Liquidity score and bid-ask spread nexus: Empirical research on exchange traded bonds

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Abstract: Recognition of the liquidity of financial assets is important management and accounting requirement in holding of the bank or trade book of financial security position. Financial theory explains the securities prices bid-ask spread and market liquidity nexus. Market liquidity decreases inventory costs of market makers and reduces the spread value. After the 2007 global financial crisis, Bloomberg has developed a new comprehensive measure of liquidity, accepted by market professionals. Finding the liquidity score and bid-ask spread nexus is the base research objective of the paper. The research of the correlation between bid-ask spread and liquidity score value is done on the public listed fixed income securities on Euronext and London Stock Exchange. The significant negative relations exist only on high liquid debt securities, as well as non-liquid securities. Researching results can be used in investing decisions strategies and in security portfolio classification under the International Financial Reporting Standards requirement.

Key words: liquidity measures, bid-ask spread, liquidity score, IFRS 13.
JEL classification: D82, G24, C10

1 Introduction

Liquid market performs to investors significant trading without impact of significant price variation (Garman, 1976). Liquid assets have to meet price and time condition, meaning that every market supply will meet market demand in acceptable time at objective price equal to assets fundamental value. Higher liquidity has inverse effect on assets return. Many studies connected liquidity with market efficiency and ability to absorb large turnover without causing significant price varying (Easley and O'Hara, 2010). Liquidity is a fundamental characteristic of assets in investment positioning. Liquidity of a financial instrument is important in short run investment decision and in pricing function of financial assets (Chirinko and Schaller, 1995). After the global financial crisis, regulatory framework has taken different aspects of liquidity into consideration, including the fundamental review of trading book (Basel Committee on Banking Supervision, 2012) allocation in net stable funding ratio (Basel Committee on Banking Supervision, 2014) and liquidity coverage ratio under the Basel III regulation (Basel Committee on Banking Supervision, 2010). In business practice liquidity is also important in fair value hierarchy reporting level under the IFRS 13 requirements (International Financial Reporting Standards 13, 2011) and general accepted reporting standards (Committee of European Banking Supervisors, 2009). [1] To increase valuation consistency and reporting comparability in disclosure mechanism reclassification of financial instruments have significant macro prudential effects on balance sheet structure of financial institutions and their market activities (European Systemic Risk Board, 2020).

Modern liquidity measures are based on transaction cost, order execution period, market depth, trading orders quantity, and the count of market dealers (IMF, 2015). Bid-ask spread is a widely used measure of liquidity of financial assets and represents the market transaction costs. On quoted driven market bid and ask are market makers quote prices. Market makers quote bid and ask prices assuming their guarantee to execute buying and selling orders at bid and ask prices.

There are two base models which explain bid-ask spread existence: inventory based and information-based theory (Bailey, 2005). According to the inventory-based theory, bid-ask spread is caused by cost of holding assets inventory, market power and risk aversion. Information based theory ignores inventory costs and makes the focus on informational aspects of price determination. In spite of the base of existence of bid-ask spread on financial market, the fact is that efficient, informed and liquid market should be in inverse relation with the bid-ask spread size. In financial theory and practice, there is no common accepted measure of bond liquidity (Schestag et al., 2016). Most liquidity measures are proxy on available data under the assumption of market efficiency and investors' rational behaviour. Bloomberg's Liquidity Score is the most comprehensive relative measure of liquidity of a particular security. [2] Liquidity Score is a professional contribution to liquidity risk global management that is in the focus of financial regulators after the last financial crisis. It is based on systematic and objective criteria of expected average liquidation costs for a range of trading volume, assuming one-day liquidation horizon (Bloomberg, 2019). The quality of the indicator arises from contributor position and available real time data access. [3] The Liquidity Score reflects the range from 1 to 100, where higher Liquidity Score reflects the lower average liquidation cost for a range of trading volume (Bloomberg, 2019). [4] The liquidity score is developed from available bidding base and real trading effects and activities of market participants and represents the financial markets conditions. The Liquidity Score should be inversely related with bid-ask spread on a particular security, due to the lower inventory costs and lower information asymmetry between the market participants, what is the base researching hypothesis of the paper. In case of significant correlations, bid-ask spread can be used as an appropriate comparative measure of liquidity of securities traded on trading venues. Otherwise, the market makers are exploring insignificant or zero inventory costs in earning extra profits in trading with less informed or non-qualified market participants.

