Empirical Paper

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Impact of financial constraints and financial distress on cash holdings

https://doi.org/10.2478/ijme-2022-0032
Received: April 5, 2022; accepted: December 14, 2022

Abstract: The aim of the study is to examine the impact of financial constraints and financial distress on cash holdings, both in normal and crisis times. We collected the 4,406 firm-year observations of companies listed on the Warsaw Stock Exchange (WSE). Our research shows that companies maintain higher cash holdings during a crisis than in a normal period. However, in contrast to our expectations, companies with financial difficulties (constraints and distress) have lower cash holdings both in normal and crisis times. The originality of our research lies in realizing that different sources of difficulties might overlap at the same time (external with internal). We also analyze how cash holdings react to a combined impact of difficulties of different natures (external and internal). We believe that cash holdings have recently increased their meaning as we face the situation of constant and increasing uncertainty: still ongoing COVID-19 crisis prolonged with Russian aggression on Ukraine and outburst of inflation.

Keywords: cash holdings, COVID-19 crisis, financial constraints, financial distress, global financial crisis
JEL Classification: D25, G32, G33

1 Introduction

In recent years, we have witnessed several serious crises. Despite the fact that the nature of the crises is different, it had affected company functioning. Therefore, in this study, we focus on examining the impact of financial difficulties on cash holdings. This topic is interesting as we still feel the effects of the two crisis shocks. After the experience of the global financial crisis (GFC), companies are now, once again, facing difficulties that influence their activities and survival. Because of the one-two punch, many aspects that had been researched before are a valuable, yet not sufficient, source of knowledge. That is why we undertake a research referring to the cash holdings by companies in difficult times.

Cash holding is the most important factor affecting financial liquidity and company survival. Ferreira da Cruz et al. [2019] found that cash holdings are increasing recently. They investigated the cash ratio average in 1994 and 2013 and found an upward trend for cash holding ratios around the world. There are a lot of positive effects of cash holding (financial flexibility, freedom of actions), as well as costs (especially opportunity costs). Hence, the focus on cash holdings is increasing.

This growing interest in cash holdings is justified in turbulent and difficult times as having cash is essential for company survival. Nowadays, we face the situation of constant and increasing uncertainty: still ongoing COVID-19 crisis prolonged with Russian aggression on Ukraine and outburst of inflation. In such a situation, cash holdings seem to increase their meaning. Cash holdings might determine how strong and how resilient the company is to difficulties.

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Difficulties affecting cash holdings might come from internal or external environments. Internal sources of problems are reflected in financial constraints or financial distress, while external sources of problems are linked with economic downturn and crisis. Financial constraints are defined as inability to obtain sufficient external funds, as well as limitations in company capacity to raise external finance. These also imply a need to rely on internal sources (cash holdings) to finance business activities. This might mean that the company is in a good financial health, but due to some reasons, it is unable to obtain external funds. On the contrary, financial distress is connected with financial difficulties and is connected with situations wherein cash flow is not sufficient to cover current obligations. As financial constraints mean difficulties in gaining external funds (especially debt), financial distress means difficulties in debt servicing (when the company has already gained debt). However, there are few studies that distinguish financial constraints from financial distress [Duong et al., 2022]. In addition, economic crisis makes the environment more uncertain and push companies to implement specific cash holding strategies.

However, existing research has investigated the cash holding decisions separately for different sources of difficulties. We realized that there is a gap in existing research as in some companies, the sources of difficulties might overlap (internal with external) at the same time, while existing research tackles only impact of one type of difficulties on cash holdings. That is why we attempt to add to cash holdings research by combining external with internal sources of difficulties in one study. In addition, we try to distinguish what kinds of difficulties affect the cash holdings to a greater extent.

The aim of the study is to evaluate how difficult situations (financial constraints, financial distress, crisis) affect company cash holdings. We assumed to find that facing difficult situations (financial constraints, financial distress, crisis) makes cash holdings increase. To conduct our analysis, we collected data from the Notoria Serwis database of companies listed on the Warsaw Stock Exchange (WSE) and mined financial data for 419 companies over the period of 2007–2020 (14 years). We compared the level of cash holdings depending on the source of difficulties (financial constraints, financial distress, crisis) by using statistical tests and regression analysis.

We also included data from 2020, that is, data derived from dealing with the ongoing COVID-19 crisis. This makes our study up-to-date and more helpful for companies currently struggling with financial difficulties. The GFC has already been well researched, and researchers can find many studies from different countries. However, the COVID-19 crisis is new. Thus, our study is a valuable resource of knowledge as it complements aspects that have not yet been fully explored. In addition, we want to inspire future researchers to examine the topic from the prospective of other countries and expand the topic to explore other aspects affecting cash holdings maintained by companies during this ongoing crisis.

We believe that it will be interesting to compare the individual determinants of cash balances including the GFC and COVID-19 crisis. Our research is original and pioneering as we found no other research linking cash to financial constraints, and financial distress in a crisis time in one study.

In the study, we found significant results that can contribute to decision-making by companies in a difficult situation. The study confirms the conclusion that companies accumulate more cash in a crisis period. In addition, we note that companies with financial constraints maintain lower cash holdings and companies in financial distress have smaller cash resources. Our findings regarding the relationship between the financial constraints and financial distress and cash holdings are not consistent with our expectations and the results of previous studies.

The remainder of the article consists of several parts: Initially, a detailed review of the available literature and research was performed. The sample and research methods were then defined. The variables used in the study were also described in detail. Subsequently, the most important findings and conclusions of the study are described and compared with previous research.

2 Literature review and hypothesis development

In this research, we tackle several issues: cash holdings, crisis, financial constraints, and financial distress. We start with describing the role of cash holdings and theories explaining their meaning and level. Then,

we try to untangle the relation between each issue included in the research: cash holdings and financial constraints, and cash holdings and financial distress. Then, we include the crisis as the factor affecting cash holdings but also affecting the relation between cash holdings and financial constraints, and cash holdings and financial distress.

Based on the literature review, at the end of each subsections, research hypotheses were formulated. The literature review is, at the same time, the justification of the hypotheses. These hypotheses were verified in the empirical part of the study.

