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The Impact of Agency Costs on Corporate Cash Holdings

A Study of German Public and Private Tech Companies

by

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Abstract

Purpose: The main objective of this thesis is to examine the effect different drivers of agency costs have on corporate cash holdings in public and private German technology firms. The analysis identifies three potential sources of agency costs. By determining target cash levels first and then obtaining deviations from these targets, the influences of agency costs are measurable.

Data Set: The sample consists of 97 public firms, which were identified through the Deutsche Börse AG stock exchange, and 21 private firms, which were identified through the Bureau van Dijk's Orbis database. Financial and non-financial information were then drawn from CapitalIQ for the period of 2004 to 2014. Further, TecDax data for this period complement the company information. Overall the sample contains 1240 unique observations.

Methodology: The paper follows a quantitative approach where panel data regressions are estimated. In order to test how agency costs influence excess cash holdings, three distinct models are utilized. The first is set up to prove that firms do have cash targets. The second determines the level of these cash targets. Deviations from these cash targets are defined as excess cash. In the third model, excess cash holdings are then explained by the three drivers of agency costs.

Results: The study finds that agency costs do exist and significantly influence a firm's cash holding decision. Threat of takeovers, corporate governance quality, and bank power are shown to be jointly significant. With an increase of these variables agency costs decline and so does excess cash.

Keywords: agency costs, cash holdings, excess cash, Germany, technology industry, bank power, TecDax

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Abbreviations

ACI	Agency Cost Index
AG	Aktiengesellschaft (stock corporation)
AIC	Akaike Information Criterion
BP	Bank Power
CCC	Cash Conversion Cycle
CF	Cash Flow
CFV	Cash Flow Volatility
CPI	Consumer Price Index
D	Dividend Payments and Stock Repurchases
EU	European Union
FS	Firm Size
FTSE	Financial Times Stock Exchange
GAAP	Generally Accepted Accounting Principles
GIM index	Gompers, Ishii, and Metrick index
HGB	Handelsgesetzbuch (German Commercial Code)
HQ	Hannan-Quinn Information Criterion
IFRS	International Financial Reporting Standards
IO	Investment Opportunities
L	Leverage
NAICS	North American Industry Classification System
NWC	Net Working Capital
PoD	Probability of Default
R&D	Research and Development

R^2	Coefficient of determination
SC	Schwarz Criterion
Std. Dev.	Standard Deviation
Std. Error	Standard Error
TA	Total Assets
Tax	Effective tax rate
ToT	Threat of Takeover
U.K.	United Kingdom
U.S.	United States (of America)

1 Introduction

The first section of this thesis demonstrates the background and the problem under scrutiny. The purpose and research aim of this thesis are then developed. Finally, the section closes with a disposition of the remaining paper.

1.1 Background

Over the last two decades corporate cash holdings significantly increased worldwide (Amess, Banerji & Lampousis, 2015). Since the year 2000 the cash holdings of the Financial Times Stock Exchange (FTSE) 100 non-financial firms went from approximately 50 billion US-Dollar up to nearly 200 billion US-Dollar in 2013. This trend is also visible in European countries (Ferreira & Vilela, 2004).

This development attracted the attention of researchers, who investigated why firms hold cash (Bigelli & Sánchez-Vidal, 2012). While most papers looked at United States (U.S.) publicly listed companies (Harford, Mansi & Maxwell, 2008; Kim, Mauer & Sherman, 1998; Opler et al., 1999), recently authors started to examine private companies' cash holdings as well, both in- and outside the U.S. (Bigelli & Sánchez-Vidal, 2012; Gao, Harford & Li, 2013; Gogineni, Linn & Yadav, 2012). Still, most of these papers are primarily concerned with investigating which theory explains cash holdings best. Potential candidates are Keynes (1936) transaction and precautionary motive, the financing hierarchy theory by Myers and Majluf (1984), or the agency costs of free cash flow by Jensen (1986).

Agency cost are mostly considered as an additional, even though important, explaining factor in the investigation of cash holdings. As it is the case, for example, in Opler et al. (1999), which is one of the most cited and referred works. This thesis focuses on the effect of agency costs on excess cash holdings. The difference to other works is that they are not simply treated as another explanatory factor, but analyzed under isolation in order to attain information of the significance and direction of effect of each factor.

In order to make the analysis comparable between different firms, it depends on a dataset of private and public German technology companies. The reasoning behind the sample choice is as follows. First of all, private and public companies differ in a lot of ways. Public companies in this context are those that are traded at a regulated stock exchange, private firms are not. Most important to mention is that private companies are considered to suffer significantly less from agency costs as public firms do (Bigelli & Sánchez-Vidal, 2012; Jensen, 1986).

Secondly, the German market has some characteristics that makes it particularly interesting for this investigation. In contrast to the Anglo-American capital market-based system, German companies rely much more on banks, which was shown to reduce agency costs (Pinkowitz &

Williamson, 2001). Therefore, German banks have relatively high power over private companies, while the public firms are still mostly independent of the banks. Banks in this context act as an institution, monitoring private companies' managements in order to reduce managerial discretion (Pinkowitz & Williamson, 2001). This additional regulatory force potentially makes the differences between private and public firms larger and, in turn, the analysis in this paper more significant.

Finally, technology firms also bear certain characteristics, making them an interesting research target for the topic of agency costs. That is, firms in the technology industry are usually research and development (R&D) intensive and subject to high investment risks (Zakrzewska-Bielawska, 2010). Being subject to these uncertainties, technology companies are expected to hold higher levels of cash for precautionary reasons, as further explained later (e.g. Opler et al., 1999). Higher cash holdings in turn give rise to agency problems, and therefore the results of such companies are potentially more striking.

With this sample choice another critique regarding existing studies on cash holdings, given by Amess, Banerji and Lampousis (2015), is taken care of. The authors state that all too often macroeconomic effects on cash holdings are not taken into account. Some authors as Opler et al. (1999) and Bigelli and Sánchez-Vidal (2012) try to solve this issue by including year dummies in their models. In this thesis, an alternative is offered in addition. The TecDax is used to explain macroeconomic effects. The TecDax is an index of the 30 largest technology firms listed in stock markets of the Deutsche Börse AG. Hence, it appropriately reflects exogenous effects on the German technology industry. The difference between the two approaches is then that the year dummies cover all exogenous effects, while the TecDax reflects only industry movements. However, in terms of model effectiveness, the TecDax as a single variable could be better than multiple year dummies.

The thesis finally proves theoretical considerations about agency costs. It is shown that agency costs decrease with a higher threat of company takeovers, with better corporate governance and with higher bank surveillance. Moreover, as a novelty, there is evidence that bank power is a significant driver of agency costs which not simply substitutes other sources of managerial discretion. The three different drivers are jointly significant and bank power cannot be omitted. As a sideshow it is further shown that the TecDax is indeed able to capture macroeconomic effects as suggested and more effective than year dummies.

1.2 Research Purpose

The main purpose of this study is to examine how agency costs influence cash holding decisions. Scrutinizing this question, the thesis contributes to the literature of cash holdings and agency costs. On the one hand by providing evidence of the existence of agency costs itself and on the other hand by studying a further source of agency costs. To the author's best knowledge, this is the first work to investigate the effect of bank power in combination with the two, already more reviewed, agency costs drivers threat of takeovers and corporate governance quality.

Another difference to prior works is the separation of the model determining cash levels and the model that explains excess cash holdings with different measures of agency costs. The idea is to examine agency costs in isolation of other cash determinants.

By providing a detailed discussion of theoretical suggestions and empirical findings a model is designed to first find cash targets for the firms under examination. Panel data of 118 private and public companies over the period from 2004 to 2014 are used in order to estimate a model that explains cash holdings in the best way possible. From this model, the excess cash holdings are derived. By quantifying different measures of agency costs, it is then estimated how these variables influence excess cash holdings.

1.3 Research Limitations

This paper is subject to some limitations. Obviously, the focus on German technology firms reduces the sample size significantly in contrast to other works, such as Opler et al. (1999). Further the results, even if corrected for macroeconomic impacts, might not be generalizable on both non-German and non-technology firms.

Another potential problem lies within the comparison of private and public companies, caused by accounting standards. All German companies must publish their annual reports in accordance with the German Generally Accepted Accounting Principles (GAAP; leading law is the Handelsgesetzbuch (HGB) which is the German Commercial Code). However, firms listed at the regulated stock market of the Deutsche Börse AG are committed to disclose their annual reports in accordance to the International Financial Reporting Standards (IFRS), which at the same time free these companies from their obligation to disclose their HGB reports. Therefore, a comparison between private and public companies is certainly biased to some extent. Some of the variables used in this paper are subject to arbitrary accounting principles. For instance, total assets are usually higher in a firm reporting IFRS than it would be, if the company had used HGB. The reason is that in under IFRS assets are valued at the fair value and in HGB at historical costs (Devalle, Onali & Magarini, 2010). Hence, all variables that are normalized by total assets, are biased downwards in public firms.

1.4 Outline of the Thesis

The remaining thesis is separated into four parts. In section two different theories on corporate cash holdings are outlined and compared to empirical research findings. Based on this discussion, hypotheses on the underlying research are drawn. Section three introduces the research approach, describes the data collection and, importantly, explains the methodologies used to analyze the research question. The next section presents the results from the analysis supplemented by an interpretation and discussion of the findings. Eventually, section five gives a conclusive overview and discussion of the empirical findings and rises potential future research topics.

