Bank i Kredyt 53(6), 2022, 565-586

BANK I KREDYT
BANK & CREDIT

The liquidity of shares and the risk of bankruptcy

Agata Gniadkowska-Szymańska*

Submitted: 16 April 2021. Accepted: 8 August 2022.

Abstract

The aim of the article is to present the problem of the relationship between the liquidity of shares and the risk of bankruptcy. Integrating the respective approaches should reveal whether the liquidity of shares will affect the bankruptcy of a company. The study analyses companies from the Warsaw Stock Exchange included in the WIG index, from the Frankfurt Stock Exchange included in the DAX index and from the Baltic countries' market included in the OMXBBGI index listed on the Nasdaq stock exchanges in Tallinn, Riga and Vilnius. It involved several separate evaluations conducted with the use of various measures describing liquidity based on the data obtained for the Polish, German and the Baltic countries' markets, and it confirms the hypothesis put forward at the beginning of the study that there is a statistically significant relationship between the liquidity of shares and the bankruptcy risk of the company.

Keywords: financial liquidity, bankruptcy, the economic condition of companies, capital market, liquidity of shares

JEL: G12, G13, G32, G33, M2

* University of Lodz, Faculty of Economics and Sociology, Department of Capital Market and Investments; e-mail: agata.gniadkowska@uni.lodz.pl; ORCID: 0000-0002-7321-3360.

1. Introduction

Assessing the economic condition and liquidity of companies on the capital market must acknowledge the purpose of their operations. One should also take into account the influence of financial liquidity on the economic condition of companies in the context of investors' expectations; they are guided by decision-making ratios, which are also a cost of capital (Penman 1996).

The author understands companies on the capital market as companies that raise capital through the issuance of financial instruments traded on the secondary market. Alternatively, it is a company which can be compared to such business entities, making it possible to conduct an appropriate comparative analysis. The characteristic feature of the capital market is that the assessment of a given company's economic condition is made in relation to investors' expectations, among other factors (Geetha et al. 2011). On the capital market, the company's goal is to maximize its market value. Maximizing value and, consequently, profitability is related to the management of financial liquidity, a minimum level of which enables the maximization of profitability, but can also lead the company into bankruptcy (O'Connell, Ward 2020). This paper studies three European stock markets, examining companies grouped in key broad-market indices: the WIG index for Poland, DAX for Germany and OMXBBGI for the joined market of the Baltic countries.[1] These countries represent a variety of economies that comprise the EU. The strength of the relationship under examination may be associated with market characteristics, such as the size of the country or the liquidity and age of the stock of exchange. The stock market may affect economic activity through the creation of liquidity. Liquid equity markets make investments less risky and more attractive because they allow savers to purchase financial instruments and sell them when necessary. Meanwhile, new stock markets provide timely and accurate information about companies to investors.

One of the factors that investors increasingly pay attention to is the liquidity of a given security. The liquidity of assets in the financial market is usually understood as the cost and ease with which individual types of shares can be converted into cash. Many basic models built within this theory in its classic form did not, however, give a comprehensive account of problems related to liquidity (Hearn, Piesse, Strange 2010).

The liquidity of shares can have a huge impact on the risk of bankruptcy. The increasing liquidity of stock trading may lead to high volatility of the share price of a given company (see: Goldstein, Guembel 2008; Polk, Sapienza 2008; Ozdenoren, Yuan 2008) or reduce the ability to monitor what is happening on the market by managers of a given company (Bhid 1993). However, higher liquidity of shares may, in some situations, lead to a lower risk of bankruptcy by improving both corporate governance for investors and the efficiency in the valuation of securities issued by the company. Fang et al. (2009) confirmed in their research that an increase in the liquidity of trading in shares of a given company may lead to an increase in its value, which is very much desired by investors.

The aim of the article is to present the problem of the relationship between the liquidity of shares and the risk of bankruptcy. Integrating the respective approaches should reveal whether the liquidity of listed assets will affect the bankruptcy of a company.

[1] By Baltic countries the author understands Lithuania, Latvia, and Estonia. Together, they form the Nasdaq Baltic, with exchanges in Tallinn, Riga, and Vilnius.

2. Liquidity of shares

The liquidity of assets on the capital market is understood by investors as the ease with which a given type of assets can be converted into cash; in other words, it is the easiest way to sell. High liquidity of trading is a very desirable feature of the market (Utami, Wahyuni, Nugroho 2020). Low liquidity means that investors will demand a liquidity risk premium because they consider the danger of there being no possibility of reselling large blocks of shares at the price the market offers for small packages. Investment portfolio managers earn by diversifying the investments included in a given portfolio in terms of liquidity preferences and the client's time horizon (Edelman, Baker 1990). However, despite the obvious importance of liquidity in making investment decisions, it has not found the rightful place in financial theory. Even the Capital Asset Pricing Model (CAPM) does not pay attention to the effects of the liquidity of assets or the time span for which investments are made (Fraser, Groth, Byers 1996). Admittedly, the situation has changed since the mid-1980s, when the liquidity issue was formally introduced into the analysis of the financial market. The work by Amihud and Mendelson (1986), which in a theoretical manner and through empirical research showed the existence of a relationship between the rate of return on shares and the liquidity measured by the spread on the American market, is considered to be of special importance in this respect. Subsequent studies confirmed the thesis put forward in this paper that liquidity exerts a significant influence on share prices and their rates of return (Shannon et al. 2000; Chordia, Roll, Subrahmanyam 2000; Dater, Hirst, Jones 1998; Chan, Faff 2005; Acharyal, Pedersen 2005). As a result, the liquidity problem began to be taken into account in financial models, such as the CAPM, for which versions were created that included liquidity effects (Liu 2006; Martınez et al. 2005). There is an abundance of evidence that liquidity affects profits from shares. However, the liquidity of shares is still difficult to define and measure (Chan, Wong 2004). The commonly accepted definition of liquidity is the ability to trade shares in large quantities without affecting the prices. Yet, a serious debate continues on defining precisely what liquidity is and the role that it plays. Acharya and Pedersen (2005) see the liquidity effect as a trait (the return on investment depends on the level of liquidity) and as a risk factor. Korajczyk and Sadka (2008), using high-frequency data, confirm that both the liquidity risk and its level have an impact on the valuation of shares.

