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Cash holdings are increasing and financial crisis strenghts it.

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ABSTRACT

The goal of this paper is to study the determinants of firms' cash holdings and how cash holdings were affected by the financial crisis of 2008. Using data from the period of 1995 to 2014 of non-financial firms, we present almost 265,000 firm-year observations. Our results suggest that cash holdings have a positive relationship with investment set and a negative relationship with liquidity and firm size. Our results also show that cash holdings are influenced by capital market development and banking sector, as well as by inflation. Agency theory determinants demonstrate that firms in common law countries and countries with higher law enforcement still hold higher amounts of cash holdings. Cash holdings post-crisis are higher than pre-crisis and there is a spike in cash holdings during 2009. Our hypothesis for these results are explained by the precautionary motive.

Keywords: *Free cash flow theory, Pecking order theory; trade-off theory; Precautionary motive; Financial crisis.*

1. INTRODUCTION

Why are firms hoarding large amounts of cash when there is no profitability in doing so? According to a study by PWC on non-financial corporations, there has been an average increase in firms' cash holding from the period of 2000 to 2014. Even after the major financial crisis of 2008, firms still hoard more cash than before. Is this a trend we will keep seeing in the future? Another recent article by Forbes presents that Alphabet is worth \$500 billion, despite holding \$80 billion in bank, which means that if you buy a share of Alphabet, you are effectively buying more than \$100 in cash. Are companies sitting on cash because they have no growth opportunities or is there another reason to do so?

There are three fundamental theories that have been widely used to explain firms' decisions on cash holdings. First, the trade-off model. This theory argues that firms identify their optimal cash holding level by weighing the marginal benefits and costs of holding cash. Keynes (1936) states two benefits for holding cash— the precautionary motive and the transaction motive. The precautionary motive justifies that firms will hold cash for precaution in case they enter a situation of financial distress. In these situations, liquidity can finance their activities and investment set when external funding is extremely costly or not available. The transaction motive is related to the costs of transaction during the firm's activity, which happens when liquidating assets to finance their activities. The major costs of holding cash have to do with the opportunity costs of doing so. The second model used is the pecking order theory by Myers and Majluf (1984) that maintains that there is no optimal level of cash holding. Instead, firms have a hierarchy for investment. First, they finance themselves with retained earnings, then with safe debt and risky debt, and equity is used lastly. Finally, the free cash-flow theory by Jensen (1986) suggests that managers prefer to hold cash to gain discretionary power over the firm's decisions, increasing the number of assets over their control, which allows them to pursue their own objectives. Shareholders, on the other hand, prefer managers to pay dividends, increasing the agency problem.

The determinants of cash holdings have not been widely studied in the past. However, probably due to the increase of cash holdings in firms, more studies on the determinants of cash holdings have been performed and there has been a good progression to explain how these determinants affect the level of firm's cash holding.

Opler *et al.* (1999) found that for a sample of US firms from 1971-1994, firms with more growth opportunities, riskier activities and small firms tend to hold more cash than other firms. Firms with easier access to capital markets, such as large firms and firms with higher credit ratings, tend to hold less cash. Their results justify that firms hold more liquid assets in order to keep financing their investment opportunities when cash-flow is too low and when external funds are expensive. They also find evidence that managers will accumulate cash if they have the opportunity to do so. Nonetheless, contrary to the free cash-flow theory, managers will do so as a precaution rather than to follow their own interests. They do not find a strong relationship between cash holdings and agency costs. Similar results have been found by Ozkan and Ozkan (2004) for a sample of UK firms, by Faulkender (2002) for a sample of small US firms and by Ferreira and Vilela (2004). Ferreira and Vilela (2004) also found evidence that the firms in countries with superior investment protection, measured by both the legal rules and quality of law enforcement hold more cash. The level of capital market development is negatively related with cash holdings, supported by the precautionary motive but contradicting the agency costs view. Empirical studies on the determinants of cash holdings support both the trade-off theory, which explains that firms find their optimal level of cash holdings by weighing the marginal benefits and costs of cash holding, and the pecking order theory, justifying that firms follow an investment hierarchy. Little evidence has shown a strong evidence between cash holding and the free cash-flow theory. Managers that hoard cash usually do so according to the precautionary motive rather than to follow their own objectives, although results show that managers are putting too much weight in the precautionary motive to hold cash.

The impact of financial crisis on cash holdings is a recent issue on financial economics literature. Lee and Song (2012) studied the long term impact of Asian financial crisis in eight East Asian countries and concluded that the mean (median) cash to assets ratio for the Asian firms increased to 16.6 % (12.2%) in 2005 from 10.7 % (6.6%) in 1996. Pinkowitz *et al.* (2013), by its turn, showed that American firms begun holding cash after the crisis more than firms with similar characteristics in the late 1990s. Bliss *et al.* (2015) found a payout reduction of firms during 2008-2009 financial crisis together with an increase on cash holdings.

We contribute to the literature by studying the evolution of cash holdings pre-crisis, during the crisis and post-crisis of 2008. We study how firm-specific, macroeconomic and agency costs variables affect a firm's decision on cash holdings. We use a sample of publicly traded non-financial worldwide firms from Worldscope database over the period of 1995-2014.

Our firm-specific variables are in line with previous literature¹ for the US and the UK firms. Results from our sample show that cash holdings are positively related with the firm's investment set and negatively correlated with liquidity and firm size. Macroeconomic variables show that the influence of the financial and banking sector is negatively correlated with cash holdings and that inflation is a two sided determinant, just like predicted by previous literature. In fact financial infrastructures are negatively related with cash holdings once it is easier to obtain external funds on environments where capital markets and banking sectors are more developed (La Porta et al (2000)). Lastly, our agency variables, just as previous literature suggests, state that common law countries have more investor protection (La Porta *et al.*, 1998) and that, where law enforcement is higher, firms tend to hold more cash (Ferreira and Vilela, 2004). Finally, we obtained results that show an increase in post-crisis cash holdings relatively to the pre-crisis cash holdings. There is also a spike in cash holdings during the year 2009, year when the impact of the 2008 financial crisis was felt.

The remainder of this paper is organized as follows— Section 2 provides the literature review and Section 3 describes the theory and empirical hypothesis. Data sample and methodology are discussed in section 4. Section 5 presents the empirical results. Section 6 serves as conclusion.

2. LITERATURE REVIEW

2.1. Cash holding motives

Even though there is not a standardized cash holding level for firms, it is of great importance that firms decide their own optimal cash holding level, as cash is fundamental for a firm's operational purpose. Current literature has identified four major motives for cash holding— the transaction motive, the precautionary motive, agency motive and the tax motive.

The transaction motive, developed by Baumol (1952) and Miller and Orr (1966), suggests that, during activity, firms need liquidity in order to make their operational transactions. Thus, cash holdings increase during economic downturns. The cost of being more cash dependent is greater, due to being more expensive for firms to turn cash equivalents into liquidity. Keynes (1936) stated that the precautionary motive for holding cash is to secure the firm's future by saving cash from previous free cash-flows. As such, in the case of entering in a cash shortfall, these reserves of cash allow the firm to maintain its operational activities. The free cash-flow in a firm is a very sensitive subject, both to shareholders and to managers. While shareholders want a return for their shares, managers prefer either to invest this cash-flow in new projects or to save it. As Jensen (1986) stated, this conflict of interest between shareholders and managers is crucial, mainly because increasing agency costs can lower the discrepancy between shareholders and managers. Lastly, Foley *et al.* (2007) found that tax is also a motive for firm cash holding, especially repatriation tax for foreign income. According to their study, for US firms that incur in tax consequence for repatriating foreign income, these firms hold a higher amount of cash than firms who do not suffer from the same consequences. It was also found that firms that are financially constrained have less incentives to hold their cash abroad. Besides, the tax for repatriating foreign income, double-taxation for distributing cash for shareholders was also discovered to cause this cash to be taxed on a corporate level and then on an individual level. In this situation, firms prefer to hold cash instead of paying dividends.

2.2. Cash holding theories

This subsection discusses three of the main theories used to describe which firm's characteristics influence cash holdings decisions. As explained below, all three theories have different perspectives on firm's cash holdings decisions. Albeit agency costs are explained below, they are not one of the main theories used for explaining cash holdings decisions.

2.2.1 Trade-off theory

According to the trade-off theory (Miller and Orr, 1966), firms must equate the marginal benefits against the marginal costs of holding cash and optimize this relationship the best possible way. Because it is not possible to determine the correct value, firms must

determine this relationship by trying to set an optimal level of liquidity for their own needs, allowing them to perfectly balance both ends of this problem.