2 Literature review

Tripathi et al. (2019) made a systematic review of available literature on the liquidity of financial markets, importance of the liquidity in market functionality, as well as studies of liquidity measures. Sarr and Lybek (2002) researched the different indicators of liquidity measures used by market participants. Many authors analysed the components of bid-ask spread on financial markets and spread relations with price volatility (Stoll, 1989). One of the alternative measures is bid-ask spread. In analysing trading data on most liquid financial markets, Zhang et al. (2014) tried to explain bid-ask spread as an acceptable liquidity measure researching the securities portfolio traded on most liquid world markets. Ripamonti (2016) analysed the relationship between bid-ask spread, asymmetric information, and security prices at particular financial markets. Corwin and Schultz (2012) developed the bid-ask spread assessment from daily trading data analysing the highest and lowest prices of securities. Amihud and Mendelson (1986) developed the model of bid-ask spread impact on asset pricing and asset volatility. They concluded that return and yield volatility of financial instrument is increasing function of bid-ask spread. In further empirical research, author found positive relations between the return on the security and their liquidity, with suggestions to indicate liquidity of the security with the range of related bid-ask spread (Amihud and Mendelson, 2015). In analysing the segment of emerging markets, Bekaret et al. (2007) found positive relations in market liquidity and bid-ask spread.
Empirical results confirm base theoretical assumptions that bid-ask spread is related with inventory costs and adverse selections with the significant impact of trade turnover (Huang and Stoll, 1997). Other authors explain bid-ask spread in the context of transaction costs where securities with higher transaction costs are less attractive to investors, and accordingly less liquid (Thomas et al., 1991). Roll (1984) first developed model of implicit bid-ask spread, concluding that bid-ask spread is related with security price changes and represents direct investment costs. There is evidence of declining of bid-ask spread with the developing of financial markets and competition between institutional investors, due to the reducing of asymmetric information between market makers (Roll and Subrahmanyam, 2010). Gregoriou et al. (2005) emphasize the role of market makers in increasing of bid-ask spread on condition of enhancement of trading risk. Beside the many theoretical and practical studies of the bid-ask spread impact on liquidity of trading securities, some authors emphasize that bid-ask spread is insufficient liquidity measure and can not be practically used in trading activities (Goyenko et al., 2020).

3 Empirical research

Empirical research will be done on the sample of public quoted bonds at Euronext and London Stock Exchanges. Sample of 7328 bonds is selected based on the criteria that bid and ask quotation is publicly available, as well as Liquidity Score indicator. From the market price quotation, the basis points of bid-ask spread (Bid_Ask_BP) can be calculated from equation as following:[5]

$$Bid\_Ask\_BP = \left(\frac{Ask - Bid}{(Bid + Ask) \cdot 0{,}5}\right) \cdot 10.000 \quad (1)$$

Liquidity Score data are available per particular security on Bloomberg data provider. The Liquidity Score indicate the liquidity level of the security in the range of 1 (non-liquid) to 100 (high liquid) indicating the market opportunity to cash conversion (Bloomberg, 2018).
In order to test the research hypothesis, Pearson's correlation coefficients were calculated. Pearson's correlation test is "a univariate statistical test, which measures the magnitude and the direction of correlation between two numerical variables." The aim of the correlation analysis is to "determine to

what extent two numerical variables are correlated with each other" (Bujang and Baharum, 2016). In this paper, the correlation refers to the bid-ask spread and the Liquidity Score connection, which are the main variables of interest of the research hypothesis. Since the aim of the research is to find that the Liquidity Score is inversely related to the bid-ask spread on a particular security, correlation analysis is an appropriate statistical method for hypothesis testing.

Additionally, both of the variables are numerical, therefore confirming the adequacy of the correlation analysis. Although both trading venues should be efficient and enough liquid, there are significant differences in spread and Liquidity Score relations on the level of particular security, as well as on the industrial sector level (Figure 1).