There are many liquidity measures, although turnover ratio is the most popular. The turnover ratio is simply the average number of shares in a given company traded in a given period, divided by the number of shares in the company in that period. The turnover rate is a non-quantified (or percentage) value (Campbell, Grossman, Wang 1993) expressing a relative size. Being unencumbered by the effect of the size of the company, it is particularly useful in any comparative analysis of the liquidity of capital assets.

It is expressed by the formula:

$$Turnover_{it} = \frac{\sum_{j=1}^{d_t} vol_{it}}{SO_{it}} \tag{1}$$

where:

vol_{it} – the average number of shares i traded in period t,

SO_{it} – the number of shares i existing in period t.

In the case of an instrument with a turnover ratio of 100%, it can be said that during the audited period, all shares were traded. Research on the turnover ratio as a measure of liquidity was presented by, among others, Brennan and Subrahmanyan (1996), Bertsimas and Lo (1998), Pastor and Stambaugh (2003), Acharya and Pedersen (2005), and Sadka (2006).

Another measure of liquidity is spread, which was used in the first studies starting with Amihud and Mendelson (1986). Hasbrouck (2009) proposes a new way to estimate effective spreads. However, he only found a weak impact on the stock price, and he did not confirm the impact of the liquidity risk on the return rate expected by investors.

The measure proposed by Amihud (2002) is the most popular asset liquidity measure. This measure is used in many empirical studies on markets around the world (Acharyal, Pedersen 2005; Bekaert, Harvey, Lundblad 2007; Goyenko, Holden, Trzcinka 2009; Lischewski, Voronkova 2012; Lesmond 2005). The Amihud measure is determined on the basis of daily data, usually on a monthly scale, but the design of the formula also makes it possible to calculate this measure with a frequency other than monthly.

A lack of liquidity is defined as:

$$ILLIQ_{it} = \frac{1}{D_{it}} \times \frac{\sum_{t=1}^{D_{it}} |R_{itd}|}{DVOL_{itd}} \tag{2}$$

where:

D_{it} – the number of days in which stock quotes took place in a given week or month,
R_{itd} – the absolute value of the daily rate of return for the shares i under investigation,
$DVOL_{itd}$ – the daily volume of transactions in shares i in PLN.

This indicator shows the daily impact of orders on prices (Amihud 2002). The measure is not specified for days with zero turnover. The ratio of lack of liquidity assumes high (low) values in the case of low (high) liquidity. In contrast to the other measures, it is expressed as the average daily rate of return per unit of monetary turnover (on the Polish market – per 1 thousand PLN turnover) (Olbryś 2013).

This indicator was used in its original form in the work of many researchers (Acharya, Pedersen 2005; Bekaert, Harvey, Lundblad 2007; Goyenko, Holden, Trzcinka 2009; Lischewski, Voronkova 2012; Lesmond 2005). However, there are frequent modifications, such as using the inverse of the indicator. Hasbrouck (2009) emphasizes in his work that index modifications often lead to inaccuracies in calculations.

3. The risk of bankruptcy

Under conditions of uncertainty, it is important to analyse the economic standing of companies to identify hazards and shape future strategies. An economic and financial analysis of past and present results should prepare for future events and possible scenarios. It is important to recognize crises and threats in the examined company early because it means the right decisions can be made (Soboleva et al. 2018).

Apart from simple financial and accounting indicators, the analysis of the company's financial situation also includes various methods of bankruptcy risk assessment (Ezzamel, Willmott, Worthington 2008). There are simple and complex methods, which give great opportunities to control the health of an organizational unit. With the help of numerous indicators, it is possible to draw conclusions with respect to the most important areas of operation. In terms of the financial result, the property and financial situation of a company or the efficiency of using the resources held, economic entities carry out their analyses with the help of numerous indicators. Accurate selection of the structure and the entire set of indicators makes it possible to obtain the correct pattern of financial and economic activity and determine the company's condition (Bratamanggala 2018). The examination of the economic situation is related to the liquidity and bankruptcy arrangements, but it should also take into account investors' expectations in terms of maximizing the value of the company. The possibility of predicting the bankruptcy of a company has always been an area of interest for many scientists and, therefore, attempts have been made to construct tools that are sufficiently precise to determine whether a company is threatened with bankruptcy or not (Holder-Webb, Wilkins 2000; Chava, Jarrow 2004; Reisz, Perlich 2007). The general need to build such tools appeared for the first time during the Great Depression, at the turn of the 1920s and 1930s (Altman, Hotchkiss 2006). In the course of research and analyses, new methods were developed that allowed making a relatively quick and effective assessment of a company's condition on the basis of economic and financial data (Franc-Dąbrowska, Zbrowska 2008). They mainly used information from internal sources, i.e. from the balance sheet and the profit and loss account.

One of the first works on the creation of a model that could predict a company's bankruptcy was carried out as far back as 1968 by Edward I. Altman. Altman can be considered the forefather of the use of multidimensional discriminant analysis to predict the risk of enterprise bankruptcy. In 1968, he constructed the Z-score (Z-Score Bankruptcy Predictor) model, for which he used financial data from 66 US companies, 33 of which were bankrupt, and 33 which had been operating on the market without interruption (Altman 1968). The studies initiated by Altman were then continued by numerous authors who developed similar models for economies of different countries using ever more modern methods of multidimensional data analysis (Kumar, Ravi 2007; Altman et al. 2014; Aktas et al. 2012; Lyandres, Zhdanov 2013).

