Aalto University
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The effect of information problems and growth opportunities on the valuation of cash.

Finance

Master's thesis

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Abstract
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THE EFFECT OF INFORMATION PROBLEMS AND GROWTH OPPORTUNITIES ON THE VALUATION OF CASH

PURPOSE OF THE STUDY

The purpose of the thesis is to study the effect of information problems on the valuation of cash holdings. The thesis extends previous research from two aspects. Firstly, the thesis takes into account the growth opportunities of a firm and examines the effect on the valuation of cash. Secondly, earlier research regarding the interrelation of asymmetric information and the valuation of cash has mainly been conducted with international samples, whereas this thesis takes a single-market perspective and focuses only on US firms.

DATA

The data of this study consists of 815 firms listed in the New York Stock Exchange between 1999 and 2009, a total of 5,596 firm-year observations. The valuation regression analyzes the total market value of the firm as the dependent variable against control variables for earnings, net assets, R&D expenses, interest expenses and dividends. The firm-specific degree of asymmetric information is measured by an index that combines four proxies: (1) error in analysts' forecasts, (2) forecast dispersion, (3) the number of analysts following the firm, and (4) firm size. All data comes from Thomson One Banker: regression variables are taken from the Worldscope- database and the analyst forecasts are from I/B/E/S- database.

RESULTS

First, the study finds that the market value of a marginal dollar of cash is close to par i.e. one dollar. This confirms the results of earlier research. Secondly, the thesis finds that asymmetric information does not have a significant effect on the valuation of cash for an average firm. However, information problems are found to have a significant negative effect on the valuation of cash for firms with low growth opportunities. Results do not suggest a distinct effect for high growth opportunity firms.

Previous evidence for a negative valuation of cash under asymmetric information is in the sample found to occur only for firms with low growth opportunities. The results support the agency cost theory and the free cash flow problem.

KEYWORDS

Valuation of cash, cash holdings, asymmetric information, growth opportunities

Aalto-yliopiston Kauppakorkeakoulu
Pro Gradu -tutkielma

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29. huhtikuuta 2011

INFORMAATIO-ONGELMIEN JA KASVUMAHDOLLISUUKSIEN VAIKUTUS YHTIÖN KASSAVAROJEN ARVOSTUKSEEN

TUTKIMUKSEN TARKOITUS

Tämän tutkielman tavoitteena on tutkia informaatio-ongelmien vaikutusta yhtiön kassavarojen arvostukseen. Tutkielman jatkaa aikaisempaa kirjallisuutta kahdesta näkökulmasta. Ensinnäkin, tutkielma huomioi kasvumahdollisuuksien vaikutuksen kassavarojen arvostukseen. Toiseksi, aikaisempi kirjallisuus, joka tutkii asymmetrisen informaation ja kassavarojen välistä yhteyttä on pääosin tehty kansainvälisellä aineistolla. Tämä tutkielma keskittyy tutkimaan vain Yhdysvaltalaisia yrityksiä.

LÄHDEAINEISTO

Lähdeaineisto koostuu 815 New Yorkin pörssissä listatusta yhtiöstä vuosien 1999 ja 2009 väliltä, yhteensä 5596 yritysvuodesta. Analyysissä tutkitaan selitettävänä muuttujana yrityksen kokonaismarkkina-arvoa tuloksen, nettovarojen, T&K- kulujen, korkokulujen sekä osinkojen avulla. Yrityskohtaisen asymmetrisen informaation määrää mitataan indeksillä, joka koostuu neljästä muuttujasta: analyytikkojen ennustevirheestä, ennusteiden hajonnasta, yritystä seuraavien analyytikkojen määrästä sekä yrityksen koosta. Kaikki data tulee Thomson One Banker:n kautta. Regression muuttujat otetaan Worldscope- tietokannasta ja analyytikkojen ennusteet I/B/E/S- tietokannasta.

TULOKSET

Ensiksi, tutkielman tulokset osoittavat, että marginaalinen dollari käteistä on markkina-arvoltaan lähellä yhtä dollaria. Tämä vahvistaa aikaisempien tutkimusten tulokset. Toiseksi, tuloksista käy ilmi, että asymmetrisellä informaatiolla ei ole merkittävää vaikutusta kassavarojen arvostukseen keskimäärin. Tulokset kuitenkin osoittavat, että asymmetrisellä informaatiolla on merkittävä negatiivinen vaikutus matalan kasvumahdollisuuksien omaaviin yrityksiin. Korkean kasvumahdollisuuksien yrityksiin informaatio-ongelmilla ei tuloksien mukaan ole merkittävää vaikutusta.

Tutkielman vahvistaa aikaisemmat todisteet asymmetrisen informaation negatiivisesta vaikutuksesta kassavarojen arvostukseen vain osittain. Lähdeaineistossa tämä vaikutus rajoittuu vain matalan kasvumahdollisuuksien omaaviin yrityksiin. Löydökset tukevat agenttikustannusten ja ns. vapaan kassavirran teoriaa.

AVAINSANAT

Kassavarojen arvostus, kassavarat, asymmetrinen informaatio, kasvumahdollisuudet

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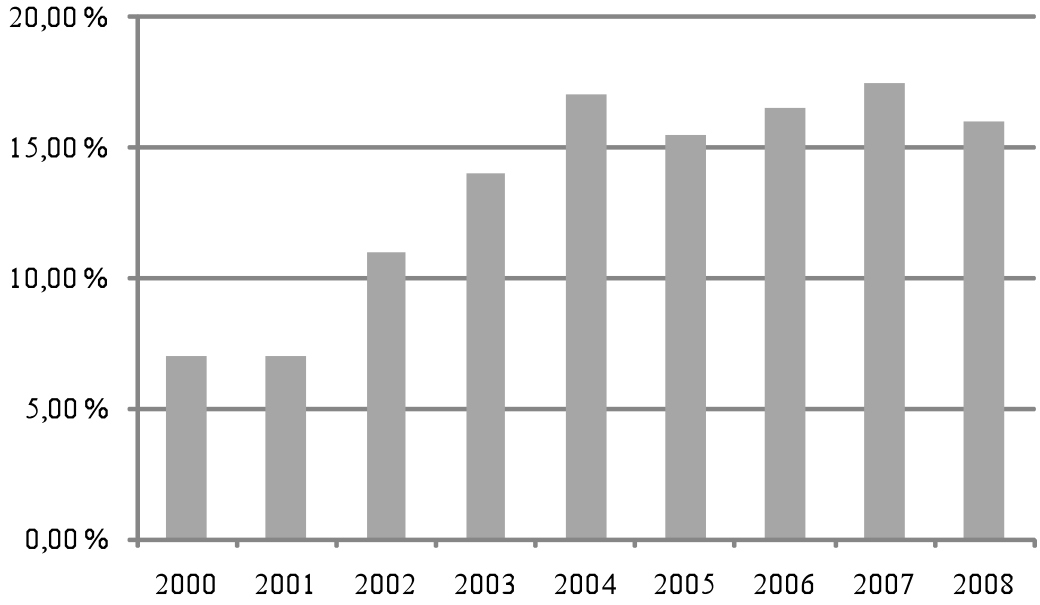
1. INTRODUCTION

1.1. Background

The amount of cash held by firms has increased significantly during the last few decades. This is evident from the recent study by Bates et al. (2009), reporting that the average cash ratio has more than doubled from 1980 to 2006. Similar phenomenon is apparent in Figure 1, which depicts the share of cash and liquid asset holdings of total assets for the sample of 815 firms listed in the New York Stock Exchange between 2000 and 2008.

Considering the financial difficulties the recent subprime crisis and the following recession has caused for many firms, the increased level of liquidity has not necessarily been a bad thing. However, Bates et al. (2009) argue that in fact, the massive reformation of the informative and technological environment in the financial markets should have led to the opposite outcome – a decrease in cash holdings. For instance, hedging opportunities have

Figure 1: Development of the cash and liquid asset holdings to total assets- ratio within the 815 sample firms listed in the New York Stock Exchange between 2000 and 2008. Average of year-end figures. See section 4 for further details of the sample construction.



become more effective enabling one to get protection from adverse shocks. Moreover, the expansion of capital markets in terms of technology, information and liquidity have made it easier to raise external funds. Holding large cash reserves for a sudden need of liquidity is thus becoming less and less justifiable.

In other words, financial markets are evolving towards the assumptions of the efficient capital markets theory. Frictions between firms, capital markets and investors are becoming smaller as the information flow is increasing all the time. In the light of this development, the motives and drivers for the increasing cash holdings are very interesting. One way to approach this question is the viewpoint of investors; how do they conceive the fact that managers are piling up cash in their balance sheet and how is this valued?

This is the question my thesis attempts to give answers to. The topic has already encouraged research focusing on how cash is valued and which factors have most effect on the valuation. A major part of this research revolves corporate governance issues and investor protection. My focus in this thesis is asymmetric information, which is a fundamental part of the efficient capital markets theory. Furthermore, it is another market characteristic that should have improved along the rapid development of the financial markets.

The thesis follows the very recent study by Drobetz et al. (2010). They investigate two opposing hypotheses that originate from two fundamental theories of finance. Based on the pecking order theory by Myers (1984) and Myers and Majluf (1984), the authors argue that cash holdings provide *financial slack*. This *asymmetric information theory* predicts that cash is valuable when a firm suffers from information problems because raising external funds would be relatively expensive due to adverse selection. In the opposite, the *agency cost theory* by Jensen (1986), predicts that cash is less valuable for firms suffering from information problems because it leads to moral hazard; managers have a tendency to waste internal funds when they are unreachable from the control by capital markets, also known as the *free cash flow problem*. The two hypotheses predicting opposite outcomes for the valuation of cash under information asymmetries are also tested in this thesis.

My study extends previous research by studying the information problems and firm valuation also in connection with the growth opportunities of the firm. Previous literature states that growth opportunities are one of the factors having the most effect on the valuation of cash

(e.g. Pinkowitz and Williamson, 2004 and Opler et al., 1999). Moreover, I perform the empirical tests with data from a single market (US firms), whereas earlier literature has analyzed international samples with relatively large differences between countries. The within-market setting enables me to examine whether investors account for firm-specific information problems also in a market that is generally considered as the most developed financial market in the world.

My empirical methodology utilizes the modified Fama and French (1998) valuation regression that controls for several variables; earnings, net assets, R&D expenses, interest expenses and dividends. To measure the level of asymmetric information I use four proxies that earlier research has found to be connected to information problems: (1) error in analysts' forecasts, (2) forecast dispersion, (3) the number of analysts following the firm, and (4) firm size. The proxies are combined into an *information asymmetry- index* to be included to the valuation regression as a single variable that captures all the available information. The data set comprises of 815 NYSE listed firms over 9 years, totaling to 5,596 firm-years.

The empirical results show that for an average firm, a marginal dollar of cash is valued close to par i.e. one dollar. This is in line with the findings of previous studies. When the effect of information problems is included I find no significant change in the valuation of cash. The results contrasts to Drobetz et al. (2010) who report a significant negative valuation for cash under asymmetric information. In order to go beyond existing literature, I combine the effect of information problems and the growth opportunities of a firm, measured by the common market-to-book ratio. The sample split to low and high MB firms reveals that the valuation is not equal for all firms. The results suggest that firms with low growth opportunities experience a lower valuation of cash when information problems are present. This supports the agency cost theory, as it seems that investors are not placing value on cash holdings because they are afraid that managers are not using it to value-adding purposes. For firms with high growth opportunities I am unable to find a significant effect and thus no support for the asymmetric information theory.

On a final note, to clarify differences among some of the earlier studies I bring forth the definition of cash and financial slack, which in this thesis is defined as cash and liquid asset holdings. The notation is emphasized, because academic literature sometimes refers to financial slack strictly as cash held in the bank account. On the other hand, cash at bank plus

liquid asset holdings plus committed bank financing have been referred as financial slack (see e.g. Hadlock and James, 2002). In my opinion, liquid asset holdings can justifiably be considered as cash since they are available for use solely on the managers' discretion. One could argue that this is the case with committed bank financing, but drawing credit implies monitoring from the creditor's side on what the funds are being used for. I also point out that the terms asymmetric information, information asymmetry and information problems are used interchangeably in the thesis.

1.2. Limitations of the study

Data related issues are the main limiting factor for the results presented in this thesis. Firstly, the quality of the data is not perfect with many missing observations in the time-series data set. As the topic relates to information problems, the fact that firms with missing data are skipped when running the regressions might create a bias towards firms that have better data access and thus might suffer less from asymmetric information. Secondly, constructing the time-series data by including only firms that have data available throughout the time period creates potential survivorship bias. Pinkowitz et al. (2006) further note that the Worldscope database, which is used in the thesis, is biased towards large firms, which in general are seen to have less information problems (e.g. Frank and Goyal, 2003). The total impact of these data related problems seems to be that firms with most information problems may potentially be excluded from the sample. Consequently, the effect of information asymmetry on the valuation of cash may be understated.