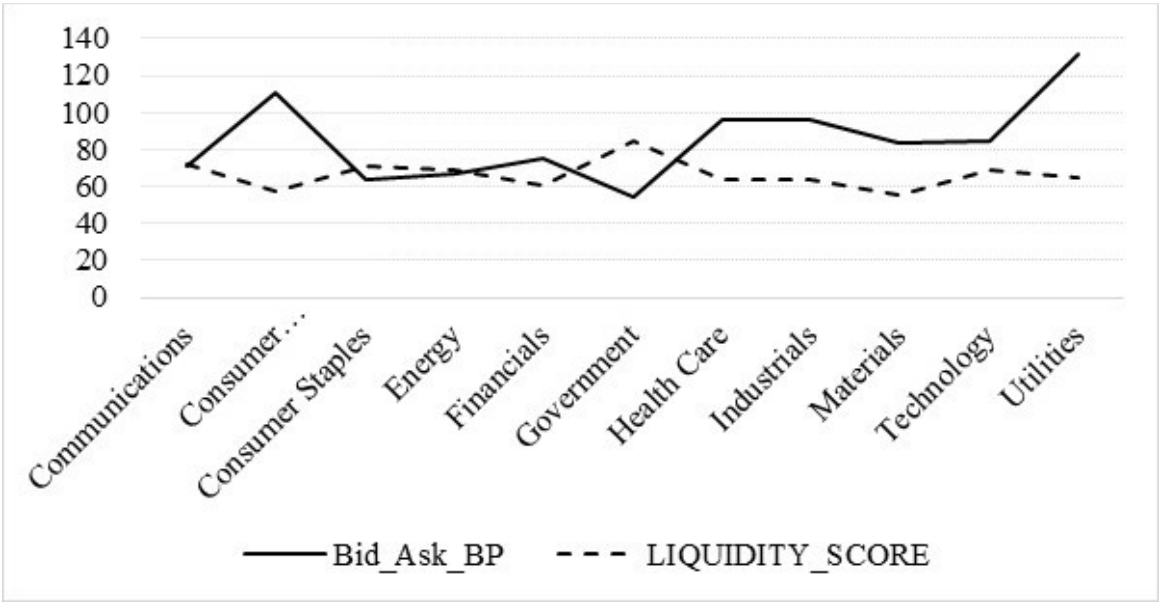

Figure 1 Bid-ask spread (in bp) and Liquidity Score (1 to 100 value scale)
Source: Author calculation based on data from Euronext, London Stock Exchange, and Bloomberg.

Furthermore, the correlation between these two variables was calculated for the whole sample, and individually for 11 types of sectors, based on the sector structure classification on the trading venue, five score groups and eight spread groups, which were defined according to the authors' assessment. The data classification is based on heuristic approach and practical workflow.

However, since the sample includes 7328 bonds, which is a rather large sample, low coefficients may turn out to be statistically significant, even if the variables' relationship is not practically significant (important) (Sari et al., 2017). Therefore, "before conducting any correlation analysis, it is important to plan for the sufficient sample size, to ensure that the results will be able to reach a desired minimum correlation coefficient value with sufficient power and desired type I error or p-value" (Bujang and Baharum, 2016). In this case, a sample size of 193 is needed to be able to detect the correlation coefficient of 0.2 with significance of 0.05 and power of 80.0%.

The values of significance and statistical power, which are taken into consideration for sample size determination in this research, are the most commonly used values (Bujang and Baharum, 2016). Thus, besides calculating Pearson's correlation coefficients for all data included in each of the sectors, score groups and spread groups, calculations were also made for randomly selected 193 bonds of the sample, as well as for randomly selected 193 bonds for each sector, score group and spread group, which initially had more than 193 bond data.

4 Results and discussion

Before conducting the correlation analysis, a classification for the observed sectors, score groups and spread groups was made, in order to calculate the correlation between the bid-ask spread and Liquidity Score for all of those groups individually, as mentioned in the previous section. The classification is shown in table 1. Sectors were simply labelled with numbers from 1 to 11. Score groups were defined based on the Liquidity Score of the bonds, while the spread groups were defined based on the bid-ask spread values of the bonds.

