Handelshøyskolen BI

GRA 19703 Master Thesis

Thesis Master of Science 100% - W

Predefinert informasjon

Startdato:	09-01-2023 09:00 CET	**Termin:**	202310
Sluttdato:	03-07-2023 12:00 CEST	**Vurderingsform:**	Norsk 6-trinns skala (A-F)
Eksamensform:	T		
Flowkode:	202310||11184||IN00||W||T		
Intern sensor:	(Anonymisert)		

Deltaker

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Informasjon fra deltaker

Tittel *:	Trend in Cash Holdings. A Study of Industrial Firms in U.S.
Navn på veileder *:	Michael Kisser

Inneholder besvarelsen konfidensielt materiale?:	Nei	**Kan besvarelsen offentliggjøres?:**	Ja

Gruppe

Gruppenavn:	(Anonymisert)
Gruppenummer:	254
Andre medlemmer i gruppen:	

Master Thesis:

Trend in Cash Holdings.

A Study of Industrial Firms in U.S.

Hand-in date:

03.07.2023

Campus:

BI Norwegian Business School in Oslo

GRA 19703 Master Thesis

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Abstract

This master thesis examines the trend in cash holdings among industrial firms in the United States, building upon the research of Bates et al. (2009) by analyzing a more recent sample period from 1980 to 2020. The study utilizes regression analysis to investigate the relationship between firm characteristics and cash ratios, aiming to understand the factors driving changes in cash holdings. The findings of the study confirm that changes in known determinants play a significant role in the rise of cash holdings among industrial firms. Furthermore, the study uncovers evolving relationships between firm characteristics and cash holdings over time, indicating the influence of external factors.

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1. Introduction

1.1 Background and Motivation of the Research

According to Bates, Kahle, and Stulz (2009), the question of why firms hold so much cash on their balance sheets remains one of the most puzzling issues in corporate finance. The authors highlight the ongoing debate in the literature about the optimal level of cash holdings for firms and review various explanations for why firms hold cash. While cash holdings provide firms with a cushion to meet short-term obligations and take advantage of investment opportunities, holding excess cash also leads to an opportunity cost. The authors also suggest that the optimal level of cash holdings may depend on a variety of factors, including industry, business cycle, and firm characteristics.

Cash holdings constitute a crucial component of a firm's' financial management. They represent the amount of cash and cash equivalents that a company holds on its balance sheet, which can be used to fund various activities such as investments, acquisitions, dividends, and debt repayments. Cash holdings can also function as a safeguard against unexpected economic shocks, providing companies with the flexibility to weather financial downturns.

According to Almeida, Campello, and Weisbach (2004), the literature on cash holdings has seen significant growth due to various factors, such as the increasing importance of cash holdings as a financing tool for firms and the changing financial environment. Additionally, research has sought to better understand how firms manage their financial resources, including cash holdings (Bates, Kahle, & Stulz, 2009; Harford, Klasa, & Walcott, 2009).

Research on cash holdings has examined a range of factors that can influence the amount of cash firms hold, including financial constraints, investment opportunities, and corporate governance structures. Some notable academic papers and articles that discuss the growing interest in studying cash holdings and their determinants include Opler et al. (1999), Bates et al. (2009), Harford et al. (2009), Almeida et al. (2004). Studies have also investigated the implications of holding

cash, such as the effect on firm value and the potential for excess cash to be used for value-destroying activities. There is a growing body of literature that examines the implications of holding cash for firms. One study by Harford et al. (2009) found that firms with high levels of cash holdings tend to have higher valuations and are less likely to experience financial distress. However, other studies, such as those by Almeida et al. (2004) and Gao et al. (2013), have shown that holding excess cash can lead to agency problems and the potential for value-destroying activities, such as overinvestment or excessive executive compensation.

Finally, the literature on cash holdings has highlighted the importance of understanding the factors that influence the level of cash holdings. Several studies have examined the determinants of cash holdings, such as profitability, cash flow volatility, investment opportunities, and financial constraints (e.g., Baumol, 1952; Opler et al., 1999; Bates et al., 2009). Most of these studies have focused on developed economies, such as the US, Europe, and Japan (e.g., Bates et al., 2009; Gao et al., 2013; Harford et al., 2014; Wang & Guedhami, 2018).

Bates et al. (2009) highlighted the increasing trend of cash holdings among firms and its implications for leverage analysis. Their findings suggested that firms' cash reserves were rising significantly, which led to a decline in the net debt ratio. This decline was notable even though traditional measures of leverage, such as the debt-to-assets or debt-to-equity ratio, did not show a substantial decrease in average leverage.

Building upon the findings of Bates et al. (2009), our research aligns with their conclusions and provides further evidence of the impact of cash holdings on firms' leverage. We observe a consistent decline in the net debt ratio among the sampled U.S. firms, and this decline is primarily attributed to the increase in cash holdings.

The connection between the increase in cash holdings and the disappearing dividends and new listings phenomena is apparent as documented by Fama and French (2001). As firms opt not to distribute dividends and accumulate more cash, there is a parallel increase in the population of nondividend-paying firms with substantial investment opportunities but lower profitability. This aligns with the notion that financially constrained firms, particularly those without dividend payments, tend to hold larger cash reserves. The evidence presented by Fama and

French sheds light on the link between the changing nature of firms and their dividend policies, providing insights into the dynamics of cash holdings and dividend decisions in the market.

Upon observing the documented increase in cash holdings and the corresponding decrease in net debt, our study delves into understanding the underlying factors driving this increase. Our investigation reveals that the rise in average cash ratio cannot be solely attributed to the evolution of cash holdings in large firms. Across all size quintiles, it is evident that small firms have experienced a considerable accumulation of cash.

The observed surge in cash holdings can be closely linked to the phenomena of declining dividends and increasing new listings, as documented by Fama and French (2001). This significant increase in cash holdings among nondividend-paying firms, as observed in relation to the declining dividends and increasing new listings phenomena documented by Fama and French (2001) and Bates et al., 2009, can be attributed to the precautionary demand for cash theory. According to this theory, firms accumulate cash reserves as a precautionary measure to safeguard against unexpected negative cash flow shocks.

The precautionary demand for cash theory offers a plausible explanation for the observed secular increase in cash holdings among nondividend payers. This theory suggests that firms hold cash as a safeguard against potential adverse cash flow shocks. Throughout the sample period of Bates et al. (2009) – (1980 to 2006), it is well-documented that idiosyncratic risk has consistently risen as reported in the study conducted by Campbell, Lettau, Malkiel, and Xu (2001).

By categorizing the industries in our sample into quintiles based on idiosyncratic cash flow volatility, we observe that firms situated in the top quintile, representing industries with the highest increase in idiosyncratic cash flow volatility, exhibit a notable surge in their cash reserves. The findings indicate a clear relationship between industry-specific volatility and cash holdings.

Lastly, to understand the underlying reasons for the increase in cash holdings, we conducted regression analysis similar to the approach used in a prior study by Opler, Pinkowitz, Stulz, and Williamson (1999). We aimed to determine whether the surge in cash reserves resulted from changes in firm characteristics,

shifts in the demand for cash unrelated to firm characteristics, or adjustments along the demand curve for cash.

1.2 Research Questions and Objectives

The aim of ours is to investigate the determinants of cash holdings for firms in a specific context, with the objective of replicating and extending the findings of the study by Bates et al. (2009). This study aims to extend the research by Bates et al. (2009) by examining and comparing the determinants influencing cash holdings among industrial firms in the US. By focusing solely on the US market, this investigation intends to shed light on the determinants of cash holdings in this specific context.

To achieve this objective, our study addresses several research questions. Firstly, we aim to identify and analyze the factors that influence the level of cash holdings among industrial firms in the United States. By examining variables such as profitability, cash flow volatility, investment opportunities, and financial constraints, we seek to uncover the key drivers that shape cash holdings in the industrial sector.

The United States presents an intriguing context for studying corporate cash holdings due to several reasons. First, the US is home to a diverse range of industries and companies, providing a broad sample for analysis. This diversity allows for a comprehensive exploration of the factors that influence cash holdings across different sectors. The US has been a focal point of academic and policy discussions regarding cash holdings, making it essential to examine the determinants of cash holdings within this specific context.

The chosen time scope for our study spans from 1980 to 2020. This extensive period allows us to capture the long-term trends in cash holdings, enabling a comprehensive analysis of the determinants that have influenced cash holdings decisions over the past four decades. By considering this extended time frame, we aim to provide an understanding of the determinants of cash holdings and how they have evolved over time in the US industrial sector.

1.3 Significance and Contribution of Study

The significance and contribution of this study lie in its ability to provide valuable insights into the determinants and effects of cash holdings for firms in the USA. By replicating the methodology of Bates et al., 2009 and applying it to a different context, this study contributes to a better understanding of the factors that influence cash holdings and provides insights for firms and policymakers on how to manage their financial resources effectively.

Our research findings contribute to the existing literature by reinforcing the importance of considering cash holdings when analyzing a firm's leverage. While traditional leverage measures may not capture the full picture, the net debt ratio provides a more comprehensive understanding of a firm's financial position. Researchers and practitioners can use this insight to refine their analysis of leverage and better assess a firm's risk profile and financial health.

The findings of this study can inform firms financial management decisions, including aspects such as determining how much cash to hold, allocating cash towards investment or dividend payouts, and managing associated risks linked to cash holdings. By shedding light on the factors influencing cash holdings, this study provides valuable insight that can help guide firms in making informed decisions regarding their financial resources.

Additionally, policymakers can leverage the findings of this study to formulate effective regulations and policies related to cash holdings, particularly in the manufacturing industry. By understanding the determinants of cash holdings in this specific sector, policymakers can enhance their understanding and decision-making in relation to cash management, thereby fostering improved financial outcomes and optimal cash management practices.

1.4 Scope and Limitations of Study

This study focuses on the determinants and effects of cash holdings for industrial firms in the US. The scope of the study is limited to firms in the manufacturing industry and does not include firms in other sectors or industries. The study uses data from publicly traded firms, which may not be representative of all firms in the manufacturing industry, particularly those that are privately owned or not listed on stock exchanges.

One limitation of this study is that it relies on secondary data sources, which may contain measurement errors or data quality issues. Moreover, the study only considers a limited set of factors that may influence cash holdings, and other factors that are not included in the analysis may also play a role in determining cash holdings.

Finally, it is important to note that this study is intended to compare the determinants of cash holdings among industrial firms in the US, there may still be variations in the institutional and regulatory environments that impact cash holdings practices. Therefore, it is essential to interpret the result of this study with caution and understand that the applicability may be limited to other nations or industries.

2. Literature Review

2.1 Overview of the Theoretical Framework

The literature on economics and finance has identified four primary reasons for why firms hold cash, which are precautionary, transaction, tax and agency motives. These motives can influence a firm's cash policy in various ways, depending on the specific circumstances of the firm. This literature review delves into the theoretical framework surrounding cash holdings, providing a detailed examination of each motive and their influence on firm value. By synthesizing

existing research, this review aims to illuminate the determinants of cash holdings, uncovering the factors that shape a firm's decision to hold cash.

2.1.1 Precautionary motive

Holding cash for precautionary reasons stems from “the desire for financial security regarding the future cash equivalent of a certain proportion of total resources (Keynes, 1936, p. 85).” This motive explains the need for holding cash as a buffer against unexpected opportunities that may require immediate payments. Thus, companies can mitigate their financial risks and enhance their capacity to react to unforeseen circumstances and investment opportunities by holding cash (Keynes, 1936, p. 98).

According to Opler, Pinkowitz, Stulz, and Williamson (1999) (henceforth OPSW), their empirical study supports the notion that management tends to accumulate excess cash when the opportunity to do so arises. The authors propose that firms hold excess cash to ensure they have enough resources to invest when cash flow is too low, and outside funding is costly. Specifically, the study explains that firms with riskier cash flows and poor access to external capital hold more cash as a precautionary measure.

The Almeida et al. (2004) model suggests that firms may hold cash as a precautionary measure in order to mitigate potential liquidity shocks. The model considers how financially constrained firms may differ in their cash holding behavior compared to unconstrained firms. According to the model, financially constrained firms may invest in cash out of cash flow, meaning that they may use their available cash flow to build up their cash reserves. This is because financially constrained firms may face difficulty obtaining external financing in the event of a liquidity shock, and therefore need to rely on their existing cash reserves. On the other hand, unconstrained firms may not need to hold as much cash, as they have greater access to external financing and are therefore less reliant on their cash reserves. The Han and Qiu (2007) model provides further insight into the behavior of financially constrained firms and the factors that influence their cash holding decisions. By extending the model of the Almeida et al. (2004), they contribute to

a deeper understanding of the relationship between cash flow volatility and corporate liquidity demand. In this model, Han and Qiu show that an increase in the volatility of cash flow leads to an increase in cash holdings for firms that are financially constrained but has no determinate effect on other firms. Empirically, Han and Qiu find support for their theoretical prediction. They examine data from 1998 to 2002 and find that the cash holdings of financially constrained firms increase with cash flow volatility. This suggests that the increase in cash holdings is driven by a precautionary demand for cash rather than other factors such as investment opportunities or tax considerations.

However, the precautionary motive for holding cash is not limited to financially constrained firms but also applies to firms with better investment opportunities. OPSW study shows that holding cash is a rational decision for firms in various financial situations, and not solely a result of financing constraints. They found that firms with higher market-to-book ratios and higher R&D spending, which are commonly used proxies for investment opportunities, tend to hold more cash as a precautionary measure.

According to Bates et al. (2009), an analysis of the increase in cash holdings for non-dividend paying firms provides empirical evidence that supports the precautionary motive for holding cash. The study suggests that this increase in cash holdings is not primarily due to changes in investment opportunities or financial constraints, but rather a response to the increasing uncertainty and risk associated with the global economy. This finding implies that the precautionary motive for holding cash is a response to the changing economic environment, rather than being solely driven by firm-specific factors. Furthermore, the study can be linked to the increasing uncertainty and risk faced by firms in their operating environment, particularly due to the rise in idiosyncratic risk. This measure of uncertainty and risk faced by firms may be related to the increasing cash flow risk, which is partially addressed by the increase in cash holdings among U.S. firms. Therefore, the Bates et al. (2009) study provides insight into the reasons behind the rising cash holdings among non-dividend paying firms, emphasizing the importance of the precautionary motive for holding cash in response to changing economic conditions.

2.1.2 Transaction motive

The transaction motive refers to the need for firms to hold cash to facilitate day-to-day business exchanges and meet their obligations for cash flows arising from daily transactions. This motive ensures that companies have the necessary funds available to cover their daily expenses and avoid delays or disruptions in their operations.