Another limiting aspect from the empirical perspective is the measurement of the level of firm-specific information asymmetry. As a concept, asymmetric information between the firm and the financial markets is subjective, and thus accurate measures are practically impossible to construct. Nevertheless, financial literature has successfully created proxies for asymmetric information and their significance and reliability have been reported in several studies (see e.g. Drobetz et al., 2010; Autore and Kovacs, 2010). All the proxies used in the thesis follow the ones already tested in financial literature.

Finally, the implications for the valuation of cash with and without information asymmetry are subject to the statistical estimation capability of the valuation model. The regression introduced by Fama and French (1998), presented in Journal of Finance, has been widely

applied in financial literature particularly for the purpose of valuing cash holdings since (e.g. Drobetz et al., 2010; Dittmar and Mahr-Smith, 2007; Pinkowitz et al., 2006). The model includes several firm-specific control variables and has been modified by following research by adding variables that measure the contribution of certain firm characteristics, such as information asymmetry.

1.3. Structure of the study

My thesis begins by reviewing the relevant academic literature. I introduce the financial theories that are fundamental for the topic of this thesis and also review the empirical results of earlier research.

Based on the theory, I state the hypotheses that form the basis of the empirical tests in section 3. In section 4 I go through the applied methodology: First, I show how and which proxies I use to measure the degree of firm-specific information asymmetry. After that, I introduce the valuation model that is used to estimate the value of cash as such and in connection with asymmetric information. The section also discusses the research setting and statistical issues.

Data and descriptive statistics of the sample are shown and analyzed in Section 5. In section 6 I present the results of my empirical tests and do a comparison with previous research. Conclusions and avenues for future research are presented in section 7.

2. RELEVANT THEORIES AND LITERATURE

In this section I review the relevant theories. I start by introducing the agency theory and the free cash flow problem. Then I go through the implications of asymmetric information, which leads us to the pecking order theory and the concept of financial slack. As mentioned in the introduction, financial slack and the free cash flow form the two competing hypotheses. In order to compare these two theories from a broader theoretical perspective, I also review other motives for a firm to hold cash. Finally, I report the findings earlier research has made on the valuation cash.

2.1. Agency costs and free cash flow

Jensen and Meckling (1976) define agency relationship as a contract under which a principal engages an agent to perform services on her behalf. If we assume that both parties are utility maximizers, it becomes obvious that the interests of the principal and the agent are not always aligned. Because the contract involves delegating some decision-making authority to the agent, agency costs arise from attempts to decrease the divergence between interests. First, the principal can limit divergences from his interests by establishing incentives for the agent to act according to his preferences. Similarly, by *monitoring* the principal can limit the agent to take unwanted actions that might harm her. Secondly, the agent can incur *bonding* costs by guaranteeing that she will not take certain actions. In spite of these restricting means, the divergence between the interests of the two parties will remain in most cases. The result is a reduction in the welfare of the principal, *the residual loss*, which is also a cost of the agency relationship.

More recently, Eisenhardt (1989) presents a view of the agency theory with slightly different definitions. He suggests that there are mainly two problems that arise from the agency relationship. For joint-stock corporations, whose governance is a typical example of separation of ownership and control his view incisively summarizes the problem, consisting of

1) *Goal congruence* problem, which consists of the conflicting objectives between the agent and the principal, and of the principal's troubles in confirming the true actions of the agent.

2) *Risk sharing*, which arises from the differing risk taking preferences of the principal and the agent.

The argument by Jensen (1986) is that managers are tempted to waste the excess cash in a way that destroys the value of the firm i.e. the welfare of stockholders. Managers are likely to act this way because of the different utility maximization functions. They might overinvest in order to pursue abnormally high growth since they gain from more power and non-pecuniary benefits. Together with the increasing size of the firm managers' compensation increases and they might receive more prestige (Dyck and Zingales, 2004). On the other hand, because of the separation of ownership and control managers do not fully bear the cost from a bad investment like the shareholders do. In essence, the problem comes down to motivating managers to forgo the excess cash and pay it out to shareholders as dividends instead of wastefully retaining it.

Jensen (1986) defines free cash flow as the excess cash that is needed to fund all projects with positive net present value. In other words, the conflicts of interest between the managers and shareholders are especially severe when a firm has or is producing a substantive amount of cash, has no investment opportunities available, and when the asymmetry of information is high. The above-mentioned firm specific variables are utilized in my research setting in order to spot the potential free cash flow problem.

2.2. Information asymmetry

Asymmetric information between market participants arises when they do not share the same amount of information. The case of particular interest in finance is a transaction in which one party has better information than the other. Information asymmetry in an economical setting was first examined by Akerlof (1970). His example from a used cars' market has become a classical reference for the problems arising from asymmetric information.

The assumption by Akerlof (1970) is that there are only two types of cars in the market, good cars and bad cars, which are called lemons. Information about the quality of a car can be collected through time. Thus, the estimate for the probability q of a car being a good one becomes more accurate when a buyer of a new car has owned it for some time. The problem is that the buyer of a used car does not know whether a car is good or bad. The seller on the

other hand, has superior information about the quality of the car. It follows that a good car has to sell for the same price as a bad car because it is impossible for the buyer to tell the difference. She only wants to pay the price corresponding to the average quality of a car.

What follows from the information asymmetry between buyers and sellers is *adverse selection problem*. The sellers of lemons are better off since they gain the difference between the true price of a bad car and the average price. In the opposite, the sellers of good cars lose because they get the average price, which is lower than the true price of a good car. Consequently, only bad cars are offered in the market. Akerlof (1970) also argues that therefore the average quality of goods and the size of the market tend to go down.

1.1.1. Financing hierarchy

Financing hierarchy and the pecking order theory are covered in this section. Although the pecking order as such is not the focus of this study, the theory is reviewed in order to completely understand the factors affecting the valuation of financial slack.

The model by Akerlof (1970) has been extended to cover different markets, including the financial markets. Most relevant for the topic of this thesis is the relationship between the firm and its shareholders, because most of the valuation sensitive factors are based on the information held by the investors. Myers and Majluf (1984) apply Akerlof's model to study the effects of asymmetric information when a firm raises capital to finance a new investment. Their model suggests the *pecking order theory*, according to which firms will initially prefer internal funds over debt, and debt over equity in order to minimize adverse selection costs.

Internal financing i.e. retained earnings or cash, is the first choice of financing because it is not annoyed by asymmetric information and is thus frictionless. In case internal financing is not available and the private information held by managers (which they do hold given asymmetric information) is favorable, the firm is better off when issuing securities that are least affected when the private information is disclosed to the markets, i.e. debt. On the other hand, when the private information held by managers is unfavorable, the firm is better off issuing equity because it is riskier than debt. Therefore, the asymmetry of information between well-informed managers and the less-informed equity and debt investors leads to firms preferring internal funds over external financing, creating a hierarchy of financing choices. The fact that managers will issue securities when they are overpriced results in a

discount in the price the investors are willing to pay for the securities, since they are aware of the managers' incentive. To avoid the potential underinvestment problem that occurs, firms prefer using internal funds to avoid informational problems in the first place.

Leary and Roberts (2010) note that the pecking order behavior might as well be a consequence of other economic factors, such as agency costs and taxes. Still, most of the research regarding the pecking order has concentrated in determining the extent to which firms follow the pecking order in their financing decisions. Empirical evidence for the pecking order theory has been rather mixed, however. Support for the theory has been found by Shyam-Sunder and Myers (1999): Their view is that the pecking order offers as an "excellent first-order descriptor of corporate financing behavior" as they show that a significant fraction of mature firms' financing deficits are financed with debt.

However, the significance of the results by Shyam-Sunder and Myers (1999) is reduced by Frank and Goyal (2003), who, by extending the sample to include smaller firms and by using more recent data, provide evidence violating the pecking order theory. Specifically, firms appear to issue more equity relative to debt. Fama and French (2005) present similar results as they discover an interesting, increasing trend in net equity issuance. Of their sample firms between 1973 and 1982, 54% make net equity issuance each year. This amount increases significantly by time, totaling to 72% between 1993 and 2002. Gross issuance of equity is found to be even higher, the fraction being 86% in the last sub-period. The results indicate that there are ways to issue equity with low transaction costs and minor asymmetric information, which contradicts with the assumptions of the pecking order.

Very recently, Autore and Kovacs (2010) present interesting evidence on the interrelation of information asymmetry and equity issues. They study the relative change in the level of information asymmetry and find that firms that have narrowed the information gap (from being at high levels in recent past) are more likely to issue equity than debt. The authors argue that this results from the firms being prone to adverse selection and thus they have more to gain by issuing equity when possible. The findings can be seen in line with the pecking order. In essence, they imply that the financing hierarchy is a dynamic process; when information asymmetry between shareholders and managers declines, the firm can go up in the hierarchy of financing choices.

Another explanation for the higher equity issuance than suggested by the pecking order, is offered by Lemmon and Zender (2004). They argue that debt capacity concerns prevent firms issuing debt. Thinking of debt capacity concerns, we could argue that they could be mitigated by having financial slack, which itself is a product of the pecking order theory. However, this study does not attempt to take a hold on to the existing pecking order research, but to focus on how cash as a provider of financial slack, and how this liquidity is valued under information asymmetry. I thus intentionally exclude the predictions that the pecking order theory has for financing decisions regarding debt or equity, and investigate financial slack separately. Nevertheless, should financial slack prove to be valuable, it would speak in favor of the pecking order theory.

2.3. Why do firms hold cash?

According to the theorem of perfect capital markets by Modigliani and Miller (1958), the capital structure nor the amount of cash holdings have an effect to value of a firm. Yet, the capital markets in a real world are not perfect and there are opportunity costs, costs related to raising new capital, costs for holding liquid assets and finally, costs related to the agency relationship.

2.3.1. Financial slack

As was discussed in the section concerning financing hierarchy, firms have a tendency to prefer internal funds to debt, and debt to equity. Referred to as the pecking order of financing choices, it originates from the adverse selection costs related to external financing, which in turn is due to asymmetric information between corporate insiders and investors (Myers and Majluf, 1984). In the bottom of the pecking order is cash, which a firm can use as decided. However, the reason why companies don't usually hold large amounts of cash idle in the bank count is opportunity cost. As an alternative for the cash holdings, the company could invest the funds in positive NPV-projects or other types of assets that provide a higher return. As a consequence, a firm must balance between the marginal costs of holding cash and the marginal benefit of investing it.

The fundamental idea of financial slack is that when a firm suffers from a high degree of information asymmetry, the benefits for holding cash exceed the opportunity cost. As Myers

and Majluf (1984) argue, the benefit from holding cash becomes relatively higher since now the firm can avoid raising external finance from the capital markets, which is costly. Thus, the financing hierarchy theory creates a motive for holding cash in spite of the costs when information asymmetry is high. It also follows that in relative terms, financial slack is most valuable for a firm with high growth opportunities, since not being able to raise funds for an investment results in higher opportunity cost.

2.3.2. Agency costs of free cash flow

The agency costs of free cash flow that were discussed earlier also create a motive for holding cash. Rather than being in the shareholders' interest, it is the managers who are willing to hold cash because it allows investing in projects of their choice without the shareholders' approval or debt holders' monitoring (Jensen, 1986). There are several reasons for the managers' willingness to invest in non-profitable projects that have already been discussed. Moreover, managers are unwilling to pay out cash as dividends, since this would restrict their authority regarding their usage, as raising new funds would institute new monitoring.

The bottom line is that if the free cash flow theory holds, cash should be less valuable for firms with a higher degree of information asymmetry.

2.3.3. Other reasons to hold cash

In addition to financial slack and agency costs there are other motives for firms to hold cash, as presented by Bates et al. (2009). The most significant ones that have attracted attention in the literature are discussed in the following in order to give a complete picture of the topic.

The transaction motive for holding cash relates to the costs that arise when a firm converts cash substitutes into cash in order to make payments. Raising funds from the capital markets, liquidating assets and reducing investments or dividends all generate costs for the firm if it runs out of liquid assets. Thus, to avoid costs from frequently raising new funds, a firm is better off by holding a buffer of cash.

The transaction motive seems to relate to financial slack as a motive for holding cash, since they both arise due to costs arising from using other sources of financing. However, the

differentiating factor between the two is asymmetric information and the resulting adverse selection. Transaction motive for holding cash should occur independent of whether a firm suffers from information asymmetry, whereas financial slack should become valuable only in case of asymmetric information. Thereby, I should be able to detect financial slack if cash holdings for firms with higher information asymmetry are more highly valued, controlling for other factors.

