

Cash Holdings and Firm Characteristics: Evidence from UK Market

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Abstract

This paper investigates the determinants of UK corporate cash holdings during the period 1980-2012. The global and long term phenomenon of corporate cash piling has drawn significant attention from researchers. Similarly, this study aims at shedding light on the empirical relationship between cash holding and specific firm characteristics. The empirical findings suggest that cash holdings are positively related to investment opportunity, as R&D and market to book ratio. Cash ratio is also positively related to industry cash flow volatility and negatively affected by cash flow, net working capital, capital expenditures, leverage, tax expenses, age and size. Regarding the development of the determinants of cash holdings, the study indicates that three major variables influenced cash holdings over the years of analysis. In particular, leverage, tax regime and capital expenditures significantly affect the corporate liquidity in UK market. Furthermore, the results suggest that cash holdings are mostly defined by trade off theory. Indeed, our findings offer stimulating insights on the factors that determine the firms' cash holdings during the past three decades.

JEL Classification numbers: G34, L20, L25

Keywords: Cash holdings, trade-off model, pecking order theory, free cash flow theory, liquid assets.

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1 Introduction

Liquid asset holdings of firms have risen significantly during the recent financial crisis in the U.S. and Europe. Cash reserves for firms are vital - like oil in a car's engine. This paper aims at shedding light on the empirical relationship between corporate liquidity and firm characteristics in the UK market.

First of all, a corporation is a legal entity and as such it can make contracts, carry on business borrow or lend money, make takeovers, merge and certainly pay taxes. Moreover, corporations invest in real assets. These assets can be tangible such as plant and machinery and intangible such as brand names and patents. Corporations make financial decisions to borrow, retain and reinvest cash flow and sell additional shares of stock to its stockholders (Brealey et al., 2011). The purpose of this paper is to examine the determinants of corporate cash holdings in the UK. As a definition, in the context of this paper, cash holdings are the assets available in ready cash, as opposed to shares, bonds etc. Gill and Shah (2011) defined cash holding as "cash in hand or readily available for investment in physical assets and to distribute to investors".

Financial flexibility and liquidity are important subjects for any firm. Cash holdings compose an important financial issue and consider a relatively new trend of firms mostly in the United States and Europe. "According to the Office for National Statistics, UK private non-financial companies have held around £500bn in cash in recent quarters, while US companies hold some \$2 trillion and Eurozone companies around €2 trillion, according to consultancy Treasury Strategies".⁴

Companies tend to hold excess cash to make sure that they can invest when cash flow is low. Cash allows to managers to invest on projects relieved from the anxiety of failure, maybe confronting them with the shareholders best interest. The real question is how to determine the optimal cash holdings. Even so, the bigger the cash amounts are, the greater the performance is (Opler et al., 1999). The objective of this paper is to find out whether operating cash flow, leverage, capital expenditures, net working capital, market to book ratio, R&D expenses, tax expenses and firm size and age have a positive or negative impact on cash holdings.

The research questions of this paper are the following: What is cash holding? Why firms hold cash? Which firm characteristics influence on cash holding of UK non-financial listed firms? Do these firm characteristics influence cash holding positively or negatively? How cash holdings affect firm value and performance? This paper seeks to add on to existing literature in answering these questions. In particular, we define the cash policy in UK market using a sample of UK non-financial firms for a period going from 1980 to 2012 and we study the characteristics of firms and the main factors affecting the likelihood of high cash holding policy.

The remainder of this paper is organized as follows. Chapter 2 provides an overview of the motives and theories on cash holdings. Chapter 3 reviews the empirical literature and prior studies on this subject. In Chapter 4, the sample is described and a description of the dataset is given along with the research method. In Chapter 5, the empirical analysis is conducted, and simultaneously, the corresponding results of the descriptive statistics and regression analysis are presented. Finally, Chapter 6 summarizes the results and

⁴<http://www.treasurers.org/mags/10559/files/assets/basic-html/page6.html>

concludes.

2 Review of Relevant Theories and Empirical Studies

Cash holdings are an essential part of the firm's growth and survival receiving a significant amount of interest by investors and financial analysts. Liquidity is measured as the ratio of cash and cash equivalents over the net assets (Ferreira and Vilela, 2004; Opler et al., 1999). This ratio deviates to numerous factors as the industry and firm's characteristics.

Why do firms hold cash? There are some benefits proving that cash holdings are valuable for the firms and its shareholders. In particular, Chen and Chuang (2009) report that firms tend to hold cash in order to reduce transaction costs and to prevent from underinvestment due to shortage of funds. Ferreira and Vilela (2004) supported that cash holdings reduce the likelihood of financial distress. In addition, they allow the pursuance of investment projects regardless the unexpected financial constraints and minimize the costs of raising external funds from borrowing ready cash or forcing to liquidate assets. However, the decision of holding excessive amounts of cash may have negative consequences under ineffective use. The accumulation of cash holdings may hide lost performance or investment opportunities (Ferreira and Vilela, 2004).

Cash holding has both benefits and shortcomings. According to Ali (2013), ready cash is the liquid asset that can be used any time to take advantage of a positive NPV project. On the other hand, a high amount of cash holding may reduce the transaction cost of the corporation. In perfect financial markets, assuming no transaction costs, bankruptcy costs, taxes, agency costs, and asymmetric information the capital structure does not affect firm value (Modigliani and Miller, 1958). Modigliani's study has been the cornerstone of modern finance, constituting a starting point for the majority of the most prominent models (Pagano, 2005). The lack of agency costs implies that there aren't hidden costs of holding cash. However, outside an M&M world there are frictions (as transaction costs, taxes, or mispricing) that make holding cash costly. Moreover, no opportunistic speculation exists in choosing different ways of financing (Luigi and Sorin, 2009). At this point, when it comes to investigate cash, it is relevant to dividend policy, hedging, and capital structure (Faulkender, 2002).

Cash held by firms is a significant part of the balance sheet, which has been vindicated in the existing empirical literature. In order to link cash holding with respective motives, the background of theoretical framework will be briefly investigated. In previous studies (e.g Opler et al., 1999, Ferreira and Vilela 2004, Ozkan and Ozkan 2004) had been examined the determinants of cash holding in light of three theoretical models. Financial research on the subject of the corporate cash holding and its volume is determined by utilizing the theories of the trade-off model (Myers, 1977), the pecking order model (Myers and Majluf, 1984) and free cash flow theory (Jensen, 1986).

The trade-off model is based on the assumption that there is an optimal level of cash. In particular, firms determine the level of cash detention by weighting the marginal benefits and marginal costs. Provided that there is uncertainty in the cash flow process, financially constrained firms' investment may be compromised when the cash flows are lower than expected. Research has shown that that there is a simple trade-off guiding the constrained

firm's choice between higher cash and lower debt. Furthermore, due to this compensation, the preference of a constrained firm will be cash detention at that certain point where the correlation between cash flows from existing assets and future investment opportunities is low enough (Acharya et al., 2007).