The transaction motive is a crucial concept in finance that helps firms determine the optimal level of cash holdings. Classic finance models, such as Baumol (1952) and Miller and Orr (1966), demonstrate that firms incur transaction costs when converting noncash financial assets into cash and using it for payments. As a result, firms must strike a balance between holding too much cash and incurring holding costs or holding too little cash and incurring transaction costs.

Moreover, these models reveal that larger firms benefit from economies of scale with the transaction motive, allowing them to hold less cash relative to their smaller counterparts. This concept has been extensively researched, with ample evidence supporting the existence of these economies of scale (Mulligan, 1997).

2.1.3 Tax motive

Foley et al. (2007) found that some firms could be motivated to hold cash due to tax considerations rather than the precautionary or transaction cost motives. Generally speaking, the US taxes the foreign operations of domestic firms and grants tax credits for foreign income taxes paid abroad. In the case of the majority of US affiliates, such taxes are equal to the disparity between foreign taxes paid and the tax payments that would have been incurred if the foreign earnings were taxes at the US rate and can be postponed until the repatriation of earnings. Such tax burdens induce incentives for US-based multinational corporations to retain earnings abroad and, if the retained earnings are not associated with attractive investment opportunities, to hold the retained earnings as cash (Foley et al., 2007).

Further, Foley et al. (2007) found that US corporations that would incur tax consequences associated with repatriating foreign earnings hold higher levels of cash compared to those that would not. It is particularly true for affiliates for which the implied tax consequences of repatriation are the highest since they are subject to the highest tax rates. Consequently, as a result, there is a higher probability of multinational firms to accumulate cash.

2.1.4 Agency motive

Jensen and Meckling (1976) introduced the concept of agency cost and highlighted the potential inefficiencies that can arise in firms due to the separation of ownership and control. They define it as the sum of monitoring expenditures by the principal, the bonding expenditures by the agent, and the residual loss. The agency's motive for holding cash arises if there is potential for conflict of interest between shareholders and managers. In the presence of agency costs, management may hold cash to pursue its own objectives at shareholders' expense (OPSW, 1999). Shareholders typically prefer that the firm invest in positive net present value projects or return excess cash to shareholders through dividends or share buyback to increase shareholder value. However, managers may have their own interests in mind, such as maximizing their own salaries, which would not align with the interest of shareholders. Holding excess cash provides managers with more discretion over investment decisions, which can cushion against financial distress or enable investments or provide opportunities for investments that may not be in the best interest of shareholders.

Dittmar and Mahrt-Smith's (2007) suggest that the value of cash is influenced by investor expectations regarding its use in the presence of managerial agency problems. They suggest that managers with potential agency problems are likely to invest excess cash inefficiently. Shareholders assign a lower value to an additional dollar of cash reserves when agency problems are likely to be greater at the firm. In situations where agency problems are more prevalent within a firm, shareholders tend to place a lower valuation with an increase in cash reserves.

Harford et al. (2008) provide support for this assertion, as they found that firms with weaker governance tend to maintain lower levels of cash reserves as a means to mitigate potential agency problems that may arise from excess cash holdings.

Further, OPSW (1999) states that managers may exhibit a stronger preference for holding cash due to its capacity to decrease firm risk and increase managerial discretion. This preference may result in an excessive focus on holding cash for precautionary motive, benefiting managers' objectives. As a consequence, management may hold cash to further its own goals/objectives at the expense of shareholder interests.

Harford et al., (2008) explored the relationship between cash holdings and agency problems/investor protection. In situations where the interests of the controlling shareholder and outside investors are not fully aligned, giving rise to agency problems, the controlling shareholder may at times prioritize his own personal welfare at the expense of outside investors. The extent to which the controlling shareholder can extract personal benefits from their position depends on the level of protection to outside investors in the country where the firm operates. In countries with weak investor protection, it is less costly for controlling shareholders to consume private benefits associated with cash holdings. This increases the capacity of controlling shareholders to exploit their situation, leading to lower/reduced cash holdings.

Dittmar and Mahrt-Smith (2007), Harford et al. (2008), and Pinkowitz et al. (2006) provide evidence implying that managerial entrenchment firms are more likely to build excess cash balances but spend excess cash quickly, as well as agency conflicts leading managers with excessive cash balances to make poor acquisitions.

2.1.5 Cash and debt policy

In practice, cash policy is not independent from capital structure decisions. While a detailed description of capital structure theories goes beyond the scope of the thesis, we refer the interested reader to a recent empirical study by DeAngelo, Goncalves, and Stulz (2022). The authors find strong empirical evidence supporting

the idea that firms dynamically manage leverage and cash policy. They observe that firms adjust their leverage slowly over time, and changes in leverage are primarily driven by changes in the costs and benefits of debt financing. They also find that firms adjust their cash holdings quickly in response to changes in investment opportunities and changes in investment opportunities and shocks, but more slowly in response to changes in financing costs. Hence, DeAngelo et al., 2022 highlight the importance of treating capital structure and cash balances as complementary elements of financial policy.

2.2The Determinants of Cash Holdings and the Optimal Level of Cash

Academic literature and industry practice often identify several determinants of cash holdings that companies may consider when making decisions about how much cash to hold on hand. These determinants intuitively relate to the factors discussed above can include factors such as the company's size, financial goals, leverage, operating cash flows, capital expenditure requirements, investment opportunities, non-cash liquid assets, managerial ownership, board independence, ownership concentration, dividend payments, debt levels, industry characteristics, regulatory requirements, and more.

2.2.1 Growth opportunity, riskier cash flows and cost of external capital

In accordance with the belief that financial constraints impact the precautionary motive for holding cash, OPSW (1999) conducted a study on cash holdings of publicly traded US firms from 1971 to 1994. Their findings indicate that firms establish a target level of cash that is influenced by their growth opportunities and the riskiness of their project cash flows. Additionally, the study reveals that firms tend to hold higher levels of cash when the cash flow required for investment is low and external capital is costly. These findings support the argument put forth by Myers and Majluf (1984) that firms with higher information

asymmetry problems prefer to maintain financial slack to avoid the need for external financing.

According to Ozkan and Ozkan (2004), firms with greater growth opportunities are motivated to mitigate the risk of financial distress, leading them to maintain higher levels of cash and marketable securities. Additionally, firms facing riskier debt and greater growth opportunities tend to forego potentially valuable investment opportunities. As a result, the increased cost associated with external financing causes firms to maintain higher levels of cash holdings as a means of maintaining financial flexibility.

Furthermore, the results of the study align with the model presented by Kim, Mauer, and Sherman (1998), which emphasizes the trade-off between the lower returns associated with holding liquid assets and the benefits of funding future investment opportunities. This model suggests that firms optimize their cash holdings based on the availability and cost of external finance.

2.2.2 Corporate governance metrics

Focusing on managerial ownership, Nikolov and Whited (2014) examine the impact of agency problems on corporate cash holdings using a structural estimation approach. They found that low managerial ownership is a significant factor contributing to increased cash holdings. On the other hand, the research conducted by Liu and Mauer (2011) suggests that CEO compensation programs that incentivize risk-taking are associated with increased levels of cash holding. However, it is important to note that this cash may have lower value to shareholders.

In an empirical investigation of UK companies, Ozkan and Ozkan (2004) found that the ownership structure of firms plays an important role in determining their cash holdings. They found a non-monotonic relationship between managerial ownership and cash holdings, with cash holdings first falling as managerial ownership increases up to 24%, then rising as managerial ownership increases to 64%, and falling again at higher levels. They also found that family-controlled firms tend to hold higher levels of cash and marketable securities. Their findings contribute to the literature on the empirical determinants of cash holdings of firms

by incorporating ownership and board structure, effectively controlling for endogeneity, and accounting for the dynamic nature of firms' response to changes in their target cash levels.

The study of Megginson et al. (2014) focuses on the relationship between state ownership and corporate cash holdings in China's share-issue privatized firms from 2000 to 2012. According to their results, there is a positive relationship between the level of cash holdings and the decline in state ownership in firms. This suggests that as state ownership decreases, firms are less inclined to hold cash for liquidity purposes due to the reduced influence of soft budget constraints. In this context, the increase in corporate cash holdings can be attributed to a decrease in the impact of soft budget constraints on firms' behavior. Additionally, the study indicates that the decline in state ownership is associated with a higher marginal value of cash, indicating that shareholders place more value on cash that is less likely to be appropriated for state use.

The board of directors has a crucial role in protecting shareholders' interests and ensuring strong corporate governance. The study of Kao et al., (2019) examines the impact of board characteristics, ownership structure, and corporate governance mechanisms on firm performance in Taiwanese firms. The findings indicate that a higher proportion of independent directors typically leads to a more effective board. An effective board can mitigate agency problems related to high cash holdings by monitoring senior executives and restricting their ability to extract personal benefits. However, there is no clear evidence indicating a direct impact of board structure on cash holdings or the operating performance of firms with high cash holdings. Nevertheless, high cash holdings can still affect the prudent utilization of the cash (Amess et al., 2015).

Finally, financial leverage serves as a means to regulate managers' discretionary behavior, thus reducing the costs associated with their control over cash holdings. According to Jensen (1986), the fixed interest obligations of debt compel managers to allocate cash to creditors rather than retaining it or utilizing it for personal gains through unprofitable investments. Consequently, higher leverage diminishes managers' control over cash, subsequently mitigating the agency costs linked to expenditures that yield personal benefits. This reduction in discretionary spending is anticipated to augment firm value and deliver advantages to

shareholders. However, it is important to note that higher leverage also amplifies financial risk due to the increased likelihood of default and bankruptcy costs. Faulkender and Wang (2006) have observed empirical evidence supporting the notion that elevated levels of cash and leverage diminish the incremental value of cash. They discovered that an additional dollar of cash in an all-equity financed firm is worth $0.143 more than an additional dollar of cash in a firm with a 10% leverage ratio.

Cash holdings levels in a company can be influenced by various firm-specific factors. Several studies have examined these determinants of cash holdings in different countries and industries. For example, the paper of Ahmed et al. (2018) provides context on the factors that affect corporate cash holdings and the possible implications of these determinants on firm performance. The paper's findings offer insights into the determinants of corporate cash holdings for large Chinese listed firms from 2012 to 2016. Specifically, the study highlights several firm-specific determinants that impact cash holdings levels. These determinants include leverage, bank debt, non-cash liquid assets, cash flow volatility, investment opportunity, dividends, firm size, cash flow, board independence, and ownership concentration. The results indicate that cash holdings are negatively related to leverage, bank debt, and non-cash liquid assets, and positively related to cash flow volatility, investment opportunity, and dividends. A study by Drobetz et al. (2007) analyzed the determinants of cash holdings for Swiss firms and found that larger firms, firms with higher profitability, and firms with higher debt ratios tend to hold more cash.

2.3 The Relationship Between Excess Cash Holdings and Firm Behavior

Excess cash holdings and their impact on firm behavior have been a topic of significant interest in corporate finance research. Several studies have examined the relationship between excess cash and investment decisions, considering various factors such as financial constraints, information asymmetry, and managerial entrenchment. For instance, OPSW (1999) found that firms with higher levels of excess cash tend to have greater capital expenditures and acquisition spending, even

when they have poor investment opportunities. They also find that negative excess cash has greater impact on reducing investment than positive excess cash has on increasing it.

Additionally, the impact of excess cash on shareholder payouts is similar in magnitude to its impact on investment and acquisition spending. Another finding is that rises in excess cash result in a relatively minor increase in capital expenditures, acquisitions spending, and payouts to shareholders. This indicates that excess cash levels tend to pe persistent unless firm performance is poor, and that the lumpiness of capital expenditures and acquisitions is not an important reason for changes in the excess cash policy (OPSW, 1999; Arnold, 2014). However, Sheu and Lee (2012) highlighted the moderating effects of financial constraints and managerial entrenchment on the relationship between excess cash and investment. They found that the positive impact of excess cash on investment is stronger for financially constrained firms, while managerial entrenchment weakens the relationship. Additionally, other studies have explored the implications of excess cash for R&D expenditure and shareholder payouts.

2.4 Development of Hypotheses

We develop hypotheses and research propositions based on the main research question: *What drives/explains the strong growth in cash holdings that we have observed over the years?* Building upon the theories and previous research discussed in the literature review, we aim to investigate the factors that contribute to the increase in cash holdings of US firms since 1980.

Hypothesis 1:

There has been a significant increasing trend in cash holdings of US firms since 1980.

This hypothesis posits that there has been a consistent and significant upward trend in cash holdings among US firms over the years (Bates et al., 2009).

It suggests that the average cash ratio has been steadily increasing, indicating a greater emphasis on holding cash reserves. By testing this hypothesis, we aim to explore whether there is a statistically significant trend in cash holdings and gain a deeper understanding of the trajectory of cash management practices among US firms.

By examining historical data and conducting regression analyses, we will investigate the relationship between time and cash holdings to determine if there is a significant annual increase in cash holdings over the sample period. The findings will help shed light on the overall pattern of cash accumulation and provide insights into the factors driving the observed growth in cash holdings.

Hypothesis 2:

Smaller firms, categorized in lower quintiles based on their book value of assets, are more likely to exhibit higher cash ratios compared to larger firms.

Considering the observed upward trend in cash ratios across all firm size quintiles, with a more pronounced increase for smaller firms, we propose the presented hypothesis 3. This hypothesis is based on the results obtained from the regression analysis, which revealed a positive and statistically significant slope coefficient for each quintile. It aligns with the conclusions of Bates et al. (2009) and suggests that firm size plays a significant role in driving the increase in cash holdings over time.

Hypothesis 3:

Firms with a higher emphasis on dividend payments are expected to have lower cash ratios compared to firms that prioritize cash retention.

This hypothesis is based on the understanding that firms with a greater focus on distributing dividends may allocate a smaller portion of their available funds to cash reserves. It implies that dividend policy influences the level of cash holdings, with firms favoring either dividend payouts or cash retention strategies.

Hypothesis 4:

Firms operating in industries with higher levels of risk are more likely to maintain higher cash reserves compared to firms in industries with lower risk levels.

This hypothesis is based on the notion that industries characterized by greater risk and uncertainty may require larger cash reserves as a precautionary measure. It suggests that industry risk serves as a determinant of cash holdings, with firms adjusting their cash management strategies in response to the specific challenges and characteristics of their respective industries.

Hypothesis 5:

The increase in cash holdings of US firms since 1980 can be attributed to changes in known determinants of cash holdings.

This hypothesis posits that firm-specific factors, such as firm size, market-to-book ratio, cash flow, leverage, acquisition activity and net working capital management efficiency, play a significant role in driving the observed growth in cash holdings. Larger firms and firms with higher market-to-book ratios may hold higher cash reserves to mitigate liquidity risks and ensure financial stability. On the other hand, firms with higher cash flows and more efficient working capital management may maintain lower cash ratios as they have better access to external financing and investment opportunities. By testing this hypothesis, we seek to understand the extent to which firm-specific factors influence cash holdings.

