12.355*** (4.173)	8.020*** (2.974)	
Bear market - $amLLIQ^R$	9.330 (0.610)	34.492 (1.209)	6.759 (0.294)	42.568 (1.518)	
<i>Panel E: estimates for stocks with different levels of risk</i>					
Variable	Low risk	2	3	High risk	
Bull market - $amLLIQ^R$	27.901*** (3.324)	20.442*** (3.623)	19.930*** (2.883)	7.730*** (3.566)	
Bear market - $amLLIQ^R$	32.321 (1.046)	12.813 (0.574)	-17.485 (0.670)	61.594*** (2.792)	
Notes: Panel A presents estimated per unit liquidity premium after adjusting returns for various risk factors ($r_{it} - r_{Mt}$, $r_{it} - r_{CAPM}$, $r_{it} - r_{FF3}$ and $r_{it} - r_{Carhart}$) is the market-adjusted, CAPM-adjusted, Fama-French three-factor model-adjusted and Carhart model-adjusted stock return, respectively); Panel B presents estimated per unit liquidity premium during bull and bear markets after adjusting returns for various risk factors; Panel C presents per unit liquidity premium during bull and bear markets for stock with different capitalisations (MV); Panel D contains estimated per unit liquidity premium during bull and bear markets for stock with different book-to-market values ($B-MV$) and Panel E presents per unit liquidity premium during bull and bear markets for stock with different levels of risk. t -statistics are given in the parentheses and asterisks denote the statistical significance at the 0.1 (*), 0.05 (**), 0.01 (***) level					

4. Robustness check

To test for the robustness of the results presented in the previous section, a series of robustness test has been applied. At first, to check whether the results are not the effect of the use of specific liquidity measure, two other liquidity measures have been applied, namely, [Fong et al. \(2017\)](#) effective spread estimator and [Amihud's \(2002\)](#) illiquidity ratio computed based on 1 min intervals rather than on daily ones [5]. To test whether the results are robust to the choice of the method of determining the unexpected liquidity, it has been quantified based on the first differences in values of liquidity measure. As the OLS assumption of homoskedasticity of the residuals is not fulfilled in previously estimated models, the WLS estimator has been applied with two different sets of weights to test for robustness. The first set of weights uses the lagged rates of return ([Huh, 2014](#)), and the second one uses the inverse of the unit-specific variance of residuals in the OLS model.

Also, the robustness for the identification of the periods of bullish and bearish markets has been tested, and two different Markov-switching models have been applied, namely, AR (0) and ARCH. To avoid the model risk in the identification of bull and bear market states, a model-free approach has been applied: bull and bear market phases have been identified with a semiparametric method based on the market return. Month t has been assigned to the bull (bear) market state if excess market return in month t is positive (negative).

As all of the modifications mentioned above have been considered jointly, the total number of estimated models is significant. Thus, for conciseness and sake of brevity, the results are not presented here, especially, as they do not provide new insights into researched relationships. However, these results are available upon request.

5. Concluding remarks

The paper was aimed to empirically indicate the factors influencing stock liquidity premium (i.e. the relationship between liquidity and stock returns) in the Polish stock market. The results of the study indicate that there is a statistically significant stock liquidity premium in the WSE. The liquidity premium is partially captured by the return on a market portfolio, market risk premium and size and value risk factors.

The results presented vividly contradict the common sense that liquidity premium increases during the periods of a market downturn. Total liquidity premium turns out to be higher during bull markets rather than during bear markets, which is in line with the results presented by [Jang et al. \(2015\)](#) for the emerging Korean stock market. As our results contradict previous evidence by [Jang et al. \(2017\)](#) and [Grillini et al. \(2019\)](#) on state-dependent liquidity premium in developed markets, this proves that stock liquidity premium in emerging markets behaves differently than in the developed ones. These differences might be a result of differences in the market microstructures between developed and emerging markets. As [Stereczak \(2019b\)](#) presents that in a developed market (the US market has served as an example) permanent price impact dominates a temporary one. In an emerging market (WSE has served as an example) is the opposite: temporary price impact is more pronounced than a permanent one. He also shows that these differences affect the relationships between stock risk and liquidity premium and between expected stock return and liquidity premium as well.