The demand for liquidity (Keynes, 1936) implies that there are three possibilities one has for holding cash—the transaction motive, the precautionary motive and the speculative motive. The transaction motive implies that firms need liquidity to be able to make their own transactions during the firm's activity and that there is a positive correlation between income and liquidity. Thus, firms with high income need high liquidity and vice-versa. Even though firms usually tend to save more cash during economic downturns, the costs of being more cash dependent increase. During recessions, it is harder for firms to replace cash substitutes into liquidity and, at the same time, there is an increase in debt agency costs. When the market is performing well, the reverse happens — the opportunity cost of holding cash increases and the companies can have easier access to external markets.

The precautionary motive states that cash holding is used by firms, especially when external funding is more expensive, in order to proceed investing in projects with positive net present value (NPV). This alternative allows firms to be independent of external funds to finance their own projects. The company's poor financial performance is one of the reasons why managers tend to hoard cash. They tend to become more cautious and save cash in case of financial distress. When firms are going through financial distress, the access to external markets and the possibility of raising external funds becomes more difficult, and having a cash buffer can save the firm from a financial downturn. Lastly, the speculative motive allows firms to save cash in order to pursue better investment opportunities without having to change their positions in other investments. The relation between money and cash substitutes is inverse — when cash substitutes tend to value more, liquidity decreases and vice-versa, making liquidity volatile when related to interest rates.

Cash holdings must be also taken into consideration, because it can increase the firm's possibility to face a situation of financial distress. Cash acts as a reserve in case of need when external funding is too expensive or difficult to access. It allows firms to finance themselves in a more affordable way during recession periods without having to pay the high debt agency costs, making firms pursue optimal investment policies even when faced with financial constraints. As a final note, cash holding allows firms to maximize their options between liquidity, cash substitutes or having to liquidate other assets in order to face their normal operations.

The major counter for holding cash according to the trade-off model is the cost of opportunity, since there is a low return in cash and cash substitutes commanding firms to access the external market to fund their own projects. This situation often leads to higher costs of financing (Ferreira and Vilela, 2004).

2.2.2 The pecking order theory

The pecking order theory (Myers and Majluf, 1984) states that firms have a certain preference order to finance their investments. According to this theory, firms prefer to start by financing with retained earnings, then with safe debt and risky debt and lastly with equity. This order is often preferred by firms in order to minimize information asymmetry, as debt and equity send different information to the market.

Because outside investors do not have the same information as the firm manager about the financial health, firm value, debt and/or equity issuing, it may induce different ideas about the firm's current financial situation. The issue of debt suggests that firms know that their investment is safe and profitable, as well as if their shares are underpriced. Yet, issuing equity can send a negative information to the market, as firms may be stating that their share price is overpriced, thus leading to a drop in share price.

Such difference in issuing debt or equity has a major influence on the firm's capital structure, since firm leverage has a negative correlation with cash holding (Ferreira and Vilela, 2004). Thus, when the firm's retained earnings can finance their investments, it will repay debt and accumulate cash. If retained earnings are not enough to finance their investments, firms will use their cash savings to finance those projects and, if needed, issue new debt. New equity can only be issued as last resort.

2.2.3. Free cash-flow theory

According to Jensen (1986) free cash-flow theory, managers have a tendency to hoard cash to increase the amount of assets under their control and gain discretionary power over the firm's investment decisions.

Risk-averse managers tend to hoard cash as a buffer in case of an economic downturn. They will save as much free cash-flow as possible, in order to be less dependent on the capital market. Cash reserves will most likely be enough to sustain the firm and increase the possibility of investing in new projects.

Conflicts of interest between managers and shareholders caused by the firm's payout policies emerge from the different perspectives on the firm's payout policies. Payout to shareholders decreases the resources under the manager's control, in case new investment opportunities arise. In the case cash savings are not enough to support this investment, firms will have to obtain capital through external markets. On the one hand, firms that access external markets will have their investments going under the capital market monitoring, which prevents them from engaging in low-return or value-destroying projects that have a negative impact on shareholders' wealth. On the other hand, if they keep free cash-flow inside the firm and accumulate it, they do not need to obtain external funds, avoiding the capital market monitoring. This conflict for payout policies is even greater when firms have larger amounts of free cash-flow.

Moreover, managers have the incentive to grow their firm over the optimal size, as manager compensation is usually related to firm growth. This incentive to grow the firm beyond its optimal size engages managers in investing as much as they can in new projects for the firm. Managers that have high free cash-flow and discretionary power to invest in new projects, do so in order to fulfil their own private interests, even if it means engaging in low-return or even value-destroying projects.

Free cash-flow is the excess required to finance all positive net present value projects and be used to repurchase stock or pay dividends, creating managerial costs of agency. Thus, increasing these costs in firms with high free cash-flow reduces the conflicts of interest between shareholders and managers

According to Jensen (1986) debt creation forces firms with high cash-flows but low-return or even value-destroying projects to reduce the amount of free cash-flow at the manager's disposal and using the free cash-flow to invest only in projects with high-return instead. This reduces the conflict between shareholders and managers.

This theory states that managers with discretionary power and high free cash-flow tend to engage in value-destroying or low-return projects in order to pursue their own private benefits.

2.2.4. Agency Theory

Agency theory is also an important aspect to consider, as it makes firms' access to external markets more difficult and expensive. This happens because shareholders may have a different perspective than managers and turn down possible profitable projects.

External funding can make the company extremely levered, increase debt risk and debt cost, leading to an underinvestment situation (Myers, 1977).

In order to deepen our study variables, and be able to increase the extent of the possible factors that explain part of the cash holdings throughout our data, we included two variables that were used by La Porta *et al.* (1998). These two variables are the Rule of Law and a dummy variable for common and civil law. Rule of law is an index developed by Worldwide Governance Indicators (WGI) composed by many factors. This index captures the perception of the extent to which agents have confidence and abide by the rules of society and, in particular, consider the quality of contract enforcement, property rights, the police and the courts, as well as the likelihood of crime and violence. This index ranges from -2,5 (weak) to 2,5 (strong). The second variable is used to distinguish civil from common law. According to La Porta *et al.* (1998), common law countries usually have the highest investor protection and civil law countries have the lowest. We use a dummy variable set to 0 for civil law countries and to 1 for common law countries. Using these two variables will allow us to have some control over investor protection and law enforcement, which definitely has an impact over cash holdings.

2.3. Determinants of cash holding: Empirical evidence

The determinants of cash holdings used for our study are the following: Dividend payout, Cash-flow, Cash-flow uncertainty, Liquidity, Leverage, Research and development (here forward mentioned as R&D), Tangibility, Growth opportunity, Size, Bank Debt, Inflation, Market Capitalization and GDP Growth. The goal is to summarize all previous empirical evidence on these determinants.

Dividend payment is a non-consensual determinant. According to Opler *et al.* (1999) and Ferreira and Vilela (2004), firms that pay dividends are expected to hold less cash, since they can reduce or not pay dividends in case of cash shortfall, using the dividend cash to finance the firm from within, causing a negative relation between cash holding and dividend payment. Ditmar *et al.* (2003) and Ozkan and Ozkan (2004) show that, nevertheless, dividend payment can have a positive relation with cash holding as companies almost never reduce dividend payments unless they are in a serious financial distress situation. As such, an increase in cash holding and dividend payment could be a precautionary motive for future dividend payment that may come and is already being held in anticipation. Cash-flow is not a unanimous determinant for cash holdings. Cash

flows are generated by firms and, according to most authors, there are two options for cash flows. On the one hand, those that state cash-flow have a negative relationship with cash-holdings say that cash-flows are a substitute for cash. Thus, one does not need more cash than the optimal level, therefore not accumulating more cash through cash-flows. On the other hand, authors affirming that cash-flow have a positive relationship with cash-holding state that excess cash-flow can be held for precautionary motives in order to later fund growth opportunities. As for Cash-Flow uncertainty, firms with more volatile cash flows can face higher possibilities of cash shortage due to cash flow deterioration. As such, it is expected that firms with higher cash flow uncertainty will hold more cash (Opler *et al.*, 1999 and Ferreira and Vilela 2004).

Liquid asset substitutes are seen as substitutes for cash and can be easily liquidated to obtain cash. For this reason, they are not a complement but a substitute for cash. A negative relation can be expected between cash holdings and liquid assets.

Leverage is said by many to have a negative relationship with cash holdings, for higher levered firms have a higher probability of bankruptcy. Hence firms will hold more cash to avoid this problem. Ferreira and Vilela (2004) state that this relationship can be ambiguous. Highly levered firms are more likely to enter bankruptcy and will cause higher levels of cash holding. However, leverage can also be seen as the ability for firms to issue debt, reducing the necessity of holding cash.