3. Research Methodology

3.1 Data Description

The research design for this master's thesis involves an empirical investigation of the determinants of cash holdings for U.S. industrial corporations, as well as an examination of the relationship between cash holdings and firm

performance. The study aims to replicate and extend the findings of the study by Bates et al. (2009) to a more recent sample period.

The sample includes publicly listed firms in the US over a fourty-year period spanning from 1980 to 2020, which is collected from the WRDS Compustat database. In order to ensure the quality and reliability of the data, the sample is refined by applying filters in accordance with prior empirical research. Specifically, firms with particular Standard Industrial Codes (SIC) are excluded from the sample to minimize the influence of factors that could potentially confound the results. In this case, exclusion from certain SIC codes are based on prior research indicating that these codes are associated with industries that have unique cash flow characteristics that could influence the cash holdings of firms withing those industries.

Consistent with previous empirical research conducted by Bates et al. (2009), Dittmar and Mahrt-Smith (2007), and OPSW (1999), companies operating within the financial service industries (SIC codes 6000-6999) are excluded due to the challenges associated with accurately assessing their liquidity. Additionally, the utility sector (SIC codes 4900-4999) is excluded due to prior research suggesting that the liquidity and governance factors of companies in the utility sectors may be influenced by regulatory policies. As a result, cash holdings of such firms may be subject to regulatory supervision.

3.2 Variables and Measurements

Dependent variable

Cash-to-assets ratio

A key variable in our analysis is cash-to-assets ratio that is calculated as the average value of the cash and short-term investments variable (CHE) divided by the average value of the total assets variable (AT), across a sample of U.S. firms over a period of time.

CHE **AT**	Cash and Short-Term Investments Assets – Total	**CHE / AT**	**Cash-to-assets-ratio**
CHE **AT**	Cash and Short-Term Investments Assets – Total	**AT – CHE**	**Net Book Assets**
CHE **NA**	Cash and Short-Term Investments Net Book Assets *(calculated above)*	**CHE / NA**	**Cash-to-net assets-ratio**

We focus primarily on regressions using cash to assets as the dependent variable but reproduce regressions using the log of cash to net assets (where net assets equals book assets minus cash).

Explanatory variables

The explanatory variables are followed by Bates et al. (2009) as well as OPSW.

Leverage

We measure leverage as total long-term debt, plus total debt in current liabilities, divided by total assets. Outliers in firm-year explanatory variable leverage is winsorized so that it is between zero and one.

DLTT	Long-Term Debt - Total	**(DLTT + LCT) / AT**	**Debt-to-assets-ratio**
LCT	Current Liabilities - Total		
AT	Assets - Total		

Market-to-book ratio

The market-to-book ratio is often used as a proxy for investment opportunities. We may expect companies with high market-to-book ratios to hold more cash, since the costs they incur if their financial condition worsens are higher

(OPWS, 1999). The variable is measured as (market value of equity + book value of assets – book value of equity)/book value of assets.

PRCC_F	Price Close - Annual - Fiscal	**([PRCC_F] * [CSHO] + [AT] - [CEQ]) / [AT]**	**Market-to-book-ratio**
CSHO	Common Shares Outstanding		
CEQ	Common/Ordinary Equity - Total		
AT	Assets - Total		

Firm size

Firm size is used as a proxy for takeover deterrent in OPSW, which is where Bates has taken his variables from. The tradeoff model argues that there are economies of scale in liquid assets, that way one would expect firm size to have a negative impact on cash holdings (OPSW, 1999). Our size measure is the logarithm of book assets in 2004 dollars. Measured as total assets multiplied with the consumer price index (CPI) for the US.

CPI	Consumer Price Index U.S.	**LOG(AT * CPI ratio)**	**Firm size**
AT	Assets - Total		

Cash flow to assets

Firms with higher cash flow accumulate more cash, all else equal. (Bates et al., 2009). We measure cash flow as earnings after interest, dividends, and taxes but before depreciation divided by book assets.

EBITDA	Earnings Before Interest	**[EBITDA] / [AT]**	**Cash flow to assets**
AT	Assets - Total		

Net working capital to assets

Net working capital (NWC) consists of assets that substitute for cash. We expect a negative relation between NWC and cash holdings, measured by net working capital/assets.

WCAP	Working Capital (Balance Sheet)	**([WCAP] - [CHE]) / [AT]**	**Net working capital to assets**
CHE	Cash and Short-Term Investments		
AT	Assets - Total		

Capital expenditures to assets

This variable measures the proportion of a firm's total assets that are invested in capital expenditures. Capital expenditures can act as proxies for financial distress costs and investment opportunities, implying that they may be positively associated with cash. Concurrently, capital expenditures may expand a firm's debt capacity and decrease its demand for cash if they lead to the creation of assets than can serve as collateral. Measured as: Capital expenditures/Total assets.

CAPX	Capital Expenditures	**[CAPX] / [AT]**	**Capital expenditures to assets**
AT	Assets - Total		

Industry cash flow risk

The degree of cash flow risk among firms is defined as the standard deviation of industry cash flow to assets. To achieve this, Bates et al. (2009) employ the computation of standard deviations of cash flow to assets for the previous 10 years for each firm-year. To ensure the reliability of the results, a minimum of three observations is required. We then average the cash flow standard deviations for each firm by two-digit SIC codes, which represents groups of firms that operate in similar industries. This allows for a more precise assessment of cash flow risk, as it

considers the industry-specific factors that may affect cash flow. Firms with greater cash flow risk are expected to hold more precautionary cash.

OCF / AT	Operating cash flow to assets	**Standard deviation of (OCF/AT, NI/ AT, DP/AT)**	**The cash flow volatility measure**
NI / AT	Net income to total asset ratio		
DP / AT	Depr. and amort. to assets		

Dividend payout dummy

We follow Bates and introduce a dummy variable that assumes a value of one during years where a firm pays a common dividend, and a value of zero in the absence of such dividend payments. This approach is based on the premise that firms with dividend payouts are perceived as having lower levels of risk and greater access to capital markets. Consequently, their incentive to hold cash for precautionary purposes is expected to be weaker than that of firms without dividend distributions.

DVC	Dividends Common/Ordinary	**If DVC > 0**	**dividend payout dummy variable = 1, else dividend payout dummy variable = 0**

R&D to sales

This variable also serves as an indicator for growth opportunities. Firms that engage in higher levels of R&D activities are assumed to have increased financial distress costs. While R&D expenditures tend to consume cash, their function as a proxy for growth opportunities and financial distress may lead to a positive association between R&D spending and the cash ratio. In our analysis, R&D is measured as the ratio of R&D to total revenue, with a value of zero in cases where R&D data is unavailable.

RXD	Research and Development Expense	**XRD / REVT**	**Growth opportunities**
REVT	Revenue - Total		

Acquisitions to assets

Acquisition activity is operationalized as the ratio of acquisition expenditures to total assets, where only the cash outflows associated with acquisition are considered.

ACQ	Acquisitions	**AQC / AT**	**Acquisitions to assets**
AT	Assets – Total		

3.3 Selection of the Data Analysis Methods

The selected data analysis methods in this study are mainly based on regression analysis using OLS estimates, pooled regression approach, cross-sectional regression, and panel data models, specifically the fixed-effects model. Each of these methods is instrumental in addressing specific research objectives and hypotheses. Here's how these methods align with our research objectives and hypotheses:

OLS and Pooled Regression Approach: These methods are fundamental to our analysis as they serve to examine relationships between our explanatory variables and firm cash holdings over time. They help to test Hypothesis 1 by assessing the significance of the increasing trend in cash holdings among US firms since 1980. Through these methods, we can measure the magnitude of the relationship between time and cash holdings, providing evidence of an upward trend, if any. There are certain assumptions and potential limitations associated with these chosen analysis methods. These methods assume linearity, independence, homoscedasticity, and absence of multicollinearity in the data, which may not always be held in real-world datasets. Particularly in the pooled OLS, we are

assuming that the error term is uncorrelated across time and individuals, which may be too restrictive. There is also a risk of omitting relevant variables, potentially biasing our results.

Incorporation of Dummy Variables: By integrating dummy variables representing different years, we are acknowledging the time-varying effects within our panel data. This technique allows us to account for any potential bias due to heterogeneity that might affect our OLS estimates. It aligns with the study's objective to provide accurate and reliable estimations by mitigating inconsistencies and bias in the estimators.

Cross-Sectional Regression: This method aligns with the aim to examine the relationships between variables in a cross-sectional context. It will be particularly useful in testing Hypotheses 2, 3, and 4 where we are exploring associations between cash holdings and firm size, dividend policy, and industry risk, respectively. A limitation of this method is that it assumes independence across all cross-sectional units and time invariance, potentially disregarding important time-varying effects. Furthermore, it doesn't take into account the possible correlation between observations within the same cross-sectional unit over time.

Fixed-Effects Model: The fixed-effects model allows us to account for unobserved individual or firm-specific factors, commonly referred to as unobserved heterogeneity. It is especially useful for testing Hypothesis 5, where we want to understand how firm-specific factors contribute to the increase in cash holdings since 1980. By allowing for the correlation between firm-specific effects and the explanatory variables, the fixed-effects model provides a more appropriate representation of our research context.

By leveraging a combination of these statistical techniques, we will be better equipped to accurately test our hypotheses, allowing us to draw meaningful conclusions regarding the factors that have influenced the growth in cash holdings of US firms since 1980.

In the selection of data analysis methods, we performed a Hausman test to compare fixed effects (fe) and random effects (re) regression models. The results of the Hausman test, with a significant chi-square test statistic (5381.36) and a probability value of 0.0000, favored the fixed effects model. This test indicated that the individual-specific effects are correlated with the independent variables,

supporting the use of the fixed effects model. By incorporating the fixed effects model, we can account for unobserved individual or firm-specific factors that may be associated with the explanatory variables, providing a more appropriate representation of our research context.

We employ a **pooled regression** approach in Table 3. This methodology involves pooling observations from different time periods, disregarding heterogeneity between the units and time-varying effects. One significant advantage of this approach is the ability to increase the sample size by incorporating data from multiple time periods. This is particularly advantageous when there is limited cross-sectional data available for a specific period, but a desire to include a larger number of explanatory variables in the regression equation. By pooling observations, the degrees of freedom are increased, facilitating a more accurate and reliable estimation of the regression coefficients. Notably, this regression technique has been successfully utilized by notable authors such as Bates et al. (2009), Ferreira and Vilela (2004), and Pinkowitz and Williamson (2001).

Addressing heterogeneity is crucial in the analysis of the dataset for our master's thesis, as highlighted by Wooldridge (2013), due to the potential inconsistency and bias that can arise in the estimators of the ordinary least squares (OLS) regression. As highlighted by Wooldridge (2013), when heterogeneity is present, the estimators of the ordinary least squares (OLS) regression can become inconsistent and biased. To mitigate this concern, we will incorporate dummy variables representing different years into the regression model. Specifically, dummy variables will be established for the 1990s and 2000s, where a value of "1" indicates if the observation was made in that particular year, and "0" otherwise. This inclusion of time-specific dummy variables allows us to account for the time-varying effects of the data, ensuring a more accurate estimation of the regression coefficients. By incorporating these dummy variables, we aim to address the potential biases arising from heterogeneity and obtain reliable results.

The **cross-sectional regression** shares similarities with the pooled ordinary least squares (OLS) model. However, there is a difference in how time series effects are accounted for. In the pooled effects model, year dummies are used, whereas in the cross-sectional regression, averaging across yearly coefficient estimates is

employed. This approach, similar to studies conducted by Opler et al. (1999) and Ferreira and Vilela (2004), is also applied in this paper. By averaging both the dependent and independent variables over the 40-year period, the analysis effectively reduces the sample to a single cross-section while eliminating the time-series dimension. This allows for a comprehensive examination of the relationships between variables in a cross-sectional context in Table 3.

$$CASH_i = \beta_0 + \beta_j x'_i + \alpha' + \mu$$

Where, $i = 1,2, \dots, N$; for every variable $j = 1,\dots,k$

x'= vector of explanatory variables

α'= vector of industry dummy variables

The pooled ordinary least squares (OLS) model assumes that the error term is uncorrelated with the explanatory variables in each period. However, in certain datasets, this assumption may be too restrictive (Wooldridge, 2002). Panel data models, such as **fixed-effects** and **random-effects models**, are specifically designed to address the "omitted variable problem" by considering unobserved individual or firm-specific factors (unobserved heterogeneity). The fixed-effects model is widely applied in the literature on cash holdings by previous authors (Bates et al., 2009; Drobetz and Grüninger, 2007; Harford et al., 2008; Kim et al., 1998; Opler et al., 1999; Ozkan and Ozkan, 2004; Pinkowitz and Williamson, 2001). In these models, a typical equation includes the dependent variable for a firm at a specific time, the vector of independent/explanatory variables, regression coefficients, and the firm-specific effect (α_i) and idiosyncratic disturbances (μ_{it}). The random-effects model assumes no correlation between the firm-specific effect and the explanatory variables, while the fixed-effects model allows for such correlation. However, both models require the assumption of strict exogeneity. To choose between the two models, a test is performed based on the assumption that the firm-specific unobserved factors are uncorrelated with the explanatory variables. Based on the Hausman test results and the observed differences in coefficient estimates, we have decided to choose the fixed-effects model (FE) for our analysis. This model accounts for the correlation between firm-specific effects

and the explanatory variables, making it a more appropriate choice for our research context.

In the context of our study, we believe that these methods collectively allow us to best address our research objectives, given the data at our disposal. The use of panel data models, particularly the fixed-effects model, offers us the ability to control for unobserved time-invariant characteristics that might be correlated with the explanatory variables. By pairing this with pooled regression and cross-sectional regression, we can enhance the robustness of our findings and minimize potential biases.

Moreover, the inclusion of time dummies can help control for common shocks and reduce omitted variable bias. However, we will remain cautious about the assumptions made and conduct appropriate diagnostic tests (e.g., checking for multicollinearity, testing for heteroscedasticity, etc.) to ensure our results are valid and reliable.

Lastly, while we acknowledge the potential limitations of these methods, we also believe that there are no perfect statistical models or techniques. Each has its strengths and weaknesses, and the choice of which to use depends largely on the research questions, data availability, and context. In our case, we are confident that these methods can provide meaningful insights into the factors influencing the growth in cash holdings of US firms since 1980.

3.4 Validity and Reliability

We have taken several measures to enhance the internal validity of our study. First, we have carefully selected and refined our sample by excluding certain SIC codes and industry sectors to minimize potential confounding factors. This ensures that our analysis focuses on industrial corporations in the U.S. and reduces the influence of industries with unique cash flow characteristics or regulatory policies. Additionally, we have applied appropriate data filters and quality control measures to ensure the accuracy and reliability of our data.