The precautionary motive says that a firm should hold cash to be able to survive adverse shocks that might also lead to abnormally high costs when raising external finance (Bates, 2008)

Empirical evidence supporting the precautionary motive mostly has to do with financial constraints and investment opportunities, presented by Opler et al. (1999) and Almeida et al. (2004). They find that firms whose access to capital markets is bad and whose cash flows are riskier hold more cash than their more stable peers. On the other hand, Opler et al. (1999) also suggest that firms with better growth opportunities hold more cash. The reason is that financial distress and adverse shock can be relatively more costly, as these companies would be forced to forgo profitable investments. The precautionary motive can be separated from financial slack because of information asymmetry, similar to the reasoning with the transaction motive.

Of all the motives stating reasons for holding cash, I only examine the agency motive and the financial slack motive, which are relevant from the perspective of information problems.

2.4. Valuation of cash

The traditional view is that cash is considered as having zero NPV and thus, in perfect capital markets the market value of a firm should increase by one dollar given a one-dollar increase in cash. However, this may not be the case in real, imperfect capital markets.

Motivated by the differing theories, Pinkowitz and Williamson (2004) use Fama and French (1998) regression approach in their seminal working paper to examine how investors value cash holdings and which factors affect the valuation. The results reveal interesting insight on how cash is valued. The average valuation clearly supports the traditional view; the estimates

for the value of a marginal dollar ranges from $0.94 to $0.97. When the sample is split according to firm characteristics, a large cross-sectional variation occurs as the estimate range widens from $0.27 to $1.76. The factors mostly affecting the valuation of cash are the growth options for the firm, volatility of its investment opportunities, and the magnitude of stockholder-bondholder conflicts. The findings are basically supportive for both of the views by Myers and Majluf (1984) and Jensen (1986) highlighting the positive valuation effect of growth opportunities and in the opposite, the negative effect of having excess cash, also argued by Harford (1999).

Pinkowitz et al. (2006) focuses on the predictions of agency theory regarding firms' holdings of cash. The implication studied in the paper is that the value of cash holdings is less in countries with poor investor protection because of the greater ability of controlling shareholders to extract private benefits from cash holdings in such countries. This is because investors would discount the value of cash since they expect it is partly wasted as private benefits. It follows that in countries with poor investor protection dividends should be valued at a premium. Empirical tests use the Fama and French (1998) valuation regression modified to recognize cash and non-cash components with various measures of investor protection across countries. Specifically, Pinkowitz et al. (2006) find that a dividend payment equaling 1% of a firm's assets increases firm value by 9,8% in poor investor protection countries (identified as being below the median) and only 4,07% in other countries. Results strongly support both hypotheses, stating that differences in the intensity of agency problems do affect the valuations of firms in different countries.

Dittmar and Mahr-Smith (2007) examine the effect of corporate governance on the value of excess cash and also find that the dollar value is considerably less for a firm with bad corporate governance. The results also show that poorly governed firms dissipate excess cash more quickly on value destroying investments than their well-governed peers. As a conclusion, governance increases firm value by improving the use of cash holdings. Correspondingly, the results indicate that cash policy i.e. how much cash to hold, can in fact matter very little when the firm is well governed.

2.4.1. Value of cash under asymmetric information

The implication from the pecking order theory is that cash creates financial slack when information asymmetry is high. If a firm has sufficient cash holdings, it is able to take positive-NPV investments without the need to issue new capital. Otherwise, the firm may be forced to forgo profitable projects since the negative effects of information asymmetry when raising external financing will wipe away the appreciation in the firm's market value. In theory, raising external funds to finance a new project would be worthwhile only when information asymmetry is extremely low or nonexistent. Thus, the financial slack generated by cash is valuable. This is one of the main implications that are tested in this thesis; a dollar of cash is more valuable for firms with higher information asymmetry. The inference is in contrast with the free cash flow theory, stating that a dollar of cash is less valued for firms with higher information asymmetry.

The valuation of cash and the effect of information asymmetry are very recently studied by Drobetz et al. (2010). Their paper tests the two contradicting hypotheses presented above, the pecking order theory and the free cash flow theory, using an international sample covering 45 countries with different degree of information asymmetry over a time period of 1995 to 2005. Specifically, they measure the marginal value of cash in the presence of firm-specific and time-varying information asymmetry by using an extended version of the Fama and French (1998) valuation regression and proxying information asymmetry with the dispersion of analysts' earnings forecasts and with an index- based measure.

When information asymmetry is left out, the results show that the marginal value of a dollar is approximately one, on average. However, when a firm faces high information asymmetry the value of cash is significantly reduced. Cash being valued less given high information asymmetry supports the free cash flow theory by Jensen (1986), meaning that the costs caused by moral hazard problems exceeds the benefits of financial slack. Similarly, the reduced valuation of cash is evident when comparing developed and emerging markets with lower valuation occurring in the latter one. Drobetz et al. (2010) view this as a sign of worse corporate governance structures and thus also of higher information asymmetry.

Evidence supporting the free cash flow theory in the presence of information asymmetry is also found by Lundstrum (2003). He studies the effect of internal capital market access to a

diversified firm's value by comparing the cash flow per dollar of capital expenditures in excess of that of a portfolio of industry-matched firms. Empirical results show that when information asymmetry is high, the access to internal capital market has no value. This is in line with the predictions of the free cash flow theory; the increasing agency costs destroy the value from possible savings that arise when a firm is not forced to raise funds in the un-informed external capital markets.

However, when information problems are low, Lundstrum (2003) finds that the access to internal capital markets has a positive effect on firm value. The reason for this is not explicitly discussed, but it is most likely due to the increasing efficiency of the capital allocation process. It is to be noted that this might occur also in the presence of information problems, but it seems that capital allocation is more efficient when using internal funds in any case.

Although the results by both Drobetz et al. (2010) and Lundstrum (2003) support the free cash flow theory, clear evidence against the pecking order theory cannot be found as what comes the preference of using internal funds before external financing. As Drobetz et al (2010) argue, it may not be optimal to accumulate cash in order to avoid raising external finance because this precautionary motive is not valued by the shareholders. In contrast, investors seem to think that managers are wasting it in private pet projects.

3. HYPOTHESES

As appears in the literature review, the agency motive and the financial slack motive for holding cash predict a different valuation for cash when information problems are present. In this section, I summarize the predictions and state the hypotheses that are tested in the empirical section of this thesis.

Financial slack is valuable for a firm that suffers from high information asymmetry. Because of the adverse selection problem that arises when the firm raises external finance, cash becomes relatively more valuable because it allows the firm to undertake new investments with a lower cost of capital and also to survive in case of a sudden need of liquidity. Thus, the value investors place for cash is higher than the replacement cost for each unit of cash. The first hypothesis is:

H1: Valuation of cash is higher for firms with high information asymmetry (asymmetric information theory).

In contrast, lower valuation of cash under information asymmetry results from the shareholders' inability to restrain self-serving managers. Value-destroying behavior is attempted to limit by corporate governance mechanisms and incentives that align the distinctive interests. In spite of this, Drobetz et al. (2010) argue that the higher the information asymmetry, the more difficult it is for the outsiders to recognize value-destroying behavior and investments from value-increasing investments, for instance. It follows that the difference in the level of cash holdings required for meeting daily liabilities and buffering for unusual situations (which are discussed further below), and the excess part which is due to managerial discretion, may not be obvious to determine. Therefore, a dollar of cash may not be given a value of one dollar, as shareholders discount the agency costs of free cash flow when information asymmetry is high. Formally, the second hypothesis is:

H2: Valuation of cash is lower for firms with high information asymmetry (agency cost theory).

The previous literature brings forth the effect of growth opportunities in the valuation of cash. For example, Pinkowitz and Williamson (2004) report that growth options of the firm and

volatility of its investment opportunities are the factors mostly affecting the valuation of cash. Opler et al. (1999) argues that firms with better growth opportunities hold more cash. The reasoning for the argument that the valuation of cash for a firm increases with high growth opportunities and high information asymmetry can be found from the predictions of the financial slack- motive; the increased liquidity allows the firm to undertake more positive-NPV projects. Faulkender and Wang (2006) present similar argument based on their research on financial constrained firms, although they do not test it empirically.

On the other hand, low growth opportunities increase the exposure of the firm to agency costs of free cash flow (Opler et al., 1999 and Stulz, 1990). The value placed on cash of a firm in this situation should be less than for a similar firm with good growth opportunities, because the likelihood of having agency costs that destroy firm value increases. Thus, by splitting my sample according to the growth opportunities of a firm I expect to find further evidence for the two hypotheses above. The logic is that under high information asymmetry, support for the financial slack- hypothesis is found if the valuation of cash increases for firms with high growth opportunities. In the opposite, free cash flow- hypothesis is supported if firms with low growth opportunities are associated with lower valuation of cash.

H3: Under information asymmetry, valuation of cash is higher for firms with higher growth opportunities (asymmetric information theory).

H4: Under information asymmetry, valuation of cash is lower for firms with lower growth opportunities (agency cost theory).

4. METHODOLOGY

This section describes the methodology used in this thesis. I start by showing how the degree of firm-specific information asymmetry is calculated. Then, I introduce the regression model and motivate the use of specific control variables. Interpretation of the model and statistical issues are also discussed.

4.1. Measuring information asymmetry

In order to measure information asymmetry at firm level I follow the approaches introduced in the previous literature. I combine 4 separate proxies for asymmetric information and construct an index to use all the information provided by the different measures, similar to Drobetz et al. (2010). My first two measures relate to analysts' earnings forecasts and are defined by Drobetz et al (2010) as the *forecast error* and the *dispersion in analysts' forecasts*.

Forecast error is calculated as the absolute error between the consensus forecast i.e. the mean of all forecasted earnings per share and the actual earnings per share. The value of the error is normalized by the median forecast in order to get comparability across firms (see Equation 1). The actual earnings per share are for the full fiscal year and the mean forecasts are taken as of November in the previous year. Large forecast error indicates high information asymmetry, as it depicts the inconsistency of information between managers and the financial markets. In the opposite, with consistent information the market is able to give more accurate forecasts for future earnings.

The *dispersion in analysts' forecasts* is defined as the standard deviation of all available forecasts for full year earnings per share, also taken as of November in the previous year and normalized by median forecast (Equation 2). To further enhance comparability of the measure, dispersion is converged to normal distribution by adding one (1) and taking the natural logarithm. According to Krishnaswami and Subramaniam (1999), the forecast dispersion is an indication of the level of disagreement between analysts' and thus, information asymmetry for a given firm. Exact formulas for the forecast error and forecast dispersion are given below.

It is to be noted though, that the specification of the forecast dispersion by Drobetz et al. (2010) differs from the one used in this thesis in terms of the time window within the forecasts are measured, as they use the monthly average dispersions in each year. However, extracting the forecasts for those months, which the data is available was not possible in this case. On the other hand, Drobetz et al. (2010) note regarding the forecast error that the forecasts in the last month of the fiscal year are not affected by industry or economy-wide factors, but are only driven by misestimation of firm-specific factors and thus act as a suitable proxy. Similarly, using forecasts from the last month of the fiscal year for calculating the dispersion should produce reliable proxies as well. Due to these arguments I use forecasts from the latest month of the year, which is November. I further rationalize this approach along with the previous argument; using forecasts from the end of the fiscal year sets different firms to a consistent starting line, as the likelihood that most value-relevant information regarding a specific firm has been published, increases.

To present criticism, one could consider that forecast error and dispersion are rather measures of risk as they can be a result of earnings volatility. However, Diether et al. (2002) argue that dispersion brings forward the differences of opinion, as they find a negative relation between stock returns and the dispersion in analysts' forecasts and the preceding stock returns. D'Mello and Ferris (2000) and Autore and Kovacs (2010) also present evidence supporting the suitability of the dispersion as a proxy. The former observe that firms with higher dispersion experience stronger announcement effects. The latter in turn, find that firms' willingness to raise external finance is negatively related to the dispersion in analysts' forecasts, thus suggesting asymmetric information.

In addition to the forecast- based proxies, Drobetz et al. (2010) use the following variables: firm size, R&D expenditure Tobin's Q, and the number of analysts following a firm. Of these measures, I only include *firm size* and the *number of analysts' following the firm* in my information asymmetry- index and leave out R&D expenditure and Tobin's Q. My argument is that since R&D expenditure is an independent variable of the valuation model applied in this study, using it also as measure for information would result in regressing the same variable twice. Tobin's Q could cause endogeneity problems as my intention is to do sample splits based on Tobin'n Q.