2.1 Cash holdings

Cash is the most liquid asset that supports corporate financial liquidity [Almeida et al., 2014]. A firm's cash holding helps it ensure its transaction needs and allows it to use investment opportunities (transactional motive). Cash also helps risk and uncertainty provisions (precautionary motive) and the management of interest rate variability and uncertainty (speculative motive) [Keynes, 1936]. However, large cash holding increases opportunity costs. In addition, high cash holding also causes agency costs between the firm's managers and shareholders [Jensen, 1986].

Classic models in finance assume that the transactional motives of having cash are based on the assumption that having readily available cash assets enables companies to avoid transactions related to liquidation of assets, reduction of dividends or issuance of new securities [Keynes, 1936; Baumol, 1952; Opler et al. 1999]. In line with the precautionary theme, companies reserve a certain amount of cash to take over profitable investment projects and to protect against unexpected expenses. The company keeps more cash at hand to be able to cope better and prepare for future adverse conditions, for example, when the cost of capital is relatively high [Bates et al., 2009]. The last is a speculative motive, which states that firms can proactively anticipate changes in interest rates, and as a result, firms can adjust their cash holdings accordingly. Such actions may lead to profit from cash resources [Shiau et al., 2018].

The determinants of cash resources are also explained by the agency theory [Jensen, 1986], compromise theory [Myers, 1977], and pecking order theory (POT) [Myers and Majluf, 1984]. In the agency theory, managers are motivated to increase the amount of cash and control over its use [Jensen, 1986]. However, companies with high cash resources can face high costs from ineffective asset management and agency problems [Jensen, 1986]. In the compromise theory, the optimal level of cash will be determined by the cost (opportunity cost of capital invested in liquid assets) and the benefits of having cash (lower transaction costs). Thus, companies maintain an optimal amount of cash based on marginal benefits. According to the POT, companies should first finance with retained earnings, then with safe debt, and finally with equity. Cash, herein, is treated as a buffer between retained earnings and investments.

Cash holding has drawn the attention of many researchers. A thorough review of the evolution and the main contributions of cash holding research has been provided by, for example, Ferreira da Cruz et al. [2019]. There are several streams of research: cash management activities, optimal cash holdings, the value of cash holdings, the determinants of cash holdings, and impact of cash holdings on, for example, firm performance.

2.2 Financial constraints and cash holdings

A firm is said to be financially constrained if its investment is limited by its inability to obtain sufficient external funds. Financial constraints mean that some firms have limitations in their capacity to raise external finance and must rely on internal sources to finance their activities. Since the 1980s, financial constraints have been the subject of many empirical studies [Fazzari et al., 1988]. These mainly concerned the analysis of the relationship between company investments and the availability of internal financing.

Existing research shows that inability to access external sources of funding has an impact on corporate activities. Almeida et al. [2004] revealed that the emerging financial friction prevents companies from

fully financing investment opportunities. Almeida and Campello [2001] demonstrated that for financially constraint companies, external financing becomes more costly.

The existing empirical literature suggests that financial constraints are difficult to identify. This is because these have latent characteristics. Financial constraints are, therefore, usually measured indirectly through variables that are assumed to be related to financial constraints. There are several approaches to identifying financial constraints. After Kaplan and Zingales [1997] and their KZ index, Whited and Wu [2006] also prepared their own measure of financial constraints – the WW index. In addition to these, in 2010, a new measure was introduced by Hadlock and Pierce [2010] – the SA index. Thorough review of different financial constraints measures is provided by Ahamed et al. [2022].

There are several ways that financial constraints affect corporate financial decisions. Almeida et al. [2004] indicated that apart from affecting investment decisions, financially constrained firms tend to save cash, whereas unconstrained firms do not. They also provided evidence that firms with much friction in raising outside financing save a greater portion of their cash flow as cash than do those with little friction. Denis and Sibilkov [2010] explained that higher cash holdings allow financially constrained firms to undertake profitable projects. Sheu and Lee [2012] found that excess cash is significantly correlated with capital expenditure, particularly for firms financially constrained. Studies by Pinkowitz et al. [2006] and Habib et al. [2022] uncovered evidence consistent with the view that cash holdings are more valuable for constrained firms than for unconstrained firms.

These findings allow us to formulate the first research hypothesis:

H1: We expect to find higher cash holdings in financially constrained companies.

2.3 Financial distress and cash holdings

A firm is considered in financial distress when its cash flow is not sufficient to cover its current obligations [Couwenberg, 2015]. However, firms are declared bankrupt when this situation occurs. Beaver et al. [2010] defined financial distress as the probability that the company will not be able to repay its debts within a particular time interval. Koh et al. [2015] defined distress as the condition where a firm's liquidation of total assets is less than the total value of creditor claims. This is because a firm is desperate enough to sell assets (timing and pricing) to obtain cash. If prolonged, this situation can lead to forced liquidation or bankruptcy (direct and indirect costs of financial distress – Salehi et al., 2017). For this reason, financial distress is often referred to as the likelihood of bankruptcy, which is dependent on the availability of liquidity: financial distress precedes bankruptcy, and bankruptcy occurs subsequent to financial distress [Platt and Platt, 2006].

Identification of financial distress allows implementation of remedial actions to possibly correct the causes of the problems (restructuring); otherwise, the company is left to fail. As again, financial distress is a latent feature; however, there are specific signs of financial distress: employee layoffs, low interest coverage ratio, cash flow less that current maturities of long-term debt, and negative earnings before interest and tax (EBIT) [Platt and Platt, 2006]. Opler and Titman [1994] connected financial distress with high leverage. They saw that high leveraged companies are more likely to experience performance losses in industry downturns than do other firms.

Although, as previously touched upon, financial distress is a latent feature, there are different ways of identifying this situation. The first idea of measure comes from credit scoring systems developed for identifying the determinants of a firm's repayment likelihood. The most common ways of uncovering financial distress are, however, those developed via discriminant analysis and by applying Altman's achievement in building financial distress models – Altman *Z*-score. There are also models connected with artificial intelligence systems – such as neural networks or machine learning. All these models are called "bankruptcy prediction models" [Altman, 2018].

When a firm experiences financial distress, it encounters various types of bankruptcy costs, including those directly related to the bankruptcy process as well as the probable reduction in sales revenues due to

customer doubts about the firm's ability to maintain quality. Moreover, the additional pressure generated by deteriorating financial conditions adversely affects management initiatives since expenditures for research, development, and employee training will likely be reduced.