The pecking order of Myers and Majluf (1984) argued that firms identify the optimal level of cash holdings, though they use cash in order to balance between retained earnings and investment opportunities. The key aspect of this argument is that the firm's management possesses deeper knowledge about its value than the potential investors. It is obvious that investors interpret the firm's procedures rationally. Moreover, the hierarchical model reported the trend that firms prefer internal funding for investment projects and prefer debt to equity when it comes to external financing (Myers and Majluf, 1984). In order to minimize the costs of asymmetric information, firms use a specific hierarchical classification. In particular, firms' primary preference is the internal funding of their investment projects. Next, firms choose to meet their debts or loan obligations and pay dividends. Only in this case, firms choose to accumulate cash. Clearly, the financing of investments projects under insufficient profits, lead the firms to use their cash holdings issuing new debt (Ogunpide et al, 2012).

Another model of free cash flow theory is introduced, where cash holdings are used to reduce pressure on managers to improve their performance and increase their flexibility on firms' growth opportunities. According to Jensen (1986), "Free cash flow is cash flow in excess of that required to fund all projects that have positive net present values discounted at the relevant cost of capital." In this work CEOs create large amounts of cash reserves in order to increase the number of assets under their control to contribute mostly in investment decisions.

Furthermore, the supporters of the free cash flow theory state that the cash accumulation in the business benefits CEOs with two ways. At first, finance investment programs without reporting to shareholders about projects with negative impact to their wealth. Secondly they avoid bank loans, a decision that offers greater financial flexibility. This enables managers to undertake projects without reporting either to shareholders or lenders (Ali 2013). Exactly for this reason, a negative relationship between cash holdings and leverage of the firm is expected.

In further support of the importance of agency theories, the relation between dividends and firm value is weaker in countries with stronger investor protection. Pinkowitz and Williamson (2005) pointed out that the relation between cash holdings and firm value is much weaker in countries with poor investor protection than in other countries. However, Opler et al. (1999) note the danger of high costs of external funding, when managers use cash to promote their own agenda. In addition, managers accumulate cash within the firm by restricting the payouts policies to shareholders. However, if decent investment projects are unavailable, then management will have to harvest underinvestment through poor projects. Bearing in mind the previous arguments, if managers don't seek to maximize shareholders' wealth, the costs of cash holding become higher including the agency cost of managerial discretion (Ogunpide et al, 2012).

The optimal cash holding decision would receive no interest by the financial literature if markets were perfect as in Modigliani and Miller world. Nevertheless, imperfections do exist and firms have several motives to hold cash. From the financial literature and the main theories of capital structure that were discussed above may be derived a number of motives of cash holdings. For instance, the transactions motive, the precautionary motive, the agency/speculative motive and the tax motive. These four primary motives for holding

cash have different implications for the bases and consequences of the phenomenon of the excess cash holding for U.K. firms.

First is the transaction motive of the cash holdings. This motive refers to the use of cash for the firms' daily transactions and obligations. More specifically, a certain level of cash holdings is required to support the regular operations of the firm, since cash cannot be upraised instantly. According to Keynes (1936) the level of activity of the firm is the undisputable factor that influences the cash holding decision. However, Baumol (1952) was the first who created a model in order to identify the optimal rate of cash holdings along with the reduced costs. Baumol (1952) and Tobin (1956) were those that established an economic model for the effective cash management. This model assumes that the regular day-to-day transactions carried out by firms are foreseeable. Furthermore, it assumes that cash payments are fixed. Company should be able to convert the bonds into cash, keeping the transaction's costs unaffected. Lastly, the company should be able to anticipate the needs of cash with relative confidence. A major drawback of this approach is that most firms fail to predict the cash level because cash is paid and received almost simultaneously.

Based on studies of Keynes (1936) and Baumol (1952) many economists provided further research upon the transaction motive. Subsequently, Miller and Orr (1966) tried to overcome the weakness of Baumol-Tobin model. In addition, economies of scale should be detected (Beltz and Frank, 1996). Miller and Orr (1966) presented a model that meets the randomness of cash flows, under the presence of only two assets, cash and investment (Moraes and Nagano, 2013). In this context, the firm can buy or sell assets only within the limits set by the model. When cash reaches the higher limit, the firm purchases a sufficient amount of marketable securities, whereas when the cash flows reach low, the firm sells securities.

An interesting approach to this issue has been proposed by Dittmar (2005), who used working capital as a proxy. He scaled cash by total sales and included a measure of other, non-cash liquid assets in order to control for potential cash substitutes. Other studies, based on the transaction motive, also concluded that firms hold cash for their operating expenses. Additionally, firms use cash to meet their payment responsibilities, while the industry sector determines the rate of cash or the time needed (Bates et al., 2009; Opler et al., 1999).

The second motive for businesses to hold cash is the precautionary motive. According to this motive, firms accumulate cash as precaution to cover unanticipated future necessities and new investment opportunities in times where external finance is costly or unavailable (Ferreira et al, 2005; Myers and Majluf, 1984). Several publications have appeared in recent years documenting the cash holding's precautionary motive. Opler et al. (1999) in their research found that firms with higher growth prospects and higher risk tend to hold more cash in relation to all of their assets. Specifically, when a firm faces high loans, prefers to decrease debt and use liquid assets to fund its activities. Moreover, Ferreira and Vilela (2004) also provided evidence that firms in countries with superior investment protections hold more cash. The level of capital markets and credit quality are negatively related with cash holdings, which is contrary to the agency costs view, but supportive of firms holding cash for precautionary motives.

Almeida et al. (2004) further examined the precautionary motive that drives firms to the accumulation of cash in connection with the existence of financial constraints. The financial limited companies' investments depend highly on the capital markets and are forced to hold cash. The cash holding decision involves costs by reducing their

opportunity in efficient investment programs. Companies subject to financial constraints need to increase their liquidity (Almeida et al., 2004). During recession, firms tend to hold more cash. Thus, the opportunity cost of cash is higher and liquidity is extremely difficult (Ferreira et al., 2005).

Furthermore, firms with higher cash reserves and lower debt levels, have greater future funding. Hence they are able to exploit investment opportunities. Moreover, firms subject to financial constraints, prefer to accumulate cash instead to reduce their debt when the correlation between cash flow and investment opportunities is low (Acharya et al. 2007). Examining this motive, Bates et al. (2009) argued that firms need to hold cash in order to cover unexpected financial crises.

Another motive for firms to hoard cash is the agency motive. It refers to the influence exerted on the cash holdings by the conflicted interests between agents (shareholders and managers) of a company. Free cash flow is cash flow in excess of the amount required to finance investment projects that have a positive present value calculated, using the average cost of capital. Jensen (1986) examined the presence of free cash flow and agency costs. Free cash flow should be distributed to shareholders, but this distribution diminishes the number of the resources under the control of managers. Therefore, managers aim to expand the company beyond the size that maximizes the wealth of shareholders.

Entrenched managers choose to hoard cash than increase payouts to shareholders even when the firm has low investment prospects (Dittmar and Mahrt-Smith, 2007). These cash holdings are estimated as the excess cash holdings (Opler et al., 1999). Then Dittmar et al. (2003) highlighted the importance of the agency problem as an important factor that influences cash holdings. The insufficient protection of shareholders, spend cash reserves much faster, compared with managing a business with strong protection of their shareholders. Self-interested management's behavior is highlighted by the fact that they prefer to spend cash than to hoard, when the shareholders wish higher dividends (Harford et al., 2008). According to Damodaran and Damodaran (2005), it relies on management to pay the cash to the shareholders or keep it for expanding and funding the firm's projects. Summarizing, often the management of the company may carry out investments with negative present value to control more assets and to drive business to overinvestment.