In Poland and in the Baltic countries, the problem of forecasting bankruptcy was also considered, especially when their economies were undergoing transformation from a centrally planned economy to a market economy after the fall of communism. Thus, the need arose to build discriminatory models for Polish economic realities. Many Polish scientists addressed this problem, resulting in the creation of models based on various indicators (Gajdka, Stos 1996; Hamrol, Czajka, Piechocki 2004; Mączyńska, Zawadzki 2006; Hadasik 1998). It should be noted that analysing data from financial statements and indicator analysis are the most frequently used methods for assessing the economic and financial standing of companies (Kliestik, Vrbka, Rowland 2018). The analysis of companies on the basis of absolute values is simpler, but less objective in comparison to multidimensional models. Multidimensional analysis is not an entirely effective method, however (Achim, Mare, Borlea 2012). This is caused by the high uncertainty and propensity for change of economic processes in emerging countries in the last twenty years. The low usefulness of multidimensional models is also determined by the insufficient amount of data on bankrupt companies, the insufficient number of units under examination, the diversity of legal forms, and plenitude of models having been tailored for selected

industries only (Brozyna, Mentel, Pisula 2016). It is worth noting, however, that the creation of multidimensional models has contributed to the development of this area and it has set new directions for research. It can be expected that the international applicability of a model to other countries is affected by country-specific differences. Economic environment, legislation, culture, financial markets and accounting practices in a country may affect the financial behaviour of firms and shift the boundary between bankrupt and non-bankrupt entities. These factors may potentially weaken the classification performance of the model in other countries outside the country in which the model was originally estimated (Ooghe, Balcaen 2007).

4. Data

The study analyses companies from the WIG index (i.e. the Warsaw Stock Exchange Index), the main index of the Warsaw Stock Exchange. Regarding the Baltic countries' market, the subject of analysis is companies included in the OMXBBGI index listed on the Nasdaq stock exchanges in Tallinn, Riga and Vilnius. The present article also examines companies from the Frankfurt Stock Exchange included in the DAX index.

The survey was carried out between 31 March 2012 and 31 December 2017. Only companies that were included in each of the analysed indexes at the end of 2017 were analysed. The Bloomberg database, which includes quotations of shares in the entire period from 31 March 2012 to 31 December 2017, was used. The prices have been adjusted for the type of subscription rights, dividends, and splits. The study was conducted using quarterly rates of return calculated on the basis of prices from the last day of each quarter.

The analysed markets represent small and large countries and liquid and non-liquid as well as new and old exchanges within the EU. The information about the markets is presented in Table 1. There are liquid exchanges, like those in Germany and the Baltic countries, and non-liquid ones like that in Poland. The old exchanges are those based in Germany and the new ones are located in Poland and the Baltic countries.

In order to estimate the risk of bankruptcy, the expected default frequency (EDF) measure created by Bharath and Shumway (2008), which is a simplified measure of Merton (1974), was used. The EDF measure is calculated according to the formula:

$$DD_{it} = \frac{\log\left(\frac{E_{i,t} + D_{i,t}}{D_{i,t}}\right) + \left(\mathrm{r}_{i,t-1} - \frac{\sigma^2_{Vi,t}}{2}\right) \times T_{i,t}}{\sigma_{Vi,t} \times \sqrt{T_{i,t}}} \tag{3}$$

$$\sigma_{i,t} = \frac{E_{i,t}}{E_{i,t} + D_{i,t}} \times \sigma_{Ei,t} + \frac{D_{i,t}}{E_{i,t} + D_{i,t}} \times \left(0.05 + 0.25 \times \sigma_{Ei,t}\right) \tag{4}$$

$$EDF_{i,t} = N\left(-DD_{i,t}\right) \tag{5}$$

where:

$E_{i,t}$ – the value of the company's equity in period t,
$D_{i,t}$ – the value of the liabilities (debt) of the company in period t,
$r_{i,t-1}$ – the rate of return on the company's shares in period $t-1$,
$\sigma_{Vi,t}$ – the volatility of the company's assets in period t,
$\sigma_{Ei,t}$ – the volatility of the company's share price in period t,
$T_{i,t}$ – a variable denoting the time remaining to the asset maturity date calculated as a fraction of the year,
$N(.)$ – normal distribution.

The research aimed to check how the liquidity of shares issued by a given company would affect both its bankruptcy and its growth potential. Three popular liquidity measures have been used: spread, turnover ratio and Amihud's liquidity ratio (Amihud 2002).

Table 2 presents the basic statistics of data used in the study for all analysed markets.

To detect collinearity in the model the Variance Inflation Factor (VIF) statistics was used. The independent variables were not collinear because most VIF values were < 5. Table 3 shows the correlation between variables used in the study for all analysed markets.

5. Methodology and results

The purpose of the study is to determine if there is a statistically significant relationship between the risk of bankruptcy, the liquidity of shares and the possibilities of increasing the value of a given company. To this end, two models were analysed for all the markets studied.

The first model checked whether there is a statistically significant relationship between the liquidity of shares and the risk of bankruptcy. The applied research methodology is similar to that described by Brogaard, Li and Xia (2017). Initially, the relationship between the liquidity of shares and the risk of bankruptcy and control variables will be checked. For this purpose, the model is estimated according to the formula:

$$EDF_{i,t} = \alpha + \beta L_{i,t-1} + \gamma_1 \ln(E)_{i,t-1} + \gamma_2 \ln(D)_{i,t-1} + \gamma_3 \frac{1}{\sigma_{Ei,t-1}} + \gamma_4 r_{i,t-1} + \gamma_5 ROA_{i,t-1} + \varepsilon_{i,t} \quad (6)$$

where:

$L_{i,t}$ – one of three liquidity measures (spread, ILLIQ or turnover) calculated for the company at time $t-1$,
$E_{i,t-1}$ – the value of the company's equity in period $t-1$,
$D_{i,t-1}$ – the value of liabilities (debt) of the company in period $t-1$,
$r_{i,t-1}$ – the rate of return on the company's shares during period $t-1$,
$\sigma_{Ei,t-1}$ – the volatility of the company's share price in period $t-1$,
$ROA_{i,t-1}$ – the profitability of the company's assets in period $t-1$.

The second model, on the other hand, checked whether there is a statistically significant relationship between the risk of bankruptcy and the possibilities of the value of a given company increasing. The applied research methodology is similar to that described by Brogaard, Li and Xia (2017). The relationship between the risk of bankruptcy and the possibilities of the value of a given company increasing and the control variables will be checked here. For this purpose, the model is estimated according to the formula:

$$EDF_{i,t} = \alpha + \beta TQ_{i,t-1} + \gamma_1 \ln(E)_{i,t-1} + \gamma_2 \ln(D)_{i,t-1} + \gamma_3 \frac{1}{\sigma_{Ei,t-1}} + \gamma_4 r_{i,t-1} + \gamma_5 ROA_{i,t-1} + \varepsilon_{i,t} \quad (7)$$

where $TQ_{i,t-1}$ is the Tobin's Q ratio of the company in period $t - 1$.