To avoid being forced to sustain such costs, management must hold higher levels of liquid assets as a hedge [Shah, 2011, Gupta and Mahakud, 2022]. Research has demonstrated the existence of negative relations between cash holdings and *Z*-score [Demir and Ersan, 2017; Shiau et al., 2018; Ranajee and Pathak, 2019; Hadjaat et al., 2021]. This means that the lower the *Z*-score, the higher the cash holdings. However, a lower *Z*-score means higher financial distress. Thus, higher financial distress is linked to higher cash holdings, which implies positive relations between financial distress and cash holdings.

These findings allow us to formulate the second research hypothesis:

H2: We expect to find higher cash holdings in financially distressed companies.

2.4 Impact of crisis on cash holdings

The two recent crises (GFC of 2008–2009 and COVID-19 crisis in 2020) were different in nature, reasons, and course. What they have in common is that they have strongly affected (and the latter is particularly still affecting) the realities of global economies and of private industry. The GFC came from internal weaknesses of the financial system, particularly asset inflation and related mal-investments.

The GFC can be characterized as a credit–supply shock due to difficulties in the banking system [Gorton, 2010]. Ivashina and Scharfstein [2010]. Herein, losses from "toxic" assets compelled banks to reduce the supply of credit to non-financial firms. This led to difficulties in financial conditions and in funding availability of all firms as banks restricted their lending policies [Ivashina and Scharfstein, 2010]. The GFC was "a crisis waiting to happen", with markets "ignoring signals to an imminent infection point" [Haralambides and Thanopoulou, 2014].

By contrast, COVID-19 was an external shock with few (short-term) warning signs, which suddenly impacted the global economy. The COVID-19 crisis is exogenous in nature [Cowling et al., 2020] and came about when government decisions froze many companies and industries within a COVID-19 crisis "winter" [Notteboom et al., 2021]. During the COVID-19 crisis, bank lending decreased, and bank loan spread increased due to soaring business and investor pessimism. As the COVID-19 played out, governments and central banks established monetary stimulus policies in response to heightened concerns about the solvency and liquidity of non-financial corporate firms. The weakening in bank lending resulted from a decline in loan demand [Colak and Oztekin, 2021].

No matter whether the contraction of bank lending comes from the demand or supply side, the crisis environment affects the real sphere of non-financial corporation activity due to increased uncertainty. Difficult economic surroundings make financial standing challenging and increase financial constraints as well as changes cash behavior [Tut, 2019].

The time of crisis increases difficulties in the access to external funds. Moreover, it increases reliance on internally generated cash flows and cash holdings [Drobetz et al., 2016]. Indeed, Lian et al. [2011] argued that during a financial crisis, precautionary motive becomes more important in corporate cash holdings. The crisis environment can influence the organization's cash management since there are fewer investment opportunities and higher market uncertainties [Nason and Patel, 2016; Batuman et al., 2022].

Research on corporate cash in crisis times (especially GFC of 2008–2009) is quite abundant [e.g., Song and Lee, 2012; Adjei, 2013; Bliss et al., 2015; Ranajee and Pathak, 2019; Joseph et al., 2021; Chang and Yang, 2022]. All the aforementioned saw an increase in corporate cash holding. Shin et al. [2018], for example, noted an increase in uncertainty and that the number of bank loans taken out was limited during the GFC. There is also an increasing amount of research on corporate cash holding and the COVID-19 crisis [e.g., Cowling et al., 2020; Honda and Uesugi, 2021; Zheng, 2021]. Again, the researchers find increase in corporate cash holdings.

These findings allow us to formulate the third research hypothesis:

H3: Cash holdings increase in crisis times.

2.5 Impact of crisis on financial constraints and cash holdings

In general, it is perceived that crisis time and uncertainty diminish the capacity to obtain external funds and thus increases financial constraints. The pattern of financial constraints, however, differs from normal in a crisis time [Driver and Munoz-Bugarin, 2019], and financially constrained companies act differently during crisis. During the GFC of 2008–2009, firms planned deeper cuts in tech spending, employment, and capital spending. Duchin et al. [2010] added that financially constrained firms cut about two times more investments than did unconstrained firms during the crisis. Korajczyk and Levy [2003] demonstrated that target leverage was counter-cyclical for the relatively unconstrained sample but pro-cyclical for the relatively constrained sample.

These findings allow us to formulate the fourth research hypothesis:

H4: Financial constraints increase in crisis times.

Economic crisis also has impact on the relations between financial constraints and cash holdings. During the GFC of 2008–2009, some firms were affected more than others. Duchin et al. [2010] showed that the GFC made financially constrained firms to rely more on their cash holdings. Ranajee and Pathak [2019] provided empirical evidence that financially constrained firms during the GFC held higher levels of cash compared to their counterparts.

Chang et al. [2017] observed that cash holdings are more valuable to constrained firms than to unconstrained firms in a non-crisis period. Cash holdings act as an effective device against cash flow fluctuations during financial crisis. Moreover, the role of cash holding is more important for financially constrained firms than for unconstrained firms – especially during periods of financial crisis. Azmat and Iqbal [2017] revealed that financially constrained firms increase their cash holdings, while financially unconstrained firms do not. They also found that during the 2008 financial crisis, constrained firms were more prone to saving cash than did unconstrained firms.

These findings allows us to formulate the fifth research hypothesis:

H5: During crisis times, companies facing bigger financial constraints have higher cash holdings.

2.6 Impact of crisis on financial distress and cash holdings

During crises, more bankruptcy filing takes place. This means that there is a higher probability of bankruptcy due to greater financial distress. This is true for all types of crises: the GFC [Aasen, 2011; Sarlija and Jeger, 2011; Bredart, 2014; Vo et al., 2019] and the COVID-19 crisis [Holtemoller and Muradoglu, 2020]. During crisis times, the bankruptcy rate increases rapidly due to contraction in demand and, as a result, in supply. Indeed, probability of financial distress is higher by 10% during crises than before crises [Sarlija and Jeger, 2011].

Macroeconomic factors play important roles in financial distress as firm defaults increase dramatically during economic downturns. In most cases, macroeconomic conditions have good explanatory power for corporate financial distress and bankruptcy. Financial distress can be triggered either because the idiosyncratic shock has reached the default threshold in a given regime or because of a change in the value of the aggregate demand. The economic cycle (macroeconomic indicators) has been found to affect profitability, gearing, and cash flow, and thereby influence company failures [Hackbarth et al., 2006; Bhattacharjee and Han, 2014; Sami, 2014].