Another motive for firms to hoard cash is the tax motive. More specifically, the relationship between cash holdings and taxation on firms when necessary to repatriate foreign capital is investigated (Foley et al., 2007). They report that firms facing higher taxes tend to increase their holdings of cash, especially those firms in no-financial sector and the tech industry. *“Microsoft, Apple and Google each boosted their accumulated foreign profits by more than 20 percent over the year, the largest increases by any of the 34 companies with at least \$16 billion outside the U.S. International Business Machines Corp., Cisco Systems Inc., Oracle, Qualcomm Inc. and Hewlett-Packard Co. each added at least \$4 billion.”*⁵

Multinationals fall into that rule mostly and the reason is the high tax cost needed in order to repatriate these cash holdings that they stash in their subsidiaries (Fernandes and Gonenc, 2014). In addition to empirical support for both transaction and precautionary motives, Foley et al. (2007) found strong evidence consistent with taxes on foreign earnings affecting cash balances. A significant relation was reported between the fact that

⁵<http://www.bloomberg.com/news/articles/2015-03-04/u-s-companies-are-stashing-2-1-trillion-overseas-to-avoid-taxes>

U.S. multinational firms prefer to hold cash in their foreign subsidiaries and the tax costs related to repatriating foreign income.

First, Opler et al. (1999) examined the determinants and implications of holdings of cash and marketable securities by publicly traded U.S. firms in the 1971-1994 period. Specifically, they provide evidence through time-series and cross-section tests that firms with solid growth opportunities and riskier cash flows hold fairly high ratios of cash to total non-cash assets. Oppositely, large firms and those with high credit ratings that have the greatest access to the capital markets, tend to hold lower amount of cash to total non-cash assets. However, firms with high levels of performance tend to accumulate more cash. Finally, they reported that the main reason that firms experience great changes in excess cash is the existence of operating losses.

In the context of cash holding policies, Schwetzler and Reimund (2004) investigated firms' excess cash reserves in Germany. They contribute to the corporate cash holdings literature in two ways. Firstly, they prove that excessive cash holdings lead to a significant operating underperformance which is in line with expectations of the agency theory. Secondly they report that positive deviations from the industry benchmark ratio yields increasing excess values. They suggested that industry aggregate ratios are no good proxies for firm individual firm optimal cash holdings and consisted an interesting subject to further research.

Concerning the EU firms, Ferreira and Vilela (2004) investigated the determinants of corporate cash holdings based on sample of 400 EMU firms from 1987 to 2000. According to their results, cash holdings are positively affected by the investment opportunity set and cash flows. On the other hand, cash holdings are negatively related to asset's liquidity, leverage and size. In addition, bank debt and cash holdings are also negatively associated, which supports that a close relationship with banks allows the firm to hold less cash for precautionary reasons. Firms in countries with higher investor protection and concentrated ownership hold less cash, supporting the role of managerial discretion agency costs in explaining cash levels. Finally, Ferreira and Vilela (2004) reported that capital market development has a negative impact on cash levels, contrary to the agency view.

Important findings are also provided by Ozkan and Ozkan (2004) who investigated the empirical determinants of corporate cash holdings using a sample of 1029 publicly traded UK firms from 1984-1999. Their study focused mostly on the importance of managerial ownership among other corporate governance characteristics. In particular, evidence of a significant comparable relation between managerial ownership and cash holdings is presented. Additionally, they observed that the way in which managerial ownership exerts influence on cash holdings does not change with board composition and the presence of finance controllers. The results reveal that firms' growth opportunities, cash flow, liquid assets, leverage and bank debt are important in determining cash holdings. The authors (2004) also suggested that firm heterogeneity and endogeneity are crucial in analyzing the cash structure of firms.

Moving on the same wavelength, Nguyen et al. (2006) collected a total sample of 9,168 firm-year observations from Tokyo Stock Exchange for the period of 1992 to 2003. They tested the hypothesis that cash balances have a precautionary motive and serve to mitigate the volatility of operating earnings. The results of this study proved that cash holdings are positively associated with firm level risk, but negatively related to industry risk. Cash holdings in Japan firms are decreasing with the firm's size and debt ratio, and increasing with its profitability, growth prospects, and dividend payout ratio. Moreover, the results

show that Keiretsu affiliated firms hold less cash and are less risk sensitive. Their findings also provide evidence that financial constraints reduce the incentives to mitigate earnings risk. Finally, they showed that bank-controlled firms and highly leveraged firms increased their sensitivity to earnings volatility as the condition of Japanese banks depreciated after 1998. Generally, the results of this study strongly supported the precautionary motive for holding cash and underlined the significance of corporate risk mitigation.

In an attempt to elucidate the trend of cash holdings, Saddour (2006) investigated the determinants of the cash holdings of 297 French firms over the period 1998 - 2002, using the trade-off theory and the pecking order theory. According to the study, French firms increase their cash level when their activities are risky and the levels of their cash flow are high, and reduce it when they are highly leveraged. Furthermore, growth companies tend to hold higher cash levels than mature companies. Indeed, for growth companies, there is a negative relation between cash and the firms' characteristics: size, level of liquid assets and short-term debt. He suggested that the cash level of mature firms increases with their size, their investment level, and the payout to their shareholders in the form of dividends or stock repurchases, and decreases with their trade credit and their expenses on research and development.

Similarly, Drobetz and Grüninger (2007) examined the holdings of cash and cash equivalents of 156 non-financial Swiss firms over the 1995 to 2004 period. A main result of their analysis was that the median Swiss firm has substantially higher cash reserves than firms from most other countries. Using regression analysis, they observed significant influences from various firm-specific variables on cash holdings, and our findings support different hypotheses derived from the theory. The strong negative relationship between asset tangibility and the cash ratio indicated that firms with assets that can easily be liquidated hold less cash to minimize the opportunity costs of holding cash. In addition, they found evidence for the hypothesis that large firms hold less cash due to economies of scale in security issuances.

The later literature highlighted the incentives of cash holdings during and after the recent fiscal crisis. Jung and Kim (2008) investigated the empirical determinants of Korea manufacturing corporate cash holdings during the period 1991-2003. They suggested that there is a significant shift in the behavior of corporate cash holdings after the financial crisis. Before the crisis, the determinants of cash holdings included target cash adjustment, liquidity constraints, leverage, market to book ratio, dividend policy, and size. On the other hand, those after the crisis include only two variables such as growth opportunity (market to book ratio) and foreigners' shares. Finally, they reported that firms dynamically respond to the change in target ratio, while it is reducing gradually after the crisis.

In the perspective of real firm size, García-Teruel and Martínez-Solano (2008) analyzed the explanatory factors of the cash holdings of a sample of 860 small and medium-sized firms from Spain during the period 1997-2001. They suggested that the firms pursue a target cash level to which they attempt to converge. This certain level is higher for firms with larger cash flows, for those that are more highly leveraged and for those that have more short-term debt. In contrast, the study reported that the cash level falls with the use of bank debt and in the presence of substitutes for cash.