2 Literature Review and Hypotheses Development

As Keynes (1936) states, under the condition of existing perfect capital markets corporate cash holdings are deemed irrelevant. That is, in a frictionless economy with no transaction costs, taxes, information asymmetries, or agency costs cash holdings would only be a sideshow to investment and financing decisions (Amess, Banerji & Lampousis, 2015; Opler et al., 1999; Pinkowitz & Williamson, 2007).

However, markets are not frictionless and bear different implications for cash holdings (Bigelli & Sánchez-Vidal, 2012; Pinkowitz & Williamson, 2007). Keynes (1936) himself describes the transaction motive and the precautionary motive of holding cash, which reflect the two main benefits he observes. These are "lower transaction costs from not having to liquidate assets when facing a payment and a valuable buffer to meet unexpected contingencies" (Bigelli & Sánchez-Vidal, 2012, p.26). Miller and Orr (1966) introduce a formalized model, the trade-off model, which balances the costs and benefits of cash holdings under uncertainty. Within this model, an optimal amount of cash holdings can be obtained that maximizes shareholder wealth (Bigelli & Sánchez-Vidal, 2012; Opler et al., 1999).

Agency theory can help explain why firms deviate from an optimal cash level, since managers and shareholders view costs and benefits of corporate cash holdings differently (Opler et al., 1999; Pinkowitz & Williamson, 2007). The theory is based on Jensen and Meckling's (1976) work, stating that agency costs arise from the separation of ownership and control in companies. In his later work, Jensen (1986) develops the agency theory further by taking the role of excess cash into consideration.

Often contrasted to the trade-off model is the pecking-order theory, or financing hierarchy theory, by Myers and Majluf (1984). It is based on the assumption of existing information asymmetries between a firm, or its managers, and its investors. In this model there is no optimal amount of cash holdings (Gogineni, Linn & Yadav, 2012; Opler et al., 1999). However, empirically the distinction between the trade-off model and the financing hierarchy model is not perfectly clear (Opler et al., 1999). Many considerations of these theories lead to the same outcomes as can be seen in section 2.2.

Prior research papers on corporate cash holdings choose different approaches on describing these theories. For instance, in Opler et al. (1999) the discussion of the precautionary motive includes information asymmetries as well as agency costs of debt. Also, while Shyam-Sunder and Myers (1998) show that the financing hierarchy model is very successful at explaining changes in leverage, Opler et al. (1999) argue that the trade-off model cannot be dismissed. Amess, Banerji and Lampousis (2015), on the other hand, emphasize the precautionary and the agency theory as the most important drivers to explain corporate cash holdings.

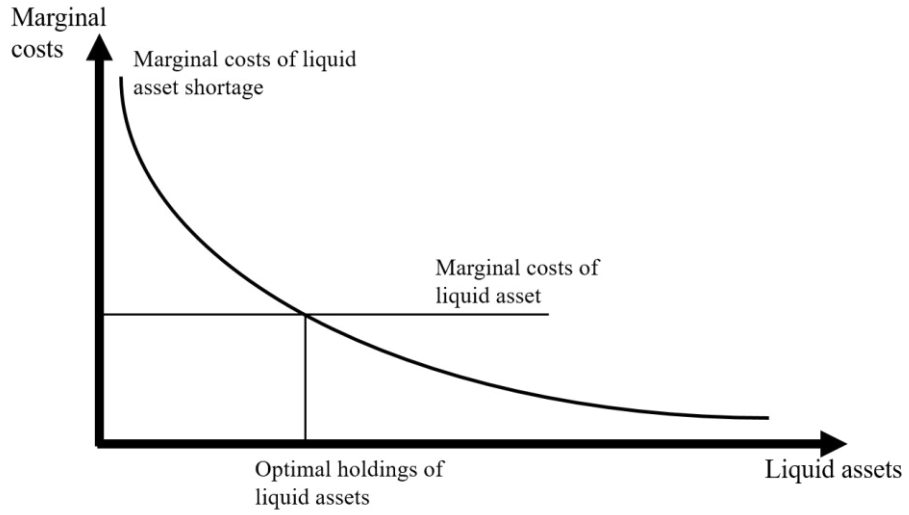
For this reason, and because the main interest of this thesis lies on agency costs rather than answering which model is superior in explaining corporate cash holdings, the following section is structured in a different way than most prior papers. The section is broken down in conformance with the model set up and ultimately the analysis. That means, instead of separating the topics by the different theories, they follow the line of action undertaken in this paper.

Namely, the section starts with a discussion whether firms do have cash targets or not. Then, it is examined which distinct firm characteristics determine the level of such possible cash targets. Deviations from these targets are defined as excess cash. Hence, following this discussion, different drivers of agency costs, which are supposed to explain excess cash holdings, are explored. This also includes the hypotheses development. Finally, a concluding section breaks down and summarizes the main points of the literature review.

2.1 Is there an Optimal Level of Cash Holdings?

According to the trade-off theory, a management that wants to maximize company value should choose an optimum corporate cash level by equating the marginal costs and benefits of cash holdings (Bigelli & Sánchez-Vidal, 2012; Miller & Orr, 1966; Opler et al., 1999; Pinkowitz & Williamson, 2007). Opler et al. (1999) assume a trade-off between missed investment opportunities, due to a lack of funds or access to external capital, especially access to capital markets, and the liquidity premium associated with cash holdings. This premium was introduced by Amihud and Mendelson (1986), and basically is an opportunity cost, arising from the counter-effect of holding liquid assets, which bear lower transaction costs, a lower return rate. The premium increases further with tax disadvantages of liquid assets (Opler et al., 1999). The optimal cash level can then be obtained from measuring the costs of a liquidity shortage and the costs of holding liquid assets, as shown in Figure 1. Agency theory can then explain deviations from the optimum (Opler et al., 1999; Pinkowitz & Williamson, 2007).

Figure 1: Trade-off Model (adapted from Opler et al., 1999)



A contrary view is that an optimal cash level does not exist (Gogineni, Linn & Yadav, 2012; Opler et al., 1999). The financing hierarchy theory aligns this view with shareholder wealth maximization (Myers & Majluf, 1984). However, the underlying assumptions for this consistency are restrictive, cash or liquid assets in this set up would be assumed to bear no holding costs (Opler et al., 1999). The pecking order of financing is retained earnings, debt, and lastly equity, and is driven by costs arising from information asymmetries (Myers & Majluf, 1984). Since equity is expensive, firms issue debt when facing insufficient funds to invest. If they do have sufficient funds, they repay debt and accumulate cash (Opler et al., 1999). In this case, cash would simply be negative debt. That means, for a firm it would make no difference to hold one Euro of cash or repay debt with it (Gogineni, Linn & Yadav, 2012; Opler et al., 1999). Hence, liquid assets would follow the same pattern as the firm's fortune and – assuming no costs of holding liquid assets – there is no need for a target cash level. However, if one allows for a liquidity premium in the financing order theory, the distinction toward the trade-off theory becomes unclear (Opler et al., 1999).

A discussion whether cash can be considered negative debt will follow in section 2.2.5. In this section the further focus lies on empirical findings whether companies have target levels, or not, independent of possible determinants.

Opler et al. (1999) study listed U.S. companies and find evidence that they show mean reverting behavior by adjust their cash balances to target cash levels. They find evidence in favor of both the trade-off and the financing hierarchy theory. The results show that firms with higher growth and investment opportunities, riskier firms, and small firms hold relatively more cash than others. Further, firms with greater access to capital markets tend to hold less cash.

In contrast, Dittmar, Mahrt-Smith and Servaes (2003) find that firms with easier access to capital markets hold larger amounts of cash. Also, Gao, Harford and Li (2013) compare private and public U.S. companies and find that, despite lower access to capital markets for private firms, public firms hold significantly higher cash amounts. This is consistent with Gogineni, Linn and Yadav (2012), who compare private and public firms in the United Kingdom (U.K.) They find that both kinds of companies have cash targets, but the speed of adjustment toward these targets is higher in private firms, which also hold lower amounts of cash. As Opler et al. (1999) they also find evidence that supports both theories. Gogineni, Linn and Yadav (2012) show that younger, riskier, and more financially constrained private firms hold more cash than other private firms. This result is in line with Opler et al. (1999) as well as with the results of Bigelli and Sánchez-Vidal (2012), who study private Italian firms.

However, Amess, Banerji and Lampousis (2015) point out that many of the empirical studies on cash targets assume optimal cash levels to be constant over time. This is, in their opinion, problematic since the targets are likely to depend also on exogenous economic and environmental effects, such as the financial crisis. Duchin, Ozbas and Sensoy (2010) investigate the transfer of cash holdings in U.S. firms over different economic states. They find that firms that hold excess cash during good states transfer it to bad states as a financing buffer, as assumed by the precautionary motive. The same evidence is drawn from a survey of Campello, Graham, and Harvey (2010), which further shows that financially constrained firms decrease their cash levels more in bad states than financially unconstrained firms. Bigelli and Sánchez-Vidal

(2012), on the other hand, observe that in their study some determinants lost significance when economic control variables are introduced.

To conclude, independent of being public or private, the sample firms in this thesis are expected to have target cash levels and to adjust their cash balances to these. Most findings point to the assumption that cash levels of private firms are, on average, lower than those of public firms.