These findings allow us to formulate the sixth research hypothesis:

H6: Financial distress increases in times of crisis.

There is scarcity of research on the relations between cash holdings and financial distress during crisis time. Tran [2020] found that the *Z*-score positively affects cash holdings during the GFC. This means that the higher the *Z*-score, the lower the financial distress. Moreover, he also noted that lower financial distress is connected with higher cash holdings. Sethi and Swain [2019] indicated that during financial crisis periods although the inverse *Z*-score did not have a statistically significant impact on cash holdings, this was still a negative effect. This suggests that the higher the inverse *Z*-score, the higher the financial distress and the lower the cash holdings. This implies positive relations between the *Z*-score and cash holdings. According to Sethi and Swain [2019], during crisis times, the demand for cash increases, but companies being in financial distress find it difficult to generate cash from their troubled activities.

These findings allow us to formulate the seventh research hypothesis:

H7: During times of crisis, companies facing bigger financial distress have lower cash holdings.

3 Methodology

To achieve our research aim, we need to verify hypotheses on the factors affecting the cash holdings. In order to evaluate how specific difficult situations (financial constraints, financial distress, crisis) affect company cash holdings, we utilized the research procedure. At the beginning, we collected data (detailed description of sampling and data are included in Subsection 3.1.). Then, we identified variables, especially dependent variables (DVs) (reflecting cash holdings), independent variables (IV) (reflecting financial constraints and financial distress), and some control variables (CVs), for example, size, profitability, and debt ratio (the description of variables is presented in Subsection 3.3.). The main method we used was regression analysis (the description of the model is presented in Subsection 3.2.) – to estimate relation between DV (cash holdings) and IVs. Regression analysis was carried out separately for financial constraints and for financial distress. To find out how financial constraints and financial distress affect cash holdings in crisis times, we separated data for crisis time and carried out regression analysis for this sub-period. In addition, we implemented the *U* Mann–Whitney test to find out how the variables (dependent, independent, control) differ in crisis times from those in normal times. In this way, we were able to find the impact of crisis on the analyzed issues.

3.1 Sample and data

To conduct our analysis, we collected data of companies listed on Poland's WSE. As of July 2021, there were 435 companies listed, but after excluding banks and other financial institutions, we were left with 419 companies. The source of data was the Notoria Serwis database. The financial data cover the period of 2007-2020 (14 years). The sample constitutes an unbalanced panel, with some companies entering and leaving the WSE. Ultimately, we obtained 4,406 firm-year observations. All data were "winsorized" at 98% upper and 2% lower percentile.

We divided the whole period into two sub-periods: normal time (2007–2008 and 2010–2019) and crisis time (2009 and 2020). This division was made on the basis of similar macroeconomic conditions within each period. Although most current research studies take 2008 as the start of the GFC, we decided to consider both 2007 and 2008 as periods before the GFC. This is because in Poland, the presence and impact of the GFC were delayed [Drozdowicz-Bieć, 2010; Pawelec, 2016].

3.2 Models

In our research, we constructed several hypotheses, and thus, we used different statistical methods to verify each of them. First, we applied the *U* Mann–Whitney test to evaluate the differences in the variables in

normal and crisis times. The *U* Mann–Whitney test does not require that the distribution of the sample has to be assumed to be normally distributed. By comparing the level of variables during normal times and crisis times and testing this level using the *U* Mann–Whitney test, we were able to ascertain whether these variables differ significantly.

We also utilized ordinary least squares (OLS) regression analysis, and we prepared several OLS regression models separately for (1) financial constraints and financial distress and (2) for the whole period and sub-periods (normal crisis time). The formula of the regression model is as follows:

$$DV = \beta_0 + \beta_1 IV + \beta_2 CV + \varepsilon_i,$$

where DV is the dependent variable vector, reflecting proxy for cash holdings; IV is the independent variables vector, reflecting proxies for financial constraints, financial distress, and crisis time; CVs is the control variable vector; Beta is the coefficient estimate for the independent and CVs; ε_n and is the random error term/residual variable.

3.3 Variables

To identify cash holdings, we employed the cash ratio calculated as the relations of cash and cash equivalents to net total assets (total assets – cash and cash equivalents). This way of calculating cash holdings is used, for example, by Opler et al. [1999], Ozkan and Ozkan [2004].

To explain cash holdings, we explored three IVs: Kaplan–Zingales index, Altman *Z*-score, and crisis variables.

The Kaplan–Zingales index is a proxy for financial constraints. We calculated it according to the methodology found in Kaplan and Zingales [1997]. We decided on applying this measure of financial constraints because it is a common financial constraint variable used in existing research [(e.g., Sheu and Lee, 2012; Azmat and Iqbal, 2017]. The formula of the KZ index is the as follows:

$$\mathrm{KZ}_{\mathrm{it}} = -1.001909 \times \frac{\mathrm{CFit}}{\mathrm{Kit}-1} + 0.2826389 \times \mathrm{Q}_{\mathrm{it}} + 3.139193 \times \frac{\mathrm{Levit}}{\mathrm{Kit}-1} - 39.3678 \times \frac{\mathrm{Divit}}{\mathrm{Kit}-1} - 1.314759 \times \frac{\mathrm{Cit}}{\mathrm{Kit}-1},$$

where *CF* is the operating cash flow; *Q* is the market value of assets divided by the book value of assets; *Lev* – debt *Div* is the value of dividend paid out; *C* is the cash holdings; and *K* is the capital as measured as net property, plant, and equipment. All the data are for the firm i during the period t. All variables are divided by the beginning-of-period capital (*K* – net property, plant, and equipment).

Research on financial constraints and cash holdings show a positive relation [e.g., Almeida et al., 2004; Pinkowitz et al., 2006], and the higher the KZ index, the greater the financial constraints. A positive relation implies that the higher the KZ index (hence, the higher the financial constraints), the more difficult access is to external financing and the higher that cash holdings are needed. We also expected to find a positive relation between financial constraints and cash holdings.