US setting also gained attention by Bates et al. (2009) who provided evidence that the average cash-to-assets ratio for the U.S. industrial firm doubles from 1980 to 2006. They conducted a measure of the economic importance of cash holdings' increase at the end of the sample period, where the average firm can withdraw all debt obligations with its cash

holdings. Cash ratios are increased because firms' cash flows become riskier. In addition, they reported that firms change since they hold fewer inventories and receivables and are increase R&D expenses. While the precautionary motive for cash holdings plays an important role in explaining the increase in cash ratios, this study found no consistent evidence that agency conflicts contribute to the increase.

In addition, Gill and Shah (2011) investigated the determinants of corporate cash holdings in Canada. A sample of 166 Canadian firms listed on the Toronto Stock Exchange for a period of 3 years, from 2008-2010, was selected. This study applied co-relational and non-experimental research design and its results showed that market-to-book ratio, cash flow, net working capital, leverage, firm size, board size, and the CEO (chief executive officer) duality significantly influence the corporate cash holdings in Canada.

On the other hand, Megginson and Wei (2012) examined the relation between state ownership and corporate cash holdings in China's share-issue privatized firms from 1993 to 2007. They proved evidence that cash holdings and state ownership are negatively related. They also suggested that the level of cash holdings is also negatively related to institutional ownership. In addition, more profitable and higher growth firms hold more cash and that debt and net working capital are negatively related to cash holdings, under the belief that debt and working capital are cash substitutes. These findings are consistent with evidence found in U.S. and international firms. Moreover, this paper examined the relation between state ownership and the value of cash and found that the marginal value of cash declines as state ownership increases.

Further research in this area was provided by Ogunpide et al., (2012). The authors used a sample of 54 Nigerian firms listed on the Nigerian Stock Exchange for a period from 1995-2010 aimed to examine the empirical relationship between cash holding and characteristics of these firms. The results showed that cash flow, net working capital, leverage, profitability and investment in capital expenditure significantly affect the corporate cash holdings in Nigeria. Furthermore, a positive relationship between cash and cash flow was found that indicated that firms with large cash flows will keep higher cash levels. The finding of a positive relationship between cash holding and leverage is in accordance with agency theory. The authors supported the pecking order theory of positive relationship between ROA and cash holding and the negative relationship between net working capital and cash holdings. Moreover, growth opportunities represented by MTB and firm SIZE are insignificant as cash holding determinants in Nigeria.

To portray the issue in Euro and non-Euro terms, Akguc (2013) compared the cash holdings of publicly and privately held firms using a unique sample of firms in 33 emerging and developed European countries from 2002 to 2011. He found that European public firms on average hold more cash as a percentage of total assets than private firms. He argued that during the recent European financial crisis, firms in European Monetary Union countries on average hold more cash, in contradiction to non-Euro countries. Furthermore, public firms seem to hold much more cash than private firms in Euro-zone countries when compared to non-Euro countries, indicating higher precautionary demand for cash due to the adoption of the Euro zone's single currency. Finally, the results exposed that both public and private firms show significant cash flow sensitivity to cash holdings.

Moreover, Bokpin (2013) collected a data covering a period from 2002 to 2007 for 23 firms listed in the Ghana Stock Exchange (GSE). The purpose of his study was to document the effect of corporate disclosure and transparency on cash holdings in these

firms. He employed the Fama and French (1998) valuation model of relating firm level variables to firm value and found that the relationship between corporate disclosure, transparency and cash holdings is economically significant and negatively associated. Additionally, the study reported that firm size, profitability, financial leverage and investment needs are economically significant determinants of cash holdings.

A different US study focused in an international sample. Pinkowitz et al. (2013) argued that USA firms hold more cash after the crisis than firms with similar characteristics in the late 1990s. They found that for the period before the crisis to after the crisis, cash holdings increase most for highly profitable firms. Moreover, they provide evidence that the firms that become multinationals after 1998 have high cash holdings when they become multinationals. These results suggest that the type of firms that are or become multinational firms have unique attributes that make cash holdings of great significance. The study presented that the relation between R&D and cash holdings is substantially stronger for multinational firms than it is for purely domestic firms. Finally, they proposed for further research the investigation of the exact reasons these firms hold more cash require further investigation.

Another empirical work focused to analyze the effect of product market competition, in the context of risk regarding the relationship between cash holdings and firm value. In particular, Schoubben and Van Hulle (2013) collected a panel data set of listed firms in 14 Western European countries. They showed that both investor protection and product market competition strongly influence the cash-value relationship. Moreover, cash holdings are more valuable when the possibility of predatory rivalry behavior in a specific industry is high. Furthermore, they provided evidence of a substitution between institutional governance and competition in the form of cash policy as high predation risk. On the corporate governance side, Zia-ul-hannan and Asghar (2013) investigated its impact on managerial cash holding decisions based on agency theory. A panel data procedure for a sample of 138 firms listed on Karachi Stock Exchange during 2008 - 2012 was used. The results suggested that cash flow is the only variable which is statistically significant and positively related to cash holdings. Alternatively, liquidity, leverage, bank borrowing variability of cash flow is significantly and negatively related to cash holdings. However, dividend, market-to-book ratio and ratio of non-executive to total directors are positively associated, whereas firm size family dummy and CEO duality are negatively related to cash holdings. The study concluded that these variations indicate the non-linear relationship between managerial ownership and cash holdings.

Finally, an important cross-country analysis is given by Fernandes and Gonenc (2014). They used foreign sales data across 58 countries, in order to show that cash holdings have actually a negative relation to the amount of foreign sales. More specifically, a dataset of international firms' was used to point out the impact of geographic and industrial diversification to cash holdings. A comparison was also made for the determinants of cash holdings across developed and emerging markets some asymmetric effects were found. They also found that multinationals from emerging markets frequently need more cash to support their international expansion, whereas developed-market firms have by rule less liquidity needs.

In summary, the empirical studies presented above suggest a number of cash holding's determinants such as firm size, market-to book ratio, cash flow, net working capital, leverage. The constantly changing economic environment especially in times of financial distress and pressure should also count macroeconomic factors like inflation or interest rates (Vatavu, 2012). Nevertheless, the various empirical studies both in emerging and

developed countries are of great importance. The results even when inconsistency or contradiction among the theories appear, provide solid ground for further future research.

3 Hypotheses Development

The target of hypotheses concerns the evidence of the cash holding theories. The research illustrates the determinants that affect the results in favor of one theory or the other. As a consequence, the hypotheses are developed upon the determinants of the cash holdings. The determinants are: cash flow, leverage, capital expenditures, net working capital, market to book ratio, firm size and age, R&D expenditures, operating cash flow, tax expenses and industry cash flow volatility. We briefly review the specific determinants of cash holdings and develop the testable hypotheses about the relationship between cash holdings and these determinants.