As presented, the lack of a statistically significant increase in liquidity premium during the bear market phase results from the fact that investors lengthen the investment horizon when liquidity worsens. This means that stock liquidity does not significantly affect companies' cost of equity financing causing companies to not have incentives to improve the liquidity of their stocks. Hence, such incentives should be created by entities supervising the capital market.

Per unit liquidity premium increases with the stock capitalisation, decreases with the stock return volatility and takes an inverse U-shape for stocks with different book-to-market value. However, taking into account that amortised liquidity costs increase with book-to-market value and stock return volatility, and decrease with the stock capitalisation, total liquidity premium is higher for stocks with lower capitalisations, higher book-to-market values and higher return volatility. Thus, small and highly risky companies should take care of the liquidity of their shares, as their cost of equity capital (rate of return required by stockholders) is the most impacted by liquidity premium. However, bigger and less risky companies can benefit more from improving the liquidity of their shares. As per unit liquidity premium is higher for those companies, an increase in their shares' liquidity results in a higher reduction of cost of equity capital.

The results presented in the paper may be burdened with the problem of endogeneity as there may exist reverse causality between stock returns and liquidity (Czuderna *et al.*, 2015), and liquidity proxy applied may under- or overestimate the true liquidity. However, applied methods of estimation (i.e. the use of panel data and fixed effects estimator with time dummy variables) allow us to, at least partially, eliminate the problem of endogeneity.

Further studies on the topics discussed in this paper may be pursued in several directions. As the relationships between various companies' characteristics and liquidity premium hold only during periods of bullish market and seem to vanish during periods of the bear market, there is a need for further research on the phenomenon of the peculiar behaviour of liquidity premium in the WSE, especially during the bear market phase. An investigation of the relationships between liquidity premium and stocks' characteristics other than studied in this paper, e.g. return momentum, investment policy and firm's profitability, is of great interest. These factors are included in the six-factor Fama-French model (Fama and French, 2018). Further, one could investigate whether the relationships discovered in this article appear in different markets, both developed and emerging. Finally, considering two factors or more simultaneously (e.g. joint consideration of size and risk) may yield some interesting observations.

Notes

1. See, e.g. for US equities: Amihud and Mendelson (1986), Eleswarapu and Reinganum (1993), Brennan and Subrahmanyam (1996), Chalmers and Kadlec (1998), Datar, Naik and Radcliffe (1998), Chordia, Subrahmanyam and Anshuman (2001), Amihud (2002), Pastor and Stambaugh (2003), Liu (2006), Acharya and Pedersen (2005), Huh (2014), Jang, Kang and Lee (2017), for international developed markets: Lee (2011), Amihud *et al.* (2015), Chiang and Zheng (2015), Grillini *et al.* (2019) and for emerging markets: Bekaert, Harvey and Lundblad (2007), Stereńczak, Zaremba and Umar (2020).
2. One should mention studies carried out by Gajdka *et al.* (2010), Gniadkowska (2012), Garsztko and Rutkowska-Ziarko (2012), Stereńczak (2017), Lischewski and Voronkova (2012) and Olbryś (2014).
3. It might be the case that this is the other way around, i.e. investors with long investment horizon seek for less liquid shares. However, it does not change the fact that per month investor incurs liquidity costs amortised over stock holding period. It is irrelevant what is the cause and what is the effect.
4. One should remain that ILLIQ^R is a modification of Amihud's (2002) illiquidity ratio aimed to capture short-living price pressure, which may be viewed as a temporary price impact as defined by Stereńczak (2019b).

5. These measures have been indicated as one of the best performing in the WSE (Stereńczak, 2019a).

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