The Altman *Z*-score is a proxy for financial distress. We calculated it according to the Altman et al. [1998] approach Z''-score model for manufacturer and non-manufacturer industrials, as well as developed and emerging market credits. In the formula, 0 is the threshold of being financially distressed (below 0) and not distressed (above 0). Accordingly, the higher the *Z*-score, the lower the financial distress. The formula of the *Z*-score is as follows:

$$Z = 3{,}25 + 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4,$$

where X_1 is the working capital/total assets; X_2 is the retained earnings/total assets; X_3 is the earnings before interest and taxes/total assets; and X_4 is the market value equity/book value of total liabilities.

Existing research on financial distress and cash holdings found negative relations between the *Z*-score and cash holdings in normal times [e.g., Demir and Ersan, 2017; Shiau et al., 2018; Ranajee and Pathak, 2019; Hadjaat et al., 2021]. A negative relation implies that the lower the *Z*-score (the higher financial distress), the higher the cash holdings. We expected to find a negative relation between the *Z*-score and cash holdings in normal times; however, during crisis times, we expected a positive relation [Sethi and Swain, 2019; Tran, 2020]. This means that the higher the *Z*-score (the lower financial distress), the higher the cash holdings.

In our work, crisis is a dummy variable that takes 1 for crisis time (2009 and 2020) and 0 otherwise. This way of including crisis time is quite common in research [e.g., Manoel et al., 2017; Honda and Uesugi, 2021]. All the research studies on cash holdings and crisis found positive relations [e.g., Song and Lee, 2012; Adjei, 2013]; and thus, we assumed to find positive relations between cash holdings and the crisis variable.

We also employed several CVs: size, profitability, debt ratio, and asset turnover.

Size is an important factor affecting financial decisions. Small and medium firms implement different financial strategies as they are more vulnerable to the outside economic environment. In addition, large firms face lower costs of transactions in accessing external sources of financing. Size is calculated as a natural logarithm of total assets. This variable is commonly used as an important factor affecting cash holdings. Existing research on cash holdings found negative relations between size and cash holdings – for example, Opler et al. [1999], Bates et al. [2009], Ranajee and Pathak, [2019], and Marin et al. [2017], and thus, we assumed to find negative relations between cash holdings and size.

Another CV is profitability. Profitability is an important factor affecting cash holdings. A profitable firm will have comparatively strong cash flows from operating activities – and a strong cash flow is an important source of cash. This relationship is confirmed by POT [Myers and Majluf, 1984; Almeida and Campello, 2005]. Profitable firms are thus inclined to have financial slack [Opler et al., 1999; Ferreira and Vilela, 2004]. Our measure of profitability is the ratio of EBIT divided by total assets return on assets (ROA). Existing research on cash holdings has found positive relations between profitability and cash holdings [(e.g., Drobetz and Gruninger, 2006; Ranajee and Pathak, 2019], and hence, we assumed to find positive relations between cash holdings and the crisis variable. However, it is also possible to find negative relationships between cash holdings and profitability. The trade-off theory assumes the existence of negative relations between profitability and cash holdings and argues that profitable firms have enough cash flows to avoid under-investment problems [Almeida and Campello, 2005].

In our research, we implemented the debt ratio as another CV. Accordingly, companies having high cash holdings do not need additional external financing; therefore, firms use cash to reduce leverage, resulting in a negative relation between cash holdings and leverage. The pecking order hypothesis, as formulated by Myers and Majluf [1984], also suggests a negative relationship between cash holdings and leverage. Thus, we might expect negative relations between cash holdings and the debt ratio. Indeed, existing research studies on cash holdings found negative relations between the debt ratio and cash holdings [(e.g., Opler et al., 1999; Ferreira and Vilela, 2004; Ozkan and Ozkan, 2004; Bates et al., 2009]; hence, we assumed to see negative relations between cash holdings and the crisis variable.

In addition, we included the asset turnover ratio as a factor affecting cash holding. We calculated asset turnover as the relationship between sales revenues and total assets. This ratio is sensitive to industry belongings and also to the economic environment. Capital-intensive industries have low asset turnover ratios: for example, the coal mining industry has a ratio of 0.6, furniture and fixtures 1.15, and food stores 1.7 (Industry Ratios benchmarking). This ratio captures both changes in sales revenue and changes in total assets. Existing research on cash holdings demonstrates positive relations between cash holdings and the asset turnover ratio [(e.g., Poti et al., 2020], and thus, we assumed to find positive relations between cash holdings and the crisis variable. Table 1 presents the set of variables included in the research.

Table 1. Variable specification and expected impact of variables on cash holdings

Variable	Formula	Expected sign of impact on cash holdings
DV		
Cash ratio	Cash and cash equivalents To total assets minus cash and cash equivalents (%)	NA
IV		
KZ index	Kaplan–Zingales index of financial constraints	"+"
Z-score	Altman Z-score of financial distress	"–" for normal time "+" for crisis time
Crisis	1 for crisis time (2009, 2020), 0 otherwise	"+"
CVs		
Size	Natural logarithm of total assets	"–"
Profitability	Operating profit to total assets (%)	"+"
Debt ratio	Total liabilities to total assets (%)	"–"
Asset turnover	Sales revenue to total assets (%)	"+"

Source: author's own elaboration.
CVs, control variables; DV, dependent variable; IV, independent variables.

Table 2. Descriptive statistics of the variables included in the research

Variables	Mean	Median	Min	Max	SD
Cash ratio	9.4	5.9	0.2	45.1	10.3
KZ index	220.8	4.0	−120.2	6,615.9	1,043.7
Z-score	7.5	7.0	−4.8	20.6	4.4
Profitability	1.8	3.7	−5.0	31.5	14.7
Debt ratio	50.5	49.4	8.9	119.8	23.2
Asset turnover	103.3	91.4	8.4	340.5	76.6

Source: author's own calculations.
SD, standard deviation.

4 Findings

When examining the relationship between cash and financial constraints in normal times and in crisis times, we can expect differentiation. Moreover, we can assume that the shares of cash collected by companies to finance their activities vary depending on the period. Table 2 presents the descriptive statistics of variables included in the research.

Average ratio of cash holdings in our sample is at the level of 9%, with median at 6%. This level of cash holdings is similar to that seen in previous research – for example, Opler et al. [1999] demonstrated a mean value of 18% and median of 6%, Sheu and Lee [2012] indicated mean value of 10% and median of 6%, Poti et al. [2020] uncovered mean value of 9% and median of 3%.