An increasingly studied determinant is Research & Development. The impact of this determinant in recent studies has shown great importance for understanding the relation between R&D and cash holding (Bates *et al.*, 2009). According to Bates *et al.* (2009), R&D's percentage has been increasing at the same rate firms need to innovate. Bate *et al.* (2009) discovered that R&D investment opportunities are costly to finance through external funding. High intensive R&D companies have a much greater buffer of cash as a precautionary measure against future shocks on internally generated cash flows. Thus, it is expected that both cash holding and R&D have a positive correlation (Opler *et al.*, 1999 and Bates *et al.*, 2009)

Tangibility is a measure of tangible assets to total assets. This determinant allows us to understand the proportion of tangible assets within a firm. As previously stated by Opler *et al.* (1999) and Drobetz and Grüninger (2007), fixed assets can be liquidated to generate cash for a firm. Despite the fact that fixed assets are not as easy to turnover into cash as liquid assets are, it is possible to understand that, even though firms have the possibility

of facing costs to liquidate fixed assets, it is expected that tangibility has a negative relationship with cash holding. Firms with assets that can be liquidated will accumulate less cash in order to minimize the opportunity costs of liquidity (Drobetz and Grüniger, 2007).

One of the most studied determinant of cash holding is the growth opportunities. Many authors have studied this determinant and the majority has stated that the level of cash holding is positively correlated with growth opportunities. As previously mentioned, one of the reasons a firm has to hold cash is for precautionary measures. The probability of incurring in a cash shortage is higher for firms with higher growth opportunities. The need for cash can be obtained through external funds but, with the possibility of how expensive this external funding might be, some firms tend to hoard more cash to pursue future growth opportunities without having to depend on external financing. Therefore, it is expected that a positive relationship between growth opportunities and cash holdings is sustained.

Firm Size is, according to most authors, negatively correlated to cash holdings. Larger firms usually have easier access to external markets and a smaller probability of financial distress, ultimately leading to less cash held. Reversely, smaller firms have a higher probability of financial distress and higher costs of external funding. Thus, smaller firms tend to have a higher amount of cash holdings in order to avoid cash shortages.

We use domestic credit provided by the financial sector (%GDP) as a proxy to measure banking and financial sector development and depth in each sample country in order to study the impact that the banking and financial sector development have on cash holdings. High values on this indicator show that countries have high levels of banking and financial services and vice-versa. According to Levine *et al.* (2000), higher development of the banking and financial sector is correlated with an increase in GDP growth. Thus, we can expect that countries with higher values of DCP by FS will be more developed ones. If we extrapolate this information and relate it with cash holdings, it is not wrong to assume firms in countries with more banking and financial development will have a higher probability of financing themselves through debt. As previously mentioned, leverage can be used as a replacement for cash holdings, since cash holdings will be negatively related to DCP by FS.

Due to the fact that Inflation is not a common determinant, research on monetary policies has not yet made considerable progress explaining the relation between cash holdings and

inflation. Inflation is the increase in prices created by a demand and supply unbalance in the market (Stiglitz and Weiss, 1981), hence it is expected that one has to spend more money to buy the same raw material during the inflation period. To avoid this situation, firms can reduce their cash holdings and purchase assets in the anticipation that those assets will increase in price, not only reducing the cost of opportunity for cash holding but generating excess earnings. Nevertheless, when inflation reaches a certain point, the government may apply tighter monetary policy measures in order to try and balance the market. At this point, banks may become more careful with their possibilities to lend and loan conditions. Consequently, firms may take precautionary measures and increase their cash holding in order to face the possibility of not being able to access external funding (Wang *et al.*, 2014). Inflation is a double-edge sword, reducing cash holdings up to a certain level on the one hand, but making banks become more careful with lending cash on the other. Cash holdings will rapidly increase as firms become more cautious.

Market Capitalization (%GDP) is used as a proxy for stock market development. This indicator is, according to La Porta *et al.* (1998), a rough approach to this determinant as this estimation does not take in account the reasons why a firm may have a higher or lower values of outside investors. Through this determinant, we are able to understand how the development of the capital market is in certain countries. Higher levels on this determinant show a more developed capital market and vice-versa. When relating capital market development with cash holdings, we can expect that there are more options for firms to finance themselves. Thus, it is predicted that there will be a negative relationship between cash holding and capital market development, as firms can use capital markets to fund themselves.

Even though firm-level specific variables have been widely used to demonstrate the relation between cash holdings and those indicators, not many researches have used macroeconomic variables to explain cash holdings. To widen our research with more than firm-level indicators, we used GDP Growth as a macroeconomic determinant. There is little research on this indicator and we believe that it is possible to achieve good results by inserting it in our model. A recent study by Graham and Leary (2015) using this indicator showed that, using data from 1920 until 2012 of US Center for Research in Security Prices (CRSP), cash holdings have a positive relation with GDP Growth.

Table 1

Summary of model predictions

Variable	Trade-off theory	Pecking order theory	Free cash-flow theory
Dividend payout	Negative		
Cash-flow	Negative	Positive	
Liquidity	Negative		
Cash flow uncertainty	Positive		
Leverage	Negative	Negative	Negative
R&D	Positive		
Tangibility	Negative	Positive	
Growth opportunity	Positive	Positive	Negative
Size	Negative	Positive	Positive

3. THEORY AND HYPOTHESES

In the presence of a perfect capital market, information asymmetry and agency costs would be non-existing. All firms would have full access to market information and there would be no agency costs, for firms would have full description of their intentions and goals. However, we do not experience this perfect market. The world we live in is imperfect, information is asymmetric and agency costs are high.

The financial crisis in 2008 assumed such outstanding proportions that even today it still has a major economic impact in countries, firms and individuals.

Information asymmetry is of great importance and the financial crisis is the very proof of that. Before the crash of the banking sector, leading to the beginning of the crisis, almost no one knew what was about to happen and definitely no one was ready for it.

Two of the main causes of the 2008 financial crisis were both agency theory, as managers had full discretionary power, and information asymmetry, since there was a massive mispricing of the Credit Default Swap (CDS) market (Murphy, 2008).

The implications of an imperfect market justifies that firms adjust their cash holdings according to an optimal cash level, balancing both the benefits and costs of doing so.

In the mid-2007, there was the peak of the credit boom and, according to Ivashina and Scharfstein (2008), the lending volume was immense until the fourth quarter of 2008 — more precisely, the lending volume dropped 47% from the third to the fourth quarter of 2008. Thus, we expect that, as a replacement for cash holdings, lines of credit were of easy access and companies would have low cash holdings during this period.

H1: Cash holdings are the lowest during 2005-2008.

As previously mentioned in the literature review, one of the motives for cash holding is the precautionary motive. During the financial crisis in the fourth quarter of 2008, lending volume was 79% lower than in the second quarter of 2007, when there was the credit boom (Ivashina and Scharfstein, 2008). Lines of credit are at their lowest point and access to external funding is extremely hard. This is the moment when, according to previous literature, external funding is harder — cash holdings increase in order for firms to proceed with their own projects.

H2: In 2009 cash holdings are the highest.

No previous studies have shown how cash holdings were affected by the post-crisis for the period after 2009 to 2014.

H3: Cash holdings are higher than pre-crisis.

4. DATA SAMPLE AND DESCRIPTIVE STATISTICS

For our empirical analysis, data was collected from two sources. First from the Worldscope Database, characterizing firm specific indicators and winsorizing our data from the highest (2.5%) and lowest (-2.5%). Macroeconomic data was retrieved from World Bank Data where we matched our Worldscope data with World Bank data and filled in for the information that was lacking.

After collecting and filtering all data, we have a sample of 265.640 firm-year observations, corresponding to 37.508 companies within 50 countries.

4.1. Cash Holding

In previous literature two major ways of calculating cash holdings ratio have been developed. The first one divides cash and equivalents by total assets (Kim *et al.*, 1998; Ozkan and Ozkan, 2004) and the second one divides cash and cash equivalents by net assets (total assets minus cash and cash equivalents) (Opler *et al.*, 1999; Ferreira and Vilela, 2004).

In this study, we measure cash holdings ratio as the ratio of cash and short-term investments to net assets, according to previous literature (Opler *et al.*, 1999; Ferreira and Vilela, 2004).