2.2 What Determines the Level of Cash Holdings?

The focus of this section lies on the determinants of cash holdings. That means to identify both theoretically and empirically through existing studies, which factors influence the level of cash targets. Note that generally the determinants are the same for private and public companies but with different magnitudes. Differences, as a matter of course, are pointed out.

2.2.1 Firm Size

Theoretical arguments and empirical research consistently agree that firm size has a negative effect on corporate cash holdings, no matter whether a firm is private or public and independent of where it is located (Bigelli & Sánchez-Vidal, 2012; Brown & Petersen, 2011; Ferreira & Vilela, 2004; Gao, Harford & Li, 2013; Gogineni, Linn & Yadav, 2012; Opler et al, 1999). However, the reasons for this connection are manifold and firm size further incorporates many other firm characteristics, which are also considered as determinants of cash holdings.

First of all, due to substantial fixed costs of raising external capital large firms get easier and cheaper access to external financing (Barclay & Smith, 1995; Dittmar, Mahrt-Smith & Servaes, 2003; Miller & Orr, 1966). This effect holds for private and public companies likewise (Gogineni, Linn & Yadav, 2012). Furthermore, large companies tend to be more diversified (Rajan & Zingales, 1995) and therefore are able to sell non-core assets more easily in order to raise cash when needed (Lang, Poulsen & Stulz, 1995). Also larger and more diversified companies are more likely to establish internal capital markets and thereby lower the precautionary demand for liquid assets (Amess, Banerji & Lampousis, 2015).

Opler et al. (1999), Bruinshoofd and Kool (2004), and Harford, Mansi and Maxwell (2008) report that small firms are significantly lower leveraged, claiming that debt is a cash substitute in a sense that cash is interpreted as negative debt. Bigelli and Sánchez-Vidal (2012) support the effect firm size has on cash and cash substitutes by finding small firms also hold lower levels of working capital, another cash substitute.

Bigelli and Sánchez-Vidal (2012) find that small firms face a higher effective tax rate, probably caused by less optimization potential through international or group diversification. This is consistent with the evidence in Gao, Harford and Li (2013), who state that multinational firms hold more cash. The reason is that a higher tax rate increases the costs of holding liquid assets and thus the cash level increases with the marginal tax rate (Opler et al., 1999).

Whilst agreeing with the overall impact of firm size on cash holdings, Ferreira and Vilela (2004) identify two possible reasons, why larger firms might in fact hold more cash. Namely, they argue that larger firms have a more dispersed ownership structure and are therefore more subject to managerial discretion, giving rise to the second reason. Larger firms are less likely to be the target of takeover attempts and therefore the management have more discretionary power over the firm's resources, resulting in higher cash levels.

Bigelli and Sánchez-Vidal (2012) find that firm size is also correlated to some other firm characteristics than cash holdings. However, it must be pointed out that these findings are based on a study on Italian private firms and may not be generalizable. Moreover, the direction of causality might not be clear as well for these correlations. The findings are that small companies are significantly younger and riskier than their large counterparts. Further characteristics of private, small firms are a larger financing deficit whilst having a lower leverage and a lower proportion of bank debt on total debt. The authors explain these results with a lower credit worthiness because of the higher firm risk. Moreover, a longer cash conversion cycle and lower level of net working capital could be due to a lower bargaining power with contractors in terms of receivables and payables.

Consistently with theory and prior findings, firms in the sample of this thesis should show a negative relation between firm size and cash holdings, no matter if private or public. Note that all firms in the sample are defined as very large firms by Bureau van Dijk. Even if there are still economically significant variations in firm size, the effect of firm size on cash holdings in the cross-section should be less significant than in the papers cited here. Those papers usually include firms of every size.

2.2.2 Investment Opportunities

As with firm size, theory and empirical evidence consistently predict that cash holdings increase with better growth or investment opportunities (Bigelli & Sánchez-Vidal, 2012; Brown & Petersen, 2011; Ferreira & Vilela, 2004; Gao, Harford & Li, 2013; Gogineni, Linn & Yadav, 2012; Opler et al., 1999; Ozkan & Ozkan, 2004; Pinkowitz & Williamson, 2007).

The precautionary motive, partly, explains this dependency. A firm, short on cash, might miss valuable investment opportunities when they appear (Opler et al., 1999). Cash holdings can be interpreted as a real option on investment opportunities, and as such, in uncertain price and cost environments, the option value increases with the investment opportunities (Dixit & Pindyck, 1994; McDonald & Siegel, 1986). Supportive and consistent with this is also the finding of Pinkowitz and Williamson (2007) that not only an increase, but also a higher magnitude in investment opportunity volatility leads to higher corporate cash values. Brown and Petersen (2011), further, find evidence that firms use cash to smoothen R&D expenditures. Ang (1991) states that the costs of forgone investment opportunities are much higher for private than for public firms. Hence, the precautionary motive, and consequently the cash holdings, should be greater for private firms (Bigelli & Sánchez-Vidal, 2012; Gogineni, Linn & Yadav, 2012).

Information asymmetries influence the impact of investment opportunities on cash balances as well. To ensure not to miss valuable investment opportunities when they arise, firms could choose a low leverage. However, for firms which suffer from information asymmetry, the costs

of raising external capital could still be higher than the cost of holding liquid assets (Amess, Banerji & Lampousis, 2015; Myers & Majluf, 1984; Opler et al., 1999).

Again, in line with theory and empirical evidence, the firms observed here are expected to show a positive correlation between investment opportunities and cash balances. However, note that due to the selection of tech companies, implying similar expectations for growth opportunities, differences between the single firms should be negligible, regardless of their organizational structure.

2.2.3 Cash Flow

Cash holdings increase with cash flow volatility. Again, this dependency is consistently assumed by theory and proven by empirical research (Bates, Kahle & Stulz, 2009; Bigelli & Sánchez-Vidal, 2012; Gao, Harford & Li, 2013; Gogineni, Linn & Yadav, 2012; Opler et al., 1999; Pinkowitz & Williamson, 2007).

Uncertainty in cash flows increases the likelihood of a firm, suffering from poor business conditions and thereby increases the probability of bankruptcy or of bypassing valuable investments. Hence, the precautionary motive predicts cash holdings to increase with cash flow volatility, since cash acts as a buffer in such times (Bigelli & Sánchez-Vidal, 2012; Ferreira & Vilela, 2004; Gogineni, Linn & Yadav, 2012; Opler et al., 1999). Pinkowitz and Williamson (2007) state that cash flows and investment opportunities are strongly correlated, and argue that therefore cash flow volatility has the same implications for cash holdings as investment opportunity volatility. Namely, higher cash value for higher cash flow risk.

While these results should apply to all companies, there are probably differences in the magnitude of the dependency between public and private companies, driven by financial constraints (Amess, Banerji & Lampousis, 2015; Bigelli & Sánchez-Vidal, 2012; Gogineni, Linn & Yadav, 2012). Almeida, Campello and Weisbach (2004) and Han and Qui (2007) argue, and find evidence, that financially constrained firms have even more incentives to save cash out of cash flows than less constrained firms. Since financing frictions and the degree of financial constraints should be higher in private firms, cash flow volatility should have a greater impact on cash holdings than for public firms, and lead to higher cash levels (Bigelli & Sánchez-Vidal, 2012; Gogineni, Linn & Yadav, 2012). Moreover, Almeida, Campello and Weisbach (2004) show that in the absence of financial constraints cash flow should not affect cash holdings at all.

Alternatively, a firm's financing deficit potentially comprises more information since it not only measures a firm's cash flow, but also the exact amount of the yearly external financing demand (Shyam-Sunder and Myers, 1999). By financing hierarchy theory, a firm with a larger financing deficit is expected to hold less cash or more debt, or both (Bigelli & Sánchez-Vidal, 2012; Gogineni, Linn & Yadav, 2012).

Again, the expectation for the chosen sample is the same as by theory and prior work. Cash holdings should increase with firm risk. The selection of the sample again should smoothen

differences between single firms, since they operate with similar industries. However, the impact of operating risk on cash holdings of private firms is predicted to be higher than on public firms.

2.2.4 Access to Capital Markets

Theory suggests that access to capital markets has a negative impact on cash holdings, which is mostly backed by empirical findings (Almeida, Campello & Weisbach, 2004; Bates, Kahle & Stulz, 2009; Bigelli & Sánchez-Vidal, 2012; Gao, Harford & Li, 2013; Gogineni, Linn & Yadav, 2012; Opler et al., 1999). Ferreira and Vilela (2004) find the same for access to bank financing. Opler et al. (1999) argue that the costs of raising external funds should be lower for firms that already have access to capital markets. They continue arguing that credit lines might be a substitute to capital market access, but that these lines may get cancelled when most valuable for a company. The background is that information asymmetries may disturb outside financing possibilities. As Myers and Majluf (1984) state that information asymmetries lead outsiders to discount securities when purchasing them, to ensure that these securities are not overpriced. Hence, external financing becomes more expensive. If the discount is too large, firms might not be willing to sell securities but cut back investments. Opler et al. (1999) see parallels to the transaction costs motive, including the predictions the theory allows. The difference is that information asymmetries give an explanation why outside financing would be expensive. Since information asymmetries can change over time, building up financial slack in times of low information asymmetries can be valuable for a firm (Myers & Majluf, 1984).