Table 3 presents the value of the variables in crisis and normal times, with statistical test of the difference (*U* Mann–Whitney).

We found that there are statistically significant differences in the level of cash holdings, in the KZ index, but not in *Z*-score in these two time periods. As for cash holdings, we saw that during crises,

Table 3. Descriptive statistics of variables (mean and median) in normal and crisis times

	Normal times	Crisis times	*U* Mann–Whitney test
Cash ratio	9.3	10.5	−3.227***
	5.7	7.1	
KZ index	213.2	268.5	−1.645*
	3.9	4.4	
Z-score	7.5	7.2	−0.849
	7.0	7.0	
Profitability	1.8	1.4	−1.672*
	3.7	3.4	
Debt ratio	50.3	51.9	−0.939
	49.2	50.2	
Asset turnover	104.0	99.1	−1.154
	91.8	88.9	

*$p < 0.1$, **$p < 0.01$, ***$p < 0.001$.

Source: author's own calculations.

this ratio is much higher than that during normal times. This supports our third hypothesis (H3: cash holdings increase in times of crises). We also revealed statistically significant differences in the KZ Index. However, the p-value of the *U* Mann–Whitney test is quite high as it is 0.099. As indicated in previous research, the KZ Index is higher during crises, and this supports our forth hypothesis (H4: financial constraints increase in crisis times). We noted no statistically significant differences in the level of *Z*-score (proxy for financial distress). This finding contradicts our sixth hypothesis (H6: financial distress increases in crisis times). We also observed that there are statistically significant differences in the level of profitability, but not in the debt ratio or asset turnover, and profitability is lower during crises.

The next step of our research was the application of regression analysis. We were aware that existing research studies show that some independent and CVs might be correlated, for example, that size might have an impact on profitability, and the debt ratio might be correlated with profitability. Hence, we employed the variance inflation factor (VIF) score to check for multicollinearity.

We prepared 14 regression models for the cash ratio as the DV. Here, regression models 1–7 used the KZ index as the DV, while models 8–14 included the *Z*-score as the DV. Models 1–3 and 8–10 covered the whole analyzed period both in normal and crisis times (2007–2020), models 4–5 and 11–12 covered only crisis times (2009 and 2020), and models 6–7 and 13–14 covered normal times. Models 1, 4, 6, 8, 11, and 13 reflected the results of univariate regression analysis, while the rest of the models was the outcome of multivariate regression analysis.

Table 4 presents the regression analysis results with the DV cash ratio and independent variable KZ index.

We found almost all our models (except from model 4) to be statistically significant as the *F* statistics obtained a *p*-value <0.05. Furthermore, the VIF was <2.5 and, in most cases, was close to 1.0, which demonstrates lack of multicollinearity.

Our work indicates that a crisis environment has an impact on cash holdings. The regression results revealed that during crisis times, cash holdings are higher (model 2). In our study, including the crisis variable improved the results by almost 4%, which means that 4% of all changes in cash holdings are explained only by a crisis environment.

What is notable is that there is no statistical significance in univariate regression models 4 and 5, showing relations between the KZ index and cash holdings during crisis times. This outcome implies that financial constraints have no impact on cash holdings during crisis periods. This finding contradicts our

Table 4. Regression analysis results with the cash ratio as the DV and KZ index as the independent variable

	Whole period	Whole period	Whole period	Crisis time	Crisis time	Normal time	Normal time
	1	2	3	4	5	6	7
KZ index	−0.072*** (1.000)	−0.090*** (1.009)	−0.032* (1.096)	−0.046 (1.000)	−0.003 (1.128)	−0.078*** (1.000)	−0.037* (1.085)
Crisis	X	0.044** (1.000)	0.050** (1.002)	X	x	x	X
Size	X	X	−0.168*** (1.118)	X	−0.126** (1.091)		−0.175*** (1.123)
Profitability	X	X	0.083*** (1.350)	X	0.050 (1.459)		0.088*** (1.338)
Debt ratio	X	X	−0.184*** (1.228)	X	−0.148** (1.404)		−0.191*** (1.274)
Asset turnover	X	X	0.072*** (1.206)	X	0.085* (1.235)		0.070*** (1.203)
R square	0.005	0.042	0.094	0.002	0.057	0.006	0.101
F statistics	22.975***	65.684***	76.763***	1.283	7.234***	23.257***	85.226***

*$p < 0.1$, **$p < 0.01$, ***$p < 0.001$; VIF is presented within parentheses.

Source: author's own calculations.

DV, dependent variable; VIF, variance inflation factor.

the fifth hypothesis (H5: during crisis times, companies facing bigger financial constraints have higher cash holdings). In normal times, however, the sign of the impact of the KZ index on cash holdings is negative (models 6 and 7, and also models 1, 2, and 3). This means that the higher the KZ index (the higher financial constraints), the lower the cash holdings. This outcome contradicts our first hypothesis (H1: We expect to find higher cash holdings in financially constrained companies). However, this impact is quite weak as the R square is quite low and explains only a small part of cash holdings (<1%).

Beyond the aforementioned, we observed a positive impact of profitability and asset turnover and a negative impact of size and debt ratio. These signs are in line with our expectations. Previous work has established that bigger companies have lower cash holdings, both in crisis and normal times. In addition, cash-rich companies have lower a debt ratio, and this supports the POT. Furthermore, more profitable companies have higher cash holdings, and this means that the profit is a strong source of cash; but during crisis times, the profitability has no impact on cash holdings. Moreover, according to our study results, higher asset turnover (a proxy for industry belongings) shows a positive sign. This suggests that capital-intensive companies (with high assets in relation to sales revenue) have lower cash holdings. In our study, including CVs allows the explanation of an extra 5% of changes in cash holdings.

Table 5 presents the regression analysis results with a DV cash ratio and an independent variable *Z*-score. We excluded the debt ratio from models 8–14 (with *Z*-score as independent variable) as the debt-to-equity ratio is already included in the *Z*-score formula.

We discovered all our models to be statistically significant as the *F* statistics had *p*-values <0.05. Furthermore, the VIF was <2.5 and, in most cases, was close to 1.0, which shows lack of multicollinearity.

Again, our work indicates that crisis environments have an impact on cash holdings. The regression results reveal that during crisis times, cash holdings are higher. Including the crisis variable improved the results by almost 1%, which means that 1% of all changes in cash holdings are explained by crisis environment situations.