Based on the methodology described by Brogaard, Li and Xia (2017), and according to formula (6), a preliminary analysis was carried out of the relationship between bankruptcy risk and the liquidity of shares and the control variables for the collected data, leading to the results described in Table 4. In total, three calculations of different model variants were made for each of the examined markets, taking into account all the variables concerning the liquidity of shares. Several models were estimated by the heteroskedasticity-corrected model with inclusion of various independent sets of variables. The model specification was also analysed using the RESET test, which indicated the correctness of the model used (p-value > 0.05).

Columns 1 to 3 in Table 4 present calculations for three models, where the dependent variable (EDF) depended on three different liquidity measures of the company's shares: spread, ILLIQ and turnover ratio. As can be seen from the calculations made in parts A and B of Table 4 based on data from Germany, which is a large market with a highly liquid and mature stock exchange, and on data from the Baltic countries, which constitute a small, new and highly liquid market, all three liquidity measures are important in shaping the bankruptcy risk of a given company. However, from the data presented in part C of Table 4, it appears that only liquidity expressed as a spread or a turnover ratio is significant for the risk of bankruptcy of companies on the Polish market, which constitutes an example of a large market with a new stock exchange characterized by low liquidity. The calculations presented in part A and B of Table 4 show that in the case of liquidity expressed as ILLIQ, this variable has a positive impact on the risk of bankruptcy, i.e. the greater the liquidity of the company's shares, the lower the risk of bankruptcy. The same results were obtained for liquidity expressed as a spread for the German and Polish markets. The results obtained for the spread on the German and Polish markets, and ILLIQ on the Germany and the Baltic countries' markets, are in line with the results obtained by Brogaard, Li and Xia (2017) for highly developed markets. The calculations presented in part B of Table 4 show that in the case of liquidity expressed as a spread, this variable adversely affects the risk of bankruptcy, i.e. the greater the liquidity of the company's shares, the greater the bankruptcy risk. As regards liquidity expressed as a turnover rate, it is statistically significant in all three examined markets and positively affects the risk of bankruptcy, which means that the liquidity of the company's shares should increase the bankruptcy risk of the company, which is not consistent with the results obtained for highly developed markets.

In the case of the other variables, when the calculations were made based on data from the German market, only in the case of the model where the variable determining liquidity was ILLIQ did the rate of return on shares and return on assets not significantly affect the risk of bankruptcy. However, when

the calculations were made on data from the Baltic countries' market, only the return on assets and their volatility had a significant impact on the bankruptcy risk, irrespective of the variable determining liquidity. In the calculations performed for data from the Polish market, the return on shares and the return on assets did not significantly affect the bankruptcy risk, irrespective of the liquidity variable.

The goodness-of-fit of all three models calculated for the data from the German market and the Baltic countries' market to real data, as measured by the adjusted R^2 factor, is about 0.99. However, the goodness-of-fit of all three models constructed for the data from the Polish market to real data, as measured by the adjusted R^2 factor, is about 0.63.

In addition, it was also checked whether there is a statistically significant relationship between the risk of bankruptcy and the potential for an increase in the value of a given company, expressed by the Tobin's Q ratio. Based on the methodology described by Brogaard, Li and Xia (2017), the relationships between the risk of bankruptcy and the possibilities of a company's value increasing, as well as control variables for the collected data, have been checked in accordance with equation (7) in Table 5. All models were estimated by the heteroskedasticity-corrected model with inclusion of various independent sets of variables. The model specification was also analysed using the RESET test, which indicated the correctness of the model used (p-value > 0.05).

As can be seen from the calculations made in parts A and B of Table 5, based on data from Germany, representing a large and mature market with a highly liquid stock exchange, and from the Baltic countries, representing a small, new and highly liquid market, the variable determining the growth potential of a given company is of significant importance in shaping the bankruptcy risk of this given company. The calculations presented in parts A and B of Table 5 show that the variable defining the possibility of the value of a given company increasing affects the risk of bankruptcy positively, i.e., the greater the company's growth potential, the greater the bankruptcy risk. These results are in line with the results obtained by Brogaard, Li and Xia (2017) for highly developed markets. However, in the case of calculations made for Poland, representing a large market with a new stock exchange characterized by low liquidity, the variable determining the possibilities of the value of a given company increasing is not significant in shaping the bankruptcy risk of this company.

6. Conclusions

It is quite difficult to capture the relationship between the liquidity of a company's shares and its risk of bankruptcy. Often, stock market investors pay attention to only one of these aspects. However, as shown by research carried out on highly developed markets (Brogaard, Li, Xia 2017) as well as the research presented in this study carried out for the Polish, German, and Baltic markets, the relationship between the liquidity of shares of a given company and its risk of bankruptcy does occur in reality. An additional study, also for two markets (Germany and the Baltic countries), regarding the possibility of a company growing while under risk of bankruptcy, was confirmed by research carried out both on highly developed and developing markets (Danbolt, Hirst, Jones 2011; Bolek 2018). These studies showed that the risk of bankruptcy also depends on the growth potential of the company.

The validity of our preliminary conclusion about the importance of the large-or-small country effect is unfortunately limited because it comes only from the generalization of the research results obtained for separate markets. The econometric analysis in which the data for all markets were pooled

together and market characteristics were included as additional explanatory variables in regression models showed that the size of a country seems to play no role in determining the relationship between the liquidity of a company's shares and the risk of bankruptcy. In contrast, the liquidity of the stock exchange can influence the efficiency of the market.

Having conducted several separate studies using various measures describing liquidity based on the data obtained for the Polish, German and Baltic markets, the author can confirm the hypothesis put forward at the beginning of the study that there is a statistically significant relationship between the liquidity of share trading and the bankruptcy risk of the issuing company. Regardless of the liquidity measure chosen, in most cases the relationship between the liquidity of trading and the risk of bankruptcy of a given company on the Warsaw Stock Exchange, the Frankfurt Stock Exchange, and the stock exchanges of the Baltic countries was confirmed. This allows us to conclude that another variable has been found which should be taken into account by investors and market analysts when valuing securities and estimating the return on investment. For institutions monitoring capital markets and the financial system, the results of this work may shed some light on the liquidity problem of the entire capital market, which would make it possible to take appropriate measures to increase this liquidity. Also, in the context of capital valuation, e.g. in the case of a placement of shares or a sale of a company where the CAPM model approach prevails, the results of the study can be used for a more accurate and broader valuation, taking into account the characteristics and sensitivities of companies indicated in this work.