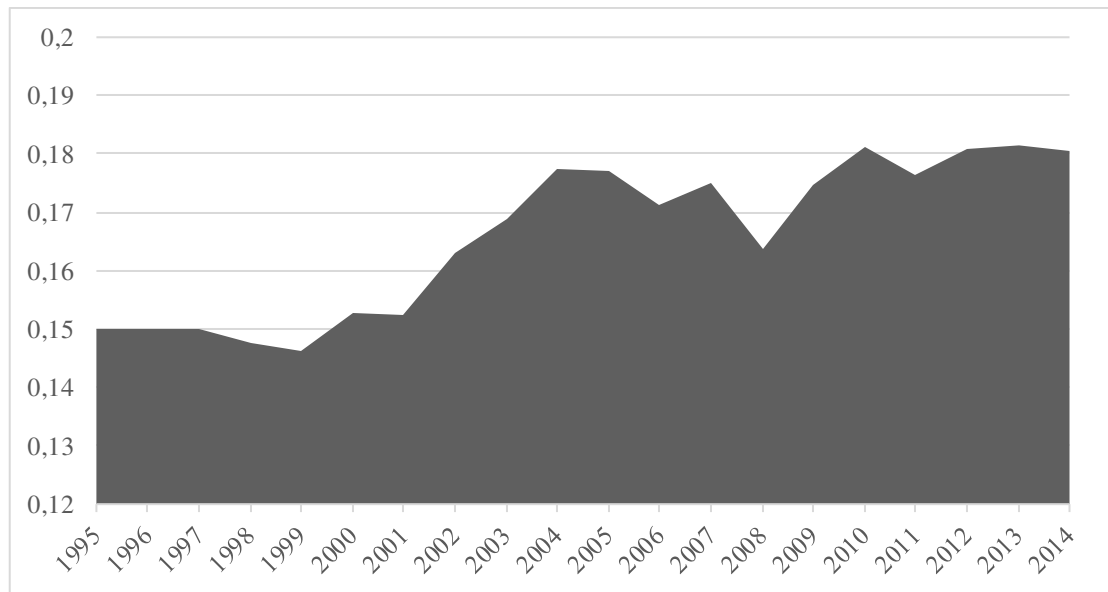


Fig. 1. Average cash holding ratio for the period of 1995-2014.

Average cash holding ratio for the period of 1995 to 2014 for our sample of firms year observations. Cash holding ratio is measured as cash and cash equivalents divided by net assets, where net assets is total assets minus cash and cash equivalents

4.2. Exogenous variables

To estimate the effects of dividend payment, we created a dummy variable set to 1 when firms pay dividends in each year and set to 0 if otherwise.

We measure Cash-flow as the ratio of Cash-Flow to Assets. Cash-flow is defined according to Opler *et al.* (1999) as earnings after interests, dividends and taxes plus depreciation.

To study liquidity, we use the ratio of working capital minus cash and short-term investments to total assets, which is in line with previous studies (Opler *et al.*, 1999; Ozkan and Ozkan, 2004; Ferreira and Vilela, 2004).

We measure Cash-flow uncertainty by calculating the volatility of cash-flow to assets for each firm from 1995 to 2014. Industry sigma represents the average of the sector for the 20 year period.

Leverage is computed as the ratio of total debt divided by total assets.

We use R&D expenses to sales ratio as a measure for both financial distress and growth opportunities. Firms that do not report R&D expenses are considered to have zero R&D expenses.

We use the ratio of tangible assets to total Assets as a measure for tangibility. Tangibility explains the impact that tangible assets have on cash holding, as one might think they can be used as a buffer in case of a financial distress situation.

We measure Market-to-Book ratio as total Liabilities plus market capitalization to total assets. This ratio allows us to understand the growth opportunities a firm has, because the higher this ratio, the greater the opportunities a firm has for growth and vice-versa.

Firm Size is measured as the natural logarithm of the book value of assets deflated in 1995 dollars (Opler *et al.*, 1999; Ozkan and Ozkan, 2004; Ferreira and Vilela, 2004).

We measure Domestic debt as the domestic credit provided by financial sector (%GDP) as an indicator for the banking sector development and financial sector depth in a given country and year.

Market Capitalization (%GDP) is measured by the share price times the number of outstanding shares at the end of year values and serves as a proxy for the stock market development.

We measure GDP Growth as GDP_t minus GDP_{t-1} divided by GDP_{t-1} .

We measure Inflation as Nominal GDP divided by Real GDP as a measure for price variation impact.

Rule of law is an index for law enforcement used by La Porta *et al.* (2005), used to study the impact of law.

Lastly, we use law as Dummy variable set to 1 for common law and set to 0 for civil law.

Table 2
Correlation Matrix

Assets in the denominator are calculated as total assets less cash and cash equivalents. Dividend dummy is a variable set to 1 when firms paid dividends that year and set to 0	Dividend dummy	0,0412
Cash/assets	1,0000	1,0000

	Size	Market-to-book ratio	Tangible assets/assets	R&D/sales	Debt/assets	Industry sigma	Net working capital/assets	Cash flow/assets
Cash/assets	-0,0699	0,2044	-0,2855	0,1701	-0,3518	0,1595	-0,2294	0,0133
Dividend dummy	0,3670	-0,0091	-0,0185	-0,0866	-0,1390	-0,1610	0,0170	0,2822
Cash flow/assets	0,2671	0,0087	0,0397	-0,1284	-0,1303	-0,0601	0,0409	1,0000
Net working capital/asset	-0,0807	-0,0647	-0,0304	-0,0168	-0,0200	-0,0325	1,0000	
Industry sigma	-0,1806	0,1767	-0,0941	0,1809	-0,1491	1,0000		
Debt/assets	0,1317	-0,1393	0,2147	-0,0865	1,0000			
R&D/sales	-0,0317	0,1432	-0,1234	1,0000				
Tangible assets/assets	-0,0712	-0,1117	1,0000					
Market-to-book ratio	-0,0542	1,0000						
Size	1,0000							

4.3. Descriptive Statistics

Table 3 summarizes the main variables used in our study for the full sample of firms. The average cash holding for our sample of firms is 17%. This value is in line with both Opler *et al.* (1999), which for a sample of US firms obtained a cash holding average of 17% and with Ferreira and Vilela (2004), which for a sample of EMU firms obtaining an average

value of 15% for cash holdings. However, Kim *et al.* (1998) and Ozkan and Ozkan (2004) showed different values, which are most likely to be lower due to their average value being calculated as total assets instead of net assets.

Table 3

Description of exogenous variables for the 1995-2014 sample

Descriptive statistics of the variables for our sample of firm year observation from 1995 to 2014. Assets in the denominator are calculated as total assets minus cash and cash equivalents. Dividend dummy is a variable set to 1 when firms paid dividends that year and set to 0 otherwise. Cash-flow is calculated as earnings interest and taxes, but before depreciation, amortization and dividends. Net working capital is defined without cash. Industry sigma is a measure of and industry cash-flow volatility for our 20 year sample. Debt to assets is defined as total debt to total assets. R&D is defined as firms spending in R&D, firms with no information are set to 0 for no R&D. Tangible is the value of tangible assets. Market-to-book ratio is calculated as total liabilities plus market capitalization divided by assets. Size is defined as the natural logarithm of assets. N is the number of observations for each individual variable.

Variable	Mean	25th Percentile	Median	75th Percentile	Standard deviation	N
Cash/assets	0,1684	0,0350	0,0993	0,2268	0,1917	265640
Dividend dummy	0,5282	0,0000	1,0000	1,0000	0,4992	265640
Cash flow/assets	0,0422	0,0189	0,0548	0,0935	0,1269	265640
Net working capital/assets	0,0073	-0,1210	-0,0175	0,1169	0,2552	265640
Industry sigma	0,1436	0,1118	0,1428	0,1638	0,0347	265640
Debt/assets	0,2392	0,0712	0,2147	0,3643	0,1942	265640
R&D/sales	0,0141	0,0000	0,0000	0,0030	0,0524	265640
Tangible assets/assets	0,3288	0,1409	0,2933	0,4776	0,2308	265640
Market-to-book ratio	1,4464	0,8825	1,1242	1,6018	1,0828	265640
Size	11,8156	10,5733	11,8577	13,1860	2,2504	265640

For purely informative purposes, Table 4 represents our firms divided by continents. Africa is the continent with the highest mean of cash holding of all countries with almost 18%. The lowest is South America with an average cash holding ratio of only 10%.

Table 4

Cash holdings by Continent

Descriptive statistics on the cash holding ratio by continent for our firm year sample from 1995-2014. Cash holding ratio is measured as cash and cash equivalents divided by net assets, where

net assets is total assets minus cash and cash equivalents. N is the number of firm year observations for each variable.