The access to external funds is, of course, very different between private and public companies (Ang, 1991). One reason for this is that private firms face higher information asymmetries. Private firms lack a public pricing mechanism, which provides aggregate information, and analyst research (Mantecon, 2008). Further, opacity to outsiders is higher and a lack of sophistication within the firm's management to estimate the true value of investments is possible (Mantecon, 2008; Myers & Majluf, 1984). Another reason for private companies not to access equity capital markets is given by Brav (2009). Private firms simply might be reluctant to tap capital markets in order to retain control, and further to avoid higher equity costs driven by their level of opacity. With less access to outside markets, financing costs increase, and the precautionary motive for holding cash would predict private firms to hold larger cash piles than their private counterparts (Gao, Harford & Li, 2013). Further, the dispersion of slack should increase with greater information asymmetry (Antunovich, 1996; Brav, 2009), for which Gao, Harford and Li (2013) found evidence. In spite of these restrictions, private firms possibly have an advantage over public firms in accessing bank debt. A lot of private firms have only few shareholders, who belong to the founding family and can pledge for the bank debt (Bigelli & Sánchez-Vidal, 2012; Brav, 2009).

This variable potentially reflects a major distinction between cash levels of private and public firms in the sample. The expectation is that access to capital markets has a negative impact on corporate cash holdings.

2.2.5 Cash Substitutes

Increasing levels of cash substitutes lower the cash levels within a firm (Bigelli & Sánchez-Vidal, 2012; Gogineni, Linn & Yadav, 2012; Opler et al., 1999). Bigelli and Sánchez-Vidal (2012) argue that cash substitutes are even more determinant in private companies, since they face higher debt agency costs and information asymmetries, as aforementioned. While these results seem intuitive, it is necessary to ask what cash substitutes are. There are five potential candidates discussed below, namely, cash as negative debt, bank lines of credit, net working capital, selling of non-core assets, and internal capital markets.

Opler et al. (1999) argue that, since cash can be used to amortize debt, it can generally be considered as negative debt. Acharya, Almeida and Campello (2007), however, find this relation only to be true in the absence of financial frictions or in financially constrained firms with low hedging needs. Bigelli and Sánchez-Vidal (2012) question these findings, reasoning that these inferences are based solely on publicly listed U.S. firms, and thus are not generalizable. Further, they note that financial constraints are hard to measure and the measures that were used are not applicable to private firms. In their own study on private Italian firms, they show that bank debt can be viewed as negative debt and that it plays a significant role in explaining cash balances. Ozkan and Ozkan (2004) and Ferreira and Vilela (2004) find the same for listed firms in the U.K. and the EU. Gogineni, Linn and Yadav (2012) also observe a negative relation between cash holdings and leverage in their study on private and public U.K. firms. Guney, Ozkan, and Ozkan (2007), however, present results indicating a non-linear relationship between the two variables. Companies tend to hold more cash when they either have a very low or a very high leverage. They argue that while leverage serves as a cash substitute it also increases the probability of default, and hence a higher precautionary demand for cash with high leverages, resulting in the U-shaped relation.

Another potential cash substitute is bank lines of credit, which can be interpreted as an option on liquidity, consistent with the precautionary motive (Holmström & Tirole, 1998). However, Lins, Servaes and Tufano (2010) find that managers use bank lines of credit and cash differently. While the purpose of cash is to represent a buffer against financial distress, bank lines of credits are used when management expects future investment outlays to need large external funds, opposing the precautionary motive. The problem about credit lines is that when they are needed as a liquidity buffer against financial distress, firms might not meet the banks covenant restrictions and the credit lines get cancelled (Amess, Banerji & Lampousis, 2015; Opler et al., 1999). Therefore, Amess, Banerji and Lampousis (2015) categorize cash as unconditional liquidity buffer and credit lines as conditional on whether a firm meets certain covenants.

Net working capital (net of cash) is considered a typical cash substitute for it can be easily transformed into cash, for example by factoring (Demiroglu & James, 2011; Opler et al., 1999). Financing hierarchy theory and empirical findings consistently report a negative impact of net working capital on cash holdings, regardless of a firm being private or public (Bigelli & Sánchez-Vidal, 2012; Gogineni, Linn & Yadav, 2012; Opler et al., 1999).

The following two potential cash substitutes are increments of firm size and were already discussed. However, to provide a complete overview of cash substitutes they find consideration here again.

Shleifer and Vishny (1992) mention monetarization of non-core assets as a potential source of liquidity. They argue that a firm's cash balances increase with the ratio of firm-specific assets they hold, since those are harder to sell. Consequently, diversified firms, assuming they are less likely to be specialized and hold substantial non-core assets, are suggested to hold lower liquid funds.

Duchin (2010) find that internal capital markets reduce a firm's precautionary demand for cash. Subramaniam et al. (2011) suggest that growth opportunities, differing across divisions, complement each other, leading to lower cash holdings. In contrast, Tong (2011) assumes a negative effect of diversification on cash value. However, there is consistent evidence that internal capital markets reallocate funds to constraint divisions (Matsusaka & Nanda, 2002; Stein, 1997). According to Rudolph and Schwetzler (2013), benefits of internal capital markets increase with financing frictions of external markets. But Shin and Stulz (1998), Scharfstein and Stein (2000), and Rajan, Servaes and Zingales (2000) report that internal market efficiency can as well suffer from internal information asymmetries and agency costs.

In general, cash substitutes should have a negative impact on cash holdings, regardless of the organizational structure. Bank lines of credit can be dismissed as a minor substitute, since it serves in different ways as plain cash. The selling of non-core assets and internal capital markets are increments of firm size and therefore also play a minor role as real cash substitutes. Leverage is expected to show either a negative or a non-monotonic relation to cash holdings. Note that a prediction about this relation is impossible at this point, since it is unknown whether there are highly leveraged firms in the sample. For net working capital the relation is clearly assumed to be negative.

2.2.6 Effective Tax Rate

Corporate cash holdings increase with a decreasing effective tax rate (Bigelli & Sánchez-Vidal, 2012; Foley et al., 2007; Gao, Harford & Li, 2013; Opler et al., 1999). Opler et al. (1999) argue that taxes increase the holding costs of liquid assets, since its interest income is subject to double taxation. First it is taxed at the corporate level and again when distributed to the firm's shareholders. If cash is instead used to repay debt or repurchase shares the investor's marginal tax rate on cash holdings would decrease by the company's tax rate. Foley et al. (2007) further state that tax laws encourage multinational firms to hold more cash. Bigelli and Sánchez-Vidal (2012) support this statement, finding that small firms, which are potentially less diversified, internationally or across sections, have a higher effective tax rate. Consistently, Gao, Harford and Li (2013) show evidence that multinational firms hold more cash.

The influence of the effective tax rate on cash holdings is supposed to be negative. Again, since all firms in the sample are defined as very large, the variation of effective tax rates should be relatively small, no matter if investigating a private or public firm.

2.2.7 Financial Distress

Keynes (1936) introduces the precautionary demand for cash as a buffer for unexpected events. In addition to just providing funds to invest when cash flows are low, liquid assets can also lower financial distress costs (Ferreira & Vilela, 2004). Therefore, several authors include this variable in their studies (Bigelli & Sánchez-Vidal, 2012; Gogineni, Linn & Yadav, 2012; Hall, Mateus & Mateus, 2014; Lins, Servaes & Tufano, 2010; Opler et al., 1999; Opler & Titman, 1994). The relation is found to be positive, meaning that firms with a higher probability of financial distress hold higher amounts of cash.

For the sample in this thesis the same correlation is expected, for both kinds of firms.

2.2.8 Dividend Payments and Stock Repurchases

The implications of dividend payments on cash holdings are very different for public and private firms. This section is therefore separated into two parts, first looking at public, then at private companies.

Public firms distribute money to shareholders by either paying dividends or repurchasing stocks and thereby reduce cash balances. Companies with investment opportunities then have to raise outside funds more frequently. The act of paying dividends hence reduces agency costs and leads to more efficient monitoring of the firm (Easterbrook, 1984). Firms that currently pay dividends can simply cut these to gain liquid funds, firms that do not pay dividends have to use the capital markets (Opler et al., 1999). In particular, financially constrained firms, which have problems to raise outside funds, would be expected to cut back dividends, in case they currently do pay out those (Fazzari et al., 1988). But cutting back dividends signals bad news to capital markets and a firm might be punished by the markets, therefore firms might be reluctant to cut dividends (Gogineni, Linn & Yadav, 2012). In fact, Brav (2009) and Michaely and Roberts (2012) provide evidence that public firms tend to smooth their pay out policies, such that dividend payments are weakly sensitive to the firm's operating performance. Therefore, the financing hierarchy model predicts public firms that pay more dividends to hold lower levels of cash. But instead, evidence shows a positive correlation (Harford, Mansi & Maxwell, 2008; Opler et al., 1999). To bring these finding together, Opler et al. (1999) compare dividend payments to capital expenditures, for which the trade-off model suggests an increase with higher corporate cash levels. Amess, Banerji and Lampousis (2015) further state that the results of Opler et al. (1999) are inconsistent with agency theory. But Brav et al. (2005) report in their study that management often disciplines itself by paying dividends or repurchasing stocks. On the other hand, they argue that it might be the case that management simply pays out enough cash to satisfy the firms shareholders and retain control over the residual funds without being monitored too much.