Firm size is used to proxy for asymmetric information because the sophistication of disclosure policy and the attention received by the markets tend to increase with the size of the firm, measured here by total assets. Thus, the smaller the firm the larger the information asymmetry is likely to be (Drobetz et al., 2010; Frank and Goyal, 2003). Similarly, the number of analysts following the firm is related to the amount of information available to market participants. Information asymmetry is larger for firms with limited analyst coverage (Drobetz et al., 2006; Chang et al., 2006)

However, both Drobetz et al. (2010) and Krishnaswami and Subramaniam (1999) note that the discussed variables may be correlated to some extent but on the other hand, each of them contains unique information. Whereas Autore and Kovacs (2010) and Drobetz et al. (2010) use the discussed proxies separately alongside an index, I only use an index to exploit all information provided by the different proxies. Furthermore, by using several proxies simultaneously I can avoid possible distortion or inconsistency within one proxy, and I am able to incorporate it to the valuation regression as a single variable. Based on these arguments, my measure of information asymmetry is an *information asymmetry –index* (hereafter *IAI*). The index consists of the four discussed proxies that previous literature has found to be related to asymmetric information and for which there is data available:

1. Error in analysts' forecasts

$$= \ln\left(1 + \frac{\left|EPS_{Consensus} - EPS_{Actual}\right|}{\left|EPS_{Median}\right|}\right) \tag{1}$$

2. Dispersion in analysts' forecasts

$$= \ln\left(1 + \frac{EPS_{Std.\ dev.}}{\left|EPS_{Median}\right|}\right) \tag{2}$$

3. Firm size

   Measured by total assets, A_t.

4. Number of analysts' following the firm

   Measured as the number of buy/hold/sell recommendations given by different analysts.

To construct the index I first calculate every firm's quartile ranking for each proxy of information asymmetry for each year. Maximum (minimum) score for one proxy is thus 4 (1) with a higher score indicating higher information asymmetry. By adding the scores for all measures the total maximum score for the index totals 16 (4). Descriptive statistics of the index are shown in Table 3.

4.2. The valuation model

My methodology in estimating the value of cash applies the valuation regression originally introduced by Fama and French (1998). The model has been used in several studies examining the valuation of cash in different contexts; in connection with asymmetric information (Drobetz et al., 2010) and in connection with corporate governance (Pinkowitz et al., 2006; Dittmar and Mahr-Smith, 2007). Initial purpose of the model was to study how firm valuation relates to dividends, debt and the taxation of these two.

The Fama and French (1998) valuation regression incorporates a comprehensive set of control variables for earnings, dividends, debt and investment with past, current and future changes. Spread of value over cost is used as the dependent variable. With this specification, the authors argue that the model captures relevant information about expected net cash flows and provides a view on how the value of a firm is compounded. The model "gives a striking picture of the richness of the information about value in investment and financing decisions" (Fama and French, 1998). Compared to event studies, the valuation regression focus on longer-term effects in value-relevant factors, as it takes into account two-year changes in the variables. This allows examining the effects of the firm's known financing strategies over time, instead of a snapshot approach with looking at an event and the following reaction. Thereby, it seems that the model fits well into the context of studying motives behind internal financing i.e. cash.

When applying the model in the valuation of cash, previous research has modified the original specification by adding variables. I follow the version used by Pinkowitz et al. (2006). It builds on the pooled ordinary least squares- regression, for which the general form can be written as:

$$Y_{i,t} = \beta X_{i,t} + u_{i,t}, \tag{3}$$

where Y is the observation on the dependent variable for cross-sectional unit i in period t, X is a $1 \times k$ vector of independent variables observed for unit i in period t, β is a $k \times 1$ vector of parameters (coefficient), and u an error term specific to unit i in period t (Cottrell and Lucchetti, 2010).

The Fama and French (1998) valuation regression as modified by Pinkowitz et al. (2006):

$$V_{i,t} = \alpha + \beta_1 E_{i,t} + \beta_2 dE_{i,t} + \beta_3 dE_{i,t+1} + \beta_4 dNA_{i,t} + \beta_5 dNA_{i,t+1} + \beta_6 RD_{i,}t + \beta_7 dRD_{i,t} + \beta_8 dRD_{i,t+1} + \beta_9 I_{i,t} + \beta_{10} dI_{i,t} + \beta_{11} dI_{i,t+1} + \beta_{12} D_{i,t} + \beta_{13} dD_{i,t} + \beta_{14} dD_{i,t+1} + \beta_{15} dV_{i,t+1} + \beta_{16} C_{i,t} + \varepsilon_t, \tag{4}$$

where V is the market value of the firm, E is earnings, NA is net assets, RD is research and development expenditure, I is interest expense, D is dividends, and C is cash holdings. dX_t denotes for past one-year change in variable X, and dX_{t+1} is the future one-year change. I use model (4) in order to find a benchmark valuation for cash without assuming information asymmetry.

For the purpose of measuring the effect of firm-specific and time-varying information asymmetry, Drobetz et al. (2010) include an additional interaction term, calculated by multiplying cash holdings with the measure of information asymmetry. The measure itself is included as a separate explanatory variable to control for the direct influence of information asymmetry on firm value. Interaction terms were also applied by Dittmar and Mahr-Smith (2007) but in connection with corporate governance. As described in the earlier section, my measure for information asymmetry is an index, *IAI*, which I include in the model as an interaction term as well as a separate control variable. The resulting regression is the model used in this thesis to value cash under asymmetric information:

$$V_{i,t} = \alpha + \beta_1 E_{i,t} + \beta_2 dE_{i,t} + \beta_3 dE_{i,t+1} + \beta_4 dNA_{i,t} + \beta_5 dNA_{i,t+1} + \beta_6 RD_{i,}t + \beta_7 dRD_{i,t} + \beta_8 dRD_{i,t+1} + \beta_9 I_{i,t} + \beta_{10} dI_{i,t} + \beta_{11} dI_{i,t+1} + \beta_{12} D_{i,t} + \beta_{13} dD_{i,t} + \beta_{14} dD_{i,t+1} + \beta_{15} dV_{i,t+1} + \beta_{16} C_{i,t} + \beta_{17} (C_{i,t} \, x \, IAI)_{i,t} + \beta_{18} IAI_{i,t} + \varepsilon i_{,t}, \quad (5)$$

In the following I go through the specific definition of each variable and its contribution from the valuation perspective as presented by Fama and French (1998).

$\boldsymbol{V_{i,t}}$ is the market value of the firm as the total of market value of equity and book value of debt. As a dependent variable and scaled by total assets, it represents the value over cost. Value over cost is also included as a control variable with one-year past and future changes.

$\boldsymbol{E_{i,t}}$ is earnings before interest and taxes. The variable controls for the effect that profits have on expected net cash flows.

$\boldsymbol{NA_{i,t}}$ is total assets less cash and liquid asset holdings. Net assets are included to control for the investment component of expected net cash flows. Pinkowitz (2006) introduce net assets as a control variable instead of total assets as in the original Fama and French (1998) specification because of the intention to value cash holdings. Thus my model also defines net assets and includes cash and liquid asset holdings as a separate variable (see below).

$\boldsymbol{RD_{i,t}}$ is research and development expenditure, set zero if missing. R&D are included because they may contain information not adopted by the earnings variables. Furthermore, specific accounting practices regarding R&D may cause under or overstatement of assets.

$\boldsymbol{I_{i,t}}$ is interest expense, controlling for how interest payments affect financing decisions and indicating the cost and proportion of debt financing. Scaled by total assets, it proxies for leverage policy.

$\boldsymbol{Di_{,t}}$ is common dividends paid. Dividends are said depict future net cash flows apart from earnings information and also indicate the cost of equity financing. Scaled by total assets, it proxies for dividend policy (Fama and French, 1998).

$\boldsymbol{C_t}$ is cash and liquid asset holdings.

$\boldsymbol{IAI_{i,t}}$ is the score for the information asymmetry index for a firm. *IAI* is included as a separate

variable to control the direct effect of asymmetric information on the firm value.

$\boldsymbol{(C \times IAI)_{i,t}}$ is the interaction term, calculated by multiplying the level of cash by information asymmetry- index. Drobetz et al. (2010) argue that such interaction term measures the dynamic effect of information asymmetry on the value of cash.

$\boldsymbol{dX_t} = X_t - X_{t-1}$ denotes the past 1-year change of variable X_t,

$\boldsymbol{dX_{t+1}} = X_{t+1} - X_t$ is the future 1-year change of variable X_t.

i*,** is a firm and ***t is the current year.

To reach comparability across firms and to control for heteroscedasticity, all variables are scaled by total assets. Net assets for year *t* is excluded since the ratio to total assets would not provide additional information as cash and liquid asset holdings (the difference between net and total assets) are already in the regression as an independent variable. Rationale for having the change-variables in the regression is presented by Fama and French (1998); the past one-year change is for estimating the immediate contribution of an increase/decrease to the valuation. Future one-year changes in turn, are meant for absorbing changes in expectations.

Finally, dummy variables DV_t are included in the model for each time period. Given the pooled time-series structure of the regression, the purpose of time dummies is to improve the fit of the model as they allow the intercept to differ across periods.

4.2.1. Interpreting the coefficients

In the first stage I estimate the value by running the regression without assuming asymmetric information i.e. excluding coefficients β_{17} and β_{18} (Equation 4). Hence, the coefficient of most interest is β_{16}. Assuming that the model accounts for the market's expectations and thus the changes in future net cash flows, the coefficient for cash holdings is an estimate of the market value of a marginal dollar of cash. Therefore, given that the valuation regression reflects all value- relevant information and assuming all rational markets, the value of a marginal dollar of cash estimated hereby should equal one (1).

Secondly, I run the regression under asymmetric information with all the introduced control variables. The coefficient under inspection is the interaction variable, β_{17}, which measures the

market value of a marginal dollar of cash in connection with firm-specific information asymmetry. Positive value for the coefficient would indicate that under asymmetric information, cash is more valuable than in case of perfect information, supporting the financial slack- hypothesis. In the opposite, negative value would support the free cash flow-hypothesis, as cash would be valued less under asymmetric information.

4.3. Supporting methodology

Drobetz et al. (2010) use two alternative methods in running their regressions: the fixed effects model with robust standard errors and the Fama-Macbeth method, whereas Pinkowitz et al. (2006) only use the Fama-Macbeth. However, my thesis takes another direction by comparing the fixed effects ordinary least squares (OLS) regression with the random effects generalized least squares- regression (GLS). According to the Gauss-Markov theorem, OLS is the best linear unbiased estimator given the condition that the error term is independently distributed. However, this condition is not very likely to be met with a large panel data and in that case GLS may produce better estimates. (Cottrell and Lucchetti, 2010).

Using the fixed effects estimator, it is assumed that the individual specific effect of each entity may be correlated with the independent variables. The random effects assumption is the opposite; it is presumed that individual specific effects are uncorrelated with the independent variables. The random effects model produces more efficient estimators and should be preferred over the fixed effects if the underlying assumption holds. In contrast, if the assumption of uncorrelated individual effects fails, fixed effects would be valid while random effects would be inconsistent.

The nature of my data set, consisting of a relatively large number of cross-sectional units and having a panel structure, is favoring the random effects model. Therefore I use the random effects model in parallel with the fixed effects. For the purpose of evaluating the consistency of the two models, I perform the *F-test* and the *Hausman test*. The F-test for the fixed effects model experiments a null hypothesis that the cross-sectional units all have a common intercept. More specifically, it tests whether all α_i*:s* are equal in the fixed effects model that can be written as:

$$y_{it} = X_{it}\beta + \alpha_i + \varepsilon_{it} \qquad (6)$$

where y_{it} is the observation on the dependent variable for cross-sectional unit i in period t, X_{it} is a 1 x k vector of independent variables, β is a 1 x k vector of parameters, α is a unit-specific and time-invariant component of the error term and ε_{it} an observation-specific error term for unit i in period t. If the hypothesis is true, the pooled OLS produc (Hausman, 1978)es sufficient estimates. If the null is rejected, the random effects model may be a more efficient estimator (Cottrell and Lucchetti, 2010). Fixed effects is estimated using robust standard errors, which means robustness against heteroscedasticity. Unfortunately, the current version of Gretl does not offer this option for the pooled random effects.

The Hausman test experiments the null hypothesis that the random effects estimates are consistent (Hausman, 1978). Rejecting the null hypothesis indicates that random effects are biased and that fixed effects model should be used instead. The Hausman test is based on a variable H that follows chi-square distribution with degrees of freedom equaling the number of time-varying independent variables of the regression. H measures the distance between the estimates provided by the fixed effects and the random effects estimates, and a large H would indicate that random effects is not consistent. H is computed via the ”regression method” as presented in the following (Cottrell and Lucchetti, 2010):

$$H = n\,(SSR_r - SSR_u) / SSR_u\,, \tag{7}$$

where SSR_r is the sum of squared residuals of the random effects- model, SSR_u is the sum of squared residuals of the fixed effects- model and n is the total number of observations used.