Further research can be related to the analysis of companies that have gone bankrupt and their growth before the distress, whether it had been faster than the market average or not, in order to determine new factor influencing bankruptcy.

References

Acharya V., Pedersen L.H. (2005), Asset pricing with liquidity risk, *Journal of Financial Economics*, 77(2), 375–410.

Achim M.V., Mare C., Borlea S.N. (2012), A statistical model of financial risk bankruptcy applied for Romanian manufacturing industry, *Procedia Economics and Finance*, 3, 132–137.

Aktas N., de Bodt E., Lobez F., Statnik J.-C. (2012), The information content of trade credit, *Journal of Banking and Finance*, 36, 1402–1413.

Altman E.I. (1968), Financial ratios, discriminant analysis and the prediction of corporate bankruptcy, *Journal of Finance*, 4(23), 589–609.

Altman E.I., Hotchkiss E. (2006), *Corporate Financial Distress and Bankruptcy*, John Wiley & Sons.

Altman E.I., Iwanicz-Drozdowska M., Laitinen E.K., Suvas A. (2014), *Distressed firm and bankruptcy prediction in an international context: a review and empirical analysis of Altman's Z-score model*, SSRN 2536340.

Amihud Y. (2002), Illiquidity and stock returns: cross-section and time-series effects, *Journal of Financial Markets*, 5, 31–56.

Amihud Y., Mendelson H. (1986), Asset pricing and a bid-ask spread, *Journal of Financial Economics*, 17, 223–249.

Bekaert G., Harvey C.R., Lundblad C. (2007), Liquidity and expected returns: lessons from emerging markets, *The Review of Financial Studies*, 20(6), 1783–1831.

Bertsimas D., Lo A.W. (1998), Optimal control of execution costs, *Journal of Financial Markets*, 1(1), 1–50.

Bharath S.T., Shumway T. (2008), Forecasting default with the Merton distance to default model, *The Review of Financial Studies*, 21(3), 1339–1369.

Bhid A. (1993), The hidden costs of stock market liquidity, *Journal of Financial Economics*, 34(1), 31–51.

Bolek M. (2018), *Determinanty wzrostu przedsiębiorstw na rynku kapitałowym*, Wydawnictwo Uniwersytetu Łódzkiego.

Bratamanggala R. (2018), Factors affecting earning per share: the case of Indonesia, *International Journal of Economics & Business Administration* (*IJEBA*), 6(2), 92–100.

Brennan M.J., Subrahmanyam A. (1996), Market microstructure and asset pricing: on the compensation for illiquidity in stock returns, *Journal of Financial Economics*, 41, 441–464.

Brogaard J., Li D., Xia Y. (2017), Stock liquidity and default risk, *Journal of Financial Economics*, 124(3), 486–502.

Brozyna J., Mentel G., Pisula T. (2016), Statistical methods of the bankruptcy prediction in the logistics sector in Poland and Slovakia, *Transformations in Business & Economics*, 15(1), 80–96.

Campbell J.Y., Grossman S.J., Wang J. (1993), Trading volume and serial correlation in stock returns, *The Quarterly Journal of Economics*, 108(4), 905–939.

Chan H., Faff R. (2005), Asset pricing and illiquidity premium, *The Financial Review*, 40, 429–458.

Chan K.C., Wong A. (2004), Long-term effects following voluntary move from American Stock Exchange to Nasdaq, *Review of Accounting and Finance*, 3(2), 48–61, https://doi.org/10.1108/eb043402.

Chava S., Jarrow R.A. (2004), Bankruptcy prediction with industry effects, *Review of Finance*, 8, 537–569.

Chordia T., Roll R., Subrahmanyam A. (2000), Commonality and liquidity, *Journal of Financial Economics*, 56(1), 3–28.

Danbolt J., Hirst I.R., Jones E. (2011), The growth companies puzzle: can growth opportunities measures predict firm growth?, *The European Journal of Finance*, 17(1), 1–25.

Dater V., Hirst I.R., Jones R. (1998), Liquidity and stock returns: an alternative test, *Journal of Financial Markets*, 1, 203–219.

Edelman R.B., Baker H.K. (1990), Liquidity and stock exchange listing, *Financial Review*, 25(2), 231–249.

Ezzamel M., Willmott H., Worthington F. (2008), Manufacturing shareholder value: the role of accounting in organizational transformation, *Accounting, Organizations and Society*, 33(2–3), 107–140.

Fang F., Oosterlee C. W. (2009), A novel pricing method for European options based on Fourier-cosine series expansions, *SIAM Journal on Scientific Computing*, 31(2), 826–848.

Franc-Dąbrowska J., Zbrowska M. (2008), Prognozowanie finansowe dla spółki X – spółka logistyczna, *Zeszyty Naukowe SGGW w Warszawie. Ekonomika i Organizacja Gospodarki Żywnościowej*, 64, 251–270.

Fraser D.R., Groth J.C., Byers S.S. (1996), Liquidity revisited, *Studies in Economics and Finance*, 17(1), 3–32, https://doi.org/10.1108/eb028724.

Gajdka J., Stos D. (1996), Wykorzystanie analizy dyskryminacyjnej w przewidywaniu bankructwa spółki, in: Duraj J. (ed.), *Przedsiębiorstwo na rynku kapitałowym*, Wydawnictwo Uniwersytetu Łódzkiego.

Geetha C., Mohidin R., Chandran V.V., Chong V. (2011), The relationships between inflation and stock market: evidence from Malaysia, United States and China, *International Journal of Economics and Management Science*, 1(1), 1–16.

Goldstein I., Guembel A. (2008), Manipulation and the allocational role of prices, *The Review of Economic Studies,* 75(1), 133–164.

Goyenko R.Y., Holden C.W., Trzcinka C.A. (2009), Do liquidity measures measure liquidity?, *Journal of Financial Economics*, 92(2), 153–181.

Hadasik D. (1998), *Upadłość przedsiębiorstw w Polsce i metody jej prognozowania*, Zeszyty Naukowe. Seria 2, Prace Habilitacyjne, 153, Akademia Ekonomiczna w Poznaniu.