Private firms have considerably fewer shareholders than public firms. Many private firms only have one shareholder, the founder, or the founding family (Brav, 2009; Corbetta & Montemerlo, 1999). As such, the shareholder's private wealth and the firm's assets are often perceived as one and salary and dividend payments mean the same to the owner (Ang, 1992). Moreover, private firms' payout choices are not affected by any market signaling issues (Bigelli &

Sánchez-Vidal, 2012). Therefore, a firm's choice to pay dividends is much more sensitive to its operating performance and the cash demand and empirical research shows that private companies that pay dividends, in fact, hold more cash (Bigelli & Sánchez-Vidal, 2012; Brav, 2009; Gogineni, Linn & Yadav, 2012; Michaely & Roberts, 2012).

Against theoretical considerations, empirical work shows that public firms that pay dividends hold high cash balances. Hence, a clear prediction for public firms in this sample cannot be made and every outcome would have an explanation. For private firms, however, dividend payments can be expected in firms that hold large amounts of cash.

2.2.9 Cash Conversion Cycle

The cash conversion cycle of a company determines how fast it generates cash from its operations. A shorter cycle means a quicker cash generation and hence a lower demand for cash holdings (Bigelli & Sánchez-Vidal, 2012; Opler et al., 1999). Opler et al. (1999) further assume diversified firms and firms with a low inventory-to-sales ratio to have a short cash conversion cycle and therefore to hold less cash. This variable has the same implications for both public and private firms and empirical evidence verifies that firms with a shorter cycle hold less cash (Bigelli & Sánchez-Vidal, 2012; Opler et al., 1999).

In consistency with theory and empirical findings, the sample firms here are expected to hold less cash with a shorter cash conversion cycle.

2.2.10 Macroeconomic Factors

Several authors point out that both a company's industry and home country have significant influence on its cash holdings. Since in this thesis both factors are the same for all companies, this section will only quickly explain this determinant.

Pinkowitz and Williamson (2007) find huge differences in the excess cash value for firms in different industries, depending to great extent on differences in investment opportunities.

Aggarwal and Goodell (2009a, 2009b) show that social and legal country characteristics influence whether a country relies more on a bank- or market-based system. This is further developed by Morck, Stangeland, and Yeung (2000). Dittmar, Mahrt-Smith, and Servaes (2003) find that corruption, country risk, and shareholder protection explain cross-country differences in cash holdings. They also named inflation as a significant macroeconomic variable.

Amess, Banerji, and Lampousis (2015), as aforementioned, further argue that exogenous economic and environmental factors affect corporate cash holdings. During better economic states firms tend to accumulate cash and use it to countervail lower cash inflows during worse economic states (Duchin, Ozbas & Sensoy, 2010). This mechanism is found to be even stronger for more financially constrained firm (Campello, Graham & Harvey, 2010). However, Bigelli and Sánchez-Vidal (2012) found that, when controlling for external effects, some cash determinants lose their significance.

Industry or country differences, of course, will be of no concern in this study. Exogenous economic and environmental influences, however, are of great interest, since most prior studies did not account for this factor (Amess, Banerji & Lampousis, 2015). Cash holdings are expected to coincide with the economic situation, with a greater magnitude in private companies.

2.2.11 Summary

In summary, cash holdings are expected to increase with

- investment opportunities,
- cash flows, with even greater effect in private firms,
- financial distress,
- dividend payments, but only in private firms, for public firms the expectations are unclear, and
- exogenous effects.

A negative impact on cash holdings is assumed with

- larger firm size,
- access to capital markets,
- higher cash substitutes like net working capital and leverage,
- higher effective tax rate, and
- shorter cash conversion cycle.

Since these relationships were proven in several other studies, they should be true for this thesis as well. That means, in case the results in section 4.3 are completely different, the remainder of the analysis cannot be considered reliable.

2.3 What Drives Deviations from Cash Level Targets?

Jensen and Meckling (1976) introduce the literature on agency costs, discussing how the separation of ownership and control disturbs firm behavior. Later Jensen (1986) develops the theory to the influence of agency costs on free cash flow, and hence cash holdings. The theory suggests that managers might allocate resources to their own advantage instead of using them efficiently in terms of shareholder wealth maximization. For instance, managers might spend excess cash on poor projects in case valuable investments are not available (Opler et al., 1999). Cash holdings are particularly easy accessible to that use. In contrast, one could also argue that managers are risk averse and simply accumulate cash to avoid market discipline or to build up financial slack (Myers & Majluf 1984). However, for firms with high investment opportunities, agency costs might be negligible, since management's and shareholder's objectives are more likely to be aligned (Opler et al., 1999).

Evidence on agency effects on cash holdings in both public and private firms is inconclusive (Gogineni, Linn & Yadav, 2012). A lot of authors agree that agency costs are important in

explaining differences in cash holdings between companies. The severity of agency costs thereby increases the deviations from cash targets (Bigelli & Sánchez-Vidal, 2012; Dittmar & Mahrt-Smith, 2007; Dittmar, Mahrt-Smith & Servaes, 2003; Gao, Harford & Li, 2013; Gogineni, Linn & Yadav, 2012; Harford, Mansi & Maxwell, 2008; Kalcheva & Lins, 2007; Nikolov & Whited; 2014). However, some disagree and report agency costs as insignificant (Mikkelson & Partch, 2003; Opler et al., 1999).

Bigelli and Sánchez-Vidal (2012) argue that the separation of ownership and control is exclusively a problem for public companies, not for private companies with a concentrated ownership structure. With such a structure management might be more easily monitored by the owners (Gogineni, Linn & Yadav, 2012). Other researchers, in fact, do find statistically and economically significant agency costs and effects on cash holdings in private firms, potentially caused by variations in the ownership structure and governance mechanisms of private firms (Ang, Cole & Lin, 2000; Gogineni, Linn & Yadav, 2013; Nagar, Petroni & Wolfenzon, 2010).

To investigate agency effects on corporate cash holdings, the next question consequently is, where agency issues precisely spring from. Obviously, the separation of ownership and control is a source of agency conflicts. In fact, Shleifer and Vishny (1986) argue that the higher the shareholder dispersion is, the higher the excess cash. The quality of corporate governance should play a role as well (Amess, Banerji & Lampousis, 2015; Gogineni, Linn & Yadav, 2012; Opler et al., 1999). Pinkowitz and Williamson (2001) further argue that bank power, as a control tool, also influences agency costs. The likelihood of a firm to not be targeted for takeovers should increase excess cash, especially if there are anti-takeover charter amendments. And lastly, a lower leverage reduces market monitoring, leaving room for agency conflicts and excess cash (Opler et al., 1999). These variables are discussed in more detail next.

2.3.1 Threat of Takeover

According to Amess, Banerji, and Lampousis (2015) the threat of takeover can discipline managers as it induces them to not take part in non-value-maximizing behavior. Consequently, antitakeover provisions, making takeovers less likely, weaken this governance device. There is evidence verifying this relation. Brisker, Çolak and Peterson (2013) find that an increased use of antitakeover provisions comes along with increasing cash holdings. Masulis, Wang and Xie (2009) show that when management have disproportionately high voting rights, protecting them from takeover threats, the value of cash holdings decreases. Further, Opler et al. (1999) argue that higher ownership dispersion makes takeovers less likely and hence increase the likelihood of holding excess cash. The reasoning is that in absence of large independent shareholders a takeover is less likely (Shleifer & Vishny, 1986) and therefore management does not have to fear market discipline and can afford to pursue its own objectives. Moreover, Opler et al. (1999) argue that excess cash also increase the threat of takeovers, since liquid funds can be used by the bidder to pay for an acquisition, and therefore with a higher threat of takeovers a firm's management might want to keep low cash balances instead of amplifying the threat by holding excess cash.

While private firms are fundamentally different from public firms with regard to their ownership structure, having significantly fewer shareholders (Bigelli & Sánchez-Vidal, 2012; Brav,

2009; Corbetta & Montemerlo, 1999), one can argue that the above argument still holds. Brav (2009) states that private firms might be reluctant to access capital markets in order to keep control over the company. A takeover would mean partial or full loss of control and consequently the aforementioned argument should hold. On the other hand, an owner-managed firm would not have to fear any takeover attempts, since all voting rights lie with the manager. But at the same time, these firms are assumed to not really suffer from agency problems anyway (Gogineni, Linn & Yadav, 2012; Jensen, 1986).

These considerations lead to the first hypothesis.

Hypothesis 1: The threat of takeover lowers agency costs, and consequently excess cash holdings, in public firms. On private firms this agency costs determinant should have no significant influence.

2.3.2 Corporate Governance

This examination of corporate governance is separated into two parts. Managerial ownership is discussed first, including issues of family ownership and political connections in private companies. The second part examines the board of directors.