Table 1. Classification of sectors, score groups and spread groups

Sector classification		Score groups		Spread groups	
Sector label	Sector name	Group	Score	Group	Spread
Sector 1	Communications	SC_G5	≤20	SP_G1	0≤G1≤10
Sector 2	Consumer Discretionary	SC_G4	21-50	SP_G2	10<G2≤50
Sector 3	Consumer Staples	SC_G3	51-65	SP_G3	50<G3≤100
Sector 4	Energy	SC_G2	66-80	SP_G4	100<G4≤150
Sector 5	Financials	SC_G1	81-100	SP_G5	150<G5≤200
Sector 6	Government			SP_G6	200<G6≤250
Sector 7	Health Care			SP_G7	250<G7≤300
Sector 8	Industrials			SP_G8	300<G8
Sector 9	Materials				
Sector 10	Technology				
Sector 11	Utilities				

Source: Author calculation based on data from Euronext, London Stock Exchange, and Bloomberg (2024)

The results of the correlation analysis between the Liquidity Score and the bid-ask spread for the whole sample and for the individual sectors can be seen in table 2. Firstly, the last row refers to the correlation for all sectors, when all 7328 bonds are included in the sample. It can be seen that there is a significant negative weak correlation between the Liquidity Score and the bid-ask spread, when considering all bonds. This negative correlation specifically indicates that the bonds with higher Liquidity Score have lower bid-ask spread, and vice versa. To control for the sample size, the next column shows the correlation coefficient for 193 randomly selected bonds from the sample. However, the conclusion is the same, indicating a significant negative weak correlation between the Liquidity Score and the bid-ask spread.

When analysing the correlations through all sectors individually, it can be seen that all Pearson's correlation coefficients are below the threshold of 0.5 in absolute value, indicating a weak correlation. All of the coefficients are also negative and statistically significant.

Therefore, the results for each of the sector confirm the significant weak negative correlation, as for the whole sample. When considering only 193 randomly selected bonds for each sector, the results are rather similar, and the conclusion is generally the same, except for the Sector 8 (Industrials), which shows a non-significant correlation, when analysing only the 193 randomly selected bonds of the sector.

Table 2. Correlation between Liquidity Score and bid-ask spread BP

	All data		n=193 Sample Correlation (p-value)
	N	Correlation (p-value)	
Sector 1	187	-0.202** (0.006)	-
Sector 2	248	-0.343** (<0.001)	-0.300** (<0.001)
Sector 3	266	-0.259** (<0.001)	-0.222** (0.002)
Sector 4	139	-0.182* (0.032)	-
Sector 5	3358	-0.213** (<0.001)	-0.271** (<0.001)
Sector 6	1949	-0.368** (<0.001)	-0.411** (<0.001)
Sector 7	105	-0.321** (0.001)	-
Sector 8	328	-0,181** (0.001)	-0.100 (p=0.168)
Sector 9	107	-0.232* (0.016)	-
Sector 10	37	-0.213** (0.001)	-
Sector 11	604	-0.228** (<0.001)	-0.287** (<0.001)
All sectors	7461	-0.262** (<0.001)	-0,213** (0.003)

Source: Author calculation based on data from Euronext, London Stock Exchange, and Bloomberg.
*significant at the 0.05 level; **significant at the 0.01 level

Table 3 shows the results of the correlation analysis for the bonds from different score groups.

Table 3. Correlation between Liquidity Score and bid-ask spread BP according to Score groups

	All data		n=193 Sample Correlation (p-value)
	N	Correlation (p-value)	
Score group 1	2966	-0.281** (<0.001)	-0.305** (<0.001)
Score group 2	1692	-0.017 (0.476)	-0.084 (0.247)
Score group 3	968	-0.047 (0.141)	-0.023 (0.748)
Score group 4	1268	-0.056* (0.044)	0.033 (0.652)
Score group 5	567	-0.239** (<0.001)	-0.213** (0.003)

Source: Author calculation based on data from Euronext, London Stock Exchange, and Bloomberg.
*significant at the 0.05 level; **significant at the 0.01 level

The correlation results indicate that there is a weak negative relationship between the Liquidity Score and the bid-ask spread in each of the score groups. Considering only the 193 randomly selected bonds from each group, the results are generally not changed.