The sign of the impact of *Z*-score on cash holdings is positive. This relation is statistically significant for both crisis and normal times. But this means that the higher the *Z*-score (the lower the financial distress), the higher the cash holdings. Thus, companies with bigger financial distress have lower cash holdings. This contradicts our second hypothesis (H2: We expect to find higher cash holdings in financially distressed

Table 5. Regression analysis results with cash ratio as DV and Z-score as independent variable

	Whole period	Whole period	Whole period	Crisis time	Crisis time	Normal time	Normal time
	8	9	10	11	12	13	14
Z-score	0.373*** (1.000)	0.372*** (1.019)	0.389*** (1.454)	0.338*** (1.000)	0.397*** (1.537)	0.381*** (1.000)	0.388*** (1.447)
Crisis	X	0.050*** (1.001)	0.053*** (1.001)	X	X	x	X
Size	X	X	−0.114*** (1.125)	X	−0.093* (1.061)		−0.118*** (1.137)
Profitability	X	X	−0.055** (1.582)	X	−0.121* (1.712)		−0.044* (1.567)
Debt ratio	X	X	X	X	X	X	X
Asset turnover	X	X	0.102*** (1.141)	X	0.110** (1.140)		0.101*** (1.142)
R square	0.139	0.142	0.168	0.114	0.143	0.145	0.173
F statistics	713.217***	243.569***	179.212***	77.705***	24.926***	645.321***	198.399***

*$p < 0.1$, **$p < 0.01$, ***$p < 0.001$; VIF is presented within parentheses.

Source: author's own calculations.

DV, dependent variable; VIF, variance inflation factor.

companies). However, this outcome confirms our seventh hypothesis (H7: during crises, companies facing bigger financial distress have lower cash holdings). Moreover, according to our results, the impact of financial distress on cash holdings is quite high as the R square is quite high, and this means that financial distress explains >10% of all cash holdings in times of crises and >14% in normal times.

We observed a positive impact of asset turnover and a negative impact of size and profitability. In addition, the sign of impact of asset turnover and size is in line with our expectations. Hence, bigger companies have lower cash holdings both in crisis and normal times. Moreover, higher asset turnover as a proxy for industry belongings shows a positive sign. This implies that capital-intensive companies (with high assets in relation to sales revenue) have lower cash holdings. However, we found negative relations between profitability and cash holdings. This suggests that less profitable companies keep higher cash holdings to secure their activities. This is in line with the precautionary motive that cash holdings help firms finance their investments if other financing sources are not available. Inclusion of CVs allows explaining an extra 2% of all changes in cash holdings.

5 Robustness check

One may ask whether our results remain robust even when we use alternative cash holdings measure. As a robustness check, we use the DV as natural logarithm of cash holdings – LnCash [(e.g., Bhuiyan and Hooks, 2019]. These results are presented in Table 6.

The results are consistent with our previous results. Both models (for KZ index and *Z*-score as IV) are statistically significant. Models explain app. 70% of changes in cash holdings.

We found a positive and statistically significant impact of crisis on cash holdings. This again confirms our hypothesis H3 assuming that cash holdings increase in crisis times.

The KZ index has an inconclusive impact on cash holdings – similarly as in the previous model (with cash ratio) for crisis time. We found a positive but not statistically significant impact of financial constraints on cash holdings. Thus, we cannot confirm hypothesis H1 assuming higher cash holdings in financially constrained companies.

Table 6. Regression analysis results with LnCash as DV and KZ index/Z-score as independent variable

	Whole period		Whole period
KZ index	0.003	Z-score	0.024**
Crisis	0.025**	Crisis	0.025**
Size	0.817***	Size	0.819***
Profitability	0.041***	Profitability	0.041***
Debt ratio	−0.013	Debt ratio	X
Asset turnover	0.055***	Asset turnover	0.056***
R square	0.669	*R* square	0.669
F statistics	1,479.041***	*F* statistics	1,778.564***

*$p < 0.1$, **$p < 0.01$, ***$p < 0.001$.
Source: author's own calculations.
DV, dependent variable.

The *Z*-score has a positive and statistically significant impact on cash holdings – similarly as in previous models (with cash ratio). But this means that the higher the *Z*-score (the lower the financial distress), the higher the cash holdings. Thus, companies with bigger financial distress have lower cash holdings. This, again, contradicts our second hypothesis (H2: We expect to find higher cash holdings in financially distressed companies).

The impact of CVs on cash holdings is in line with our expectations and previous findings. We found a positive impact of profitability, asset turnover, and size and a negative impact of debt ratio. Cash-rich companies have a lower debt ratio, and this supports the POT. Furthermore, more profitable companies have higher cash holdings, and this means that the profit is a strong source of cash. Moreover, according to our study results, higher asset turnover (a proxy for industry belongings) shows a positive sign. This suggests that capital-intensive companies (with high assets in relations to sales revenue) have lower cash holdings.

6 Discussion

We found that cash holdings increase in times of crises. This finding is in line with our expectations, theory, and previous research [Song and Lee, 2012; Adjei, 2013; Bliss et al., 2015; Ranajee and Pathak, 2019; Joseph et al., 2021]. The crisis situation also has an impact on financial constraints; in crisis times, financial constraints are higher. This outcome is in line with our expectations and previous research [Driver and Munoz-Bugarin, 2019]. However, we did not find an impact of crisis on financial distress. This contradicts our expectations and previous research [Aasen, 2011; Sarlija and Jeger, 2011; Bredart, 2014; Vo et al., 2019; Holtemoller and Muradoglu, 2020]. The lack of impact of crisis on financial distress might be explained by the composition of the sample – these are companies listed on stock exchange, so in general, these companies are in good financial standing and hence attract investors. In addition, we observed an impact of crisis on profitability (negative sign), but not on leverage.