The trade-off theory predicts a negative relationship between cash flow and cash holdings. On the other hand the pecking order theory predicts a positive relationship, while there is no evidence regarding the free cash flow theory. Specifically, Ferreira and Vilela (2004) provide evidence that supports the pecking order theory for the corporate liquidity in EMU countries.

Harford et al. (2008) predict that cash flow from operations to sales ratio is negative in 15 out of 17 industries and the results of the regression support the free cash flow hypothesis. As theory proposes, firms with higher cash flow from operations prefer to use this cash, rather than external financing. Moreover, high operating cash flow suggests a company's creditworthiness, and may indicate that a company is in a better position to grow than its competitors. However, an inadequate operating cash flow leads to greater risks, making it harder for them to obtain bank loans and thus increasing their external financing constraints (Wang et al., 2014). Therefore, they choose to accumulate more cash.

Following prior literature, we compute company's cash flow from operations (CFO) to sales ratio or the company's cash flow from operations divided by its total sales (Harford et al., 2008). Our first hypothesis predicts a negative relationship between cash holdings and a firm's operating cash flow.

H₁: "Operating cash flow is negatively related to cash holdings".

According to the trade-off theory the relationship between leverage and cash holdings is indecisive, can be either positive or negative. Both the pecking order and the free cash flow theories predict a negative relationship between leverage and cash holdings. Both the studies from Ferreira and Vilela (2003) and Bates et al. (2009) predicted the negative relationship between the variables because firms will use cash to reduce leverage. However, other studies predicted a positive relation between leverage and cash holdings (e.g Acharya et al., 2007).

We compute financial leverage for each firm as total debt (the sum of long-term debt and short-term debt or debt in current liabilities) to the book value of total assets. We expect to find a negative relationship between leverage and cash holdings supporting to prior studies about cash being negative debt.

H₂: "Leverage is negatively related to cash holdings".

The trade-off theory expects a positive relationship between capital expenditures and cash holdings that is consistent with the findings from Opler et al. (1999) that cash holding follows capital expenditures. On the contrary, the pecking order theory predicts a negative

relationship between capital expenditures and cash holdings, since capital expenses consume the firm's cash reserves (Bates et al., 2009). Capital Expenditures are divided by total assets. We expect capital expenditures and cash holdings to have a negative relationship.

H₃: "Capital expenditures are negatively related to cash holdings".

The trade-off theory expects a negative relationship between cash holdings. A firm can maintain either high levels of cash or liquid assets substitutes or the opposite. Bates et al. (2009), Ferreira and Vilela (2003) also provided evidence of this relationship between liquid assets substitutes and cash holdings. However, there is no relationship between NWC and cash holdings according to the pecking order theory (Opler et al., 1999) or the free cash flow theory.

Working capital net of cash consists of liquid assets substitutes (Bates et al., 2009). We measure net working capital minus cash and cash equivalents, divided by total assets. We expect that NWC and cash holdings are inversely related.

H₄: "Net working capital is negatively related to cash holdings".

Trade-off theory predicts a positive relationship between MTB ratio and cash holdings. Specifically, firms with high investment opportunities are endangered with high costs of external funding (Opler et al., 1999). Likewise, the pecking order theory assumes a positive relationship between investment opportunities and cash holdings, since Firms with high investment opportunities hold more cash since it is costly for these firms to be financially constrained (Bates et al., 2009; Ferreira and Vilela, 2004). In contrast, the free cash flow theory predicts a negative relationship between cash holdings and investment opportunities because of the agency problem. Managers of firms with growth/investment opportunities may use cash holdings to promote their personal agenda (Opler et al., 1999). Market to book ratio measures the firm's growth opportunities in future (Bates et al., 2009). MTB is the book value of assets, minus the book value of equity, plus the market value of equity, divided by total assets. Therefore, we predict a positive relationship between cash holdings and market to book ratio.

H₅: "MTB ratio is positively related to cash holdings".

Trade off theory predicts inverse relationship between the firm size and the cash holdings, because of the existence of economies of scale to holding cash (Bates et al., 2009). On the contrary, both the pecking order and the free cash flow theory predict the positive relationship between size and cash holdings. According to Opler et al. (1999), taking into account that large firms perform better than smaller ones, they need to accumulate higher cash volume.

Firm size is measured as the logarithm of total assets (book value of assets) of a specific firm. We predict that cash holdings and firm size have a negative relationship. On the basis of the prior studies, the following hypothesis may be developed.

H₆: "Firm size is negatively related to cash holdings".

The tradeoff theory predicts a positive relationship between investment opportunities, as research and development expenditures and cash (Dittmar et al., 2003). In addition, Dittmar et al. (2003) find that firms with higher levels of R&D expenses deflated to sales, have higher cash holdings, which supports both the transactions costs and the precautionary motives. Moreover, firms with high growth and investment opportunities hold more cash for precautionary reasons (Hanlon et al., 2014). Foley et al., (2007), Opler et al., (1999) and Bates et al. (2009) found that firms with higher R&D expenditures hold more cash.

According to Opler et al. (1999), R&D expenditures consume cash, but R&D's role as a

proxy for growth opportunities and financial distress could lead to a positive relation between the cash ratio and R&D expenditures. In contrary, Saddour (2006) predicts a negative relationship between R&D and cash holdings. We measure R&D as the ratio of research and development expenses to sales, a proxy either for intangible assets or growth opportunities (Zhang and Kanazaki, 2007). We normalize R&D expenditures by sales, as in Bates et al. (2009). Following the majority of the prior literature we develop the hypothesis:

H₇: “R&D expenditures are positively related to cash holdings”.

Additionally, we investigate corporate cash holdings under the corporate taxation regime. Taxes paid stand for just one variable that affects the decision of holding cash, nevertheless they are key for both the volume and the worth of cash holdings (Sander et al., 2014). For the firms where cash is irregularly hoarded, the marginal tax rate and leverage have a positive and significant correlation (Jung and Kim, 2008).

Moreover, both domestic and multinational firms anticipating greater tax vagueness hold excess cash to cope with these possible expectations. Another study highlights the actual effects of tax avoidance and suggests precautionary reasons for cash holdings (Hanlon et al., 2014). In several countries tax motive is a powerful reason for holding cash. US multinational firms tend to hold cash in their overseas subsidiaries because of the tax costs linked to repatriating income (Sander et al., 2014). Unambiguously, Foley et al. (2007) provide empirical evidence that US corporations hold indeed higher levels of cash. Hence, firms that face higher repatriation tax drains hold higher levels of cash and prefer to hold this cash abroad.

We use taxes paid as a proxy for the tax-paying status of the firm and calculate them as the ratio of tax expenses to sales (Zhang and Kanazaki, 2007). We expect that tax expenses are negatively correlated to cash and the following hypothesis may be developed.

H₈: “Tax expenses are negatively related to cash holdings”.

In continuous, we introduce another control variable, namely firm age. The findings of Dittmar and Duchin (2010) suggest that age is an important determinant of cash holdings (Pinkowitz et al., 2013). Firm age is expected to have negative effect on cash holdings since mature firms tend to have stronger connections with customers, suppliers, managers, employees and shareholders than young firms (Henk, 2012). Firm age is calculated as the logarithm firm age, the years since birth date. It is expected to have a negative correlation to cash, therefore the subsequent hypothesis may be derived.