However, only the correlation coefficients for score group 1 and score group 5 are statistically significant, while the middle score groups show no significant correlation, regardless of the sample size. This specifically means that the significant weak negative relationship between the Liquidity Score and the bid-ask spread exists only for the bonds with the lowest Liquidity Score and those with the highest Liquidity Score, i.e. only in the case of high liquid debt securities, as well as non-liquid securities.

The correlation coefficients obtained for each of the previously defined spread groups can be seen in table 4. Considering all data, the results show that there is a significant weak relationship between the Liquidity Score and the bid-ask spread for all spread groups, except for the spread group 1, spread group 5 and spread group 6. All of those significant correlation coefficient values are rather low, indicating a very weak relationship between the variables. The highest coefficients are obtained for the spread group 7 and the spread group 8. However, when analysing only 193 randomly selected bonds for each of the spread groups, the results are not the same. In this case, the correlation for the spread group 6 becomes significant, while remaining rather weak. When comparing the results for this whole group (n=199), it can be seen that the coefficient is significant only at the 0.1 level, and eliminating only 6 random observations, gives a slightly higher coefficient, with twice as small p-value. Correlations for the spread group 2, spread group 3 and spread group 4 become insignificant, when considering only 193 randomly selected bonds from each of those groups.

Table 4. Correlation between Liquidity Score and bid-ask spread in BP according to Spread groups

	All data		n=193
	N	Correlation (p-value)	Sample Correlation (p-value)
Spread group 1	787	0.050 (0.162)	0.071 (0.330)
Spread group 2	2903	-0.053** (0.004)	-0.100 (0.166)
Spread group 3	2176	-0.064** (0.003)	-0.130 (0.072)
Spread group 4	774	-0.1010* (0.005)	-0.012 (0.863)
Spread group 5	330	0.001 (0.996)	-0.059 (0.411)
Spread group 6	199	-0.117 (0.099)	-0.143* (0.048)
Spread group 7	95	-0.224* (0.029)	-
Spread group 8	197	-0.239** (<0.001)	-0.232** (<0.001)

Source: Author calculation based on data from Euronext, London Stock Exchange, and Bloomberg.
*significant at the 0.05 level; **significant at the 0.01 level

The initial sample size for each of those groups was large, so the results were significant. These coefficients, however, were very low in their values. Therefore, even though the initial analysis for all data included in each group obtained a statistically significant result, it can be concluded that such low

relationships between the Liquidity Score and the bid-ask spread are not practically significant. The results are the same for spread group 1 and spread group 8, regardless of the sample size, while spread group 7 was not further analysed, since it had less than 193 observations. Therefore, according to this analysis, it can be concluded that there is a significant weak relationship between the Liquidity Score and the bid-ask spread only in the case of the bonds with the highest bid-ask spread.

5 Conclusion

Finding the proper quantitative indicator of liquidity of securities traded on trading venue is an important theoretical and empirical issue in investment decisions, as well as in reporting obligation under the new regulatory framework. Bloomberg has developed the first comprehensive measure of liquidity. The Bloomberg Liquidity Score is applicable by market professionals. It is derived from available trading data taking into account all market attributes and giving priority to the opportunity of exiting a particular financial position. In analysing of Liquidity Score and bid-ask spread relations in the researching sample, the base researching hypothesis cannot be accepted, that is in accordance with some empirical studies (Goyenko et al., 2020). Inside the researching sample there is no confirmation of negative relations of the Liquidity Score and bid-ask spread on sub group levels. The result is valid only for high liquid debt securities, as well as non-liquid securities, what can be explained in risk aversion of market participants. Longstaff et al. (2005) emphasize the impact of credit risk on the bond yield spread. Houweling et al. (2005) defined additional proxies that determinate price spread on bond market, including the investor anticipation of risk position, price volatility, issued volume, number of contributors and yield dispersion. Whatever the cause of the difference of the bid-ask spread of the financial instruments traded on trading venue, the fact is that bid-ask spread cannot be an efficient and representative unique measure of liquidity. Available scores from liquid trading venues and professional information contributors can support in resolving the long-term issue of security liquidity evaluation and related bidding and offering pricing values. Researching conclusions can be recommended to regulators, financial institutions, and non-financial institutions to use the Liquidity Score, besides all relevant information including bid-ask spread, in liquidity measurement, liquidity management, and comprehensive reporting obligations under the new regulatory framework. The empirical evidences are based on market quoted securities that restrain the implementation of researching results to non-listed and non-trading portfolio. New MIFID regulatory framework will extend the available trading data from OTC market and will contribute to extent the liquidity measures indicators and their back valuations (Directive EU, 2014).