The external validity of our findings refers to their generalizability beyond the specific sample and timeframe of our study. While our research focuses on U.S. industrial corporations over a forty-year period, it is important to acknowledge that the generalizability of our results may be limited to similar contexts. The characteristics and behaviors of firms in other countries or industries may differ, which could affect the applicability of our findings in those settings. However, by utilizing a large sample size and considering a diverse range of variables, we aim to enhance the external validity of our study.

Construct validity concerns the extent to which our measurement tools accurately capture the concepts and variables of interest. To ensure construct validity, we have adopted established and validated measures used in previous studies. For example, the cash ratio, leverage ratio, market-to-book ratio, and other variables we employ have been widely used in the literature and have demonstrated construct validity. We have also discussed the measurement procedures and calculations for each variable, ensuring transparency and consistency in our measurements.

Reliability refers to the consistency and stability of our measurements and data analysis procedures. We have taken several steps to enhance the reliability of our study. These include using standardized data collection procedures, employing established measurement scales, and conducting reliability analyses where appropriate. By ensuring the consistency of our measurements and employing reliable data analysis techniques, we aim to enhance the reliability of our findings.

4. Data analysis and results

4.1 Descriptive Statistics

The dataset used in this study includes 158 459 observations of firms over the period from 1980 to 2020. The descriptive statistics for the variables are presented in **Table a.** These statistics provide an overview of the characteristics and distribution of the data.

Looking at the cash ratio, it appears that, on average, companies hold approximately 20.6% of their assets in cash. However, there is a considerable variation, with the standard deviation of 0.245 indicating a wide range of cash reserve levels across the dataset. The minimum and maximum values of 0.003 and 0.968, respectively, further illustrate this dispersion.

The industry sigma variable exhibits a lower mean of 0.097, suggesting relatively lower volatility within industries. The standard deviation of 0.060 further supports this finding, indicating a relatively narrow range of variation compared to other variables. The absence of negative values in the minimum value of 0 reinforces that volatility is non-negative.

Table a. Summary Statistics

Variable	Obs	Mean	Std. dev	Min	Max
Cash Ratio	158,459	0.206	0.245	0.003	0.969
Industry sigma	158,459	0.0973	0.060	0.000	0.252
Market to book	158,459	2.485	2.389	0.009	10.245
Real size	158,459	4.502	2.286	0.279	7.934
Cash flow/Assets	158,459	-0.0956	0.353	-1.240	0.141
NWC/Assets	158,459	0.018	0.2604	-0.736	0.343

Capital Expenditures	158,459	0.049	0.043	0.000	0.139
Leverage Ratio	158,459	0.232	0.201	0.000	0.594
Net Leverage Ratio	158,459	0.266	0.385	-0.562	0.815
R&D/Sales	154,173	0.381	1.919	0.000	15.889
Dividend dummy	158,459	0.269	0.444	0	1
Acquisition activity	158,459	0.009	0.018	0.000	0.056
Lag cash	134,899	0.203	0.241	0.003	0.969
Lag dcash	115,430	-0.008	0.130	-0.865	0.965

The market-to-book ratio reveals an average value of 2.485, indicating that, on average, companies' market value is approximately 2.5 times their book value. With a standard deviation of 2.39, there is a substantial dispersion of market-to-book ratios across the dataset, suggesting significant variations in valuation multiples. The range of 0.009 to 10.245 for the minimum and maximum values highlights the diverse market valuations observed.

Real size, as indicated by the mean value of 4.502, provides an insight into the average size of the companies in the dataset. The standard deviation of 2.286 demonstrates a significant dispersion in firm sizes, ranging from 0.279 to 7.934. This variation implies a mix of both small and large companies in the sample.

The negative mean of -0.096 for the cash flow to assets variable suggests that, on average, companies have negative cash flow in relation to their total assets. The standard deviation of 0.353 reveals substantial variability in cash flow performance, with a minimum value of -1.240 and a maximum value of 0.141.

The variables NWC/Assets, Capital Expenditures, Leverage Ratio, and Net Leverage Ratio all exhibit means of 0.02, 0.05, 0.23, and 0.27, respectively. The standard deviations for these variables indicate varying levels of dispersion in their values.

To test whether there is any significant issue with collinearity among the variables, we employed the variance inflation factor (VIF) technique. The VIF

values, presented in **Table b**, provide insights into the correlation between the independent variables in a regression analysis. When assessing collinearity, it is generally considered reasonable to conclude that there is no significant issue if all the VIF values are below 5.

Table b. Variance Inflation Factors

Variable	**VIF**	**1/VIF**
Industry sigma	1,31	0,7608
Market to book	1,66	0,6023
Real size	1,79	0,5594
Cash flow/assets	2,58	0,3876
NWC/assets	1,80	0,5570
Capital Expenditures	1,05	0,9528
Leverage	1,22	0,8189
R&D/sales	1,17	0,8524
Dividend dummy	1,36	0,7367
Acquisition activity	1,08	0,9253
Net equity issuance	1,01	0,9888
Net debt issuance	1,00	0,9991
Mean VIF	**1,42**	

In our case, all the VIF values were indeed found to be below 5. This suggests that there is no substantial collinearity among the variables in the dataset. The VIF values ranged from 1.00 to 2.58, indicating low to moderate levels of collinearity among the variables. Consequently, we can reasonably conclude that there is no significant issue with collinearity among the variables, reinforcing the reliability of the regression analysis results.

Furthermore, the correlation matrix displayed in **Table c.** examined the relationships between the dependent and independent variables. The coefficients fell within the range of -50% to 50%, indicating no significant multicollinearity issues among the explanatory variables.

Table c. Correlation Matrix

	Cash ratio	Industry sigma	Market to book	Real size	Cash flow/assets	NWC/assets	Capital Expenditures	Leverage	R&D/sales	Dividend dummy	Acquisition activity
Cash ratio	1.0000										
Industry sigma	0.4170	1.0000									
Market to book	0.3323	0.3063	1.0000								
Real size	-0.2223	-0.2339	-0.3973	1.0000							
Cash flow/assets	-0.3196	-0.3616	-0.6222	0.5523	1.0000						
NWC/assets	-0.2160	-0.3114	-0.4911	0.3070	0.6116	1.0000					
Capital Expenditures	-0.2197	-0.1806	-0.0650	0.0985	0.1516	0.0466	1.0000				
Leverage	-0.3699	-0.1310	0.0280	0.0387	-0.1360	-0.2974	0.0427	1.0000			
R&D/sales	0.3468	0.2611	0.2082	-0.1242	-0.3482	-0.1620	-0.0792	-0.0612	1.0000		
Dividend dummy	-0.2166	-0.3023	-0.1828	0.4688	0.2703	0.2031	0.1011	-0.0191	-0.1155	1.0000	
Acquisition activity	-0.1544	-0.0753	-0.1017	0.2539	0.1708	0.0904	-0.0400	0.0686	-0.0733	0.1115	1.0000

The correlation matrix provided displays the correlation coefficients between the dependent and independent variables. According to the table, there is no indication of significant multicollinearity issues since all correlation coefficients between the explanatory variables fall within the range of -50% to 50% (Wooldridge, 2002).

4.2 Analysis of the Trend in Cash Holdings

Section I The increase in Cash Ratio and the Decrease in Leverage

This section directly addresses Hypothesis 1, which posits a significant increasing trend in cash holdings of US firms since 1980. The analysis begins by presenting comprehensive data on the average and median cash ratios for a sample of firms over the sample period presented in the appendix (**Table I and Graph 1**)[1].

The findings reveal a notable upward trend in cash ratios, with both the average and median cash ratios experiencing significant growth over the years. Regression analyses confirm the presence of statistically significant positive time trends in cash holdings, further supporting the hypothesis.

The second column of **Table I** displays the number of sample firms for each year. The third column presents an overview of the aggregate cash ratio for these sample firms. This ratio is calculated by dividing the total cash by the total assets of all the sample firms. In 1980, the ratio stands at 7.2%, and it steadily increases over the years, reaching its peak of 14.3% in 2020. The following column showcases the average cash ratio for the sample firms on a yearly basis. From 1980 to 2020, this ratio exhibits a notable increase, rising from 10.9% in 1980 to reach its peak at 33% in 2020. Thus, the table shows that cash ratios increased over the sample period.

To evaluate the presence of a statistically significant trend in the cash ratio, we conducted regression analyses (see **Table d**. below) that included a cash ratio and a constant term variable representing time measured in years. The regression analysis reveals that the coefficient associated with the time trend variable in the average cash ratio model indicates an annual increase of 0.40% with a p-value lower than 0.01. Furthermore, the adjusted R-squared value of the regression stands at

[1] See Table I. and Graph 1. in the Appendix

94%, indicating that the model explains a significant portion of the variability in the average cash ratio.

Table d. The regression analysis results for the cash ratio trend.

	(1)	**(2)**	**(3)**
	Average Cash Ratio	Median Cash Ratio	Average Leverage
Year	0.0040198***	0.0024189***	-0.0040448***
Std. error	*(0.0001593)*	*(0.0001709)*	*(0.0003181)*
Constant	-7.846***	-4.747***	8.375***
Std. error	*(0.319)*	*(0.342)*	*(0.636)*
Adjusted R^2	0.9408	0.8329	0.8007

Note: The significance levels are denoted by ***, **, and *, representing the 1%, 5%, and 10%, respectively. The standard errors in parentheses.

The regression analysis for the median cash ratio indicates a slope coefficient representing a yearly increase of 0.24%, with a p-value below 0.01. The R-squared value for this regression is 84%. These findings provide evidence consistent with a positive time trend in cash holdings throughout the sample period. However, it is important to note that these regressions are only useful for understanding the evolution of cash holdings within the specific sample period. Extrapolating the in-sample trend to future years may not be meaningful or accurate.

Moving on to the impact of the rising cash ratio on leverage measurement, column 6 of Table I presents the average debt for the sample firms for each year. In this analysis, debt is calculated as the sum of long-term debt and debt included in

current liabilities, divided by the book assets. The average leverage ratio data from 1980 to 2020 reveals interesting trends. The average leverage ratio starts at 49% in 1980 and fluctuates around this value for several years.

The data for the average net leverage ratio from 1980 to 2020 reveals notable patterns. The average net leverage ratio starts at 39% in 1980 and experiences a gradual decline over the years. It reaches its lowest point of 18% in 2020. Overall, the average net leverage ratio demonstrates a decreasing trend throughout the analyzed period. This decline suggests that, on average, firms have been reducing their net debt by factoring in their cash holdings.

In the regression analysis of the average net debt ratio **(Table d.)**, the coefficient on the time variable indicates a yearly decrease of -0.40% with a p-value below 0.01. This finding suggests a statistically significant downward trend over time.

The last column of Table I shows the median net leverage ratio, which considers the subtraction of cash from debt, provides insights into the trends from 1980 to 2020. Starting at 42% in 1980, the median net leverage ratio experiences some fluctuations but generally displays a downward trend. It reaches its lowest point of 23% in 2020.

Section II Exploring Influential Factor on Cash Holdings: Firm Size.

Hypothesis 2 posits that smaller firms, categorized in lower quintiles based on their book value of assets, are more likely to exhibit higher cash ratios compared to larger firms. To examine the potential relationship between the increase in cash and firm size, we categorize the sample firms into quintiles each year based on the book value of their assets at the end of the preceding year.

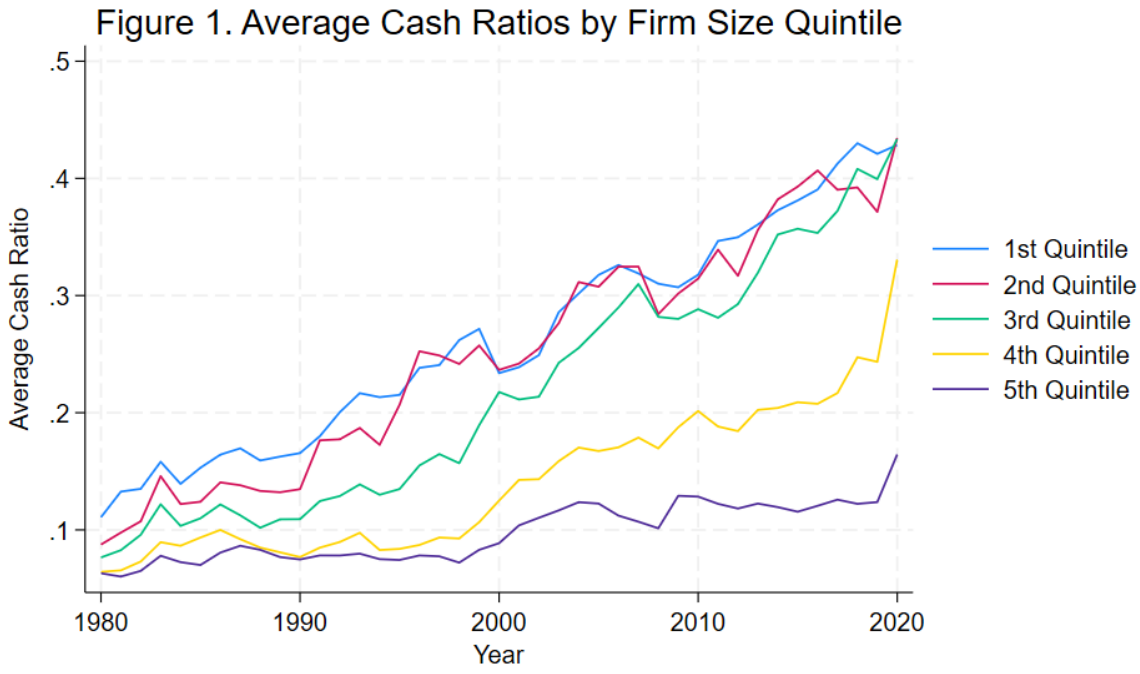


Figure 1 depicts the average cash ratios for different firm size quintiles throughout the entire sample period. The average cash ratio exhibits an upward trend across all size quintiles, with a more pronounced increase observed for smaller firms (1st quintile).