H can also be computed with the matrix-difference but with finite samples there is a potential problem that H may be given a negative value, which is not admissible under the chi-square distribution. Gretl calculates H with the regression method to avoid the problem. For further details of the two statistical tests, see Cottrell and Lucchetti (2010).

4.4. Sample splits

As a robustness check, Drobetz et al. (2010) repeat statistical tests with a measure for excess cash. At the same time, they note that calculating the excess cash goes against the assumption of the pecking order theory, since it assumes that optimal level of cash exist. Excess cash refers more to the free cash flow theory, which makes it difficult to separate between the two opposing hypotheses. Because of this reasoning, I do not incorporate excess cash.

In order to find more verification for the opposing theories and to extend the research on information asymmetry, I examine the effect of investment opportunities more closely. I do this by splitting the sample according to investment opportunities of the firm. As discussed in the hypotheses- section, this could collaborate in differentiating between the two opposing theories. As a proxy for investment opportunities I use the common market-to-book ratio. Penman (1996) argues the appropriateness of this proxy when indicating earnings growth and investment opportunities. Regardless of the fact that firm specific market-to-book ratio might be affected by firm's financing constraints and the actual capitalization probability of the investment opportunities, it is commonly used in literature (e.g. Pinkowitz et al., 2006; Opler et al., 1999).

Market-to-book is measured as the market value of equity divided by book value of equity, both measured at the end of the previous fiscal year. I divide the sample into high and low-investment opportunity groups by using the median market-to-book. Interpretation is similar with the results for the full sample. As laid out in the hypotheses, if valuation of cash under asymmetric information for high growth opportunity is higher, it supports financial slack. And again, should the value of cash be lower for low growth opportunity firms as compared to the whole sample, the free cash flow- theory would be supported.

5. DATA AND SUMMARY STATISTICS

Given the fact that the Fama and French (1998) valuation regression specifies several variables, completing the study requires a comprehensive data set. Because of this, I use data from US companies due to the good availability of data. My dataset covers companies listed in the New York Stock Exchange between 1999 and 2009. However, as the valuation model includes time-varying variables that measure both the past one-year change and the one-year future change, my 11-year data set allows a time-series regression for 9 years. The firm-level data is entirely accessed through Thomson One Banker: Financial statement items used in the valuation regression come from the Worldscope- database, whereas the data items for the forecast data for the information asymmetry- index data are from I/B/E/S- database.

5.1. Data processing

The set of companies listed in The New York Stock Exchange between 1999 and 2009 has to be processed and trimmed in order to run the regressions. First of all, I exclude all financial firms and utility companies (ICB codes 7000- and 8000-) due to the regulative nature of the business that affects profitability and leverage. This is a very standard step in financial research of this type. Secondly, I require that all firms in the sample must have a fiscal year ending on 31 December. Otherwise, matching earnings forecasts for respective actual earnings for the *IAI* and calculating the change variables would be cumbersome.

These exclusions result in 815 cross-sectional observations (number of firms) that have data available during the whole time period of 11 years, before considering data limitations. The data is not as wide-ranging as it ideally could be and as a result, the quality of the data and especially the frequency of observations decrease as we go further back in time. Since firms with missing observations have to be skipped in the regression, the number of firm years in my time-series regressions varies when adding variables and doing sample splits. Pinkowitz et al. (2006) note that the Worldscope data is biased towards large firms as they provide the most comprehensive time-series data. In addition, taking into account that my sample only includes firms having been listed in NYSE for 11 years, there is reason to suspect survivorship bias. In spite of this, Worldscope data is broadly used in financial studies and

hence in my thesis. I trim all variables at the 1% and 99% tails, similar to Drobetz et al (2010). Trimming is necessary to remove outliers in both ends.

5.2. Summary statistics of regression variables

Descriptive statistics of the sample are shown in Table 1.

Table 1: Summary statistics for the sample 2000-2008

This table presents the summary statistics i.e. the mean, median, first (25%) and third (75%) quartile and standard deviation, for the variables used in the main valuation regression (3). The sample consists of annual observations for 815 cross-sectional units (firms) over 9 years. All variables are trimmed at the 1% and 99% tails. V_t is the total market value of the firm as the sum of market value of equity and book value of debt. E_t is earnings before interest and taxes. NA_t is net assets (total assets less cash and liquid asset holdings). RD_t is research and development expenditure. I_t is interest expense. D_t is common dividends paid. C_t is cash and liquid asset holdings. All variables are scaled by total assets, A_t. Missing observations are skipped and n represents the number of valid observations.

Variable	n	Mean	Median	1Q	3Q	Std. Dev
$V_{i,t}$	6049	2.108	1.181	0.870	1.720	10.336
$E_{i,t}$	6495	0.122	0.087	0.043	0.135	0.694
$dE_{i,t}$	6333	0.010	0.008	-0.022	0.039	0.333
$dE_{i,t+1}$	6460	0.076	0.007	-0.030	0.047	1.280
$dNA_{i,t}$	6224	0.020	0.018	-0.106	0.144	0.281
$dNA_{i,t+1}$	6411	1.012	-0.003	-0.125	0.173	12.913
$RD_{i,t}$	7187	0.011	0.000	0.000	0.008	0.033
$dRD_{i,t}$	7187	0.001	0.000	0.000	0.000	0.011
$dRD_{i,t+1}$	7187	0.022	0.000	0.000	0.000	1.106
$I_{i,t}$	6502	0.021	0.016	0.008	0.027	0.024
$dI_{i,t}$	6334	0.000	0.000	-0.003	0.003	0.018
$dI_{i,t+1}$	6452	11.127	0.000	-0.004	0.008	74.200
$D_{i,t}$	6457	0.033	0.004	0.000	0.017	0.335
$dD_{i,t}$	6314	0.003	0.000	0.000	0.001	0.091
$dD_{i,t+1}$	6430	0.019	0.000	0.000	0.002	0.322
$dV_{i,t+1}$	6038	1.631	0.003	-0.257	0.338	22.700
$C_{i,t}$	6445	0.136	0.062	0.021	0.164	0.263
$A_{i,t}$	6598	5821.100	1361.500	490.560	4120.330	1684.700

To start with, deviation within observations is relatively high for three specific variables also after removing outliers by trimming at the 1% and 99% tails; $V_{i,t}$, $dV_{i,t+1}$ and $dI_{i,t+1}$. As seen from Table 1, despite the trimming the mean is still significantly higher for $V_{i,t}$ than the

median, and the standard deviation is quite large. In fact, similar pattern, or skewness in distribution is evident for all variables but in a lesser degree. Large variance and the skewness of variables are present also in the sample of Drobetz et al. (2010).

Note that the median, 1st and 3rd quartiles for current and changes in R&D variable are zeros. This is because of the variable specification, which sets RD_t to zero when no R&D expenditure is reported and when missing. If values are missing for any other variable, it is skipped in the summary statistic calculations and in the regressions.

Looking at the earnings variables, $E_{i,t}$, we can see that the profitability has been quite high for the sample companies, median profitability being 8.7%. This can also be a result of survivorship bias, which is a potential issue given the sample selection criteria of companies being listed in NYSE for 10 years. Nevertheless, mean and median for both of the change variables are positive implying that profitability in average has improved during my sample period. This is generally in line with Drobetz et al. (2010) and Pinkowitz and Williamson (2004), only that my sample implies higher profitability and growth. Recalling that Drobetz et al. (2010) use an international sample, we may think that US firms have performed better. Another explanation can be found from differing time periods, as they cover years 1995 to 2005 and we know that 2005-2008 (included in my sample) were years of substantial profit for many firms.

Only negative observation in average figures is the future 1-year change in net assets, $NA_{i,t+1}$, that can be interpreted that the share of liquid assets in balance sheet have increased more than other assets. The perception is analogical with the observed trend of increased cash and liquid asset holdings discussed in section 1. Dittmar and Mahr-Smith (2007) also report clear increase in cash holdings over their sample period of 1990-2003.

Statistics for the cash and liquid asset holdings to total assets- ratio are very close to those reported by Drobetz et al. (2010), mean and median being 0.136 and 0.062 versus 0.126 and 0.073 respectively. Both samples seem to be skewed, but standard deviation appears to be higher in my sample. Similar levels are also shown by the sample of Dittmar and Mahr-Smith (2007), the median being 0.06. Interestingly, their mean value is clearly higher, 0.22, indicating significant skewness.

Table 2: Correlation matrix of variables

The correlations between all varibles used in the main valuation regression are shown here. The sample consists of annual observations for 815 cross-sectional units (firms) over 9 years. All variables are trimmed at the 1% and 99% tails. Vt is the total market value of the firm as the sum of market value of equity and book value of debt. Et is earnings before interest and taxes. NAt is net assets (total assets less cash and liquid asset holdings). RDt is research and development expenditure. It is interest expense. Dt is common dividends paid. Ct is cash and liquid asset holdings. All variables are scaled by total assets, At. Missing obervations are skipped.

Variable	$V_{i,t}$	$E_{i,t}$	$dE_{i,t}$	$dE_{i,t+1}$	$dNA_{i,t}$	$dNA_{i,t+1}$	$RD_{i,t}$	$dRD_{i,t}$	$dRD_{i,t+1}$	$I_{i,t}$	$dI_{i,t}$	$dI_{i,t+1}$	$D_{i,t}$	$dD_{i,t}$	$dD_{i,t+1}$	$dV_{i,t+1}$	$C_{i,t}$
$V_{i,t}$	1.000	0.787	0.061	0.026	-0.021	0.015	0.060	0.063	0.001	-0.100	-0.004	-0.200	0.817	0.420	0.022	0.056	0.156
$E_{i,t}$		1.000	0.329	-0.011	0.029	0.000	-0.069	-0.061	-0.032	-0.134	-0.055	-0.007	0.742	0.276	0.243	-0.015	0.076
$dE_{i,t}$			1.000	0.015	0.073	0.036	-0.035	-0.054	0.016	-0.092	-0.114	-0.002	0.240	0.357	0.003	0.207	0.029
$dE_{i,t+1}$				1.000	-0.091	0.058	-0.001	0.023	0.235	-0.084	-0.164	-0.012	0.059	0.028	0.054	0.632	0.021
$dNA_{i,t}$					1.000	0.013	-0.033	0.109	-0.019	-0.127	0.207	0.008	-0.022	0.017	0.004	-0.001	-0.025
$dNA_{i,t+1}$						1.000	0.010	0.020	0.028	-0.027	0.002	0.004	0.240	-0.051	0.557	0.903	0.054
$RD_{i,t}$							1.000	0.485	-0.002	-0.085	-0.025	-0.020	-0.018	-0.010	-0.003	0.017	0.118
$dRD_{i,t}$								1.000	-0.002	-0.014	0.032	-0.015	-0.003	0.008	0.015	0.021	0.060
$dRD_{i,t+1}$									1.000	-0.019	-0.007	0.006	0.001	0.001	0.013	0.436	0.025
$I_{i,t}$										1.000	0.403	0.028	-0.044	-0.013	-0.015	-0.030	-0.121
$dI_{i,t}$											1.000	0.003	-0.026	0.000	0.017	-0.043	0.007
$dI_{i,t+1}$												1.000	-0.004	-0.006	-0.012	-0.024	-0.028
$D_{i,t}$													1.000	0.431	0.215	0.049	0.117
$dD_{i,t}$														1.000	-0.075	0.001	0.027
$dD_{i,t+1}$															1.000	0.533	0.025
$dV_{i,t+1}$																1.000	0.043
$C_{i,t}$																	1.000

Correlations between the variables are reported in Table 2. Practically looking, notable correlations occur between some of the cash flow, firm value, earnings and dividend variables. The correlations make sense if we consider how firm value (cash flows), earnings and dividends are related. Therefore, I would argue that correlation of some degree between these specific variables is given and cannot be avoided. The sample of Drobetz et al. (2010) most likely experiences similar correlations, however, they are not reported. I do not expect the correlations between variables to cause statistical issues for the regression results.

5.3. Summary statistics of the information asymmetry- index

The variables used in the calculation of the information asymmetry- index (*IAI*) are summarized in Table 3. As laid out is section 4.1, the *IAI* consists of four proxies; Forecast dispersion, forecast error, number of analysts following the firm, and firm size. The information embedded in these proxies is combined into a single variable by calculating an index. The effect of asymmetric information is then estimated by including the index in the regression as a control variable and as an interaction variable, $C_t \, x \, IAI_t$.

In the following (also when not specifically mentioned) I analyze the summary statistics mainly in comparison with Drobetz et al. (2010), who calculate and utilize similar variables in their study. Note that and their sample includes data from 45 countries in total, including US firms.