H₉: Firm age is negatively related to cash holdings.

Prior literature expects that firms with higher cash flow risk for holding more precautionary cash. Trade-off theory suggests that firms with higher cash flow volatility tend to hold more cash in order to minimize the estimated cost of corporate liquidity limitations (Belghitar and Khan, 2013). Belghitar and Khan (2013) found that the coefficient (CVOL) is positive and significant in all models between cash flow volatility and cash holdings. Opler et al. (1999) and Bates et al. (2009) predict firms with greater cash flow risk hold more cash for precautionary reasons. Industry cash flow volatility measures the firm’s cash flow risk and uncertainty. Ferreira and Vilela (2004) suggest a variable named industry sigma, which calculates the volatility of an industry’s cash flow during the sample period.

In this case, *indcfvol* comprises cash flow standard deviation for a period of five years. We measure the industry cash flow risk, and calculate *indcfvol* as the mean of volatility of cash flow for firms in the same industry (Fama and French 12 industry classification).

Similar to Bates, Kahle, and Stulz (2009), we predict positive relationship between cash and cash flow volatility. We require at least five observations in each industry - year. H_{10} : “Industry cash flow volatility is positively related to cash holdings”.

4 Methodology and Model Specification

The data coming from annual financial reports gathered from Thomson Reuters World scope. The sample offers the opportunity to examine the corporate liquidity during the years of the financial crisis (2007–2011), covering a period of a total 33 years, between 1980 and 2012. The population of the study is nonfinancial UK firms listed on the London Stock Exchange. Each firm per year observation contains information on cash and all independent variables which are described later in this section.

Following standard practice, we exclude financial firms (SIC between 6000-6999 and ICBIC code 8000-8999) because separation of their operating and financial activities is pointless, since there could be capital requirements that oblige these firms to maintain cash balances. Furthermore, the sample is restricted to firms with sufficient data to calculate the primary financial variables and we exclude firms reporting non-negative profits. For consistency with theory and prior studies, when we conduct regression analysis, we restrict our sample for a given year to profit firms (positive assets and sales) to ensure the validity and comparability of our findings. This procedure generated 3,489 unique firms, or alternatively 35,765 firm-year observations with the required financial statement data. From this sample we extract the yearly data we need for our empirical statistic tests.

The model is based on the variables that are consistent with prior literature. Corporate cash holding for firm i in time t is the dependent variable. The main purpose of this study is to examine whether certain firm characteristics affect cash holdings in UK market with regard to the years 1980 – 2012. Specifically, the present paper explores the significance of the ten aforementioned determinants of cash holdings. The empirical analysis examines and analyzes the data panel.

A pooled OLS (Ordinary Least Squares) regression analysis is used, where cash represents the dependent variable while the rest factors are the independent variables. This paper centers on the ratio of cash holdings to total assets of these corporations. Following Bates et al. (2009) we adopt as the dependent variable, cash ratio divided by total assets, instead of the method used by Opler et al. (1999) where cash ratio is divided by net assets. Results are similar using Cash-to-net assets ratio. Net assets are total assets minus cash holdings. Furthermore, Foley et al. (2007) prefer the natural logarithm of the cash to net assets ratio. The sample is winsorized accordingly in order to limit the extreme values. Therefore, in order to eliminate the influence of extreme outliers and reduce significantly the standard errors, all variables are winsorized at 1 and 99% level.

Following the results of previous findings based on different models and techniques, the present study will add to the existing literature by examining the determinants of corporate cash holdings of nonfinancial listed companies including all the sectors of UK market. In our regression models, we include a dummy variable for operating income (odium) and we set it equal to one if operating income is lower than zero, in order to examine its impact on the relationship between cash holdings and operating income

management.⁶ The following theoretical model is derived for analysis:

$$\text{cash} = \beta_0 + \beta_1 \text{cfo} + \beta_2 \text{capex} + \beta_3 \text{lev} + \beta_4 \text{nwc} + \beta_5 \text{mtb} + \beta_6 \text{size} + \beta_7 \text{rnd} + \beta_8 \text{taxexp} + \beta_9 \text{age} + \beta_{10} \text{indcfvol} + \beta_{11} \text{oidum} + \varepsilon_{it} \quad (1)$$

Where, β_0 is the intercept, $\beta_1 - \beta_{10}$ are the independent variable coefficients explained below and ε_{it} is the error term.

cash = cash+cash equivalents/total assets

cfo = cash flow from operations/sales

capex = capital expenditures/total assets

lev = total debts/total assets

mtb= total assets-common shareholders^equity- market capitalisation fiscal period end/total assets

nwc=Current assets – Current liabilities – Cash and cash equivalents/total assets

size = natural logarithm of total assets

rnd= R&D expenditures/sales

taxexp = tax expenses/sales

age = ln(time-bdate)

indcfvol = mean (cfvol)

oidum= 1 if operating income<0, otherwise 0

The methodology to investigate the determinants will be linear regressions on the collected data, with the cash holdings as dependent variable and the possible determinants as independent variables. As introduced in the next section, the signs of the coefficients found by regression analysis designate the relations between the cash holdings and the analyzed determinants.

5 Empirical Results

Following the regression model of Bates et al. (2009), we adopt as dependent variable the ratio of cash to total assets.

⁶For the purpose of the study, a dummy variable for earnings was also constructed accordingly. However nibex variable, as net income before extraordinary items and discontinued operation, proved of less significance to the model compared to the operating income.

Table1: Descriptive Statistics

	<i>N</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>Minimum</i>	<i>Maximum</i>
<i>cash</i>	37664	0.154	0.193	0.000	0.911
<i>cfo</i>	25360	-0.348	2.683	-22.636	2.363
<i>lev</i>	37525	0.185	0.205	0.000	1.195
<i>capex</i>	115599	0.020	0.050	0.000	0.398
<i>nwc</i>	37236	-0.004	0.230	-1.050	0.554
<i>mtb</i>	34151	1.926	1.821	0.471	12.934
<i>size</i>	37688	10.877	2.199	5.602	16.591
<i>rnd</i>	115599	0.059	0.978	0.000	25.519
<i>tax</i>	34662	0.012	0.068	-0.509	0.161
<i>age</i>	112200	8.142	1.038	0.000	9.797
<i>indcfvol</i>	101081	0.072	0.049	0.000	0.680

Descriptive statistics summarize the dataset and provide a useful overview to consider in empirical analysis. The summary statistics demonstrate the mean, the standard deviation, minimum and maximum value of the variables.

As shown in Table 1, the average cash ratio to total assets is 15.39% that is rather large for nonfinancial firms and the standard deviation is 19.33%. These values are higher than those reported for the UK firms. In fact, Ozkan and Ozkan (2004) reported the mean value of cash ratio as 10.3%. However, the statistics seem to be in line with those reported by Opler et al (1999) for the US firms where the mean cash ratio equals to 17%. Next rows demonstrate the descriptive statistics for the independent variables.