Hamrol M., Czajka B., Piechocki M. (2004), Upadłość przedsiębiorstwa – model analizy dyskryminacyjnej, *Przegląd Organizacji*, 6, 35–39.

Hasbrouck J. (2009), Trading costs and returns for US equities: estimating effective costs from daily data, *The Journal of Finance*, 64(3), 1445–1477.

Hearn B., Piesse J., Strange R. (2010), Market liquidity and stock size premia in emerging financial markets: the implications for foreign investment, *International Business Review*, 19(5), 489–501.

Holder-Webb L.M., Wilkins M.S. (2000), The incremental information content of SAS No. 59 going--concern opinions, *Journal of Accounting Research*, 38(1), 209–219.

Kliestik T., Vrbka J., Rowland Z. (2018), Bankruptcy prediction in Visegrad group countries using multiple discriminant analysis, *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 13(3), 569–593.

Korajczyk R.A., Sadka R. (2008), Pricing the commonality across alternative measures of liquidity, *Journal of Financial Economics*, 87(1), 45–72.

Kumar P.R., Ravi V. (2007), Bankruptcy prediction in banks and firms via statistical and intelligent techniques – a review, *European Journal of Operational Research*, 180(1), 1–28.

Lesmond D.A. (2005), Liquidity of emerging markets, *Journal of Financial Economics*, 77(2), 411–452.

Lischewski J., Voronkova S. (2012), Size, value and liquidity. Do they really matter on an emerging stock market?, *Emerging Markets Review*, 13(1), 8–25.

Liu W. (2006), A liquidity-augmented capital asset pricing model, *Journal of Financial Economics*, 82(3), 631–671.

Lyandres E., Zhdanov A. (2013), Investment opportunities and bankruptcy prediction, *Journal of Financial Markets*, 16, 439–476.

Martınez M.A., Nieto B., Rubio G., Tapia M. (2005), Asset pricing and systematic liquidity risk: an empirical investigation of the Spanish stock market, *International Review of Economics & Finance*, 14(1), 81–103.

Mączyńska E., Zawadzki M. (2006), Dyskryminacyjne modele predykcji bankructwa przedsiębiorstw, *Ekonomista*, 2, 205–235.

Merton R.C. (1974), On the pricing of corporate debt: the risk structure of interest rates, *The Journal of Finance,* 29(2), 449–470.

O'Connell M., Ward A.M. (2020), Shareholder theory/shareholder value, in: S. Idowu et al. (eds), *Encyclopedia of Sustainable Management*, Springer.

Olbryś J. (2013), Zastosowanie wybranych miar płynności aktywów kapitałowych na Giełdzie Papierów Wartościowych w Warszawie SA, *Zarządzanie i Finanse*, 11(3), 65–77.

Ooghe H., Balcaen S. (2007), Are failure prediction models widely usable? An empirical study using a Belgian dataset, *Multinational Finance Journal*, 11(1/2), 33–76.

Ozdenoren E., Yuan K. (2008), Feedback effects and asset prices, *The Journal of Finance*, 63(4), 1939–1975.

Pastor L., Stambaugh R.F. (2003), Liquidity risk and expected stock returns, *Journal of Political Economy*, 111, 642–685.

Penman S.H. (1996), The articulation of price-earnings ratios and market-to-book ratios and the evaluation of growth, *Journal of Accounting Research*, 34, 235–259.

Polk C., Sapienza P. (2008), The stock market and corporate investment: a test of catering theory, *The Review of Financial Studies*, 22(1), 187–217.

Reisz A.S., Perlich C. (2007), A market-based framework for bankruptcy prediction, *Journal of Financial Stability,* 3, 85–131.

Sadka R. (2006), Momentum and post-earnings announcement drift anomalies: the role of liquidity risk, *Journal of Financial Economics*, 80, 309–349.

Soboleva Y.P., Matveev V.V., Ilminskaya S.A., Efimenko I.S., Rezvyakova I.V., Mazur L.V. (2018), Monitoring of businesses operations with cash flow analysis, *International Journal of Civil Engineering and Technology*, 9(11), 2034.

Utami W., Wahyuni P.D., Nugroho L. (2020), Determinants of stock liquidity: forward-looking information, corporate governance, and asymmetric information, *The Journal of Asian Finance, Economics, and Business*, 7(12), 795–807.

Appendix

Table 1
Countries and their characteristics

Country	Stock market capitalization (USD billion)	Year of opening the exchange	Size	Liquidity	Age
Germany	1755.17	1585	large	liquid	old
Poland	160.48	1817 1991*	large	not liquid	new
Baltic countries	2.85	2003	small	liquid	new
Estonia		1995			
Latvia		1993			
Lithuania		1993			

* The exchanges in Poland have a long history that was interrupted by communists who destroyed the original market organization; therefore, the re-opening date is treated as the date of establishing the new era exchanges.

Source: https://www.theglobaleconomy.com/rankings/stock_market_capitalization_dollars/.