To start with, the comparison shows that the magnitude of my measure of forecast dispersion is slightly lower. As seen from Table 3, my median dispersion is 0.021 and mean dispersion is 0.078, whereas the comparable values for US firms are 0.052 and 0.137 respectively. Since the formula for the calculation method is the same, there are two possible explanations for the discrepancy. Firstly, I measure forecasts as of November whereas Drobetz et al. (2010) calculate the monthly averages. Referring to the point made in section 4.1, more information is published towards the year-end and thus the forecasts are more accurate than, say, in February of the same year. Using more accurate forecasts most likely results in smaller dispersion among them. Secondly, the lower values for my sample could be due the use of more up-to-date data. Analysts' capability of giving accurate forecasts may have improved along with the general development of financial markets and the more open and straightforward disclosure policies than ever before. This notion is further supported by the

fact that the standard deviation is also smaller for my sample. Yet, the two explanations are not mutually exclusive and probably both explain why the dispersion measure here is of lower magnitude.

The above conclusion of improved forecasts is slightly weakened when comparing with summary statistics for forecast errors. The mean and median errors for my sample are 0.445 and 0.249, whereas comparables are 0.344 and 0.083 respectively, indicating larger absolute errors for my sample. However, Drobetz et al. (2010) only report the forecast error statistics for all countries, and not separately for US firms. Using the previous logic, the error for US firms is probably even lower. Together with the earlier discussion, these findings seem to suggest that it is not the analysts' capability to give forecasts in absolute terms that has improved, but that they are producing more accurate forecasts in relative terms, i.e. with a smaller dispersion. In other words, the asymmetric information measured hereby prevails between firms and the market.

Moving on to the information asymmetry- index itself, we can observe the following distribution of scores: 1st quartile is at 8, median at 10 and 3rd quartile is at 12. Recall that the minimum and maximum scores are 4 and 16. Comparison for the index is not as straightforward as the scale of Drobetz et al. (2010) is different, ranging from 5 to 25. Nevertheless, we can calculate the relative degree of asymmetric information against the original scale as follows: My median score cuts at the 10 / (16) = 62.5% point of the whole scale, and the comparable median cuts at the 14 / (25) = 56%. The standard deviation is somewhat smaller (2.788 vs. 3.290), which is probably due to the smaller scale for the information asymmetry- index. The figures indicate that my sample represents slightly higher information asymmetry in general. However, since we know that the proxies and the composition of the index differ from each other we cannot confirm this conclusion.

Unfortunately, Drobetz et al. (2010) do not disclose statistics for the interaction terms or for the number of analysts following the firm to allow for comparison. From Table 3 we can see that there are 10 analysts following a firm on average, the median being 9 analysts. 25% of firms have coverage by more than 14 analysts and 25% have less than 5. The interpretation of the statistics for the interaction terms that are a product of two variables is trivial and is thus left out.

Table 3: Summary statistics of the variables for the information asymmetry- index

This table presents the summary statistics i.e. the mean, median, first (25%) and third (75%) quartile and standard deviation, for the variables used in the calculation of the *information asymmetry- index* (IAI). The sample consists of annual observations for 815 cross-sectional units (firms) over 9 years. Forecast error is the absolute error between the consensus forecast for full year earnings per share normalized by median forecast, and measured as of November of the current year. Forecast dispersion is the standard deviation of all available forecasts for full year earnings per share normalized by the median forecast, both observed as of November of the current year. Number of analysts following the firm is measured as of number of (buy/hold/sell) recommendations given. IAI is based on four proxies, the three above-mentioned, and the size of the firm, measured by total assets, A_t (see Table 2 for summary statistics for A_t). IAI_t is calculated as follows: First, every firm's quartile ranking for each 4 proxies of information asymmetry for each year is calculated. Maximum (minimum) score for one proxy is thus 4 (1) with a higher score indicating higher information asymmetry. By adding the scores for all measures the total maximum (minimum) score for the index totals 16 (4). The interaction term in the valuation regression that is based on the index (C_t x IAI_t) is also shown. Missing observations are skipped and *n* represents the number of valid observations. The IAI can be calculated for 5074 firms in total.

Variable	n	Mean	Median	1Q	3Q	Std. Dev
Forecast dispersion	5115	0.078	0.021	0.009	0.061	0.208
Forecast error	5490	0.445	0.249	0.074	0.510	0.628
Number of analysts	5655	10.190	9	5	14	7.250
IAI_t	5074	10.066	10	8	12	2.788
Ct x IAI_t	4959	1.177	0.557	0.187	1.478	1.732

In general, the summary statistics for my sample seem to be about the same levels with Drobetz et al. (2010) who use the same data source but a different time period, which in half overlaps with mine. Yet, variance for several variables in the valuation regression is significantly higher, indicating that there are some discrepancies and extreme values in both ends, also known as "fat tails". As this is not the case for all variables and considering the somewhat limited sample size, eliminating additional observations is not reasonable. We can still conclude that the sample is satisfactory but perhaps of a lower quality compared to the earlier studies in the field.

6. EMPIRICAL RESULTS

This section presents the results of my empirical tests. I start by covering the whole sample and running the valuation model without information asymmetry in order to get a benchmark value for cash. Continuing with the whole sample, I then include the interaction variables and run the regressions assuming asymmetric information.

In section 6.3 the sample is split according to the investment opportunities of the firms. The purpose of the sample split is to study the effect asymmetric information has on the valuation of cash in low versus high growth environment.

6.1. Valuation of cash without asymmetric information

The model under scrutiny in this section is regression (4), the reduced model that does not account for asymmetric information. Variables lacking from the main valuation regression (5) are the interaction variable β_{17}, and the control variable for the level of firm-specific asymmetric information, β_{18}. Hence, the coefficient of interest is β_{16}. The purpose for running the reduced model without assuming asymmetric information is to get a benchmark value for cash holdings, against which I can compare the results that include information problems, reported in the following sections. Furthermore, many studies value cash as such (e.g. Pinkowitz and Williamson, 2004) or in connection with corporate governance (e.g. Dittmar and Mahr-Smith, 2007; Pinkowitz et al., 2006). Benchmark value allows the comparison with these studies and thus an evaluation how well the sample and the valuation model performs.

Regression results are shown in Table 4. Results are for the full sample, covering the years from 2000 to 2008 with a total of 5596 firm-year observations. First column of Table 4 presents the coefficient values assuming fixed effects estimator and robust standard errors. T-values and statistical significance are shown in column 2. For comparison, columns 3 and 4 state coefficients and t-values for the random effects estimator. Regressions are run assuming both fixed and random effects in order to find the best statistical model for estimating the value of cash. Theoretical background for the alternative estimators is discussed in section 4.3.

Table 4: Regression results for the valuation of cash

This table presents the regression results for the valuation of cash without asymmetric information using model (3). The sample consists of annual observations for 815 cross-sectional units (firms) over 9 years. All variables are trimmed at the 1% and 99% tails. The dependent variable is V_t, the total market value of the firm as the sum of market value of equity and book value of debt. Et is earnings before interest and taxes. NA_t is net assets (total assets less cash and liquid asset holdings). RD_t is research and development expenditure. I_t is interest expense. D_t is common dividends paid. C_t is cash and liquid asset holdings. $dX_t = X_t - X_{t-1}$, denoting the past 1-year change of variable X_t, and $dX_{t+1} = X_{t+1} - X_t$ is the future 1-year change of variable X_t. All variables are scaled by total assets, A_t. Missing observations are skipped and thus n represents the number of observations used in the regressions. Both specifications include time dummies. * denotes statistical significance at 10% level, ** at 5% level and *** at 1% level.

	Fixed effects			Random effects		
Variable	Coefficient	*t-value*		Coefficient	*t-value*	
$E_{i,t}$	3.689	*9.067*	***	3.729	*18.040*	***
$dE_{i,t}$	-1.287	*-3.846*	***	-1.154	*-8.963*	***
$dE_{i,t+1}$	0.095	*1.521*		0.100	*3.531*	***
$dNA_{i,t}$	0.197	*1.619*		0.163	*2.527*	**
$dNA_{i,t+1}$	-0.003	*-0.115*		-0.002	*-0.283*	
$RD_{i,t}$	8.551	*8.721*	***	8.419	*15.390*	***
$dRD_{i,t}$	6.651	*1.574*		6.563	*3.594*	***
$dRD_{i,t+1}$	-0.265	*-0.519*		-0.296	*-1.132*	
$I_{i,t}$	2.020	*2.083*	**	1.670	*2.165*	**
$dI_{i,t}$	-1.079	*-0.518*		-1.354	*-1.155*	
$dI_{i,t+1}$	-0.001	*-3.684*	***	0.000	*-1.760*	*
$D_{i,t}$	6.000	*7.079*	***	5.919	*35.280*	***
$dD_{i,t}$	1.937	*-1.332*		-1.917	*-8.203*	***
$dD_{i,t+1}$	2.001	*3.178*	***	2.034	*19.510*	***
$dV_{i,t+1}$	-0.025	*-1.028*		-0.032	*-5.596*	***
$C_{i,t}$	0.752	*3.442*	***	0.765	*11.550*	***
Constant	0.777	*11.770*	***	0.871	18.040	***
R^2	0.809					
Adjusted R^2	0.775					
Standard error	1.034			1.045		
n	5596			5596		

I begin with the results run under the fixed effects assumption, which is considered as the primary specification in my study, similar to Drobetz et al. (2010). From Table 4 we can see that the coefficient for the variable C_t is 0.752, which is statistically significant at the 1% level

(t-value 3.442) Based on the specification of the regression this can be interpreted as the value for a marginal dollar of cash. Fit of the model appears to be moderate as R_2 is 0.809. Interpretation of R_2, the coefficient of determination, is such that a value of 1 would imply a perfect fit between the regression model and the data. To point out, the high R2 value here could be due to the high number of control variables. Standard error of the regression is also moderate at 1.034.

Previous studies have provided somewhat similar estimates for the value of a marginal dollar of cash. Still, many of them provide estimates that are closer to 1 dollar in value. For instance, the estimates by Pinkowitz and Williamson (2004) for equal definition of cash (cash holdings and marketable securities) range between 0.94 and 0.97. Their sample consists of US firms, but in a notably larger scale as they include all Compustat firms between 1952-1997. Due to the more comprehensive sample, their estimate may also be more accurate. Moreover, they estimate the coefficients using the Fama and Macbeth (1973) method whereas I concentrate on the fixed vs. random effects estimation. The marginal value for cash reported by Dittmar and Mahr-Smith (2007) is also close to 1 dollar. For a mean firm in their sample, cash holdings are given a value of approximately 1.09 on average. The authors note, however, that as they study the interrelation of cash and corporate governance their sample only includes firms with either very strong or weak governance, leaving out the ones in the middle. For this reason, the estimates are not totally comparable and may explain the higher value. Finally, using the Compustat firms from 1972 to 2001, Faulkender and Wang (2006) find an average marginal value for cash of 0.94.

In spite of the fact that the studies compared here are different in terms of sample period, coverage over time and the estimation method, they suggest that the value placed on cash holdings is close to 1. This is consistent with the perfect capital markets theory, which views cash having a zero NPV and is thus valued at its nominal value. It is interesting that the most recent studies, being Drobetz et al. (2010) and this thesis, both estimate a slightly lower value for cash than the earlier ones. According to Drobetz et al. (2010), the value of cash with the fixed effects assumption is 0.661, also significant at the 1% level. However, the sample is different from mine in the sense that in addition to US firms, it includes firms from 44 other countries. The authors argue that the lower marginal value of cash may be a result of taxes on

payouts. The reason why tax effects do not decrease the value of cash in the earlier studies is unfortunately not discussed in their paper. On the other hand, it is logical that the results are alike as the model specification and data processing are attempted to be similar.

Looking at the coefficients for control variables in Table 4, we can identify the ones being statistically significant for firm valuation: At 1% level, significant contribution comes from earnings and dividends, which is not surprising considering how firm value is determined. Similar findings are also evident in the results of Drobetz et al. (2010). Besides earnings and dividends, they also find that net asset variables and the change in total firm value are significant factors. In contrast, my results do not suggest the significance of these variables but instead propose that R&D expenses are highly significant. The abnormally high coefficient value may indicate some inconsistency within the variable. Recall that the R&D expense variables are set to zero is missing or not reported, following the approach by Drobetz et al. (2010). However, together with Pinkowitz et al. (2006) they observe equally high statistical significance for R&D variables, also with the same variable definition. Therefore it seems that the variable construction and its impact to the valuation regression is in line with earlier studies and that my sample does not present any additional distortion in this sense.