According to our dataset, the average UK firm's age is 8 years. The mean value of leverage is 18.5% which indicates that UK firms use a rather modest amount of debt to finance their assets. The mean market-to-book ratio is 1.926, with average R&D ratio of 5.9% that represent a relatively high level of investment opportunities for UK firms. Additionally, taking into account that market value is estimated twice as greater than book value, the existence of profitable companies for our sample is highlighted. Capital expenditure percentage change is around 2% of total assets, suggesting a solid effort by UK firms to recapitalize and invest in themselves.

On the other hand, the sample reveals that net working capital is negative, which can be a positive quality in some cases. This may be a result of a specific business strategy that drives firms to accumulate cash and delay payments, squeezing the suppliers. Also UK companies' operating cash flow represent about 34.8% of its sales. Since the mean value of operating cash flow is negative, we receive a sign of rapidly growing and expanding firms, or simply suggest poor debt structure.

Table2: Correlations

Variable	<i>cash</i>	<i>cfo</i>	<i>lev</i>	<i>cape</i> <i>x</i>	<i>nwc</i>	<i>mtb</i>	<i>size</i>	<i>rnd</i>	<i>tax</i>	<i>Age</i>	<i>indcf</i> <i>vol</i>	<i>oidum</i>
<i>cash</i>	1.000											
<i>cfo</i>	-0.250	1.000										
<i>lev</i>	-0.311	0.061	1.000									
<i>capex</i>	-0.100	0.034	0.075	1.000								
<i>nwc</i>	-0.098	0.055	-0.364	-0.107	1.000							
<i>mtb</i>	0.330	-0.160	-0.001	0.065	-0.198	1.000						
<i>size</i>	-0.265	0.164	0.164	0.052	0.071	-0.259	1.000					
<i>rnd</i>	0.303	-0.524	-0.086	-0.034	-0.020	0.151	-0.101	1.000				
<i>tax</i>	-0.243	0.363	0.037	0.078	0.047	-0.129	0.223	-0.473	1.000			
<i>age</i>	-0.212	0.135	0.029	-0.049	0.166	-0.147	0.307	-0.098	0.142	1.000		
<i>indcfvol</i>	0.291	-0.115	-0.091	-0.147	-0.126	0.162	-0.240	0.117	-0.182	-0.310	1.000	
<i>oidum</i>	0.240	-0.266	-0.028	-0.042	-0.165	0.146	-0.345	0.158	-0.279	-0.227	0.244	1.000

Table 2 exhibits the correlation matrix. Hence, a first relationship between data variables can be derived. Correlation analysis examines the existence of a linear relation between the explanatory variables. As it may be observed there are no high correlations among the independent variables (less than 0.6). Thus the multicollinearity is not a problem and no variables need to be excluded.

In our case, the maximum correlation is found in cash and market to book ratio. A deeper view at the correlation matrix reveals that the cash ratio has higher correlations with the variables market to book ratio (0.330), leverage (0.311) and R&D (0.303), that is consistent with the precautionary motive. As shown in table 2 above there is a negative and significant association between cash ratio, cash flow from operations to sales and firm's size and age. We therefore expect that cash holdings increase while operating cash flow to sales and firm's size and age decrease. There is also a noteworthy negative relationship between cash and leverage, capital expenditures to total assets, net working capital and tax expenses to sales. On the contrary, the correlation matrix indicates that cash ratio is positively correlated with market to book ratio, R&D, industry cash flow volatility and the operating income dummy variable.

In continuous, we inspect if existing empirical models elucidate the key factors affecting the decision of corporate liquidity.

Table3: Regression Analysis, SE clustered by year and DSCD

	Number of clusters (year) = 24 Number of clusters (DSCD) = 2828			
	Coef.	Std. Err.	t	P> t
<i>cash</i>				
<i>cfo</i>	-0.003	0.001	-2.230	0.026
<i>lev</i>	-0.303	0.016	-18.460	0.000
<i>capex</i>	-0.223	0.031	-7.250	0.000
<i>nwc</i>	-0.111	0.016	-6.740	0.000
<i>mtb</i>	0.023	0.001	15.690	0.000
<i>size</i>	-0.003	0.001	-3.020	0.002
<i>rnd</i>	0.016	0.002	8.170	0.000
<i>tax</i>	-0.104	0.048	-2.150	0.032
<i>age</i>	-0.015	0.003	-4.440	0.000
<i>indcfvol</i>	0.514	0.055	9.420	0.000
<i>oidum</i>	0.034	0.006	5.230	0.000
<i>_cons</i>	0.289	0.030	9.710	0.000

Number of obs = 21959
 F(11, 21947) = 469.52
 Prob> F = 0.0000
 R-squared = 0.336
 Root MSE = 0.154

Specifically, the results seem promising. The predicted model is satisfactory, since the adjusted R^2 has a percentage 33.56%. To put it differently, this suggests that 33.56% of the cash ratio is explained by the independent variables of the model. According to results of regression analysis a negative relation between cash and cash flow from operations is found ($t=-2.33$), revealing a rather moderate significance and influence to the model. Moreover, the coefficient on leverage is negative (-0.303) suggesting that firms with higher debt hold less cash. Consistent with prior literature, the leverage is undisputedly significant with $t=-18.46$ and negatively correlated with the corporate cash holdings. Correspondingly, the variable measuring capital expenditures is statistically significant with $t=-7.25$ and has a negative coefficient (-0.223). Similarly, analysis reveals negative relationship between cash and net working capital, with high significance ($t=-6.74$). In contrary to prior literature, our model detected a moderate relationship between size and cash holdings because the coefficient is -0.003. Moreover, the variable that calculates firm age has a moderate significance with $t=-4.44$ and negative coefficient (-0.015), while tax expenses variable has lesser significance (-2.15) but higher impact in the model with coefficient -0.104.

On the other hand, the regression's results in table 3 display that the market to book ratio

variable is positively correlated with the corporate cash holdings with $t=15.69$ and coefficient 0.023. Interestingly, the factor of R&D Expenditures, is also statistically significant, obtaining high values of t statistic ($t=8.17$). However, the low value of coefficient implies a small influence in financial terms. Furthermore, we observe that there is a positive and strong relationship between industry cash flow volatility and cash. In particular, *indcfvol* variable has great statistical significance in our model with $t=9.42$. Indeed, industry cash flow volatility has a coefficient (0.514) which is the higher in the model, indicating its' statistical significance. Finally, the operating income dummy that we introduced in the model is also statistically significant ($t=5.23$) taking the value 0.034. This indicator displays the firms earning power and its' place among the competition. Thus, the higher the margin, the more efficient the firm is with excess cash holdings.

6 Discussion

Firstly, our findings provide evidence that both cash flow and operating cash flow have negative relationship with cash, confirming the hypotheses made in section 3.2. In particular, the negative coefficient on cash flows for all firms corroborates hypothesis H_1 and indicates that the more profitable a firm is, the less cash it is expected to hold. According to the trade-off theory, profitable firms generate enough cash flows to dodge underinvestment problems. In contrary, the positive relationship observed for public firms between cash holdings and cash flows was predicted by the pecking order theory. Similarly, the findings on operating cash flow support the predicted hypothesis H_1 . In fact, the outcome of a negative correlation between cash flow and cash ratio is consistent with findings of Bates et al. (2009). On the other hand, Ferreira and Vilela (2004) suggested a positive relationship both for EMU countries and for financially constrained firms.