Continent	Mean	25th Percentile	Median	75th Percentile	Standard deviation	N
Europe	0,1379	0,0330	0,0770	0,1709	0,1659	54058
North America	0,1355	0,0195	0,0649	0,1780	0,1755	50694
South America	0,1020	0,0200	0,0562	0,1254	0,1373	6220
Asia	0,1568	0,0400	0,0941	0,2061	0,1752	138208
Africa	0,1767	0,0366	0,1126	0,2418	0,1933	3282
Oceania	0,1436	0,0214	0,0664	0,1797	0,1897	13178

5. EMPIRICAL RESULTS

5.1. Univariate Tests

Table 5 represents the univariate comparison of our key descriptive variables by cash-to-assets quartile. Quartiles are constructed each year, which is why the ranges of each cash-to-assets ratio overlap across quartiles. This test is conducted in order to assess if the difference between firms that stand in the first quartile, low cash holding firms, and fourth quartile, high cash holding firms, have significant differences in firm characteristics. We use a t-statistics test to analyze this difference. Nevertheless, some firm characteristics do not change monotonically across cash-to-assets ratio quartiles, which implies that comparing firms in the first and fourth quartile is not sufficient to describe the relation between cash holdings and firm characteristics. We find that all firm characteristics are significantly different below the 5% level between the first and fourth of cash-to-assets quartiles. Both Debt to assets and industry sigma show a monotonic relationship with Cash holdings. Firms with higher cash flow to assets ratio have a great amount of cash holdings. This is consistent with the pecking order theory but contrary to the trade-off theory. Inconsistent with both the pecking order theory and free cash-flow theory, firms with high debt to asset ratio have higher amounts of cash holdings. Also in the lines of both the trade-off theory and the pecking order theory, firms with higher amounts of R&D have a higher amount of cash holdings. The result is almost null for the first three quartiles

Table 5

Firm characteristics by cash/assets quartiles.

Univariate comparison of means and medians of firm characteristics for our sample of firm year observations from 1995 to 2014. Median values are bracketed. Assets in the denominator are

calculated as total assets less cash and cash equivalents. Dividend dummy is a variable set to 1 when firms paid dividends that year and set to 0 otherwise. Cash-flow is calculated as earnings interest and taxes, but before depreciation, amortization and dividends. Net working capital is defined without cash. Industry sigma is a measure of and industry cash-flow volatility for our 20 year sample. Debt to assets is defined as total debt to total assets. R&D is defined as firms spending in R&D, firms with no information are set to 0 for no R&D. Tangible is the value of tangible assets. Market-to-book ratio is calculated as total liabilities plus market capitalization divided by assets. Size is defined as the natural logarithm of assets. N is the number of observations for each individual variable. The *t*-statistic is for a difference of means from the first to the fourth quartile.

Variable	First Quartile	Second Quartile	Third Quartile	Fourth Quartile	<i>t</i> -stat (p-value)
Cash/assets range	0 to 0,05	0,024 to 0,12	0,78 to 0,25	0,19 to 1	
Cash/assets	0,0172 [0,0122]	0,0659 [0,0612]	0,1605 [0,1539]	0,6110 [0,6214]	41,07 (0,0000)
Dividend dummy	0,0000 [0,0000]	0,3750 [0,0000]	0,8750 [1,0000]	1,0000 [1,0000]	N.A.
Cash flow/assets	-0,7566 [-0,4305]	0,0375 [0,0393]	0,0750 [0,0717]	1,1393 [0,5338]	30,91 (0,0000)
Net working capital/assets	-0,5573 [-0,5553]	-0,0680 [-0,0564]	0,0503 [0,0557]	0,5576 [0,5816]	54,43 (0,0000)
Industry sigma	0,0985 [0,0957]	0,1285 [0,1206]	0,1573 [0,1614]	0,1915 [0,1989]	-25,52 (0,0000)
Debt/assets	0,0377 [0,0270]	0,1466 [0,1507]	0,2918 [0,2962]	0,6807 [0,6833]	52,42 (0,0000)
R&D/sales	0,0000 [0,0000]	0,0000 [0,0000]	0,0015 [0,0001]	0,4850 [0,4256]	8,25 (0,0000)
Tangible assets/assets	0,2197 [0,0592]	0,3858 [0,2302]	0,7359 [0,3871]	0,5365 [0,7402]	61,13 (0,0000)
Market-to-book ratio	0,4896 [0,5255]	1,0189 [1,0171]	1,3722 [1,3141]	6,7416 [6,7040]	17,37 (0,0000)
Size	5,4362 [6,4108]	11,2678 [11,5060]	12,5489 [12,7078]	16,3469 [16,2985]	29,35 (0,0000)

but in the fourth quartile the value dramatically increases. As predicted by both the trade-off theory and pecking order theory, the market-to-book value increases with cash holdings. This is, however, contradictory to the free cash-flow theory. Lastly, disproving the trade-off theory but consistent with both the pecking order theory and the free cash-flow theory, size increases monotonically with cash holdings.

5.2. Regression tests

Table 6 represents our panel regressions for the 1995-2014 period, using the independent variables described earlier. We use three different regressions methodologies to study for our variables.

First, we use the method presented in Fama and MacBeth (1973), henceforth referred to as Fama-MacBeth model. With this model, a cross-sectional regression is estimated for each year. This eliminates the problem of serial correlation in the residuals of a time-series cross-sectional regression. Second, we run a time-series cross-sectional regression in order to use all the firm related variables. We include an unreported year dummy to control macroeconomic events, adding after a country dummy to control country differences, as cash holdings have different values across countries. Lastly, we add an industry dummy to control industry specific differences that affect cash holdings and are not captured by other variables in our model. We run a cross-sectional regression using means of variables for each firm across our 20 year sample period. Firms with less than 8 years of reporting were excluded from the cross-sectional regression, reducing our sample to almost 7500 firms.

5.2.1. Firm-specific variables

We find that two models support that firms with higher cash-flow have higher cash holdings. This is sustained by the pecking order theory but not by the trade-off model. As predicted by the pecking order theory, firms always prefer to finance their investments firstly with earnings, then with debt and lastly with equity. These results support that theory in a very significant way. However, when we run a cross-sectional regression, the cash-flow ratio is not significant, which supports the pecking order still.

Industry sigma, a proxy for cash-flow uncertainty has, as predicted, a positive relationship with cash holdings. As the trade-off theory suggested, firms with more volatile cash-flows can easily enter a situation of financial distress. Holding more cash allows firms to face this situation more easily, than if they had to require external funding.

Table 6

Regression of cash holding using only firm characteristics

Regression on the dependent variable cash to assets ratio for firm characteristics for our sample of firm year observation from 1995 to 2014. Assets in the denominator are calculated as total assets minus cash and cash equivalents. Dividend dummy is a variable set to 1 when firms paid dividends that year and set to 0 otherwise. Cash-flow is calculated as earnings interest and taxes, but before depreciation, amortization and dividends. Net working capital is defined without cash. Industry sigma is a measure of and industry cash-flow volatility for our 20 year sample. Debt to assets is defined as total debt to total assets. R&D is defined as firms spending in R&D, firms with no information are set to 0 for no R&D. Tangible is the value of tangible assets. Market-to-book ratio is calculated as total liabilities plus market capitalization divided by assets. Size is defined as the natural logarithm of assets. The Fama-MacBeth model gives the average of the time series of coefficients from annual cross-sectional regressions. The cross-sectional regression uses the means of all variables for each firm, firms with less than 12 years of information were excluded. All *t*-statistics are in parentheses and were corrected for heteroskedasticity using White's (1980) correction.