Moving on to the random effects estimation shown in the two rightmost columns of Table 4, we can see that the model claims more variables to be statistically significant than with fixed effects. Specifically, the change in earnings, net assets, R&D expenses and in the total market value of the firm as well as current interest payments are all significant at the 5% level or better. In spite of this, the absolute changes in the coefficients compared to the fixed effects estimation are only minor; for instance, the coefficient for the value of cash hardly changes as it increases from 0.752 to 0.765. All in all, the random effects model suggests that more variables have a significant effect on firm valuation.

As discussed in section 4.4, I perform the F-test and the Hausman test to be able to evaluate between the consistencies of the two alternative estimators. The F-test statistic for differing group intercepts for is 1.147. Corresponding p-value is 0.00450 and so the null hypothesis is rejected at 1% significance level. The test indicates that the assumptions of the pooled OLS using fixed effects are not met and that the random effects could produce more efficient estimates.

Consequently, I perform the Hausman test that indicates whether the null hypothesis of random effects producing consistent estimators, is true. The Hausman test-statistic, *H*, under the chi- square distribution and with 24 degrees of freedom is 67.290. P-value for *H* is 5.581e-6 and so we reject the null hypothesis at 1% significance level. In other words, the test implies that the assumption of uncorrelated individual effects and regressors do not hold and for this reason, the fixed effects model should be preferred over the random effects. This is despite that the underlying assumptions for the fixed effects do not hold either. The fact that both tests reject the null hypothesis suggests that some other estimator may produce the most efficient estimates for this specific data set. Determining the optimal statistical model further than by analyzing the relative performance of the two chosen estimators is beyond the scope of this thesis.

Drobetz et al. (2010) use the Fama and Macbeth (1973) method along the fixed effects estimation, similar to Pinkowitz and Williamson (2004). Value of cash estimated hereby is 1.792, which is significantly higher and well above 1. Based on the findings throughout the literature, the Fama and Macbeth- method appears to produce higher estimates.

Based on the review of the results against the previous findings, I would argue that the model construction and the sample perform expectedly in estimating the value of cash. An interesting finding is that Drobetz et al. (2010) and my thesis, being the most recent studies with the most up-to-date data, both estimate lower values for cash holdings than studies using older data. This seems to indicate that investors have not appreciated firms piling up cash in their balance sheet.

6.2. Valuation of cash under asymmetric information

This section reviews empirical results for the full sample taking into account the firm-specific degree of asymmetric information. The model under scrutiny is now regression (5), which includes the interaction variable β_{17} and the control variable for asymmetric information, β_{18}. As the data set is not perfectly comprehensive, the *IAI* cannot be calculated for all firms and thus the number of observations available for the regression drops to 4,733 from 5,596. Unfortunately, this approach probably excludes the firms with the highest level of information asymmetry i.e. those for which no proxies are available in the first place.

Table 5: Regression results for the valuation of cash under asymmetric information

This table presents the regression results for the valuation of cash under asymmetric information using model (4). The sample consists of annual observations for 815 cross-sectional units (firms) over 9 years. All variables are trimmed at the 1% and 99% tails. The dependent variable is V_t, the total market value of the firm as the sum of market value of equity and book value of debt. E_t is earnings before interest and taxes. NA_t is net assets (total assets less cash and liquid asset holdings). RD_t is research and development expenditure. It is interest expense. D_t is common dividends paid. C_t is cash and liquid asset holdings. IAI is the information asymmetry- index that captures the firm-specific degree of information asymmetry. $dX_t = X_t - X_{t-1}$, denoting the past 1-year change of variable X_t, and $dX_{t+1} = X_{t+1} - X_t$ is the future 1-year change of variable X_t. All variables are scaled by total assets, A_t. Missing observations are skipped and thus *n* represents the number of observations used in the regressions. Both specifications include time dummies. * denotes statistical significance at 10% level, ** at 5% level and *** at 1% level.

	Fixed effects			Random effects		
Variable	Coefficient	*t-value*		Coefficient	*t-value*	
$E_{i,t}$	4.379	*12.250*	***	4.500	*30.750*	***
$dE_{i,t}$	-1.500	*−4.810*	***	-1.384	*-9.988*	***
$dE_{i,t+1}$	0.144	*2.585*	***	0.157	*6.211*	***
$dNA_{i,t}$	0.101	*0.868*		0.096	*1.538*	
$dNA_{i,t+1}$	0.024	*1.928*	*	0.030	*5.598*	***
$RD_{i,t}$	7.123	*8.263*	***	7.019	*14.360*	***
$dRD_{i,t}$	5.858	*1.561*		5.836	*3.732*	***
$dRD_{i,t+1}$	0.086	*0.284*		0.027	*0.112*	
$I_{i,t}$	3.386	*3.577*	***	3.085	*4.170*	***
$dI_{i,t}$	0.537	*0.328*		0.045	*0.038*	
$dI_{i,t+1}$	-0.001	*−2.677*	***	-0.001	*−2.166*	**
$D_{i,t}$	2.692	*4.353*	***	2.585	*6.501*	***
$dD_{i,t}$	-1.123	*−1.758*	*	-1.005	*−2.717*	***
$dD_{i,t+1}$	-0.059	*-0.204*		-0.088	*-0.620*	
$dV_{i,t+1}$	-0.026	*−1.987*	**	-0.034	*−6.573*	***
$C_{i,t}$	2.320	*3.714*	***	2.311	*6.391*	***
IAI_t	0.009	*1.259*		0.009	*1.588*	
$C_{i,t}$ x IAI	-0.055	*-0.965*		-0.060	*-1.870*	*
Constant	0.627	*6.702*	**	0.632	*8.533*	*
Adjusted R^2	0.375					
Standard error	0.819			0.839		
n	4733			4733		

To start with the fixed effects estimation, the coefficients and respective t-values shown in the two leftmost columns of Table 5 appear to be roughly similar with those estimated earlier without asymmetric information. Statistical significance is also suggested for mostly the same control variables. Adjusted R_2 decreases from 0.775 to 0.375 for the reduced model, which indicates that the explanatory power of the regression relative to the previous specification, does not improve when the additional variables are included.

From the two leftmost columns of Table 5 we can see that coefficient values for IAI_t and C_t *x* IAI_t are 0.009 and -0.055 respectively and no statistical significance is suggested. As explained in section 4, *IAI* is included in the regression to control the direct influence information problems may have on firm valuation. Based on the insignificant coefficient value however, it seems that there is no notable effect. Similarly, the insignificant interaction term does not indicate that information problems would affect the valuation of cash either.

If we look at the random effects estimation, the interaction term is assigned a negative coefficient value of -0.060, which is slightly significant at 10% level. The coefficient for the *IAI* is practically equal to the fixed effects i.e. not significant and close to zero. According to the F-test for differing group intercepts, the random effects estimates could be more efficient, as the null is rejected at 1% with *F* being 1.286 (p-value 1.044e-6). The Hausman test statistic, *H,* under the chi-square distribution and with 26 degrees of freedom is 65.228. With a p-value of 3.19e-5 the null hypothesis is also rejected at 1% level. According to the tests, the fixed effects model performs better and thus we should focus on these estimates.

My results are in contrast to those of Drobetz et al. (2010), who report a corresponding and highly significant coefficient value of -0.280 for the interaction term. They assign a significant negative value also for the information asymmetry- index, which implies a negative effect on the valuation. Coefficient values remain negative when the authors apply the Fama-Macbeth method and other measures for asymmetric information apart from the index. The authors interpret this as clear evidence for the free cash flow theory.

Most likely, the main explanation for the divergence in the results is the sample, which in Drobetz et al. (2010) is international covering 45 countries. In particular, the sample includes countries classified as emerging markets and countries with less developed market disclosure practices and investor protection. Further tests that are done separately for developed

countries and for emerging markets reveal that the negative effect is much stronger for the emerging markets, which is line with the findings by Pinkowitz et al. (2006). The effect for the developed countries is also negative and highly significant, but not as strong as for emerging markets.

The value proposed for the coefficient for cash holdings, C_t, increases considerably to 2.320 and is statistically significant at 1% level. Similar increase is evident also in Drobetz et al. (2010) but the authors do not discuss the behavior of this variable, as the focus is on the additional variables that account for asymmetric information. According to the model specification, the interaction term captures the effect of information problems on the valuation of cash. Since the coefficients estimated for this variable and for the IAI_t are not statistically significant, I follow the interpretation of Drobetz et al. (2010) and argue that the increase in the coefficient for C_t is not caused by the inclusion of asymmetric information. Interpreting C_t as the value for marginal dollar of cash in this model specification with the IAI_t and the interaction variable added would not be reasonable.

In spite of the results being somewhat mixed, it appears that information problems do not have a negative effect on the valuation of cash for an average US firm. This finding is in contrast to previous research that has studied other developed economies along with developing economies. Therefore, I am unable to find evidence for neither of the hypotheses 1 or 2. The level of asymmetric information does not seem to provide the explanation for the contrasting results since it is approximately the same for both my sample and the one in Drobetz et al. (2010) (see section 5 for descriptive statistics). It appears that in the US investors seem to consider cash holdings more or less irrelevant for firm valuation even though information problems are present.

6.3. Results for sub-samples

This section incorporates sample splits according to the investment opportunities of the firm for the purpose of isolating the effect of asymmetric information. Whether a firm has investment opportunities available is argued to be a relevant factor from the perspective of the two opposing theories. If we assume high information problems, a firm with low investment opportunities is more likely to suffer from agency costs of free cash flow as there are no justifiable targets for placing excess cash. Then again, a firm that has several investment

opportunities would benefit from ample cash holdings because of the pecking order theory, which states that raising external finance is expensive when asymmetric information is high (Opler et al., 1999).

Common market-to-book (MB) ratio is used for a proxy for investment opportunities, measured at the end of the previous fiscal year. Firms with market-to-book ratio below the median value are put in the group of low investment opportunities and firms above the median value are referred to as having high investment opportunities. I start by analyzing the sub-sample of firms with low investment opportunities.

6.3.1. Firms with low investment opportunities

Regression results for the low investment opportunity sub-group are presented in Table 6. The median market-to-book is 0.882 so the sub-sample consists of firms with having MB below this value. Number of observations in the regression for the sub-sample is 2,345.

Starting with the fixed effects estimation, a direct comparison of the coefficients between the low MB group and the full sample is that the values are much lower in magnitude for the low MB group. Most coefficient values are below one and variation across variables is lower. The only variable increasing in coefficient value is interest expense, I_t. Potential reason behind the smaller coefficient values could be that sub-sampling according to investment opportunities might also have resulted in a more balanced panel. Approximately same variables are statistically significant at 1% level than for the full sample regressions. Based on these arguments, it appears that the model produces coherent results despite the reduced sample size.

From the second column of Table 6 we can see that the coefficient for C_t declines notably when compared to the full sample results. Coefficient value is now -0.593, indicating significance at 1% level. Similarly, *IAI* is assigned a highly significant value of -0.013.

Table 6: Regression results for the valuation of cash under information asymmetry. Sub-sample for low MB- firms

This table presents the regression results for the valuation of cash under asymmetric information for low Market-to-book firms using model (4). Division into high and low Market-to-book sub-groups is done by using the median value. All variables are trimmed at the 1% and 99% tails. The dependent variable is V_t, the total market value of the firm as the sum of market value of equity and book value of debt. E_t is earnings before interest and taxes. NA_t is net assets (total assets less cash and liquid asset holdings). RD_t is research and development expenditure. I_t is interest expense. D_t is common dividends paid. C_t is cash and liquid asset holdings. IAI is the information asymmetry-index that captures the firm-specific degree of information asymmetry. $dX_t = X_t - X_{t-1}$, denoting the past 1-year change of variable X_t, and $dX_{t+1} = X_{t+1} - X_t$ is the future 1-year change of variable X_t. All variables are scaled by total assets, At. Missing observations are skipped and thus n represents the number of observations used in the regressions. Both specifications include time dummies. * denotes statistical significance at 10% level, ** at 5% level and *** at 1% level.