The underlying assumption that large cash holdings are induced by agency problems implies that any alignment between owners and managers of a firm reduces cash balances (Amess, Banerji & Lampousis, 2015). One potential solution is to tie managers to shareholder fortune, namely by managerial ownership (Amess, Banerji & Lampousis, 2015; Opler et al., 1999). While Nikolov and Whited (2014) suggest that lower managerial ownership significantly raises cash balances, Liu and Mauer (2011) contrast this view, stating that higher managerial ownership increases cash holdings, but with a lower cash value. These contrasting findings can probably be explained by two opposing effects of managerial ownership. While it aligns interests of managers and shareholders, it also protects managers against external pressure, and further potentially makes managers more risk averse. To the extent that cash holdings are costly and the firm currently holds excessive amounts of cash, the holdings are expected to fall with managerial ownership. However, if management becomes more risk averse, cash holdings are expected to increase with managerial ownership (Opler et al., 1999; Stulz, 1988). The results of Ozkan and Ozkan (2004) are complementing to this. Their evidence shows that the influence of managerial ownership on cash holdings are non-monotonic. With increasing managerial ownership, at first cash levels decrease, then rise, and later fall again. The reason is that first cash holdings decrease with agency problems. Then, however, managerial entrenchment settles in and liquidity provides managers with job security and the possibility to pursue private benefits. Eventually, management holds so much shares of the company that they themselves bear the largest share of every misused unit of cash (Amess, Banerji & Lampousis, 2015; Elyasiani & Zhang, 2015).

According to Jensen (1986) private firms should be characterized by low or even no agency costs of free cash flow. In family firms the owners or founders, often large shareholders, can act as efficient monitors of the management (Amess, Banerji & Lampousis, 2015). In fact, family control can substitute weak formal institutions (Burkart, Panuzi & Shleifer, 2003) and by

their long-term commitment to the firm even lessen debt agency problems with financiers (Anderson, Duru & Reeb, 2012; Anderson, Mansi & Reeb, 2003). These effects would lower the precautionary demand for cash (Amess, Banerji & Lampousis, 2015). On the other hand, family ownership is a potential source of another kind of agency problems between the family and minority shareholders (Almeida & Wolfenzon, 2006). There is evidence that in such settings the family owners expropriate other stakeholders. Shareholders might suffer from cash diverted for private liquidity needs or projects of private interest (Bertrand, Mehta & Mullainathan, 2002; Lins, Volpin & Wagner, 2013). Further, powerful families might have close connections to the Government and use these to pursue rent-seeking activities (e.g. Faccio, 2006, Khanna & Yafeh, 2007, Morck & Yeung, 2004), but evidence here is mixed and varies across countries (Amess, Banerji & Lampousis, 2015).

Another important governance tool to mitigate agency problems is the board of directors, which monitors management and protects shareholder interests. Consequently, the more independent the board is the more efficient it is in restricting manager's discretionary behavior (Amess, Banerji & Lampousis, 2015). This theory, however, was neglected with regard to impact on corporate cash holdings (Harford, Mansi & Maxwell, 2008; Ozkan & Ozkan, 2004) and with regard to high cash firm's operating performance (Mikkelson & Partch, 2003).

While theory suggests cash holdings to decrease with governance quality, Harford, Mansi and Maxwell (2008), studying public U.S. firms, find that worse-governed firms in fact hold less cash than well-governed firms, because those firms tend to spend instead of holding cash reserves. Gogineni, Linn, and Yadav (2012) also find that private firms with less severe agency problems, or a higher managerial ownership, hold more cash than those with higher agency problems, or less managerial ownership. Gao, Harford, and Li (2013) argue that outcomes of comparisons between public and private firms might therefore be hardly interpretable. If the outcome is that public firms hold less cash than private firms, the cause can either be financing frictions or agency costs. The only explicit proof of agency costs would be if public firms hold more cash than private firms.

In their own study of public and private U.K. companies, Gao, Harford, and Li (2013) find mixed results for the existence of agency effects. However, they explain their results as follows. Well-governed firms hold excess cash as "a natural consequence of being profitable, not overinvesting, and adjusting payout policy with a lag" (Gao, Harford & Li, 2013, p.2). Hence, instead of undertaking large investments with excess cash and spending it at a greater rate, well-governed firms slowly adjust to their target cash levels by paying out cash to shareholders or amortize debt.

Reconsidering prior findings that private firms hold less cash than public firms and assuming that private firms are on average better-governed than public firms, the second hypothesis follows.

Hypothesis 2: Agency costs are decreasing with higher quality of corporate governance and so do excess cash holdings.

2.3.3 Bank Power

Pinkowitz and Williamson (2001) examine the influence of institutional powers, namely banks, on cash holdings of industrial firms in the U.S., Germany, and Japan. Their study actually focuses on a comparison between the market-based U.S. system and the bank-based system. These institutions are both main financier and monitor in their respective markets. They predict that due to strong relationships between Japanese firms and their main banks agency costs should be reduced, as the relationship should lower information asymmetries and discretionary behavior. The main bank in Japan takes the role of a well-informed shareholder, also holding equity, that carries the costs of monitoring, disciplines management and reduces financial distress costs, especially for poor managerial performance. Further, the authors state that the German system is similar to the Japanese one, but in addition German banks have even greater voting power and there often exists another large non-bank blockholder in the company.

Interestingly, while Japanese firms hold higher cash balances than their U.S. counterparts, the cash holdings of German firms are comparable to those of the U.S. Pinkowitz and Williamson (2001) conclude that there are agency costs of a bank-based system in absence of another monitoring source, such as a large non-bank blockholder or a well-developed capital market. They argue that Japanese banks induce firms to hold higher cash amounts in order to be able to extract rents from the firms, or to lower monitoring costs. Ozkan and Ozkan (2004), in contrast, find that firms with higher fractions of bank debt hold less cash. But, they study U.K. firms, hence firms in a market-based system where bank power is lower and hence, the results are consistent. Finally, Ferreira and Vilela (2004) study European firms and provide evidence that bank power reduces agency costs and cash holdings due to better monitoring and lower information asymmetries.

Having a bank-based system in Germany, and usually a large non-bank blockholder the third hypothesis is developed.

Hypothesis 3: An increasing fraction of bank debt lowers agency costs and cash holdings in both public and private firms.

2.3.4 Leverage

Jensen (1986) argues that debt with fixed payment obligations can discipline managers by forcing them to pay out cash instead of accumulating it or pursuing private benefits by spending it on unprofitable investments. Thus, a higher leverage reduces cash holdings and agency costs thereby increasing firm value. At the same time, however, the probability of default and hence bankruptcy costs increase (Amess, Banerji & Lampousis, 2015; Barclay, Smith & Morellec, 2006). Faulkender and Wang (2006) in fact find that in firms with higher leverage, ceteris paribus, cash value decreases.

From high leverage another kind of agency costs can potentially arise between debtholders and shareholders, and possibly between different classes of debtholders. With increasing debt agency costs issuing new debt becomes harder and more expensive for firms and renegotiating existing debt contracts to prevent bankruptcy might be more difficult or even impossible (Opler

et al., 1999). In this situations firms are more likely to engage in asset substitution and to face underinvestment problems (Jensen & Meckling, 1976; Myers, 1977; Opler et al., 1999).

Obviously, the effect of leverage on agency costs is not as clear as expected. Moreover, as aforementioned, debt can also be viewed as cash substitute, even with its U-shaped relation to cash holdings. For these reasons, leverage in the forthcoming model is suggested as a cash determinant rather than an agency costs determinant.

2.4 Interim Conclusion

There are four main theories on cash holdings: the transaction motive, the precautionary motive, the financing hierarchy theory, and the free cash flow, or agency, theory. Each theory has different ways of explaining corporate cash holdings, but at some points predict the same relations or complement each other.

Based on these theories, it is possible to make certain predictions about corporate cash holdings. The first is that companies, private and public ones, do have cash targets to which they gradually adjust their cash levels.

Secondly, it is possible to make assumptions about certain firm characteristics that determine the optimal level of cash holdings. Discussing the different theories and existing research papers on cash holdings, the following relationships are expected to hold:

- Positive correlations between cash levels and investment opportunities, cash flows, financial distress, macroeconomic influences, and – in private companies – dividend payments, are predicted.
- And negative correlations with cash holdings are predicted with firm size, access to capital markets, cash substitutes, the effective tax rate, and the length of the cash conversion cycle.

Finally, deviations from these target cash levels need justification. This is provided by the introduction of agency costs. Again, theoretical considerations and empirical papers on the relationship between agency costs and excess cash led to the formulation of three hypotheses which are going to be tested.

The first hypothesis is, that in public firms a higher takeover likelihood is expected to decrease agency costs and subsequently cash holdings. In private firms no such relation should exist. Secondly, corporate governance quality potentially decreases agency costs. Finally, higher bank debt ratios are supposed to be agency costs deterrents, even more in public firms.

3 Methodology and Data

This section describes the research approach and methodologies applied to investigate the research question. Again, it is structured in the order of execution of the model, after giving a comprehensive outline of the research approach. First, the data sample and its collection, including sources and criteria, is explained. After collecting the data, the variables needed to proxy the firm characteristics, which are described in sections 2.1 to 2.3, are created. This is presented in section 3.3 and separated in three parts, based on the three distinct models that lead to the objective of measuring agency costs influences on excess cash. The three following sections describe each model and discuss their advantages and pitfalls. The order of these three sections, of course, follows the line of action, starting with the mean reversion model, then the cash target model, and finally the excess cash model. Eventually, section 3 closes with an interim conclusion.

All data was collected in Excel spreadsheets, where it was also transformed into the variables described in section 3.3. The analyses were then run in EViews 9.5.