Table 2
Basic statistics of data used in the survey for all analysed markets

	Mean	S.D.	Median	Minimum	Maximum
Germany					
Equity	23332.0838	21077.5837	15183.8500	1287.0000	109077.0000
Liabilities	150985.6768	348532.1008	33777.0000	1802.0000	2184816.0000
Spread	0.0530	0.0188	0.0509	0.0195	0.1501
ILLIQ	0.0000	0.0000	0.0000	0.0000	0.0000
Turnover	0.0844	0.0528	0.0666	0.0097	0.3365
EDF	0.9723	0.0627	1.0000	0.5827	1.0000
V_{eit}	6.6668	5.5056	5.5867	0.7437	32.3498
Tobin Q	1.4418	0.5044	1.2975	0.7998	3.2119
Rate of return	0.0699	0.2991	0.0121	-0.2267	2.0049
Volatility	12.8961	10.8329	10.7389	0.8371	58.5477
ROA	3.6540	3.7680	3.9890	-10.3582	15.6575
Baltic countries					
Equity	128.9715	229.8277	39.8541	-0.4392	839.0820
Liabilities	140.1279	305.9298	20.0460	0.0075	1794.9620
Spread	11.4100	23.4798	1.4629	0.0000	159.7166
ILLIQ	0.0003	0.0049	0.0000	0.0000	0.0788
Turnover	0.0049	0.0052	0.0032	0.0000	0.0306
EDF	0.5167	0.2714	0.5182	0.0000	1.0000
V_{eit}	0.6929	1.2592	0.4402	0.0600	15.5465
Tobin Q	1.2083	0.5687	1.0482	0.2422	2.8310
Rate of return	0.0251	0.0985	0.0066	-0.1399	0.7237
Volatility	0.7441	1.9791	0.2576	0.0113	23.3303
ROA	6.3857	10.3083	5.5943	-17.1601	80.6795
Poland					
Equity	1361.9227	4920.7894	204.5830	-54.9080	46353.0000
Liabilities	1119.5040	3391.5724	191.0430	0.0000	31017.5870
Spread	2.0642	2.0556	1.6170	0.0703	40.0000
ILLIQ	0.0000	0.0000	0.0000	0.0000	0.0000
Turnover	0.0241	0.0746	0.0117	0.0000	3.4582
EDF	0.9052	0.1561	0.9954	0.0002	1.0000
V_{eit}	9.5258	27.2430	3.2232	-4.7324	341.1033
Tobin Q	1.1929	0.8121	1.0142	0.0000	12.1131
Rate of return	0.0064	0.0657	0.0030	-0.5269	0.8513
Volatility	14.1746	39.8602	4.4572	0.3654	473.4471
ROA	0.0145	0.0314	0.0132	-0.6543	0.5137

Source: author's own elaboration.

Table 3

Correlation table between variables for all analysed markets

	ROA	Liabilities	Equity	Tobin Q	Rate of return	Spread	ILLIQ	Turnover	Volatility	V_{eit}	EDF
Germany											
ROA	1.0000										
Liabilities	-0.2224	1.0000									
Equity	-0.1042	0.5224	1.0000								
Tobin Q	0.7919	-0.0577	-0.0867	1.0000							
Rate of return	0.7480	-0.0240	-0.0439	0.9912	1.0000						
Spread	0.7406	-0.0186	-0.0477	0.9928	0.9976	1.0000					
ILLIQ	0.7413	-0.0185	-0.0467	0.9929	0.9977	1.0000	1.0000				
Turnover	0.7381	-0.0139	-0.0472	0.9923	0.9975	0.9999	0.9999	1.0000			
Volatility	0.3879	-0.0517	0.2570	0.3292	0.3233	0.3251	0.3250	0.3217	1.0000		
V_{eit}	0.6372	-0.1380	0.1220	0.6022	0.5842	0.5846	0.5847	0.5808	0.9242	1.0000	
EDF	0.7437	-0.0194	-0.0456	0.9932	0.9977	0.9999	0.9999	0.9998	0.3306	0.5896	1.0000
Baltic countries											
ROA	1.0000										
Liabilities	-0.1049	1.0000									
Equity	-0.0617	0.8029	1.0000								
Tobin Q	0.5316	-0.0216	-0.0214	1.0000							
Rate of return	0.4972	-0.0087	-0.0092	0.9958	1.0000						
Spread	-0.0575	-0.1987	-0.2496	0.2127	0.2345	1.0000					
ILLIQ	0.4984	-0.0080	-0.0080	0.9961	0.9999	0.2312	1.0000				
Turnover	0.4984	-0.0079	-0.0080	0.9961	0.9999	0.2309	1.0000	1.0000			
Volatility	0.4672	-0.0353	-0.0346	0.9521	0.9535	0.2200	0.9535	0.9535	1.0000		
V_{eit}	0.4851	-0.0218	-0.0224	0.9781	0.9803	0.2224	0.9804	0.9804	0.9936	1.0000	
EDF	0.4952	-0.0081	-0.0109	0.9958	0.9989	0.2281	0.9991	0.9991	0.9578	0.9830	1.0000

Table 3, cont'd

	ROA	Liabilities	Equity	Tobin Q	Rate of return	Spread	ILLIQ	Turnover	Volatility	V_{eit}	EDF
Poland											
ROA	1.0000										
Liabilities	-0.0049	1.0000									
Equity	-0.0039	0.9135	1.0000								
Tobin Q	0.8843	-0.0245	-0.0300	1.0000							
Rate of return	0.9990	-0.0042	-0.0038	0.8840	1.0000						
Spread	0.5892	-0.1872	-0.1683	0.4491	0.5861	1.0000					
ILLIQ	0.9998	-0.0046	-0.0039	0.8818	0.9991	0.5908	1.0000				
Turnover	0.9986	-0.0020	-0.0022	0.8804	0.9979	0.5881	0.9988	1.0000			
Volatility	0.0341	0.0062	-0.0015	0.1686	0.0337	0.0358	0.0331	0.0335	1.0000		
V_{eit}	0.0524	-0.0015	0.0017	0.1840	0.0517	0.0447	0.0510	0.0507	0.9886	1.0000	
EDF	0.9948	-0.0033	-0.0003	0.8760	0.9942	0.5884	0.9949	0.9937	0.0145	0.0325	1.0000

Source: author's own elaboration.

Table 4
Estimation of model parameters from equation (6)

Part A – Germany			
Spread	1.1724** (0.010463)		
ILLIQ		1.205339** (0.009097)	
Turnover			1.202189** (0.017486)
Ln(e)	-0.0042 (0.002857)	-0.014128** (0.002445)	0.013085** (0.004467)
Ln(d)	0.00957** (0.002061)	0.01119** (0.001754)	-0.007834** (0.003249)
Rate of return	0.017812** (0.006168)	0.003396 (0.005299)	0.027** (0.009753)
ROA	0.002055** (0.000643)	0.000972 (0.00549)	0.002821** (0.001013)
Volatility	-0.206566** (0.007954)	-0.217143** (0.0068)	-0.246181** (0.013294)
R^2	0.999	0.999	0.999
Part B – Baltic countries			
Spread	-0.001274** (0.000683)		
ILLIQ		1.307** (0.130924)	
Turnover			1.273408** (0.128326)
Ln(e)	-0.006629 (0.017148)	-0.013283 (0.013972)	-0.014709 (0.014)
Ln(d)	0.017884 (0.0134)	0.014813 (0.011293)	0.015587 (0.011313)
Rate of return	1.0693** (0.01151)	-0.222 (0.1289)	-0.189215 (0.1263)
ROA	-0.004189** (0.001413)	-0.004543** (0.001187)	-0.004452** (0.001189)
Volatility	-0.082568* (0.006912)	-0.089** (0.005879)	-0.088434** (0.005883)
R^2	0.998	0.998	0.999