In the same way, debt follows the opposite path from the cash. This result is drawn from our empirical model and appears absolutely rational. The correlation coefficient of the independent variable that calculates leverage is negative and statistically significant. Therefore, our findings are consistent with the pecking order and the free cash flow theory following the majority of the previous studies. The models predict that leverage is negatively correlated with cash. This confirms our hypothesis H_2 and underlines the strong relationship with cash. Particularly, this is in line with the findings of Ferreira and Vilela (2004) that cash and leverage are negatively related. Leverage is predicted to be negatively related with cash holdings as interest payments reduce the capability of firms to hoard cash. Furthermore, Chen et al. (2013) stated that a model that contains corporate leverage as a variable benefits to control the refinancing threat of the firm.

In addition, capital expenditures typically consume cash. Under this assumption a negative correlation is hypothesized in section 3.2. Indeed, following the pecking order theory, cash ratio and capex variable have a negative relationship, since more capital expenses are predicted to hold less cash (Bates et al., 2009). Our findings corroborate those of Bates et al. (2009) and validate our hypothesis H_3 with negative and significant coefficient for the sample. Moreover, in our analysis a negative correlation exists between cash and firm's size and liquid assets substitutes, identified as net working capital. Due to this fact, firms with excess liquid asset substitutes are expected to hold less cash for

precautionary purposes. This provides support for hypothesis H_4 and the trade-off theory of cash holdings. A plethora of authors indicated that firms holding more assets that can be liquidated tend to hold less cash (Bates et al., 2009; A. Dittmar et al., 2003; Megginson and Wei, 2012; Opler et al., 1999).

The regression analysis also demonstrates the presence of a negative correlation between company size and cash ratio. This means that the bigger the firm is, the lesser the cash holdings are. In accordance with the trade-off theory, the hypothesis H_6 for the UK firms is validated with a negative value for our sample. Therefore, the results support that larger firms with greater investment opportunities do not accumulate more cash. Dissimilar results were formulated in both the pecking order and the free cash flow theories, while according to Jensen (1986) the largest firms face higher agency costs. Similarly, the variable that calculates firm age is negative. Thus, research indicates that mature firms learn through years to manage their cash flows better. This is in line with the findings of Al-Amri et al., (2015) and confirms the H_9 hypothesis. The findings of Faulkender (2002) suggest that smaller companies are subject to greater informational asymmetry and high transaction costs and face greater difficulties in accessing external funding sources (Faulkender, 2002).

Next, the growth opportunities of the UK firms are examined. In particular, while we find negative relationship between capital expenditures and cash, market to book ratio and research and development expenses are positively related to cash holdings. A number of researchers, such as Opler et al. (1999) and Bates et al. (2009) found that the existence of high investment opportunities creates an accordingly increasing demand for excess cash.

In this study, market-to-book ratio and R&D/sales are considered as proxies for investment and growth opportunities. Firms with greater investment opportunities, are expected to accumulate more, since underinvestment proves more costly. Following previous studies, for firms with no R&D expenses reported, R&D is set equal to zero (Bates et al., 2009; Opler et al., 1999). Nguyen (2006) and Saddour (2006) supported that market to book ratio and size were significant as cash holdings determinants. The results thus obtained provide support for our hypotheses H_5 and H_7 , regarding the positive relationship between cash and market to book ratio and R&D expenditures, respectively.

Modigliani-Miller theorem may assume no transactions costs or taxes, however this is strictly hypothetical. On the contrary, real world financial conditions and tax evasion make capital structure significant. As mentioned before, firms prefer to hold cash to their foreign subsidiaries, in order to achieve low tax expenses (Foley et al., 2007). Remarkably, when it comes to the tax regime, the regression's results prove its significance in the model. In our model, we find that tax regime is also an important factor, indicating the cost of hoarding excess cash. Tax effect is another reason that firms do not hoard excess cash holdings above the optimal level. The negative correlation with cash allows presuming that larger firms hold higher levels of cash when the tax rates are lower. The coefficient on tax variable supports the hypothesis H_8 for the UK firms with a negative value for the full sample.

Another key parameter to take account is the consistently increase in the volatility of cash flows. The risk of volatility of cash flows cannot be fully compensated and that is why ultimately the precautionary motive is becoming an important factor for holding cash. As suggested by pecking order theory, firms with high idiosyncratic risk should increase further their cash. Seungjin and Qiu (2007) demonstrated that the firms financially constrained increase their cash holdings when increasing the volatility of cash flows. This is because these businesses based on their cash reserves to deal with the risk of future

cash flows, highlighting the importance of precautionary motive as a reason to cash holding decision. Thus, the volatility of cash flows reflects the idiosyncratic risk. Several researchers namely Opler et al. (1999) and Bates et al. (2009) argued that firms with more volatile cash flows are more likely to face cash shortage due to unexpected fluctuations in cash flows proving less resistance to cope with the risk of future cash flows. The coefficient on size confirms hypothesis H_{10} for the UK firms with a positive and significant value for the full sample.

Finally, regarding the operating income dummy, a positive relationship may be derived from the results. Therefore, the findings indicate that higher values of current losses indicate higher values of cash holdings as suggested from the positive and highly significant coefficient of the loss dummy. To summarize, when running the regression of the cash-to-assets ratio on our explanatory variables, we find support for the majority of the hypotheses stated in Section 3 for the full sample.

7 Conclusion

Based on the model of Bates et al. (2009), this research emphasizes on the relationship between specific firm characteristics and the trend of the excess cash accumulation. Specifically, the main purpose of this paper is to shed light on how the firms define the optimal rate of cash holdings. We test our hypotheses empirically, mainly using panel data regressions. The results of the analysis generally support our hypotheses. The results describe the determinants of cash holdings as discussed in our hypotheses.

Our findings provide evidence of the existence of a negative correlation between cash holdings and operating cash flow, net working capital, capital expenditures and leverage. In addition, firm size, age, and tax regime are also negatively correlated with holding cash. On the other hand, market to book ratio, R&D expenses and industry volatility of cash flow have a positive relationship with cash. Finally, we examine the relationship between cash holdings and tax regime and find that the higher the tax expenses in a firm, the less the levels of cash held by that firm.

Our findings for UK firms are generally consistent with previous findings in the literature for other European countries and U.S. firms. Hence, we contribute in relative literature because this study is related to the recent financial crunch. Remarkably, our research also provides ample evidence mostly in support of the tradeoff theory perspective on cash holdings. Indeed, this proves that trade off theory deserves the attention that it currently receives in the financial literature.

This paper is a modest contribution to the ongoing discussions about corporate cash holding decision. Furthermore, research on cash holdings may expand to Europe, which has suffered through a longer crisis than the U.S. Taking into consideration that the socio-economic split exists between the wealthy countries of the North and the poorer countries of the South, an interesting analysis could be conducted. In addition, a review of cash holdings during different time periods of financial crises through history could be applicable. These findings could allow researchers to draw more general inferences about the nature of cash holdings during and following systemic shocks. It is interesting that both the horizon and the effect of the present financial crisis are still unidentified.

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