3.1 Research Approach

The analysis in this paper is conducted in three consecutive steps. The first two steps, checking for mean reverting behavior of the firms and determining their respective cash targets, are largely adopted from Opler et al. (1999), in accordance with several other prior studies (Bigelli & Sánchez-Vidal, 2012; Ferreira & Vilela, 2004; Gao, Harford & Li, 2013; Gogineni, Linn & Yadav, 2012; Hall, Mateus & Mateus, 2014). These stages are preparatory for investigating agency costs impact on excess cash holdings. First of all, it is important to work out whether the firms in the sample have cash targets and consistently adjust their cash holdings to these targets. As shown in section 2.1, such a behavior is expected to be true. The next successive step is to determine the corresponding level of cash targets for each company, which allows to observe deviations from these targets, namely excess cash holdings. Finally, and divergent from prior work on cash holdings, the objective is to explain the deviations from cash targets by potential sources of agency costs, which were discussed in section 2.3.

3.2 Data

This section describes the collection and constitution of the data sample.

3.2.1 Sample Source

The first step was to identify companies suitable to this study. The main criteria for public firms was to be listed in a regulated market, which includes the General Standard and Prime Standard of the Deutsche Börse AG. Further, the companies had to be categorized as a technology company by the definition provided by the Deutsche Börse AG. Hence, not only the 30 companies constituting the TecDax were included but also any other public technological company listed at the regulated markets of the Deutsche Börse AG. In addition, these firms had to be listed during the entire period of interest, that means from 2004 to 2014. Private companies were identified using the Bureau van Dijk's Orbis database. The database contains information of private and public firms worldwide. Making use of the industry definitions provided by the Deutsche Börse AG, the TecDax provider, the following North American Industry Classification System (NAICS) codes were identified as fitting counterpart: 334, 335, 3391, 541711, 517, 518. Further criteria added to search for both public and private companies were to be active, situated in Germany, incorporated before 2002, and to be very large. The definition of a very large company by the database includes companies that have operating revenues greater than 100 million euro per year, total assets exceeding 200 million euro, more than 1,000 employees, or that are listed. Hence, every public company is considered as very large. Therefore, to ensure that private and public firms in the sample are comparable, very large was one of the criteria for private firms to be considered in the sample. The search outcome was a list of 273 private and 139 public companies.

To then obtain the financial data needed for the analysis, CapitalIQ was used. CapitalIQ provides company information as balance sheets and income statements for private and public companies in a standardized format and is thus appropriately suited for the conducted research. Further, information on the TecDax index was drawn from the Deutsche Börse AG. The Consumer Price Index for Germany was obtained from the German Federal Statistical Office (Statistisches Bundesamt).

3.2.2 Exclusions and Final Sample

To gain a comprehensive dataset, several adjustments to the initial dataset had to be made. Concerning public companies, one had to be excluded for being situated in another country than Germany. Several other companies had to be excluded for going public during the sample period, or becoming virtually bankrupt. A few more had to be left out because of incomplete data. That left 97 companies in the public sample.

Regarding private companies, all companies that have either some kind of capital market access, through a parent or any other related company, or a non-German parent company were excluded. Also firms that went bankrupt were excluded. The sample at this point included 103 private firms. A further big problem with the private sample was data availability. Because of incomplete data sets, the final sample only contained 21 private firms.

3.3 Variable Definitions

This section discusses how the firm characteristics described in sections 2.1 to 2.3 are measured most appropriately, given the available data set.

3.3.1 Cash Holdings

In order to execute the model described in section 3.4, basically only one variable is needed, cash. This variable is as well necessary in the second model, as the explained factor.

Consistent with most other studies on corporate cash holdings in this paper liquid assets will be defined similar to Opler et al. (1999) and other authors (Bates, Kahle & Stulz, 2009; Bigelli & Sánchez-Vidal, 2012; Ferreira & Vilela, 2004; Gao, Harford & Li, 2013; Gogineni, Linn & Yadav, 2012; Kim, Mauer & Sherman, 1998). That is, liquid assets, or cash holdings, are defined as cash and cash equivalents divided by total assets net of cash and cash equivalents.

Equation 1: Cash Holdings

$$Cash = \frac{Cash\ and\ Cash\ Equivalent}{Total\ Assets - Cash\ and\ Cash\ Equivalents}$$

While this definition is adopted by most authors, it needs to be mentioned that it inherits potential biases. Amess, Banerji, and Lampousis (2015) provide a summary of different papers concerned with the actual liquidity of assets included in marketable securities, which is problematic in regard to the precautionary motive. Especially the work of Duchin et al. (2014) shows that there are discrepancies between reported and actual liquid asset holdings. The paper of Opler et al. (1999) measures liquid assets as cash plus short-term investments, the other aforementioned authors measure cash as cash and cash equivalents. It seems, however, that the exact measure is related to the data source used, Oplert et al. (1999), for example, use Compustat, where cash and short-term investment are aggregated in one item (item 1). CapitalIQ, the source used here, separates cash and cash equivalents and short-term investments and thus, the cash measure is assumed to be unbiased.

Another bias incorporated is caused by differences in accounting standards. Public firms, reporting IFRS generated accounts, have higher total assets as if they had, would they report following the HGB standards (Devalle, Onali & Magarini, 2010). Therefore, cash holdings of public firms are always biased downwards to some extent.

3.3.2 Cash Determinants

Potential determinants of cash holdings are discussed in section 2.2. Now certain proxies for these determinants are to be defined. The order is the same as in the discussion.

Again, it is important to notice that because of the different accounting standards of public and private firms, the variable of total assets (TA) will always be biased downwards. Since TA is the denominator of several measures defined in this section, those measures will be biased downwards as well, leading to lower values relative to private companies.

Following Opler et al. (1999), firm size (FS) is measured as the natural logarithm of the book value of total assets in 2014 euros (cp. Bigelli & Sánchez-Vidal, 2012; Ferreira & Vilela, 2004; Gogineni, Linn & Yadav, 2012). Euro values are converted to 2014 prices using the Consumer Price Index (CPI). In this case, the described accounting bias will result in larger firm size measures for public firms.

Equation 2: Firm Size

$$FS_t = \ln\left(TA_t * \frac{CPI_t}{CPI_{2014}}\right)$$

Investment opportunities (IO) are often measured as the market-to-book ratio (Ferreira & Vilela, 2004; Opler et al., 1999; Pinkowitz & Williamson, 2007). Unfortunately, this measure is impossible to obtain for private firm and hence, investment opportunities are measured as sales growth (Bigelli & Sánchez-Vidal, 2012; Gao, Harford & Li, 2013; Pinkowitz & Williamson, 2007). Note that Gogineni, Linn and Yadav (2012) use a capital expenditures-to-total assets ratio instead, as Pinkowitz and Williamson (2007) do as well. Both seems to be possible, however, in order to avoid any multi-collinearity with cash flows or the dividend payment variable, sales growth is used to measure investment opportunities.

Equation 3: Investment Opportunities

$$IO_t = \frac{Sales_t - Sales_{t-1}}{Sales_{t-1}}$$

Cash flow (CF) is measured as earnings after interest, taxes and dividends, but before depreciation, and divided by net assets, which is total assets net of cash (Ferreira & Vilela, 2004; Gogineni, Linn & Yadav, 2012; Opler et al., 1999).

Equation 4: Cash Flow

$$CF = \frac{Net\ Profit + Depreciation}{TA}$$

Cash flow volatility (CFV) is measured by using the standard deviation of the three preceding years in relation to the current year (Bigelli & Sánchez-Vidal, 2012; Ferreira & Vilela, 2004; Gao, Harford & Li, 2013; Gogineni, Linn & Yadav, 2012; Opler et al., 1999). In contrast to

most papers, a second measure of industry cash flow risk is not included, since this thesis is restricted to only one industry.

Equation 5: Cash Flow Volatility

$$CFV_t = \frac{\sqrt{\frac{1}{3}\sum_{i=t-3}^{t-1}(CF_i - \overline{CF})^2}}{CF_t}$$

Access to capital markets is of course a main difference between public and private companies. However, private firms also have sources of external liquidity, banks for example. For both kinds of companies, the access to liquid funds might be bound to financial well-being, or put differently, they can gather external funds more easily the lower their default probability is. This reasoning is similar with the conditional liquidity provided by lines of credit (Amess, Banerji & Lampousis, 2015; Opler et al., 1999). Hence, using a dummy variable will not only capture differences in the access to capital markets but to all external financing sources. It further covers all other differences between public and private firms and is therefore named $Public\_Private$. These issues need to be reconsidered when interpreting this variable.

Equation 6: Access to Capital Markets

$$Public\_Private = \begin{cases} 1, & if\ company\ is\ public \\ 0, & if\ company\ is\ private \end{cases}$$

In order to measure cash substitutes, it is simply possible to use the cash substitutes themselves as variables. That means net working capital (NWC) is calculated as current assets subtracted by current liabilities and the measure of cash, divided by total assets. (Bigelli & Sánchez-Vidal, 2012; Ferreira & Vilela, 2004; Gao, Harford & Li, 2013; Opler et al., 1999).

Equation 7: Net Working Capital

$$NWC = \frac{Current\ Assets - Current\ Liabilities - Cash}{TA}$$

Leverage (L), as a second potential cash substitute, is measured as the debt-to-asset ratio, that means short-term debt and long-term debt divided by the book value of assets (Ferreira & Vilela, 2004; Gogineni, Linn & Yadav, 2012; Opler et al., 1999).