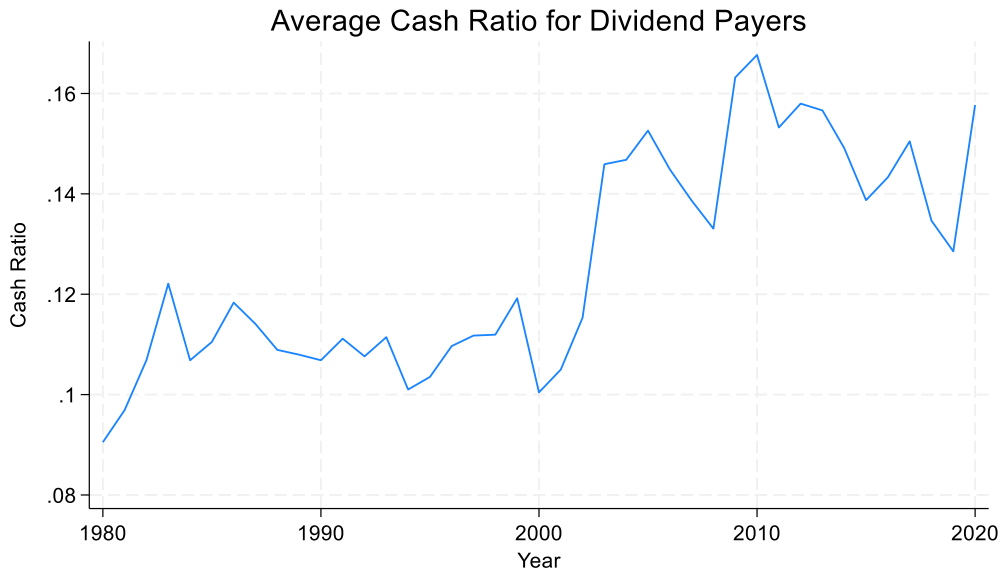
After conducting regression analysis on the cash ratio, including a constant and time (measured in years) for each size quintile, we observed a consistent pattern. In each quintile, we found a positive and statistically significant slope coefficient. Our findings align with the conclusions of Bates et al. (2009), suggesting that the observed gradual increase in cash ratios over time is not predominantly driven by the largest firms in our sample. Instead, our analysis supports the notion that smaller firms play a more significant role in this upward trend.

Section III Impact of Dividend Policy on Cash Holdings: A Comparative Analysis of Dividend Payers and Non-Dividend Payers

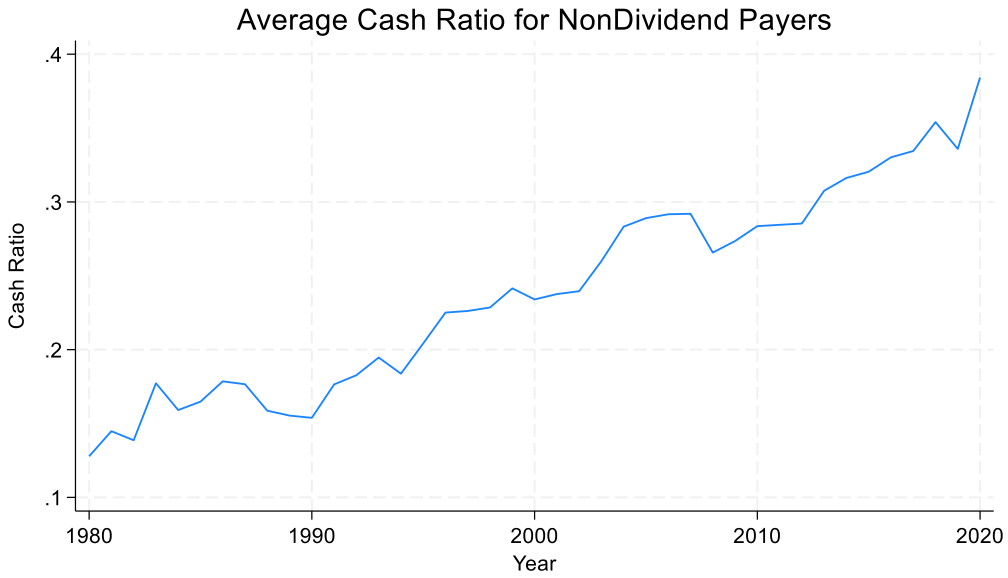
The findings presented in this section provide valuable insights into the relationship between dividend policy and cash holdings, supporting Hypothesis 3. The research builds upon the observations made by Fama and French (2001) regarding the decline in the incidence of dividend-paying firms and the surge in new listings, which contribute to the context of the observed increase in cash holdings.

We replicate the time series of the average cash ratio for two groups: dividend payers and nondividend payers, as shown in **Table II**[2] and Graph 2 (see below). The average cash ratio of dividend payers in a given year represents the average cash ratio of firms that distribute dividends during that year.

Graph 2. Average Cash Ratio for Dividend & NonDividend Payers



[2] See Table II in the Appendix



When comparing the average cash ratio between dividend-paying and non-dividend paying firms, it becomes evident that non-dividend paying firms consistently maintain a slightly higher average cash ratio throughout the years. Both groups, however, exhibit a similar upward trend in their average cash ratios over time, indicating an increasing emphasis on holding cash reserves. Generally, the average cash ratio for non-dividend paying firms tends to exceed that of dividend-paying firms in each respective year. By the year 2020, non-dividend paying firms had reached an average cash ratio of approximately 38%, surpassing the average cash ratio of dividend-paying firms, which stood at around 16%.

According to previous research, such as the study by Almeida et al. (2004), nondividend paying firms are often regarded as financially constrained. This suggests that the observed rise in cash holdings is primarily occurring among financially constrained firms. Moreover, in line with the Han and Qiu (2007) model, our findings regarding the increase in cash holdings among nondividend paying firms provide support for the notion of a precautionary motive driving these firms' cash accumulation. Finally, non-dividend paying firms are typically smaller and the stronger increase in cash holdings thus also includes size related effects.

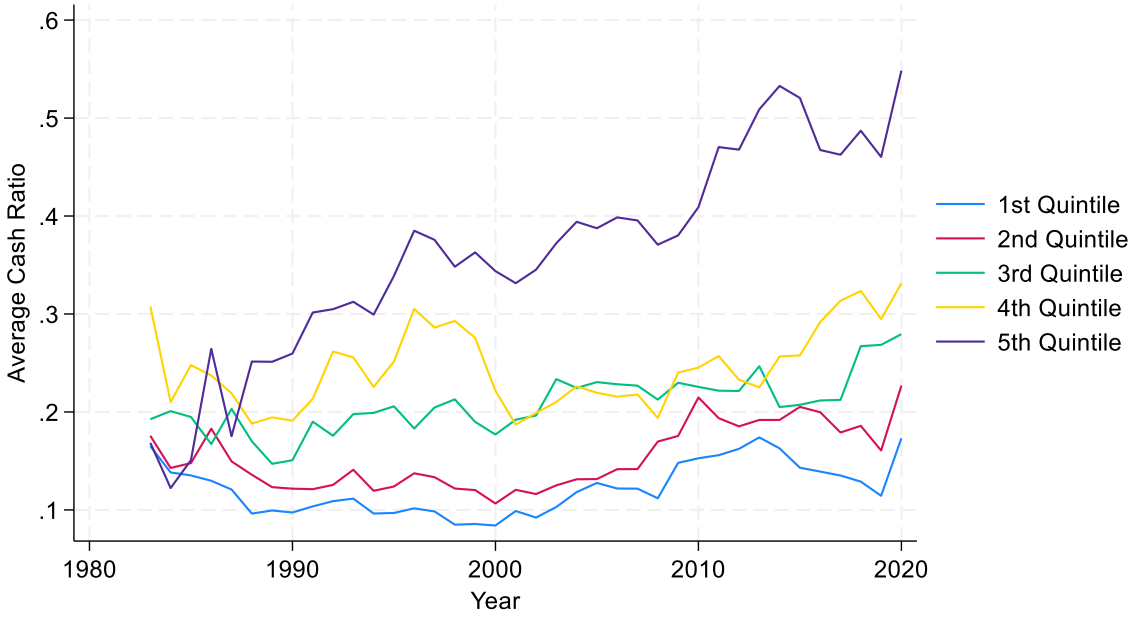
Section IV Relationship between Industry-Specific Volatility and Cash Holdings: Evidence from Quintile Analysis

According to the precautionary motive for cash holdings, it is expected that firms in industries with a significant rise in idiosyncratic risk would exhibit a greater increase in cash reserves compared to firms in industries with a minor increase in idiosyncratic risk. To investigate this relationship, we classified the industries in our sample based on their two-digit SIC code into quintiles, taking into account the change in cash flow volatility over the study period. Cash flow risk was measured as the standard deviation of industry cash flow to assets, which was computed by determining the standard deviation of cash flow to assets for the preceding ten years for each firm-year, with a minimum requirement of three observations. These firm-level cash flow standard deviations were then averaged annually across each two-digit SIC code, providing a measure of industry-level cash flow risk. Intriguingly, in recent years, more than half of the firms included in our sample were situated in industries within the top quintile of the increase in idiosyncratic volatility.

To visualize the relationship between cash ratios and the change in idiosyncratic volatility, we present **Figure 2**, which displays the average cash ratio for each of the five quintiles, sorted according to the magnitude of the increase in idiosyncratic volatility.

This study was conducted with the specific aim of examining hypothesis 4, which relates to the precautionary motive for cash holdings in the context of industry-specific volatility. Hypothesis 4 posits that firms operating in industries with a significant rise in idiosyncratic risk would exhibit a greater increase in their cash reserves compared to firms in industries with a minor increase in idiosyncratic risk.

Figure 2. Average Cash Ratios by Idiosyncratic Risk Quintile



Through the examination of Figure 2, we observe that firms situated in the top quintile of volatility growth encounter the most significant surge in their cash reserves. Starting with an average cash ratio of 12.9% in 1980, these firms witnessed a remarkable increase, reaching 54.8% in 2020. This observation suggests that as idiosyncratic volatility rises within an industry, firms within that industry tend to accumulate larger cash reserves as a precautionary measure to mitigate the associated risks and uncertainties.

4.3 Regression Analysis and Determinants of Cash Ratios

Section V Exploring the Demand Function for Cash Holdings: Firm Characteristics and the Cash Ratio

The analysis conducted in this section of the research study provides support for Hypothesis 5, which suggests that the observed increase in cash holdings of US

firms since 1980 can be attributed to changes in known determinants of cash holdings. The regression analyses examined the relationship between various firm characteristics and the cash ratio.

Our objective is to analyze whether the rise in cash holdings can be attributed to specific characteristics of the firms and whether the relationship between these characteristics and the cash ratio has changed over time. To achieve this, we begin by conducting regression analyses that associate the cash ratio with various firm characteristics. Through this analysis, we aim to determine whether these regressions can account for the increase in cash ratios by considering changes in firm characteristics. This approach enables us to investigate whether there has been a shift in the way firms determine their cash holdings. The existing literature employs multiple definitions and measures for firm characteristics that are commonly used in regression analyses. These characteristics encompass factors such as firm size, profitability, leverage, growth opportunities, and industry affiliation, among others.

Based on the regression results from model (1) in **Table III Panel A**[3], we examined the relationship between firm characteristics and the cash ratio. The analysis reveals several significant findings. Firstly, the market-to-book ratio exhibits a positive and statistically significant coefficient of 0.016 ($p < 0.001$), indicating that firms with higher market-to-book ratios tend to hold a higher cash ratio. Similarly, the variable real size demonstrates a positive and significant coefficient, indicating that larger firms tend to hold higher cash ratios. This finding was not apparent from Figure 1 and suggests that controlling for other firm characteristics is important in order to comment on the impact of size on cash policy. This association may be attributed to the greater operational complexity and financial requirements of larger firms. This finding differs from the results reported by Bates et al. (2009).

Conversely, there are negative coefficients implying an inverse relationship with the cash ratio. These results suggest that firms with higher cash flows, more

[3] See Table III. Panel A in the Appendix

efficient net working capital management, and higher levels of capital expenditure tend to maintain lower cash ratios.

Model 2 of Table III presents a re-estimation of Model 1, where the cash ratio is replaced with the log of cash to net assets as the dependent variable. This alternative specification allows for a logarithmic transformation of the cash ratio, providing a different perspective on the relationship between firm characteristics and the relative level of cash holdings. However, a notable observation is that the adjusted R-squared value is substantially lower compared to Model 1. This indicates that Model 1 performs significantly better in explaining the variation in cash holdings. This finding is consistent with existing literature, including studies by Haushalter, Klasa, and Maxwell (2007) and Harford, Mansi, and Maxwell (2008), which also report similar variations in the explanatory power of different models concerning cash holdings. Model 1 and Model 2 show differences in coefficient estimates for variables. These variations highlight the potential influence of the choice of dependent variable and the resulting impact on the magnitudes and significance of coefficients in explaining the variation in cash holdings.

In order to address the potential impact of constant unobservable firm characteristics on cash holdings, Model 3 presents a novel approach by utilizing changes in variables instead of their absolute levels. This technique aims to provide a clearer understanding of the factors influencing cash ratios by eliminating the confounding effects of fixed firm-specific attributes. Model 3 also incorporates the lagged changes in cash and the lagged cash level, allowing for partial adjustment of the cash ratio towards its equilibrium level. Interestingly, the regression results of Model 3 demonstrate slight variations in comparison to Model 1. Notably, certain factors such as firm size, cash flow, and the dividend dummy exhibit positive and statistically significant coefficients in Model 3. These contrasting outcomes suggest that the relationship between firm characteristics and cash holdings might have undergone changes over time.

To investigate whether there are changes in the intercepts of the models over time and to determine whether the increase in the cash ratio is attributable to changes in firm characteristics, we follow the approach outlined by Bates et al.

(2009). Specifically, we introduce two dummy variables representing the 1990s and the 2000s, enabling us to capture potential shifts in the intercepts during these time periods.

Notably in Model 4, the inclusion of dummy variables for the 1990s and 2000s reveals shifts in the intercepts, with the 2000s exhibiting a higher intercept compared to the 1980s and 1990s. This suggests an increase in cash holdings during the 2000s that cannot be fully explained by changes in firm characteristics alone.

In Model 5, both dummy variables have negative and significant coefficients. This suggests that changes in firm characteristics lead to higher cash ratios than what was observed in the 1990s and 2000s. Essentially, the actual cash ratios during those periods are lower than what the model predicts based on the firm characteristics alone. The dummy variable for the 1990s (dummy_1990s) demonstrated a negative and highly significant coefficient of -0.287. This suggests that, compared to the baseline period, firms in the 1990s tended to have lower cash ratios. Similarly, the dummy variable for the 2000s (dummy_2000s) showed a negative and significant coefficient of -0.183. This indicates that firms in the 2000s also tended to have lower cash ratios compared to the baseline period.

These findings provide evidence of shifts in the intercepts during the 1990s and 2000s, suggesting changes in cash management practices that cannot be fully explained by the included independent variables alone. The negative coefficients for both dummy variables imply a decrease in cash holdings during these time periods. Model 6 re-estimates model 3 with the dummy variables and gives the same conclusion as model 5.