We discovered that companies with financial constraints have lower cash holdings (both in normal and crisis times). These findings contradict our expectations and previous research [(e.g., Denis and Sibilkov, 2010; Duchin et al., 2010]. The explanation of this negative relation is provided by Denis and Sibilkov [2010]. They investigated why some constrained firms have lower cash holdings, despite the apparent benefits of holding more cash in these firms. They found that constrained firms with low cash have significantly lower Altman *z*-scores, interest coverage ratios, cash flow margins, and changes in cash flow margins than high–cash-constrained firms. Moreover, their work uncovered the fact that low-cash firms exhibited persistently negative (and declining) free cash flow (operating cash flow net of capital expenditures and

R&D) in the prior 10 years. Although these firms do raise some external capital, this external capital was insufficient to meet their needs. As a result, relative to high–cash-constrained firms, low–cash-constrained firms exhibit significantly lower cash flow sensitivities of cash and significantly higher investment–cash flow sensitivities. In other words, the low-cash firms essentially spend available cash flow on investment projects and were unable to build their cash reserves. In fact, their cash balances declined significantly over the preceding 5-year period.

As for the relation between financial distress and cash holdings, we expected to find a negative relation but only for times of crises. In reality, we discerned a negative relation to be present both in normal and crisis times. This means that our expectations were confirmed partially (for crisis times only). Our findings for the times of crisis are in line with our expectations and previous research [Sethi and Swain, 2019; Tran, 2020; Eskandari and Zamanian, 2022]. Here, the negative relation between financial distress and cash holdings means that companies being in financial distress find it difficult to generate cash from their troubled activities. Moreover, financially distressed firms have a reduced level of cash holdings due to financial problems [Ninh et al., 2018]. Thus, the negative relation must also be present in normal times.

In line with this attitude, there is some research confirming negative relations between financial distress and cash holdings in normal times. For instance, Nason and Patel [2016], Marin et al. [2017], and Gupta and Bedi [2020] noted positive relations between the *Z*-score and cash holdings. This means that the lower the *Z*-score (the higher financial distress), the lower the cash holdings. In addition, Drobetz and Gruninger [2006] indicated negative relations between the inverse of the Altman *Z*-score (1/Z) and cash holdings. This suggests that the higher the inverse Altman *Z*-score (the higher the financial distress), the lower the cash holdings. Rehman et al. [2016] also revealed that cash increase is positive for both financially distressed and non-distressed firms, but the ratio of increase is higher for non-distressed firms and lower for distressed.

Furthermore, our findings demonstrate that financial distress explains a bigger part (>10%) of all changes in cash holdings, while financial constraints explain a smaller part (<1%) of all changes in cash holdings. We also found a negative impact of company size on cash holdings. This outcome is in line with previous research studies that show that bigger companies have lower cash holdings both in crisis and normal times, and this is because they can access external sources of funding. By contrast, small and medium firms are more vulnerable to the external economic environment and face higher costs of transactions in accessing external sources of financing. Our findings are in line with our expectations and previous research [(e.g., Opler et al., 1999; Bates et al., 2009; Marin et al., 2017; Ranajee and Pathak, 2019].

We also revealed a negative impact of leverage on cash holdings. According to the outcome of our study, cash-rich companies have a lower debt ratio, and this supports the POT. This negative relation is in line with our expectations and previous research [(e.g., Opler et al., 1999; Ferreira and Vilela, 2004; Ozkan and Ozkan, 2004; Bates et al., 2009].

Our study indicates a positive impact of profitability on cash holdings (in models including the KZ index as an independent variable). Herein, more profitable companies have higher cash holdings, and this means that the profit is a strong source of cash. This relationship is confirmed by the POT [Myers and Majluf, 1984]. According to previous work, profitable firms are inclined to have financial slack [Opler et al., 1999; Ferreira and Vilela, 2004]. In addition, existing research on cash holdings found positive relations between profitability and cash holdings [(e.g., Drobetz and Gruninger, 2006; Ranajee and Pathak, 2019].

In models including *Z*-score as independent variable; however, we found a negative impact of profitability on cash holdings. This means that less profitable companies keep higher cash holdings to secure their activities. This is in line with precautionary studies that suggest that cash holdings help firms finance their investments if other financing sources are not available. The trade-off theory assumes a negative relationship between profitability and cash holdings, arguing that profitable firms have enough cash flows to avoid under-investment problems [Almeida and Campello, 2005].

Finally, in this study, we observed a positive impact of asset turnover on cash holdings. Asset Turnover is a proxy for industry belongings. This means that the specific industries with a higher asset turnover ratio (lower capital-intensity) have higher cash holdings. This is in line with our expectations and previous research [e.g., Poti et al., 2020].

7 Conclusions

The aim of the study was to discern how difficult situations of diverse nature affect cash holdings. We assumed that companies with greater financial difficulties (no matter the reason behind these difficulties: constraints or distress) have higher cash holdings. We also assumed that this positive relation is stronger for time of crises.

Our findings only partially confirm our expectations. We find that during crisis, cash holdings are higher. This means that crisis has a positive impact on cash holdings. Financial constraints have a negative impact on cash holdings, but in crisis time, this impact is not statistically significant. We also found a negative impact of financial distress on cash holdings (statistically significant both in normal and crisis times). Furthermore, our findings demonstrate that financial distress explains a bigger part (>10%) of all changes in cash holdings, while financial constraints explain a smaller part (<1%) of all changes in cash holdings.

Our findings have both theoretical and practical implications. Cash holdings have a significant meaning, especially in difficult times. Cash is important for debt service, investment financing, and ensuring operating activity continuity. From the theoretical point of view, we added to existing research on cash showing how difficulties of different natures (economic crisis, financial distress, financial constraints) affect the cash holdings. Our findings might have also some practical implications – as cash holdings have a significant meaning in difficult times. If managers have knowledge in advance how specific conditions affect the cash holdings, they would be able to take preventive actions. In this way, companies might avoid bigger difficulties, even bankruptcy. We believe that the role of cash holdings might be increasing due to increasing uncertainty and many companies seeking ways to survive in difficult times.

In this study, we encountered some limitations. Our analysis takes into account two separate crises (GFC and COVID-19 crisis, followed by Russian aggression on Ukraine). We do not know how long the current crisis will continue. Due to the fact that the situation and the effects of this sudden crisis are still being felt, these limitations indicate the direction of future research. In addition, in our study, financial constraints are based on only one measure (Kaplan–Zingales index), and financial distress is based on only one measure (*Z*-score), which, for other companies in other countries, may not be an appropriate. We also used a specific set of companies in our sample – companies listed on the WSE. Such companies strive to have better financial standing and might have better corporate governance than private (unlisted) companies or companies listed under different regulations.

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