Table 4, cont'd

Part C – Poland			
Spread	0.001261** (0.00078)		
ILLIQ		-78304.4 (7.0905)	
Turnover			0.039656** (0.019531)
Ln(e)	0.007764** (0.001511)	0.0071972** (0.001508)	0.007382** (0.001495)
Ln(d)	-0.013042** (0.001335)	-0.0013245** (0.0013245)	-0.013229** (0.01324)
Rate of return	0.031839 (0.022972)	0.0269 (0.0229)	0.028544 (0.022864)
ROA	0.009852 (0.047032)	0.00126 (0.0468981)	0.008253 (0.0469)
Volatility	0.276623** (0.003334)	0.276317** (0.0033295)	0.276569** (0.003331)
R^2	0.63	0.63	0.63

Notes:
The parameter is statistically significant for every p-value of less than 0.1, for increasing confidence intervals of 1% (***), 5% (**) and 10% (*), respectively.

Source: author's own elaboration.

Table 5
Estimation of model parameters from equation (7)

Part A – Germany	
Ln(e)	0.04256** (0.011884)
ROA	-0.0094** (0.003162)
Tobin Q	0.2756** (0.020031)
Rate of return	0.3199** (0.02241)
Ln(d)	0.0352** (0.009)
Volatility	0.3376** (0.02354)
R^2	0.99
Part B – Baltic countries	
Ln(e)	-0.0034 (0.01631)
ROA	-0.0058** (0.001518)
Tobin Q	0.0883** (0.02773)
Rate of return	0.9701** (0.03046)
Ln(d)	0.0212* (0.0213291)
Volatility	-0.0765** (0.007072)
R^2	0.99

Table 5, cont'd

Part C – Poland	
Ln(e)	0.0046** (0.001507)
ROA	0.588** (0.021906)
Tobin Q	-0.00099 (0.001872)
Rate of return	0.1455** (0.021702)
Ln(d)	-0.0106** (0.001328)
Volatility	0.2726** (0.003386)
R^2	0.99

Notes:
The parameter is statistically significant for every p-value of less than 0.1, for increasing confidence intervals of 1% (***), 5% (**) and 10% (*), respectively.

Source: author's own elaboration.

Płynność akcji i ryzyko upadłości

Streszczenie

Celem artykułu jest przedstawienie problemu płynności akcji na rynku finansowym i jego wpływu na ryzyko upadłości danej spółki. Integracja tych podejść powinna pokazać, czy płynność akcji wpłynie na upadłość firmy i w jakim stopniu te odziaływania mogą występować. W opracowaniu są analizowane: spółki z indeksu WIG (Warszawskiego Indeksu Giełdowego), głównego indeksu Giełdy Papierów Wartościowych w Warszawie, indeksu OMXBBGI notowanego na giełdzie Nasdaq w Tallinie, Rydze i Wilnie oraz spółki wchodzące w skład indeksu DAX z giełdy we Frankfurcie. Te kraje to różne gospodarki, które reprezentują UE. Siła relacji brana pod uwagę może być powiązana z cechami rynku, takimi jak wielkość kraju, płynność i dojrzałość rynku. Giełda może wpływać na aktywność gospodarczą przez tworzenie płynności. Płynne rynki akcji sprawiają, że inwestycje są mniej ryzykowne i bardziej atrakcyjne, ponieważ pozwalają oszczędzającym kupować instrumenty finansowe i sprzedawać je w razie potrzeby. Tymczasem nowe giełdy dostarczają inwestorom aktualnych i dokładnych informacji o spółkach.

Celem badania jest ustalenie, czy istnieje statystycznie istotna zależność pomiędzy ryzykiem upadłości, płynnością akcji a możliwościami wzrostu wartości danej firmy. W tym celu przeanalizowano dwa modele dla wszystkich badanych rynków.

Pierwszy model sprawdzał, czy istnieje statystycznie istotna zależność między płynnością akcji a ryzykiem upadłości. Drugi model sprawdzał natomiast, czy istnieje statystycznie istotna zależność między ryzykiem upadłości a możliwościami wzrostu wartości danej firmy. Zastosowana metoda badawcza jest zbliżona do opisanej przez Brogaard, Li i Xia (2017) w pracy *Stock liquidity and default risk*.

Przeprowadzenie kilku odrębnych badań wykorzystujących różne miary opisujące płynność na podstawie danych uzyskanych dla rynków Polski, Niemiec i krajów bałtyckich może potwierdzić postawioną na początku badania hipotezę, że istnieje statystycznie istotna zależność pomiędzy płynnością obrotu i ryzykiem upadłości spółki. Niezależnie od wybranej miary płynności w większości przypadków potwierdzono związek między płynnością obrotu a ryzykiem upadłości danej spółki na giełdach papierów wartościowych w Warszawie, Frankfurcie i krajach bałtyckich. Wyniki te są zgodne z wynikami uzyskanymi przez Brogaard, Li oraz Xia (2017). Pozwala to wnioskować, że znaleziono inną zmienną, którą inwestorzy i analitycy rynku powinni wziąć pod uwagę przy wycenie papierów wartościowych i szacowaniu zwrotu z inwestycji.

Dla instytucji monitorujących rynki kapitałowe i system finansowy wyniki tych prac mogą rzucić nieco światła na problem płynności całego rynku kapitałowego, co umożliwi podjęcie odpowiednich działań w celu zwiększenia tej płynności. Również w kontekście wyceny kapitału, np. przy plasowaniu akcji, sprzedaży spółki, w której przeważa podejście związane z modelem CAPM, wyniki badania mogą posłużyć do dokładniejszej i szerszej wyceny, biorącej pod uwagę charakterystykę i wrażliwość firm wskazanych w pracy.

Słowa kluczowe: płynność finansowa, upadłość, kondycja ekonomiczna przedsiębiorstw, rynek kapitałowy, płynność akcji