Following Bates et al., 2009 we conducted regressions for two different subperiods: the 1980s and the remaining period of our sample (in Model 7 and 8). In contrast to Bates et al. (2009), our study has diverged from the utilization of Fama-MacBeth regression. The purpose of this analysis is to examine whether the relationship between firm characteristics and the cash ratio changed over time. Both models exhibit consistent coefficient estimates with the pooled regression of Model 1, indicating stability in the overall relationships. Specifically, the coefficient estimates for "Industry Cash Flow" in both subperiods are statistically significant

at the 1% level, suggesting a positive association between industry cash flow and the cash ratio.

In addition, the intercepts show a notable difference between the two subperiods. Model 7, representing the 1980s, exhibits a higher intercept compared to Model 8, which represents the later period of the sample. This discrepancy implies that the average cash ratio levels were higher during the 1980s than in the latter half of the sample period.

The findings presented in Panel A of Table III demonstrate overall consistency in the relationship between cash holdings and firm characteristics across the estimated models.

In the context of the study conducted by Bates et al. (2009), the researchers extended their analysis to examine whether there were changes in the relationship between cash holdings and firm characteristics over time (see **Table III Panel B** below). By including indicator variables for the 1990s and 2000s and allowing them to interact with all the independent variables, the researchers aimed to capture any potential differences in the intercepts and slope coefficients between these time periods. This approach enabled them to assess whether there were changes in the way firm characteristics influenced cash holdings during the 1990s and 2000s, potentially explaining the higher cash holdings observed in the 2000s.

Table III Panel B: Regressions Estimating the Determinants of Cash Holdings

Model	**1** **Cash/Assets**		
Dependent Variable	Estimate	Interaction 1990s	Interaction 2000s
Intercept	0.295***	-0.0623***	-0.111***
Industry sigma	0.179***	0.452***	0.549***
Market to book	0.0147***	0.00272*	0.00208
Real size	-0.00493***	0.00838***	0.0173***

Cash flow/assets	0.0322***	-0.0225*	-0.0617***
NWC/assets	-0.165***	-0.00337	0.0552***
Capital Expenditures	-0.500***	-0.147***	-0.471***
Leverage	-0.431***	-0.0503***	-0.00111
R&D/sales	0.0308***	-0.00359	-0.00868***
Dividend dummy	-0.0330***	-0.0126***	-0.0244***
Acquisition activity	-0.198***	-0.553***	-1.081***
Adjusted R2	0.407		

Note for all models: The significance levels are denoted by ***, **, and *, representing the 1%, 5%, and 10%, respectively.

In our Model 1, where cash/assets is the dependent variable, several variables show significant associations. The intercept has a negative coefficient in both the 1990s and 2000s, suggesting a negative shift in the demand for cash during these periods. The industry sigma, market to book ratio, and real size variables also display significant relationships. Cash flow to assets has a positive coefficient during the 1990s but becomes negative and significant in the 2000s. Similarly, the coefficient of real size is initially negative but turns positive and significant as the time period progresses.

The cash flow to assets variable exhibits an intriguing pattern. In the 1990s, firms with higher cash flows relative to their assets hold more cash, as suggested by the positive coefficient. However, this relationship flips in the 2000s, with a negative and significant coefficient. This suggests that firms with higher cash flows relative to their assets reduced their cash holdings during the 2000s compared to the 1990s.

Similarly, the real size variable shows a shift in its impact on cash holdings. Initially, larger firms held lower levels of cash during the 1990s, indicated by the negative coefficient. However, in the 2000s, the relationship changes, with larger firms holding more cash, as evidenced by the positive and significant coefficient.

Model	2 Cash/Assets		
Dependent Variable	Estimate	Interaction 1990s	Interaction 2000s
Intercept	0.299***	-0.0560***	-0.102***
Industry sigma	0.160***	0.425***	0.507***
Market to book	0.0144***	0.000354	0.00191
Real size	-0.00558***	0.00785***	0.0167***
Cash flow/assets	0.0312***	0.00417	-0.0574***
NWC/assets	-0.167***	0.000541	0.0535***
Capital Expenditures	-0.505***	-0.181***	-0.453***
Leverage	-0.434***	-0.0432***	-0.00277
R&D/sales	0.0320***	-0.00500	-0.0102***
Dividend dummy	-0.0288***	-0.0107***	-0.0235***
Acquisition activity	-0.190***	-0.595***	-1.040***
Net equity issuance	0.00161**	0.0425*	-0.00109
Net debt issuance	0.00832	0.0246	-0.00783
Adjusted R2	0.394		

Model 2 includes additional variables, net equity issuance, and net debt issuance, to examine the impact of capital raising activities on cash levels. The results revealed notable findings. Firstly, the intercept coefficients for both the 1990s and 2000s were negative, indicating a declining demand for cash during these time periods. Consistent with previous research, the industry sigma, market to book ratio, and real size variables demonstrated significant positive coefficients, highlighting that firms in certain industries, with higher market-to-book ratios, and larger sizes tend to hold more cash. Interestingly, the cash flow to assets variable did not exhibit a significant relationship with cash holdings in either period. Furthermore, the net equity issuance variable showed a significant and positive relationship with cash holdings during the 1990s, suggesting that firms issuing more

equity held higher levels of cash. However, this relationship became insignificant and negative in the 2000s. The net debt issuance variable did not display a significant relationship in either period. These findings contribute to our understanding of the factors influencing cash holdings and emphasize the importance of considering the temporal dynamics when examining cash management practices in firms.

Model	**3 Log/Cash/Assets)**		
Dependent Variable	Estimate	Interaction 1990s	Interaction 2000s
Intercept	-1.851***	-0.260***	-0.626***
Industry sigma	1.525***	2.265***	1.386***
Market to book	0.101***	-0.00612	0.00240
Real size	-0.00732	0.0182**	0.105***
Cash flow/assets	0.333***	-0.0299	-0.371***
NWC/assets	-1.035***	-0.135*	0.448***
Capital Expenditures	-1.591***	-0.981***	-2.667***
Leverage	-3.483***	-0.424***	0.530***
R&D/sales	0.111***	-0.0271*	-0.0387***
Dividend dummy	-0.187***	-0.0466	-0.0818***
Acquisition activity	0.267	-4.861***	-6.103***
Net equity issuance	0.00641*	0.169*	-0.00893*
Net debt issuance	0.0732*	0.126	-0.0698
Adjusted R2	0.302		

Model 3 focuses on the logarithm of the cash/asset's ratio as the dependent variable. The intercept in the 2000s has a significant and negative coefficient, suggesting a downward shift in the demand for cash during that period, consistent

with Bates et al.'s results. Other variables, such as industry sigma, real size, cash flow/assets, and leverage, exhibit significant relationships as well.

Section VI Exploring the Increase in Cash Holdings: Firm Characteristics Analysis and Determinants of Cash Ratios

The analysis conducted in this section of the research study provides support for Hypothesis 5, which suggests that the observed increase in cash holdings of US firms since 1980 can be attributed to changes in known determinants of cash holdings. The regression analyses examined the relationship between various firm characteristics and the cash ratio.

We undertake a three-step analysis to understand the factors behind the increase in cash holdings. First, we estimate a modified OPSW model using regressions based on data from the 1980s. This model incorporates net equity and net debt issues.

Second, we compare the predicted cash holdings from the 1980s model with the actual cash holdings in the 1990s and 2000s. That is, we estimate the cash model using data from the 1980s. This regression yields regression coefficients for the independent variables. Using those coefficients and multiplying them with actual firm characteristics in the 1990s (or 2000s), we then compute the predicted cash holdings. By examining the differences between predicted and actual cash ratios, they determine the magnitude of deviation and assess its statistical significance. This step allows us to evaluate how well the model predicts cash holdings during different time periods.

In **Table IV** (see below), the results provided display the predicted cash ratios and variations between the actual cash ratios and the predicted values. The second column presents the forecasted cash ratios for the entire sample, while the third column shows the differences between the actual cash ratios and the predicted values same goes for the two following subgroups of the data: dividend paying and dividend nonpaying.

Table IV. Predicted Cash Ratios and Their Deviations from Actual Cash holdings over Time

	Whole Sample		*Firms paying a dividend*		*Firms not paying a dividend*	
Year	Predicted	Actual - Predicted	Predicted	Actual - Predicted	Predicted	Actual - Predicted
1990	0,144	0,16	0,106	-0,07	0,16	0,144
1991	0,162	0,142	0,111	-0,075	0,184	0,12
1992	0,172	0,132	0,114	-0,077	0,196	0,108
1993	0,182	0,122	0,115	-0,078	0,209	0,095
1994	0,167	0,136	0,102	-0,066	0,192	0,112
1995	0,18	0,124	0,105	-0,068	0,205	0,098
1996	0,205	0,099	0,107	-0,07	0,235	0,069
1997	0,204	0,1	0,112	-0,076	0,231	0,073
1998	0,19	0,114	0,095	-0,058	0,215	0,089
1999	0,212	0,092	0,098	-0,061	0,239	0,065
2000	0,219	0,853	0,094	-0,057	0,245	0,059
2001	0,223	0,081	0,102	-0,066	0,248	0,056
2002	0,222	0,082	0,108	-0,072	0,246	0,058
2003	0,241	0,063	0,135	-0,099	0,267	0,037
2004	0,259	0,045	0,143	-0,106	0,291	0,013
2005	0,259	0,045	0,143	-0,106	0,295	0,009

2006	0,259	0,045	0,134	-0,097	0,299	0,005
2007	0,26	0,044	0,133	-0,097	0,3	0,004
2008	0,237	0,067	0,132	-0,096	0,271	0,032
2009	0,249	0,055	0,162	-0,125	0,276	0,028
2010	0,256	0,048	0,164	-0,127	0,286	0,018
2011	0,248	0,056	0,154	-0,118	0,285	0,024
2012	0,241	0,063	0,153	-0,12	0,276	0,028
2013	0,259	0,045	0,153	-0,117	0,301	0,003
2014	0,268	0,036	0,147	-0,11	0,318	-0,014
2015	0,267	0,037	0,137	-0,1	0,322	-0,018
2016	0,268	0,036	0,138	-0,101	0,322	-0,018
2017	0,272	0,032	0,142	-0,106	0,325	-0,021
2018	0,281	0,023	0,132	-0,096	0,34	-0,036
2019	0,27	0,034	0,127	-0,09	0,326	-0,022
2020	0,326	-0,022	0,158	-0,122	0,384	-0,08

The table presents predicted cash ratios and their deviations from actual cash holdings over time, categorized by firms paying a dividend and firms not paying a dividend. Each year, the predicted cash ratio is provided, followed by the difference between the actual cash holdings and the predicted values for both types of firms.

Comparing these results to the findings of Bates et al., (2009) there are notable similarities and differences. For instance, both analyses highlight the challenges of accurately predicting cash ratios. In line with Bates et al.'s research, the results indicate instances of overprediction and underprediction in various years. Specifically, the model tends to overpredict cash holdings in the 1990s, consistent with Bates et al.'s observations.

However, there are differences in the specific magnitudes and patterns of the deviations. While Bates et al. provided figures for particular years, the provided results do not include specific numerical values. Consequently, a direct comparison of the magnitude of the deviations is not feasible. Nevertheless, the general trend of overprediction and underprediction aligns with Bates et al.'s findings.

In general, the predicted cash ratios tend to be lower than the actual cash holdings across all three categories (whole sample, firms paying a dividend, and firms not paying a dividend). This suggests that the predicted models tend to underestimate the amount of cash firms hold.

When comparing firms paying a dividend to those not paying a dividend, it can be observed that dividend-paying firms tend to have higher predicted cash ratios than non-dividend-paying firms. However, the deviations from actual cash holdings are also higher for dividend-paying firms. This implies that the models' predictions for dividend-paying firms are less accurate compared to non-dividend-paying firms.

The deviations from actual cash holdings fluctuate over time. For some years, such as 1990 and 1991, the deviations are relatively small, indicating that the predictions are close to the actual values. However, in other years, especially during the early 2000s and the financial crisis in 2008, the deviations are larger, indicating larger discrepancies between the predicted and actual cash holdings.

In recent years, such as 2019 and 2020, the predicted cash ratios show an increasing trend compared to earlier years, particularly for the whole sample and firms not paying a dividend. However, the deviations from actual cash holdings are negative for these years, indicating that the models' predictions overestimated the actual cash holdings during this period.

5. Conclusion and Recommendations

5.1 Summary of the key findings and contributions

The data analysis presented in this study reveals several key findings regarding cash holdings and leverage among the sample firms from 1980 to 2020. Firstly, there has been a consistent increase in the average and median cash ratios over the analyzed period, indicating a rise in cash holdings. This upward trend is particularly pronounced for smaller firms, suggesting that firm size plays a significant role in determining cash ratios. Additionally, the average net leverage ratio demonstrates a decreasing trend, indicating that firms have, on average, reduced their net debt by utilizing their cash holdings.

The analysis further highlights the influence of firm characteristics on cash holdings. Firms with higher market-to-book ratios and larger sizes tend to maintain higher cash ratios, possibly due to greater operational complexity and financial requirements. Conversely, firms with higher cash flows, efficient net working capital management, and higher capital expenditure tend to have lower cash ratios. These findings contribute to our understanding of the relationship between firm characteristics and cash holdings.

The analysis conducted in Section II of the research study provides support for Hypothesis 1, which suggests that the observed increase in cash holdings of US firms since 1980 can be attributed to changes in known determinants of cash holdings. The regression analyses examined the relationship between various firm characteristics and the cash ratio. The results revealed several significant findings. Firstly, larger firms and firms with higher market-to-book ratios tended to hold higher cash ratios, indicating that these factors played a role in driving the increase in cash holdings. Conversely, factors such as cash flow, net working capital management efficiency, and capital expenditure had negative coefficients, suggesting that firms with higher cash flows and more efficient working capital

management tended to maintain lower cash ratios. These findings imply that changes in firm characteristics, such as size and market-to-book ratio, have contributed to the observed rise in cash holdings over the years. By mitigating liquidity risks, ensuring financial stability, and providing flexibility for future investments, firms have increased their cash reserves as a precautionary measure. Overall, the analysis supports the notion that changes in known determinants of cash holdings have influenced the strong growth in cash holdings among US firms since 1980.

Moreover, the study reveals that nondividend paying firms consistently maintain slightly higher average cash ratios compared to dividend-paying firms. This finding suggests that financially constrained firms, which are more likely to be nondividend payers, are driving the observed increase in cash holdings. This supports the notion of a precautionary motive for cash accumulation among financially constrained firms.

The analysis also indicates that the relationship between firm characteristics and cash holdings may have changed over time. The inclusion of dummy variables for different time periods reveals shifts in the intercepts, indicating changes in cash management practices that cannot be fully explained by firm characteristics alone. This suggests that external factors and time-specific dynamics play a role in shaping cash management decisions.

Furthermore, the study highlights the challenges of accurately predicting cash ratios. The model tends to overpredict cash holdings in certain periods, particularly in the 1990s. This finding emphasizes the need for further research to improve the accuracy of cash ratio predictions and better understand the factors influencing cash management decisions.