Independent variable	Fama-MacBeth model	Regressions using dummy variables for:			Cross-sectional regression
		Year	Year and Country	Year, Country and Industry	
Constant	0,2848 (42,36)	N.A.	N.A.	N.A.	0,2925 (27,09)
Dividend dummy	0,0169 (11,47)	0,0168 (23,28)	0,0071 (9,75)	0,0086 (11,90)	0,0248 (6,13)
Cash flow/assets	0,0280 (4,95)	0,0309 (8,78)	0,0624 (17,13)	0,0607 (16,66)	-0,0241 (-0,80)
Net working capital/assets	-0,1799 (-66,97)	-0,1789 (-109,76)	-0,1776 (-111,52)	-0,1750 (-110,24)	-0,1880 (-23,65)
Industry sigma	0,2490 (10,05)	0,2786 (28,64)	0,2770 (28,78)	-0,5745 (-6,38)	0,1762 (4,74)
Debt/assets	-0,2494 (-30,85)	-0,2567 (-144,09)	-0,2505 (-138,87)	-0,2482 (-137,02)	-0,2729 (-30,36)
R&D/sales	0,3865 (15,60)	0,3556 (35,21)	0,3461 (33,91)	0,3348 (32,44)	0,4903 (8,67)
Tangible assets/assets	-0,1770 (-53,06)	-0,1766 (-133,24)	-0,1687 (-126,14)	-0,1788 (-121,05)	-0,1228 (-19,74)
Market-to-book ratio	0,0188 (15,54)	0,0187 (43,97)	0,0226 (51,52)	0,0225 (51,06)	0,0102 (4,50)
Size	-0,0065 (-10,86)	-0,0062 (-36,01)	-0,0092 (-49,22)	-0,0097 (-51,14)	-0,0070 (-9,91)
N	20	265640	265640	265640	7493
Adjusted R ²	0,2643	0,2622	0,3068	0,3120	0,3360

Liquidity, Leverage, R&D and Growth opportunities are all statistically significant and supported by all three models. Liquidity is, as predicted, negatively related with cash holdings, which supports the trade-off model. As firms have higher liquidity, the demand

for cash is lower. In case of a firm entering a stage of cash shortfall, short-term assets can be easily used to be turned over into cash, reducing the urgent need of stacking up cash. Leverage behaves as predicted by both the pecking order theory and the free cash-flow theory, being negatively related with cash holdings. According to the free cash-flow theory, firms that are less levered are less subject to monitoring allowing managers to pursue their own decisions. The pecking order theory, on the other hand, states that there is an inverse order to cash holdings and leverage, debt typically grows when investment exceeds retained earnings and falls when investment is less than retained earnings. Cash holdings follow the very opposite pattern — when investment is lower than retained earnings, cash holdings grow and when investment is greater than retained earnings, cash holdings decrease. As expected, firms with higher R&D have higher demands for cash, which implies that firms will hold more cash to face cash shortage. Our results act accordingly with this prediction and with the trade-off model. Market-to-book ratio, as a proxy for growth opportunities, is positively correlated to cash holdings. This result supports both the trade-off model and the pecking order theory but contradicts the free cash-flow theory instead. Firms with greater growth opportunities will hold more cash as, according to the pecking order theory, external financing is more costly to firms with higher growth opportunities. According to the trade-off model, firms do not want to pass on positive NPV projects so they will stack up cash in order to face possible cash shortages. Contradicting the free cash-flow theory, which states that managers will hold more cash to follow their own projects, even if they use funds to finance negative NPV projects.

The results for tangibility support our predictions, firms with a higher quantity of tangible assets tend to hold less cash. Even if tangible assets take longer to be turned into cash, they can be used as a substitute for cash in the long run.

Lastly, firm size is negatively related with cash holdings, as the trade-off model predicts. Our results support the theory that larger firms tend to hold less cash than smaller firms. This can be due to smaller firms having a higher cost raising external funding, the possibility that larger firms have a lower probability of entering a situation of financial distress. An alternative justification suggested by Miller and Orr (1966) claims that there may be economies of scale in cash management.

Our findings are consistent with previous empirical studies on cash holdings of US firms (Opler *et al.*, 1999), EMU firms (Ferreira and Vilela, 2004) and UK firms (Ozkan and Ozkan, 2002).

5.2.2. Macroeconomic variables

Our wide sample of firms across many countries allows us to make a better judgment on how firms across the world behave in terms of cash holding. However, using only firm related variables is not enough to explain all the possible reasons for a firm to hold cash. To better distinguish cash holding behavior by firms, we include four more macroeconomic related variables to understand the importance of the macroeconomic impact on a firm's decision to hold cash.

To do so, we use the same three regression models we used in the previous sub-section in order to study the influence of our four new macroeconomic variables.

The influence of banking and financial sector is proxied by our Domestic Credit Provided by Financial sector (%GDP) variable. DCP by FS is negatively correlated with cash holdings, going against our predictions. One hypothesis for the obtained results is the pecking order theory. Firms will always try to finance themselves with earnings, after that with debt and equity at last. Holding cash and not resorting to bank borrowing will make firms less subject to bank monitoring, allowing managers to pursue their own projects. This last assumption is connected with the free cash-flow theory by Jensen (1986) and in line with the results obtained by Dittmar *et al.* (2003). Dittmar *et al.* (2003) justify their results with the agency view that the bigger the capital markets the more cash firms will hold.

Our results for Market Capitalization (%GDP) are weak, since two of our regressions are not significant. The year dummy regression and cross-sectional regression are both significant at a 5% confidence level but contradict each other. We cannot infer serious conclusions from this determinant.

Table 7

Regression of cash holdings using firm and macroeconomic characteristics

Regression on the dependent variable cash to assets ratio for firm and macroeconomic characteristics for our sample of firm year observation from 1995 to 2014. Assets in the denominator are calculated as total assets less cash and cash equivalents. Dividend dummy is a variable set to 1 when firms paid dividends that year and set to 0 otherwise. Cash-flow is calculated as earnings interest and taxes, but before depreciation, amortization and dividends. Net working capital is defined without cash. Industry sigma is a measure of industry cash-flow volatility for our 20 year sample. Debt to assets is defined as total debt to total assets. R&D is defined as firms spending in R&D, firms with no information are set to 0 for no R&D. Tangible is the value of tangible assets. Market-to-book ratio is calculated as total liabilities plus market capitalization divided by assets. Size is defined as the natural logarithm of assets. DCP by FS is the ratio of domestic credit provided by financial sector to GDP. Market capitalization is the stock market capitalization by GDP. Inflation is calculated as Nominal GDP divided by Real GDP. GDP growth is measured as the difference between years. The Fama-MacBeth model gives the average of the time series of coefficients from annual cross-sectional regressions. The cross-sectional regression uses the means of all variables for each firm, firms with less than 12 years of information were excluded. All *t*-statistics are in parentheses and were corrected for heteroskedasticity using White's (1980) correction.

Regression using dummy variables for:					
Independent variable	Fama-MacBeth model	Year	Year and Country	Year, Country and Industry	Cross-sectional regression
Constant	0,2740 (32,15)	N.A.	N.A.	N.A.	0,2719 (23,08)
Dividend dummy	0,0150 (11,35)	0,0165 (23,14)	0,0071 (9,76)	0,0087 (11,91)	0,0219 (5,42)
Cash flow/assets	0,0541 (12,67)	0,0530 (14,69)	0,0621 (17,05)	0,0605 (16,58)	0,0640 (2,05)
Net working capital/assets	-0,1766 (-65,93)	-0,1752 (-109,42)	-0,1776 (-111,47)	-0,1750 (-110,18)	-0,1848 (-23,90)
Industry sigma	0,2328 (10,77)	0,2474 (25,71)	0,2773 (28,81)	-0,5765 (-6,40)	0,1436 (3,95)
Debt/assets	-0,2456 (-46,60)	-0,2476 (-139,92)	-0,2507 (-138,91)	-0,2484 (-137,07)	-0,2522 (-28,75)
R&D/sales	0,3690 (15,23)	0,3321 (33,29)	0,3460 (33,90)	0,3347 (32,43)	0,4502 (8,24)
Tangible assets/assets	-0,1688 (-48,99)	-0,1705 (-129,28)	-0,1685 (-125,85)	-0,1786 (-120,75)	-0,1204 (-19,53)
Market-to-book ratio	0,0202 (18,55)	0,0196 (46,11)	0,0226 (51,46)	0,0225 (51,00)	0,0143 (6,32)
Size	-0,0095 (-16,11)	-0,0090 (-50,19)	-0,0092 (-49,17)	-0,0097 (-51,10)	-0,0094 (-13,02)

Table 7

Continued.

Independent variable	Fama-MacBeth model	Regressions using dummy variables for:			
		Year	Year and Country	Year, Country and Industry	Cross-sectional regression
DCP by FS	0,0275 (8,80)	0,0285 (59,22)	0,0076 (3,42)	0,0076 (3,42)	0,0198 (9,90)
Market capitalization	-0,0034 (-1,05)	0,0054 (20,85)	0,0007 (1,23)	0,0006 (1,21)	0,0081 (9,68)
Inflation	-0,2082 (-4,34)	-0,0545 (-7,10)	0,0202 (2,43)	0,0210 (2,51)	-0,0333 (-0,74)
GDP growth	0,1541 (2,16)	0,0974 (7,72)	0,0369 (2,17)	0,0385 (2,27)	-0,0871 (-1,22)
N	20	265640	265640	265640	7493
Adjusted R ²	0,2869	0,2776	0,3069	0,3122	0,3646

Our results for Market Capitalization (%GDP) are weak, since two of our regressions are not significant. The year dummy regression and cross-sectional regression are both significant at a 5% confidence level but contradict each other. We cannot infer serious conclusions from this determinant.