	Fixed effects			Random effects		
Variable	Coefficient	*t-value*		Coefficient	*t-value*	
$E_{i,t}$	0.522	*4.571*	***	0.541	*8.943*	***
$dE_{i,t}$	-0.241	*−2.352*	**	-0.189	*-3.884*	***
$dE_{i,t+1}$	0.031	*2.705*	***	0.024	*2.842*	***
$dNA_{i,t}$	0.146	*3.678*	***	0.102	*4.799*	***
$dNA_{i,t+1}$	0.000	*-0.104*		0.001	*0.735*	
$RD_{i,t}$	0.612	*2.147*	**	0.364	*1.517*	
$dRD_{i,t}$	0.721	*0.778*		0.302	*0.390*	
$dRD_{i,t+1}$	-0.004	*-0.086*		-0.057	*-0.836*	
$I_{i,t}$	7.055	*17.650*	***	6.962	*26.270*	***
$dI_{i,t}$	-1.906	*-3.660*	***	-2.114	*-4.763*	***
$dI_{i,t+1}$	0.000	*-1.261*		0.000	*0.417*	
$D_{i,t}$	1.758	*4.143*	***	1.610	*9.132*	***
$dD_{i,t}$	-0.791	*-2.462*	**	-0.547	*-3.804*	***
$dD_{i,t+1}$	-0.039	*-0.712*		-0.035	*-0.717*	
$dV_{i,t+1}$	0.000	*0.026*		-0.002	*-1.039*	
$C_{i,t}$	-0.593	*-2.690*	***	-0.607	*-3.086*	***
IAI	-0.013	*-5.230*	***	-0.012	*-5.641*	***
$C_{i,t}$ x IAI	0.050	*2.609*	***	0.052	*2.985*	***
Constant	0.794	*23.750*	***	0.790	*28.500*	***
R^2	0.447					
Standard error	0.204			0.212		
n	2345			2345		

Most importantly, the interaction term $C_t \, x \, IAI_t$ experiences a statistically significant value of 0.050. Despite not having a negative value, it points out that the valuation of cash in connection with information asymmetry is practically zero. Recall that the benchmark value for cash estimated previously is 0.752. I interpret these findings being in favor of hypothesis 4 and the free cash flow theory. Cash being valued at zero dollars indicates that investors doubt managers' ability to find profitable use for the cash holdings of firms that are lacking of investment targets. However, my results do not support the presumption that investors would suspect managers' ability to undertake only profitable investments, also a prediction of the free cash flow theory.

My results confirm the argument by Pinkowitz and Williamson (2004) that low growth opportunities have a negative effect on the valuation of cash. They also add to the findings of Opler et al. (1999) who show that firms with low investment opportunities hold less cash than peers with better investment opportunities. According to my results these firms experience a lower valuation on their cash holdings too. On the other hand, Opler et al. (1999) present evidence that managers have a tendency to accumulate cash when they have an opportunity to do so, which flags for potential agency problems. My results suggest, however, that investors suspect the motives behind the increasing cash and consequently discount for agency costs of free cash flow when considering the value of liquid assets.

The random effects model produces very similar coefficients for the low MB sub-sample, as is evident from the two rightmost columns of Table 6. For instance the coefficients for cash, *IAI* and the interaction term are very alike in value and all significant at 1% level. The random effects model thereby confirms the above stated findings but fails in statistical coherence: the Hausman test gives a very large H of 83.365 and the null is rejected with p-value of 6.291e-8. The outcome is the same as with the earlier models, fixed effects should be preferred over the random effects, in spite of that the underlying assumptions are not perfectly met (the F-test rejects at 1% significance level, F being 1.561 with a p-value of 8.687e-9).

6.3.2. Firms with high investment opportunities

Empirical results for the sub-sample of high investment opportunity firms are presented here. The number of observations for the sub-sample is 2,388. Although the sample is split in half by using the median value, the two sub-samples are not exactly equal in size since there is a

random number of missing observations in both sub-samples that are skipped when running the regressions.

Based on the coefficient values seen in Table 7, the high MB sub-sample seems to be somewhat different from the low MB sub-sample. Whereas the coefficients previously were mostly below one there is now much more variation between variables. Furthermore, statistical significance is suggested for variables different from the low MB sub-sample.

In contrast to the low MB sub-sample, information asymmetries cannot be reported to have a distinct effect on the valuation of firms with good investment opportunities; the fixed effects coefficient for the *IAI* controlling for the direct influence of information problems is 0.015 and not statistically significant. Interestingly, the valuation of cash in connection with asymmetric information for the sub-sample, presented by the interaction term, is addressed a negative coefficient value. This is not statistically significant, however. The expected sign for the coefficient according to hypothesis 3 would have been positive, as firms having profitable projects available would benefit from holding cash for to be used in financing. Because of information problems, cash would be the preferred funding choice over the expensive external funds.

On the other hand, the value for the cash holdings variable C_t is 1.924 and significant at 1% level. From this perspective, the high investment opportunity firms experience a higher valuation for their cash holdings than firms with low investment opportunities. Nevertheless, I interpret the results based on the coefficients on the *IAI* and the interaction term, as explained earlier in accordance with the full sample results. Thus, for firms with good investment opportunities, information problems do not seem to have a distinct effect on the valuation of the firm or its cash holdings.

Opler et al. (1999) report that firms with good opportunities regarding new investments hold more cash than other firms. They argue that this is partly due to outside funds being expensive, which can be caused by information asymmetries. However, my findings suggest that the markets do not appreciate this.

Table 7: Regression results for the valuation of cash under information asymmetry. Sub-sample for high MB- firms

This table presents the regression results for the valuation of cash under asymmetric information for high Market-to-book firms using model (4). Division into high and low Market-to-book sub-groups is done by using the median value. The sample consists of annual observations for 338 cross-sectional units (firms) over 9 years. All variables are trimmed at the 1% and 99% tails. The dependent variable is V_t, the total market value of the firm as the sum of market value of equity and book value of debt. E_t is earnings before interest and taxes. NA_t is net assets (total assets less cash and liquid asset holdings). RD_t is research and development expenditure. I_t is interest expense. D_t is common dividends paid. C_t is cash and liquid asset holdings. IAI is the information asymmetry- index that captures the firm-specific degree of information asymmetry. $dX_t = X_t - X_{t-1}$, denoting the past 1-year change of variable X_t, and $dX_{t+1} = X_{t+1} - X_t$ is the future 1-year change of variable X_t. All variables are scaled by total assets, A_t. Missing observations are skipped and thus n represents the number of observations used in the regressions. Both specifications include time dummies. * denotes statistical significance at 10% level, ** at 5% level and *** at 1% level.

	Fixed effects			Random effects		
Variable	Coefficient	*t-value*		Coefficient	*t-value*	
$E_{i,t}$	5.580	*11.270*	***	5.508	*23.290*	***
$dE_{i,t}$	-0.911	*-3.180*	***	-0.897	*-3.646*	***
$dE_{i,t+1}$	0.632	*3.161*	***	0.693	*7.462*	***
$dNA_{i,t}$	0.575	*3.955*	***	0.533	*4.753*	***
$dNA_{i,t+1}$	0.107	*2.805*	***	0.092	*6.677*	***
$RD_{i,t}$	6.940	*6.666*	***	7.396	*11.000*	***
$dRD_{i,t}$	7.153	*1.634*		6.742	*3.171*	***
$dRD_{i,t+1}$	2.619	*2.172*	**	2.386	*3.604*	***
$I_{i,t}$	5.660	*3.634*	***	6.551	*5.114*	***
$dI_{i,t}$	-1.808	*-0.710*		-2.692	*-1.418*	
$dI_{i,t+1}$	0.000	*-0.820*		-0.001	*-1.828*	*
$D_{i,t}$	0.702	*1.076*		0.276	*0.481*	
$dD_{i,t}$	0.655	*0.790*		0.708	*1.183*	
$dD_{i,t+1}$	-0.342	*−1.06*		-0.199	*-0.745*	
$dV_{i,t+1}$	-0.143	*-3.220*	***	-0.141	*-9.371*	***
$C_{i,t}$	1.924	*2.732*	***	1.587	*3.204*	***
IAI	0.015	*1.423*		0.016	*1.591*	
$C_{i,t}$ x IAI	-0.015	*-0.220*		-0.004	*-0.081*	
Constant	0.750	*5.100*	***	0.788	*6.587*	***
R^2	0.464					
Standard error	0.942					
n	2388			2388		

The discovery goes along with the efficient capital markets theory as it is expected that the firms with high investment opportunities are able to raise funds rather easily. Therefore, the amount of cash held in the balance sheet should be irrelevant for firm value. The outcome is actually somewhat controversial. In general, firms having high investment opportunities are also experiencing rapid growth. Especially for these firms, future prospects between the firm and financial markets i.e. information asymmetry, tends to be high. One could argue that a relatively high amount of liquid asset holdings could mitigate potential constraints that could occur when raising new funds. Nevertheless, my results don't address a distinct valuation of cash holdings for these firms.

The results do not change with the random effects estimation, which produces roughly the same estimates. Interestingly, now the null hypothesis of the F- test is not rejected: F is 1.012 with a p-value of 0.434. The results imply that for the high MB sub-sample, the fixed effects pooled OLS is adequate estimator and that the random effects can be discarded, even though not being notably different.

7. CONCLUSIONS

Corporations hold more cash in their balance sheets than they did a few decades ago. According to financial theory, having too much cash is not optimal from the shareholders point of view because of opportunity cost; cash can be invested to earn an additional return and increase value. If company management is unable to find investment targets, the excess cash that is not needed should be returned to shareholders as dividends. On the other hand, the perfect capital markets theory states that cash holdings as such, are irrelevant and do not have an impact to the value of the firm. This is because both the firm and investors share exactly the same information and thus raising external funds is frictionless. As we know, however, financial markets in real life are not perfect. On reasonable terms we can therefore suspect the assumption of irrelevant cash holdings.

This thesis focuses on this controversy and attempts to measure the effect that asymmetric information has on the value of cash. Measurement of the firm-specific level of information asymmetry is done by constructing an index consisting of four proxies that earlier research has found to be connected to information problems: (1) error in analysts' forecasts, (2) forecast dispersion, (3) the number of analysts following the firm, (4) firm size. I use a panel data set consisting of 815 US firms over 9 years, totaling 5,596 firm-years and utilize the modified Fama and French (1998) valuation regression. The regression estimates the value of a marginal dollar of cash and isolates the effect of firm-specific asymmetric information by controlling for the level and change in earnings, net assets, R&D expenses, interest expenses and dividends.

Previously, several studies have investigated the valuation of cash empirically and found that on average, a dollar of cash is valued approximately at par. The estimates range generally between 0.661 and 1.09. My empirical results for the full sample without including the effect of information problems are in line with the earlier findings. The valuation regression indicates a value of 0.752 for a marginal dollar of cash.

Constructing the information asymmetry- index in a similar manner with Drobetz et al. (2010) reveals that by these measures, the degree of information problems in my sample of US firms is approximately the same than for the average firm in their sample of 45 countries. When I include the firm-specific information asymmetry in the valuation, I find that it has no

significant effect on the valuation of cash. This is in contrast to Drobetz et al. (2010) who report a significant negative effect for all sub-samples, also for developed countries. The US sample used in my thesis seems to differ from other developed markets; although information problems exist it has no notable effect on the valuation of cash holdings.

However, the valuation of cash changes when the sample is split according to the growth opportunities of the firm, measured by the common market-to-book ratio. The results show that information asymmetry has a negative effect on the valuation of cash for firms with low investment opportunities. The findings are in support of the free cash flow theory: If a firm has no reasonable investment targets and low growth opportunities, managers may waste cash in private pet projects and self-serving, value-destroying purposes. Therefore, cash held in balance sheet by such firms is given no additional value, as is suggested by the results. For firms with high investment opportunities, I am unable to find a distinct effect on the valuation of cash.

The other theory tested in the thesis has an opposite outcome. Asymmetric information theory predicts that raising new external funds is expensive because of the uneven information between the firm and the markets. Cash holdings would thus provide *financial slack* that could be used to finance new investments. However, I am unable to find support for the hypothesis.

Altogether, my results contribute to existing literature by suggesting that the effect of information problems on the valuation of cash is limited to firms with low investment opportunities. For an average firm, the effect is non-existent. The results are based on US firms and contradict to earlier findings that report a negative effect for developed countries also for an average firm.

Explanation why the results for US firms differ from other developed markets studied in earlier research could potentially be due to the higher efficiency its capital markets. Higher efficiency enables better allocation of funds and easier access of new capital, and may not be as sensitive to the differences in the level of information between market participants. On the other hand, managers' actions and objectives may be more transparent and better understood by the markets. This supports the well-known efficient capital markets theory, which states that the level of cash held in the balance sheet is irrelevant for firm valuation. Nevertheless,

firms with low investment opportunities should be aware of swelling amounts of cash and excess liquid asset holdings. My findings suggest that investors would rather have that money on their own bank accounts than on the disposal of corporate managers.

As my thesis has shown, the effect that information problems have on firm valuation can differ also between developed markets. Future research could thus take a grasp on other countries apart from the US to disentangle the differences between markets for example in Europe. Current studies are also limited on how information problems are measured. As mentioned, data requirements for gathering a sufficient sample may intrinsically lead to the exclusion of firms with the highest levels of information asymmetry. From this perspective a study based on a small, carefully selected sample covering firms from both extreme ends could give a new insight on how information problems affect the valuation of these firms.

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