5.2 Implications of the study for theory and practice

The findings of this study have significant implications for both theory and practice in the field of finance. Firstly, the study highlights the importance of understanding the determinants of cash holdings and their implications for firm performance. It emphasizes that holding an appropriate level of cash reserves is crucial for balancing investment opportunities and financial constraints.

Secondly, the analysis demonstrates the significance of firm characteristics in determining cash holdings. Factors such as firm size, market-to-book ratio, cash flows, net working capital management, and capital expenditure play important roles in shaping cash ratios. Understanding the relationship between these characteristics and cash holdings enables firms to tailor their cash management strategies to their specific financial goals and circumstances. For example, larger firms may require higher cash reserves due to greater operational complexity and financial requirements, while firms with efficient working capital management and higher investment opportunities may maintain lower cash ratios.

The study also reveals the prevalence of a precautionary motive for cash accumulation among financially constrained firms, particularly nondividend paying firms. These findings have practical implications for cash management strategies, as financially constrained firms may prioritize maintaining higher cash reserves to mitigate risks and uncertainties. Recognizing the financial constraints and investment opportunities of firms can guide cash management decisions and improve overall financial performance.

Furthermore, the analysis highlights the evolving nature of cash management practices over time. The inclusion of time-specific factors and dummy variables reveals changes in cash management strategies that cannot be fully explained by firm characteristics alone. This suggests the influence of external factors and temporal dynamics on cash holdings. Recognizing these changes can help firms adapt their cash management strategies to the evolving market conditions and make informed decisions regarding cash reserves.

Finally, the study emphasizes the challenges in accurately predicting cash ratios. The model tends to overpredict cash holdings in certain periods, indicating the limitations of relying solely on predictive models. This highlights the importance of complementing quantitative analysis with qualitative insights from managers or executives. Integrating qualitative data can enhance the accuracy and reliability of cash management decisions and provide a deeper understanding of the motives and strategies behind cash accumulation.

5.3 Limitations of the study and suggestions for future research

While this master thesis has made significant contributions to our understanding of cash holdings and their determinants, it is essential to acknowledge certain limitations that should be considered. These limitations pave the way for future research to further enrich our knowledge and provide more comprehensive insights into cash management in firms.

Firstly, it is important to note that the findings of this study are based on a specific sample of firms, which may not fully represent the entire population of firms. Therefore, future research could expand the sample size and include a more diverse range of industries to ensure greater generalizability of the results.

Secondly, the study relies on regression analysis to examine the relationship between firm characteristics and cash holdings. However, there may be concerns of endogeneity, such as reverse causality or omitted variable bias, which could impact the validity of the findings. To address these concerns, future research could explore alternative econometric techniques or employ instrumental variable approaches to provide more robust and reliable results.

Thirdly, the external validity of the study might be limited as it focuses on a specific time period. Economic conditions, regulatory frameworks, and industry dynamics can vary over time, and therefore, replicating the analysis across different time periods or conducting cross-country studies would enhance the external

validity and enable a more comprehensive understanding of cash management practices.

Additionally, while the study primarily focuses on firm-level characteristics, incorporating external contextual factors can provide a more holistic view of cash management. Future research could consider including macroeconomic conditions, industry-specific dynamics, and institutional factors to capture the broader influences on cash holdings.

Qualitative research methods, such as interviews or case studies, could complement the quantitative findings of this study. They would allow for a deeper exploration of the motivations and decision-making processes behind cash management strategies, providing richer insights into the managerial perspectives. A dynamic analysis approach can also be valuable in understanding cash management practices over time. Examining how firms adjust their cash holdings in response to changing economic conditions and financial shocks would provide a more nuanced understanding of cash management strategies.

Comparative analysis across different countries or regions can offer insights into the influence of institutional factors, cultural norms, and legal frameworks on cash holdings. Understanding the variations in cash management practices across different contexts would contribute to a more comprehensive understanding of the subject.

By addressing these limitations and pursuing future research along these lines, scholars can advance our understanding of cash management and develop more robust theories and practical implications for firms' cash management strategies.

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Appendix

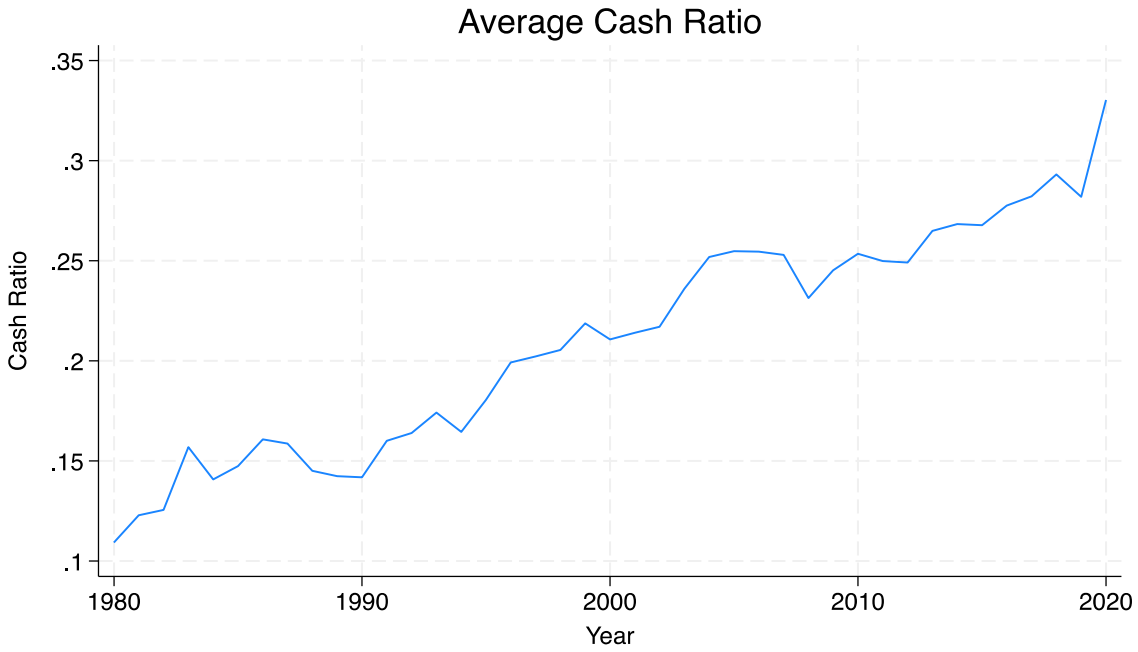
Table I. Average and Median Cash and Leverage Ratios from 1980 to 2020

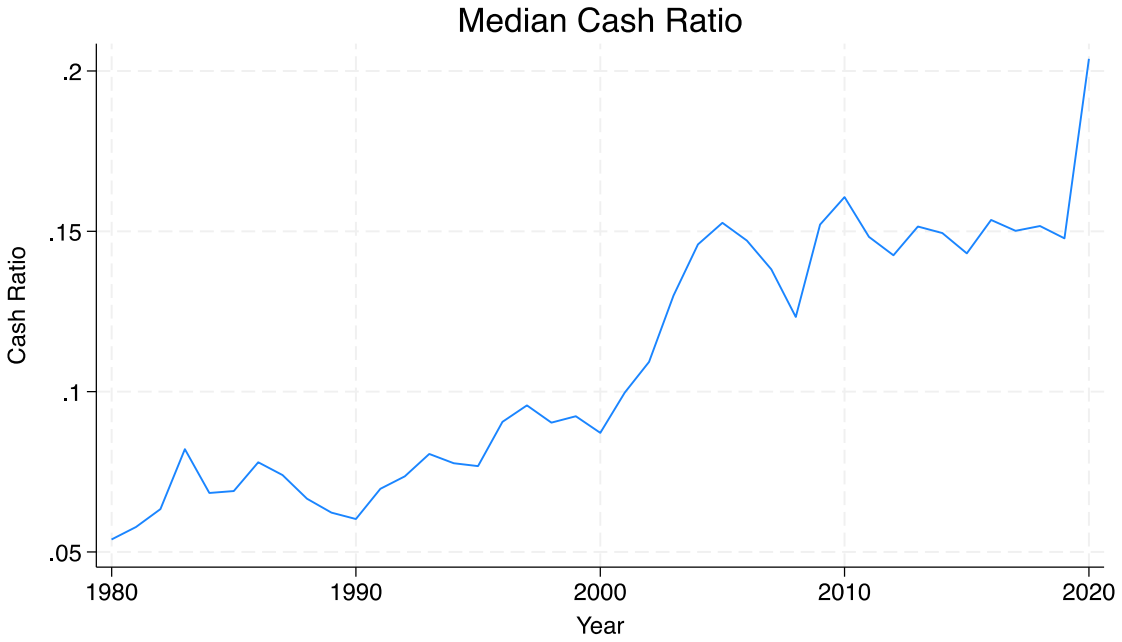
Year	N	Aggregated Cash Ratio	Average Cash Ratio	Median Cash Ratio	Average Leverage	Median Leverage	Average Net Leverage	Median Net Leverage
1980	4517	0.0717712	0.1092532	0.0539024	0.4965591	0.4895327	0.3877408	0.4194451
1981	4554	0.0664954	0.1228394	0.0577815	0.4741839	0.4659209	0.3516442	0.3889334
1982	4778	0.0700453	0.1255784	0.0633796	0.4797906	0.462947	0.3546236	0.3858977
1983	5001	0.0872872	0.1568713	0.0820557	0.4588112	0.4378811	0.3039844	0.3457662
1984	4991	0.0816158	0.140807	0.0684225	0.4699575	0.4524436	0.330898	0.3734043
1985	5299	0.0817929	0.147456	0.0690326	0.4872233	0.4715436	0.3427233	0.3851244
1986	5498	0.0966699	0.1608346	0.07797	0.491974	0.4781487	0.3348371	0.3824362
1987	5461	0.0987621	0.1586691	0.0740085	0.4942253	0.4822104	0.3391967	0.3911755
1988	5260	0.0910817	0.1450875	0.0665922	0.5024397	0.4894064	0.3598509	0.4067045
1989	5151	0.0872618	0.1423553	0.0622847	0.5114998	0.4986509	0.3706367	0.4190138
1990	5173	0.0856106	0.1418013	0.0602923	0.5093058	0.4942344	0.3701187	0.4194221
1991	5296	0.0846612	0.1600717	0.0696743	0.4936939	0.4716581	0.3396187	0.3939567
1992	5640	0.0870145	0.1639274	0.0735826	0.4764528	0.4542793	0.3184421	0.3724579
1993	5958	0.091427	0.1741348	0.0805505	0.4602836	0.4405146	0.2928739	0.3492686
1994	6269	0.0941266	0.1645093	0.0776583	0.4676923	0.4476904	0.307936	0.3564741
1995	7010	0.0866879	0.1805186	0.0767927	0.4756058	0.4559544	0.3020918	0.3649483
1996	7195	0.0896929	0.1991825	0.0905791	0.4533977	0.4252309	0.2636055	0.3239758
1997	7037	0.0888527	0.2022241	0.0957197	0.4591109	0.43102	0.2661945	0.3265136
1998	7268	0.0849279	0.2054352	0.0903468	0.4820528	0.4571067	0.2871341	0.3522003
1999	7287	0.0933249	0.2187118	0.0923082	0.4765761	0.4516579	0.2720673	0.3462739
2000	6936	0.0928858	0.2106577	0.0871703	0.4729235	0.4421027	0.2762135	0.3462076
2001	6464	0.0997884	0.2140647	0.0996925	0.4881372	0.4518988	0.2885453	0.3470228
2002	6105	0.1028786	0.2170559	0.1092941	0.4900086	0.4494378	0.2877727	0.334243
2003	5876	0.1126308	0.2360055	0.1299381	0.4755162	0.4313937	0.2587368	0.2953974
2004	5701	0.1192055	0.2518325	0.1458970	0.4578341	0.4102297	0.2287499	0.2632827
2005	5533	0.1135295	0.2547638	0.1526149	0.4569651	0.4115085	0.2264352	0.2627453
2006	5317	0.1050648	0.2545394	0.1471206	0.4505735	0.4068861	0.2197212	0.2622198
2007	5114	0.1000221	0.2528792	0.1381413	0.4447685	0.4011271	0.2168602	0.2563348

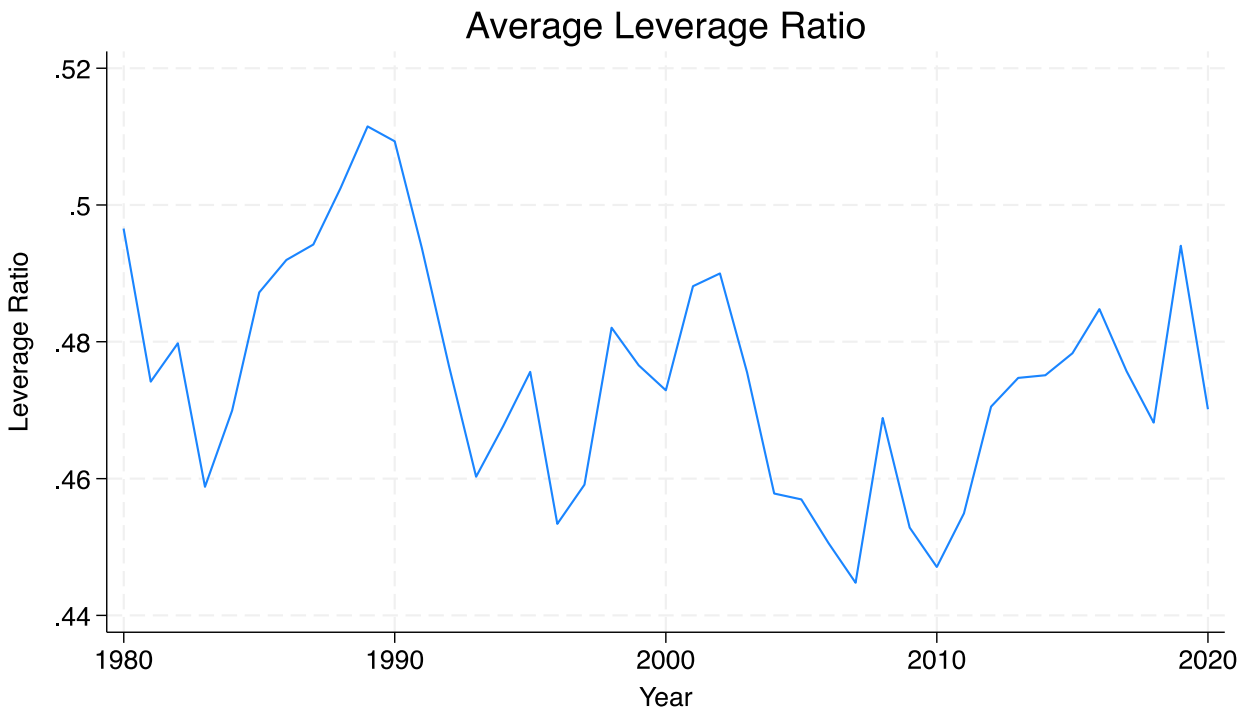
2008	4917	0.0954674	0.2313654	0.1232935	0.468861	0.4336036	0.2590315	0.29496
2009	4798	0.1140227	0.2452258	0.1520982	0.4528453	0.4060295	0.2313079	0.2439988
2010	4744	0.1162553	0.2535026	0.1606722	0.4470796	0.3990128	0.2214511	0.2455703
2011	4731	0.1078498	0.2498579	0.1482375	0.4549152	0.406539	0.2354008	0.2623894
2012	4900	0.1078234	0.2490898	0.1425383	0.4705344	0.420393	0.253296	0.2762653
2013	5006	0.1122657	0.2649253	0.151513	0.4747246	0.4212475	0.2479771	0.274481
2014	4826	0.1133956	0.2683432	0.1494495	0.4751142	0.4325506	0.2421878	0.2811341
2015	4591	0.1164973	0.2677499	0.1431166	0.4783268	0.4380408	0.2469952	0.2868385
2016	4509	0.1218825	0.2775297	0.1535527	0.4847932	0.4524762	0.2451716	0.2914827
2017	4451	0.1238419	0.2821583	0.1501688	0.4757237	0.4447724	0.2311249	0.2878878
2018	4456	0.1151245	0.293133	0.151661	0.4681791	0.4380389	0.2137295	0.2713959
2019	4594	0.1143084	0.2819628	0.1477832	0.4940501	0.4718014	0.244121	0.3007376
2020	4817	0.1426018	0.3303073	0.2037915	0.4701269	0.4408655	0.1819854	0.2285765