Inflation, also, is not a conclusive result. As predicted in our literature review and in previous literature, inflation is not a straightforward determinant. In an early stage of inflation, cash holdings have a negative relationship with inflation, as the same asset would cost more to buy after a certain period. In a later stage, when the government takes measures in regards to inflation, banks will be more careful when borrowing, which will increase firms' cash holding. This is due to the fact that the risk of not obtaining funding would increase and, as a precautionary measure, firms would stack up more cash. Fama-MacBeth model and our "year's" dummy regression report a negative correlation, while our regression with "year and country" and "year, country and industry" report a positive relation with cash holding. The other two models do not have statistically significant results. Even though we do not have enough information to state so, these results can be caused by the two phases of inflation.

Two of our models support, with a 5% level of significance, our predictions that GDP growth is positively correlated with cash holdings, only the cross-sectional regression states otherwise.

Except for GDP growth, most of our results are contradictory to previous literature, which can be explained by a large sample of firms and countries.

5.2.3. Agency costs

Although we studied for both firm and macroeconomic determinants, much of the existing literature states that there are management agency costs. Our wide sample of countries indicates that there are many different policies, proving that maybe some of these policies may have a greater impact in our study and findings.

Table 8

Regression of cash holding ratio using firm, macroeconomic and agency cost characteristics

Regression on the dependent variable cash to assets ratio for firm, macroeconomic and agency cost characteristics for our sample of firm year observation from 1995 to 2014. Assets in the denominator are calculated as total assets minus cash and cash equivalents. Dividend dummy is a variable set to 1 when firms paid dividends that year and set to 0 otherwise. Cash-flow is calculated as earnings interest and taxes, but before depreciation, amortization and dividends. Net working capital is defined without cash. Industry sigma is a measure of and industry cash-flow volatility for our 20 year sample. Debt to assets is defined as total debt to total assets. R&D is defined as firms spending in R&D, firms with no information are set to 0 for no R&D. Tangible is the value of tangible assets. Market-to-book ratio is calculated as total liabilities plus market capitalization divided by assets. Size is defined as the natural logarithm of assets. DCP by FS is the ratio of domestic credit provided by financial sector to GDP. Market capitalization is the stock market capitalization by GDP. Inflation is calculated as Nominal GDP divided by Real GDP. GDP growth is measured as the difference between years. Law is a variable set to 1 for civil law and set to 0 for civil law. Rule of law is an index measure for law and order in the country. The Fama-MacBeth model gives the average of the time series of coefficients from annual cross-sectional regressions. The cross-sectional regression uses the means of all variables for each firm, firms with less than 12 years of information were excluded. All *t*-statistics are in parentheses and were corrected for heteroskedasticity using White's (1980) correction.

Independent variable	Fama-MacBeth model	Regression using dummy variables for:			Cross-sectional regression
		Year	Year and Country	Year, Country and Industry	
Constant	0,2839 (38,07)	N.A.	N.A.	N.A.	0,2895 (23,76)
Dividend dummy	0,0103 (8,84)	0,0113 (15,98)	0,0070 (9,61)	0,0086 (11,77)	0,0113 (2,85)
Cash flow/assets	0,0556 (16,24)	0,0517 (14,30)	0,0620 (17,02)	0,0604 (16,55)	0,1021 (3,21)

Table 8

Continued.

Independent variable	Fama-MacBeth model	Regressions using dummy variables for:			Cross-sectional regression
		Year	Year and Country	Year, Country and Industry	

Net working capital/assets	-0,1778 (-70,03)	-0,1777 (-111,09)	-0,1776 (-111,48)	-0,1749 (-110,20)	-0,1811 (-23,78)
Industry sigma	0,2856 (15,85)	0,3047 (31,69)	0,2765 (28,73)	-0,5787 (-6,42)	0,1567 (4,39)
Debt/assets	-0,2472 (-47,88)	-0,2509 (-141,52)	-0,2507 (-138,95)	-0,2485 (-137,12)	-0,2613 (-29,82)
R&D/sales	0,3870 (14,23)	0,3491 (34,62)	0,3455 (33,84)	0,3342 (32,38)	0,4680 (8,32)
Tangible assets/assets	-0,1627 (-46,07)	-0,1635 (-124,77)	-0,1685 (-125,87)	-0,1785 (-120,75)	-0,1176 (-19,18)
Market-to-book ratio	0,0217 (18,34)	0,0213 (49,40)	0,0226 (51,47)	0,0225 (51,02)	0,0208 (8,87)
Size	-0,0099 (-17,99)	-0,0097 (-53,70)	-0,0092 (-49,04)	-0,0096 (-50,96)	-0,0086 (-12,05)
DCP by FS	0,0285 (10,85)	0,0293 (59,29)	0,0070 (3,12)	0,0069 (3,13)	0,0201 (10,00)
Market capitalization	0,0128 (5,23)	0,0107 (38,19)	-0,0008 (-1,49)	-0,0008 (-1,50)	0,0142 (15,80)
Inflation	-0,0425 (-20,00)	-0,0926 (-11,41)	0,0246 (2,95)	0,0254 (3,03)	-0,2303 (-4,46)
GDP growth	-0,0114 (-6,08)	0,1420 (10,42)	0,0294 (1,73)	0,0310 (1,83)	0,0469 (0,58)
Law	-0,1893 (-5,03)	-0,0393 (-54,42)	-0,0503 (-6,21)	-0,0542 (-6,69)	-0,0394 (-13,83)
Rule of law	0,2169 (3,78)	-0,0111 (-18,82)	0,0304 (10,30)	0,0303 (10,31)	-0,0214 (-8,72)
N	20	265640	265640	265640	7493
Adjusted R ²	0,2981	0,2889	0,3073	0,3125	0,3947

In order to capture the effects of different country policies in firm cash holdings, we use the three previous regression models including two new variables to study the agency theory. We include a dummy variable to measure the differences on how civil or common law affect cash holdings, as well as Rule of Law (see La Porta et al. 1998).

Table 8 demonstrates the results of our regressions. All of our variables are significant at a 5% confidence level. Results from Law support that law is negatively related with cash holdings. Negative relation with law would state that, when common law is applied in a certain country, firms will have less cash holdings and when civil law is applied, the inverse applies. This result does allow us to state that, just like La Porta *et al.* (1998), we

can say that common law countries have usually more investor protection than civil law countries.

On the other hand, the Rule of law is positive according to two of our models and negative according to the Fama-MacBeth model. This result is in line with previous literature. According to the free cash-flow theory, if investors have less control over the firm, managers will have an incentive to accumulate cash in order to proceed their own investment decisions. Our results prove otherwise, supporting the idea that when there is more investor protection firms will still hold more cash. One hypothesis for our results is that investors may prefer liquidity rather than invested cash because when there is more investor protection firms will hold more cash.

5.2.4. Can we predict a financial crisis by looking at the cash holdings?

To finalize our study of cash holdings, we were interested in observing how cash holding behaved before, during and after the financial crisis that started in the end of 2008. The financial crisis, as previously mentioned, was due to the mispricing of the CDS's. This mispricing started in earlier years when bank lending was sky rocketing. Firms optimize their cash holdings throughout time according to the trade-off, pecking order and free cash-flow theories. When the banking industry entered a default state, external financing was much harder for firms to access, so we created three hypotheses. To study them, we used a time-series regression with year, country and industry dummies, because we needed to study the evolution of cash holdings over a certain period of time. We included three dummy variables to study the period of time 2005-2008, 2009 and 2009-2014. Table 9 presents our results from our regressions.

All our results are statistically significant below a 1% confidence level.

Table 9

Regression for financial crisis dummies.

Regression on the dependent variable cash to assets ratio for our sample of firm year observation from 1995 to 2014. Assets in the denominator are calculated as total assets minus cash and cash equivalents. Dividend dummy is a variable set to 1 when firms paid dividends that year and set to 0 otherwise. Cash-flow is calculated as earnings interest and taxes, but before depreciation, amortization and dividends. Net working capital is defined without cash. Industry sigma is a

measure of and industry cash-flow volatility for our 20 year sample. Debt to assets is defined as total debt to total assets. R&D is defined as firms spending in R&D, firms with no information are set to 0 for no R&D. Tangible is the value of tangible assets. Market-to-book ratio is calculated as total liabilities plus market capitalization divided by assets. Size is defined as the natural logarithm of assets. DCP by FS is the ratio of domestic credit provided by financial sector to GDP. Market capitalization is the stock market capitalization by GDP. Inflation is calculated as Nominal GDP divided by Real GDP. GDP growth is measured as the difference between years. Law is a variable set to 1 for civil law and set to 0 for civil law. Rule of law is an index measure for law and order in the country. All t-statistics are in parentheses and were corrected for heteroskedasticity using White's (1980) correction.