Endnotes

[1] Financial instruments with quoted prices are allocated to Level 1 liquidity category, financial instruments which are not quoted but are still directly or indirectly observable are allocated to Level 2, while financial instruments which are full unobservable should be allocated to Level 3 under the minimum criteria of IFRS 13 [13: 80, 81, 86].

[2] Bloomberg developed first liquidity assessment tool in estimating cost of liquidity and simplify risk management and reporting process. See more on the following link: https://www.bloomberg.com/company/press/bloomberg -delivers-first-quantitative-model-for-calculating-liquidity-risk/

[3] Since introducing MIFID II regulation Bloomberg became official trading venue (Bloomberg's multilateral trading facility) with MIC code is BMTF.

[4] It should be separated from BVAL score that is not quantitative liquidity measure, only the comparative indicator of active market makers (Bloomberg, 2018). BVAL score values are in range from 1-10 (Bloomberg, 2018).

[5] Bond quoted at Euronext are priced at 19.05.2020 13:00, while bond quoted at London Stock Exchange are priced at 04.06.2020 14:00 when the market is most active and market price should represent daily objective value.

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Appendix

Table 5 Sectorial and Trading Venue structure of the securities in research sample

Trading Venue / Sector	Euronext	London Stock Exchange
Communications	84	103
Consumer Discretionary	126	122
Consumer Staples	73	193
Energy	43	96
Financials	1.558	1.800
Government	1.430	519
Health Care	64	41
Industrials	144	184
Materials	31	76
Technology	35	2
Utilities	204	400

Source: Author calculation based on data from Euronext, London

Analiza odnosa između mjere likvidnosti i raspona kupovnih i prodajnih kotizacijskih cijena: Empirijsko istraživanje na uzorku obveznica sa službenih mjesta trgovanja

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***Sažetak**:* Identifikacija stupnja likvidnosti financijskih imovina značajna je u procesu upravljanja i računovodstvenog priznavanja pozicija u vrijednosnim papirima priznatim u knjizi trgovanja ili knjizi banke kod bankovnih financijskih posrednika. Financijska teorija kao najznačajniji indikator likvidnosti vrijednosnih papira uzima raspon između kotiranih kupovnih i prodajnih cijena. Tržišna likvidnost vrijednosnih papira što se indicira u malom rasponu kupovnih i prodajnih cijena smanjuje troškove zauzimanja dugih ili kratkih pozicija kod ključnih nositelja trgovanja na financijskim tržištima. Nakon globalne financijske krize iz 2007 godine Bloomberg razvija novu složenu mjeru likvidnosti financijskih imovina prihvaćenu od strane profesionalnih sudionika financijskog sustava. Temeljni cilj ovoga rada jeste u analizi veze između nove mjere likvidnosti financijskih imovina te njihova raspona kupovnih i prodajnih kotacijskih cijena. Empirijska veza između pokazatelja bit će analizirana na temelju podataka javno kotiranih vrijednosnih papira na dva najveća službena tržišta, Euronext i Londonske burze vrijednosnih papira. Analizom je dokazana značajnost negativne veze između mjere likvidnosti i raspona kotacijskih cijena kod visoko likvidnih dužničkih vrijednosnih papira, ali i kod vrijednosnih papira nižeg stupnja likvidnosti. Rezultati istraživanja mogu se koristiti kod donošenja investicijskih strategija te klasifikaciji portfelja prema stupnju njihove likvidnosti sukladno zahtjevu Međunarodnih standarda financijskog izvještavanja.

Ključne riječi: stupanj likvidnosti, raspon kupovnih i prodajnih cijena, indeks likvidnosti, IFRS 13.
***JEL klasifikacija*:** D82, G24, C1