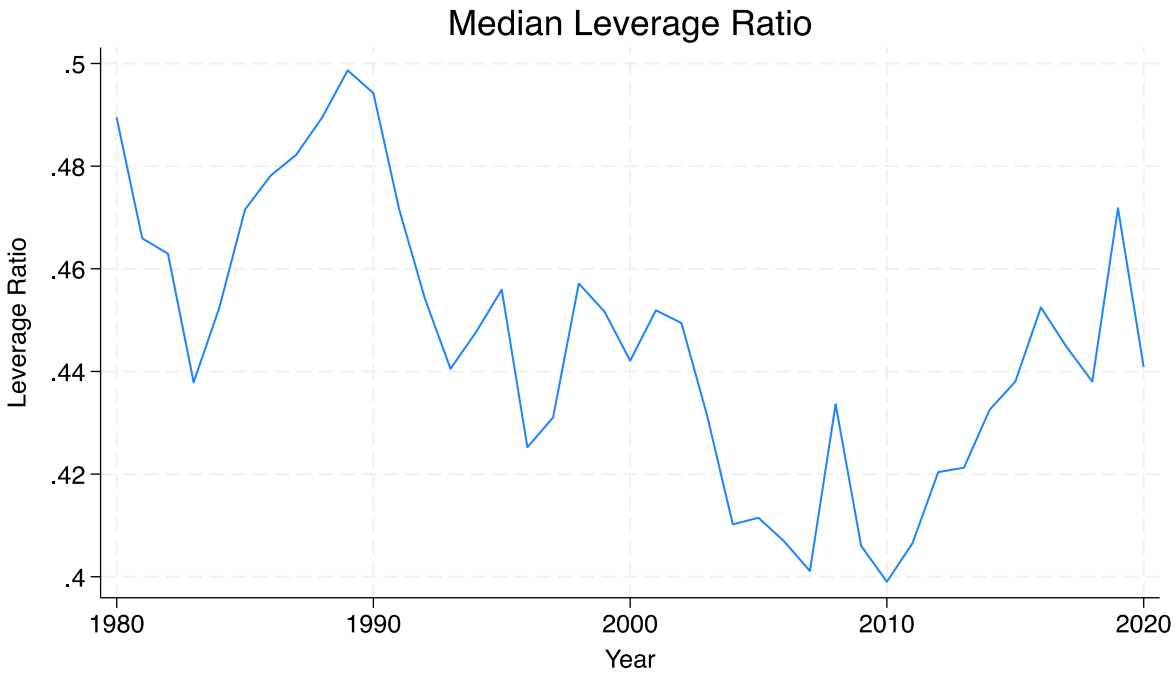
The table provides information on the average and median cash and leverage ratios from 1980 to 2020. The cash ratio represents the proportion of a company's cash assets to its total assets, indicating its liquidity. The leverage ratio measures the level of debt a company has in relation to its equity, reflecting its financial leverage. The net leverage ratio takes into account the company's cash assets when calculating its level of debt. The table shows the average and median values for these ratios over the 41-year period, providing insights into the overall cash holding and leverage trends in the analyzed companies.

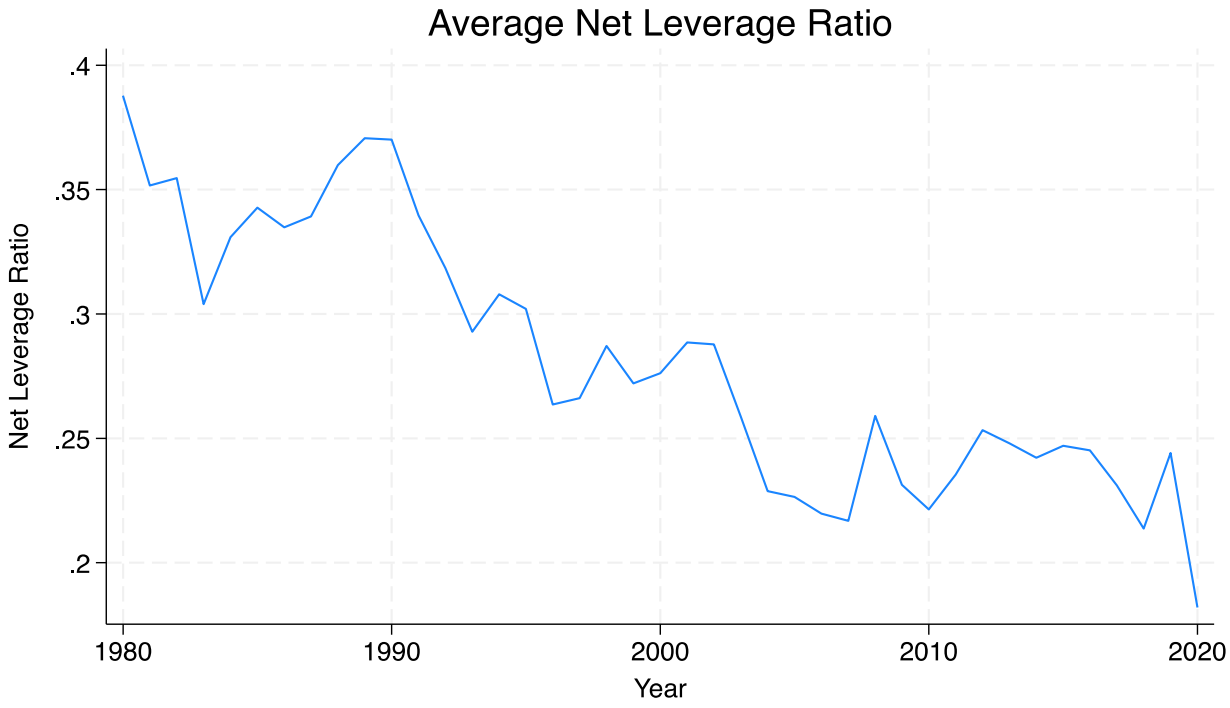
Graph 1. The increase in Cash Holdings and the Decrease in Leverage & Net Leverage






Average Leverage Ratio
Leverage Ratio
.52
.5
.48
.46
.44
1980
1990
2000
2010
2020
Year


Median Leverage Ratio
Leverage Ratio
.5
.48
.46
.44
.42
.4
1980
1990
2000
2010
2020
Year


Average Net Leverage Ratio
Net Leverage Ratio
.4
.35
.3
.25
.2
1980
1990
2000
2010
2020
Year

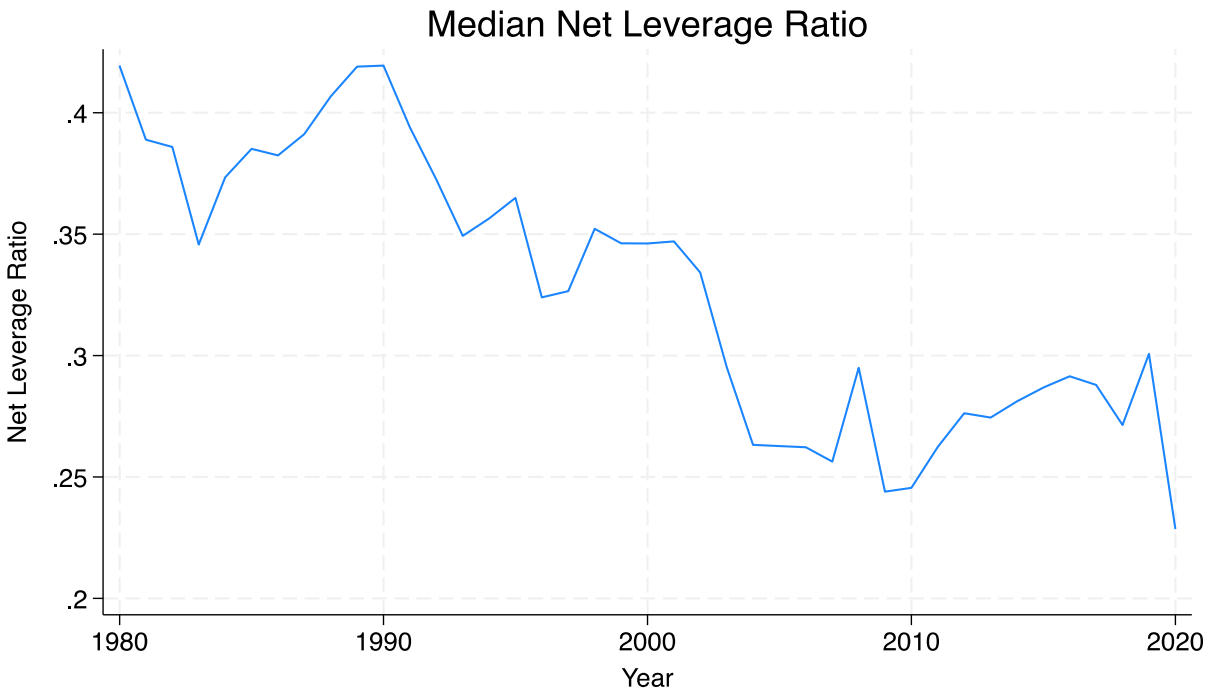

Median Net Leverage Ratio
Net Leverage Ratio
.4
.35
.3
.25
.2
1980
1990
2000
2010
2020
Year

Table II. Average Cash Ratio for Dividend & NonDividend Payers from 1980 to 2020

Year	Dividend Status	
	Dividend Payer	Nondividend Payer
1990	0,107	0,154
1991	0,111	0,176
1992	0,108	0,183
1993	0,111	0,195
1994	0,101	0,184
1995	0,104	0,204
1996	0,110	0,225
1997	0,112	0,226
1998	0,112	0,229
1999	0,119	0,242
2000	0,100	0,234
2001	0,105	0,238
2002	0,115	0,240
2003	0,146	0,260
2004	0,147	0,283
2005	0,153	0,289
2006	0,145	0,292
2007	0,139	0,292
2008	0,133	0,266
2009	0,163	0,274
2010	0,168	0,284
2011	0,153	0,285
2012	0,158	0,285
2013	0,157	0,308
2014	0,149	0,316
2015	0,139	0,320
2016	0,143	0,330
2017	0,150	0,334
2018	0,135	0,354
2019	0,129	0,336
2020	0,158	0,384

Table III. Panel A: Regressions Estimating the Determinants of Cash Holdings

Model	1 OLS	2 OLS	3 Changes	4 OLS	5 OLS	6 Changes	7 1980s	8 1990s-2000s
Dependent Variable	Cash/Assets	Log (Cash/ Net Assets)	Cash/Assets	Cash/Assets	Log (Cash/ Net Assets)	Cash/Assets	Cash/Assets	Cash/Assets
Intercept	0.233***	-2.263***	0.0673***	0.248***	-2.125***	0.0721***	0.295***	0.208***
Industry Sigma	0.597***	2.963***	0.134***	0.654***	3.156***	0.144***	0.179***	0.681***
Market to book	0.0163***	0.103***	0.00595***	0.0168***	0.105***	0.00605***	0.0147***	0.0169***
Real size	0.00433***	0.0552***	0.00276***	0.00706***	0.0629***	0.00326***	-0.00493***	0.00841***
Cash flow/Assets	-0.00235	0.0876***	0.0405***	-0.00654*	0.0886***	0.0397***	0.0322***	-0.0123***
NWC/Assets	-0.129***	-0.822***	-0.0629***	-0.137***	-0.835***	-0.0645***	-0.165***	-0.127***
Capex	-0.712***	-2.942***	-0.490***	-0.764***	-3.042***	-0.501***	-0.500***	-0.814***
Leverage	-0.443***	-3.288***	-0.115***	-0.499***	-3.309***	-0.117***	-0.431***	-0.449***
R&D/Sales	0.0247***	0.0797***	0.00555***	0.0243***	0.0790***	0.00551***	0.0308***	0.0237***
Dividend dummy	-0.0462***	-0.263***	-0.00773***	-0.0504***	-0.284***	-0.00854***	-0.0330***	-0.0531***

Acquisition activity	-0.928***	-4.455***	-1.082***	-0.936***	-4.372***	-1.085***	-0.198***	-1.078***
Lag cash			-0.121***			-0.121***		
Lag dcash			-0.244***			-0.245***		
Dummy 1990s				-0.0305***	-0.287***	-0.00699***		
Dummy 2000s				-0.0376***	-0.183***	-0.00850***		
Adjusted R2	0.399	0.296	0.211	0.402	0.300	0.211	0.320	0.409

Note: The significance levels are denoted by ***, **, and *, representing the 1%, 5%, and 10%, respectively.

Table presents the results of regression analysis estimating the determinants of cash holdings.

The table includes various models (1-8) and their respective coefficients and standard errors.

Model (1 ; 4 ; 7 ; 8): OLS – Cash Holdings

Model (2 ; 5): OLS – Log(Cash/Net Assets)

Model (3 ; 6): Changes – Cash/Assets