Regressions using dummy variables for:			
Independent variable	Year	Year and Country	Year, country and industry
Constant	N.A.	N.A.	N.A.
Dividend dummy	0,0113 (15,98)	0,0070 (9,61)	0,0086 (11,77)
Cash flow/assets	0,0517 (14,30)	0,0620 (17,02)	0,0604 (16,55)
Net working capital/assets	-0,1777 (-111,09)	-0,1776 (-111,48)	-0,1749 (-110,20)
Industry sigma	0,3047 (31,69)	0,2765 (28,73)	-0,5787 (-6,42)
Debt/assets	-0,2509 (-141,52)	-0,2507 (-138,95)	-0,2485 (-137,12)
R&D/sales	0,3491 (34,62)	0,3455 (33,84)	0,3342 (32,38)
Tangible assets/assets	-0,1635 (-124,77)	-0,1685 (-125,87)	-0,1785 (-120,75)
Market-to-book ratio	0,0213 (49,40)	0,0226 (51,47)	0,0225 (51,02)
Size	-0,0097	-0,0092	-0,0096

Table 9

Continued.

Regressions using dummy variables for:			
Independent variable	Year	Year and Country	Year, Country and Industry
	(-53,70)	(-49,04)	(-50,96)
DCP by FS	0,0293	0,0070	0,0069

	(59,29)	(3,12)	(3,13)
Market capitalization	0,0107	-0,0008	-0,0008
	(38,19)	(-1,49)	(-1,50)
Inflation	-0,0926	0,0246	0,0254
	(-11,41)	(2,95)	(3,03)
GDP growth	0,1420	0,0294	0,0310
	(10,42)	(1,73)	(1,83)
Law	-0,0393	-0,0503	-0,0542
	(-54,42)	(-6,21)	(-6,69)
Rule of law	-0,0111	0,0304	0,0303
	(-18,82)	(10,30)	(10,31)
Dummy 2005-2008	-0,0039	-0,0069	-0,0072
	(-1,64)	(-2,81)	(-2,95)
Dummy 2009	0,0135	0,0137	0,0145
	(6,93)	(6,90)	(7,32)
Dummy 2009 2014	-0,0145	-0,0093	-0,0100
	(-5,98)	(-3,40)	(-3,67)
N	265640	265640	265640
Adjusted R ²	0,2887	0,3071	0,3125

Our models state that, during the period of 2005-2008, cash holdings were the lowest during 2005-2014. Hence, we do not reject Hypothesis 1. Lending was increasing pre-crisis, peaking in mid-2007. By the last quarter of 2008, lending fell 47% from the third to the fourth quarter of 2008, as the upcoming crisis was now clear. We can assume that, as external funding for firms was easy to obtain, the need to hold cash was lower. In case of a cash shortage, firms could always borrow money to face this situation. We can also assume that, during this period, there were more growth opportunities for firms. As such, firms would borrow money in order to keep pursuing all their investment opportunities. When earnings were not enough to finance all the investments, external funding was an easy option. This is supported by both the trade-off theory and the pecking order theory.

Despite the fact that in the fourth quarter of 2008 the financial crisis was upon us, the results were only to be measured in 2009. As external funding became more difficult to be obtained by firms, their only option would be to stack up more cash in order to face the problem of entering a cash shortfall. Supported by our results, we can clearly define

that there was an increase in cash holdings for 2009. Thus, we do not reject Hypothesis 2. We can expect that, as precautionary motive, firms did not know what type of situation they would be facing in the future. As a consequence they would stack up more cash than before.

Lastly, we predicted that after the financial crisis shock in the fourth quarter 2008 and 2009 when the crisis was most felt, firms would become more afraid of the same situation in a near future and would increase their cash holdings as measure of precaution. Our models support the hypothesis that cash holdings are higher post-crisis than they were pre-crisis. Consequently, we do not reject Hypothesis 3. Our time-series regression states that cash holdings actually decreased right after the crisis for the period of 2009-2014 and have a negative relation. Therefore, we can clearly say that they are higher for the post-crisis period than for the pre-crisis period. Our results support the precautionary motive as firms are now more cautious with the probability of a new financial crisis, stacking more cash in order to face this possibility.

6. CONCLUSION

The purpose of our research is to investigate the determinants of firm cash holdings using a sample of firms from 54 countries for the time period of 1995-2014, as well as investigating the way cash holdings evolved during the financial crisis of 2008.

We used the cash-to-assets ratio as previous literature suggested. Our results on the determinants of corporate cash holdings are mainly in line with some of the most reviewed literature on this subject by Opler *et al.* (1999), Ozkan and Ozkan (2002), Ferreira and Vilela (2004).

Our findings demonstrate that cash holdings are positively related with the investment set and negatively related with cash substitutes and firm size.

The results of our study on the investment set show that firms will most likely hold cash because they do not want to let go of investment opportunities. Market-to-book ratio, a proxy for growth opportunities, shows that firms will hold cash in order to keep pursuing their investment opportunities. Contradicting the free cash-flow theory but supported by both the trade-off and pecking order theory, we can conclude that firms will hold more cash in order to proceed their investment policies, holding higher amounts of cash. Cash-

flow is also positively related with cash holdings as supported by the pecking order theory but contrary to the trade-off theory, firms will prefer to finance their investments with earnings first rather than resort to debt and/or equity. When cash-flow is uncertain, firms will hold more cash as well in order to face the possibility of cash shortage. This is in line with the trade-off model. R&D has a positive relation with cash holdings too, since firms do not want to let go off their investments and will hold more cash to face a situation of financial distress without having to stop investing in R&D.

On the other hand, cash holdings are negatively related with cash substitutes and firm size. Liquidity and leverage are both cash substitutes that firms can resort to in case of need, so they are negatively related to cash holdings. Liquidity results are supported by the trade-off theory. The trade-off between holding cash and selling short-term assets is, according to our research, an easy option for firms that will choose having to sell their short-term assets in case of need rather than stocking on cash. Leverage is supported by all three theories — firms will prefer not to have cash holdings and use external funds in case of need. Tangibility, too, is negatively related to cash holdings according to the trade-off theory. Firms will prefer to still invest their cash holdings and sell their long-term assets to face a possible situation of financial distress. Lastly, firm size is also negatively related with cash holdings. Larger firms tend to hold less cash than smaller firms since smaller firms have higher costs of financing. Larger firms, however, have a better financial situation and can easily use external funds as an option.

In a firm specific view, we can conclude that the trade-off and pecking order are the most important theories when it comes to cash holdings. Firms will generally try to invest as much as they can in growing opportunities and try to follow the pecking order theory in terms of their cash policies. As supported by the trade-off theory, firms will most likely prefer to invest their cash holdings and resorting to other methods to solve a possible financial distress situation using their cash substitutes as a buffer.

Our macroeconomic determinants were not conclusive and research on them could be either widened or more continent/country specific. Due to the fact that our research has a very wide sample and many situations can be occurring, our results may not be as reliable as they could be. Our study shows that bank influence will lead firms to hold more cash when bank influence is higher and vice-versa. This can be due to the fact that information asymmetry can cause firms to support high costs of external funding and banks may have higher risks, so premiums increase. Inflation can be seen as a cycle with two

consequences. First, when there is inflation and no government influence, firms will hold less cash, as the same cash is worth less as time goes on. Secondly, when governments take measures to slow down inflation, banks can become more careful with lending, and firms will hold more cash since external funds can become harder to access. GDP growth is positively related with cash holdings.

Lastly, our analysis on agency costs show that countries with common law will technically hold less cash rather than with civil law countries. Firms in countries with more overall protection will, too, hold more cash than firms in less protected countries.

The impact of the financial crisis was one of our study goals and, after studying firm's cash holdings react to different stimuli, we can now investigate how cash holdings were affected by the 2008 crisis. Our results show us that pre-crisis cash holdings were very low when banks were lending a high amounts of cash and firms would increase their investment using debt. When the crisis happened, banks were the first ones to take measures and reduced all their lending by 47% in a quarter period. This caused firms to hold more cash as external funding was harder to reach and firms held more cash to face an unknown future. During the post-crisis period (2009-2014), firms dropped their cash holdings again and started using more debt again. For the time period of 2009-2014, firm's cash holding were higher than pre-crisis. An investigation with a sample until 2016 should be able to investigate whether this value is still higher than pre-crisis or not. We can conclude from our sample that firms will now hold more cash than pre-crisis as a precautionary motive.

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