Equation 8: Leverage

$$L = \frac{Debt}{TA}$$

The effective tax rate (Tax) is simply obtained by dividing paid taxes by earnings before taxes. Negative tax rates are replaced by zero (Bigelli & Sánchez-Vidal, 2012).

Equation 9: Effective Tax Rate

$$Tax = \max\left[\frac{Paid\ Taxes}{EBT}; 0\right]$$

Probability of default (PoD) can be measured in different ways. Opler et al. (1999), followed by Bigelli and Sánchez-Vidal (2012), use a R&D expenses-to-sales ratio as a proxy for financial distress costs. Gogineni, Yadav, and Linn (2012) apply the so-called Quiscore, which is based on the Altman Z-score and provided by a U.K. company called CRIF Decision Solutions Ltd. The Quiscore is, however, not applicable for the sample in this thesis. Further, R&D expenses seem to be a very rough measure of financial distress, especially for technological companies which are usually R&D intensive (Zakrzewska-Bielawska, 2010). Therefore, in this thesis the Altman Z-score for private firms is used to measure the probability of default. The measure consists of five predefined coefficients measuring different aspects of potential distress variables (cp. Equation 10). Firms with a Z-Score lower than 1.23 are perceived as financially distressed (Altman, 2000).

Equation 10: Probability of Default

$$PoD = 0.717\frac{Working\ capital}{Total\ Assets} + 0.847\frac{Retained\ Earnings}{Total\ Assets} + 3.107\ \frac{EBIT}{Total\ Assets} + 0.420\frac{Book\ Value\ of\ Equity}{Book\ Value\ of\ Total\ Liabilities} + 0.988\ \frac{Sales}{Total\ Asset}$$

Dividend payments and Stock repurchases (D) are measured with a dummy variable that takes the value one when a firm pays dividends in a certain year, and zero otherwise (Bigelli & Sánchez-Vidal, 2012; Ferreira & Vilela, 2004; Gogineni, Linn & Yadav, 2012; Opler et al., 1999).

Equation 11: Dividend Payments

$$D = \begin{cases} 1, & if\ dividendes\ were\ paid \\ 0, & otherwise \end{cases}$$

The cash conversion cycle (CCC) measures for how many days a firm's cash is bound to the firm's operations. It is obtained by the sum of the inventory conversion period and the receivables collection period minus the payables conversion period. End of the year values from the

balance sheet are taken (Bigelli & Sánchez-Vidal, 2012; Gogineni, Linn & Yadav, 2012; Kim, Mauer & Sherman, 1998).

Equation 12: Cash Conversion Cycle

$$CCC = \frac{Inventory}{\frac{Cost\ of\ Goods\ Sold}{365}} + \frac{Accounts\ Receivable}{\frac{Sales}{365}} - \frac{Accounts\ Payable}{\frac{Cost\ of\ Goods\ Sold}{365}}$$

Some authors account for macroeconomic effects by including year dummies in their models (Bigelli & Sánchez-Vidal, 2012; Ferreira & Vilela, 2004; Opler et al., 1999). However, such a measure does not capture the magnitude of macroeconomic effects. This thesis therefore uses the TecDax index, which reflects any economic effects of the exact industry of interest.

In order to capture macroeconomic effects, two different approaches are used. The first one is to include year dummies in the estimation models as prior authors did as well (Bigelli & Sánchez-Vidal, 2012; Ferreira & Vilela, 2004; Opler et al., 1999). However, this approach adds a lot of variables to the regressions and therefore lowers the effectiveness of these models. The other approach adds only one variable, the TecDax. The TecDax should reflect the dynamics of the German technology industry, including macroeconomic and industry specific developments. Therefore, the TecDax potentially covers the same effects as year dummies while adding less variables to the estimations. If this is the case can be seen from the analyses in section 4.3, even if it is only a sideshow to the main research objective.

3.3.3 Agency Costs Determinants

The agency costs determinants, as the main topic of this thesis, are tested in the last model. Therefore, they are described last. However, before the different proxies of agency costs are discussed, the dependent variable of the underlying model needs to be defined, which is excess cash.

Again, the definition of excess cash follows Opler et al. (1999) and was adapted by other authors as well (Gao, Harford & Li, 2013). Excess cash is defined as the amount of actual corporate cash holdings exceeding the level of cash predicted by the cash model that is introduced in section 3.5.

Equation 13: Excess Cash

$$Excess\ Cash_t = Actual\ Cash\ Holdings_t - Predicted\ Cash\ Holdings_t$$

To proxy the threat of takeovers (ToT), Opler et al. (1999) make use of takeover charter amendments. Unfortunately, these data are not available for the sample used here. Instead, shareholder dispersion will be taken. The logic is drawn from Opler et al. (1999), who state that a higher

shareholder dispersion makes a takeover less likely. Even more, the absence of a large independent shareholder decreases the likelihood as well (Shleifer & Vishny, 1986). Hence, a higher free float should imply higher excess cash holdings, and therefore free float is taken as a proxy for the threat of takeover. For private companies the measure is set to zero. The first reason is that private companies should have no free float, by definition. And second, the threat of takeovers for private firms is very abstract, since the decision to sell firm shares lies by the owner, who is often more engaged in the company. However, opposing this assumption, in reality the threat of takeover probably varies between private companies. Different reasons for this suggestion exist, for example, there are differences in shareholder dispersion, some companies are family firms some might be owned by private equity firms, which de facto implies a takeover at some point in the firm's lifecycle, and some are owner-managed. With the available data on CapitalIQ no other reasonable measure of ToT is possible to obtain though. But, of course, this does not undermine the assumptions justification.

Equation 14: Threat of Takeover

$$ToT = \begin{cases} free\ float\ in\ \%, & if\ public\ firm \\ 0, & if\ private\ firm \end{cases}$$

To measure the effect corporate governance has on agency costs, a comprehensive variable is needed. It should cover insider ownership issues as well as board activity. There are two indices developed to proxy agency costs the GIM index by Gompers, Ishii, and Metrick (2003) and Entrenchment index by Bebchuk, Cohen, and Ferrell (2009). Unfortunately, these indices are not applicable for private companies. For this reason, Gogineni, Linn and Yadav (2013) developed an index, comparable to the former ones, the Agency Cost Index (ACI). They showed that their index is related to the GIM and Entrenchment index, and hence it is applicable in this paper as well.

Larger values of the ACI index indicate higher agency costs. To construct the index, an agency free sample is needed. Gogineni, Linn and Yadav (2013) assume single-owner-managed firms to be free of agency issues, defining them as the default variable. This thesis follows the same assumption. The logic behind the ACI follows Tirole (2006), who argues that two important consequences of agency costs are inefficient investments and inefficient management effort. The ACI therefore aggregates these manifestations in the variable called efficiency variable. It covers poor investment choices by the asset utilization as sales-to-total assets ratio and inefficient management work by operation expense efficiency measured as operating expenses-to-sales. Hence the efficiency variable is defined as operating expenses-to-total assets. The agency costs proxy for each firm is then determined by subtracting the efficiency variable of the firm of interest (i) from the average ratio of the zero agency costs firms and finally normalizing this result by the average ratios of the zero agency costs firms.

Equation 15: Corporate Governance

$$ACI_i = \frac{Average\ Value\ of\ Efficiency\ Variable_{zero\ agency} - Efficiency\ Variable\ Value_i}{Average\ Value\ of\ Efficiency\ Variable_{zero\ agency}}$$

Bank power (BP) as an explaining variable is a novelty, not used in prior research. To account for the influence banks have on companies, the ratio of bank debt to total debt is used. A higher ratio reflects stronger restrictions for managers induced by their banks. The logic is that the more a company relates on banks the more power the bank has on managerial decisions (Ferreira & Vilela, 2004; Ozkan & Ozkan, 2004; Pinkowitz & Williamson, 2001). Since private companies have, by definition, no access to capital markets, it is assumed that their debt is fully bank financed. Against the background of the provided data by CapitalIQ, this is again the only reasonable assumption. Again, without undermining the assumptions justification, not that the corporate reality probably draws another picture. Other sources of financing exist that do not require capital market access. For instance, these could be private equity firms with maybe even more power over the firm's management, or non-public bonds, where a single bondholder might have no influence on manager's behavior. However, to approximate bank power, the created variable is adequate, even more since for public companies the measure is precise.

Equation 16: Bank Power

$$BP = \begin{cases} \frac{Bank\ Debt}{Debt}, & if\ public\ firm \\ 1, & if\ private\ firm \end{cases}$$

3.4 Existence of Cash Targets

The first step in determining the sources of agency costs is to control whether firms have cash targets. The absence of such targets would imply that excess cash, by definition deviation from the cash target (Opler et al., 1999), are non-existent or at least not measurable.

3.4.1 Methodology

Opler et al. (1999) and the authors following their study, investigated the existence of cash targets by examining if firms cash holdings are mean reverting. In case they are not mean reverting, the existence of cash targets is denied. Following prior work, the methodology here is to estimate a first-order autoregressive regression of changes in the cash variable. The model looks as follows:

Equation 17: Mean Reversion Model

$$\Delta Cash_t = \alpha + \beta \Delta Cash_{t-1} + \varepsilon_t$$

where ε_t is an independent and identically distributed error term with zero mean and $\Delta Cash_t$ is the difference of cash holdings between year t and t-1. The model is run separately for private and public companies. A negative sign of the explanatory variable suggests that the firms do show mean reverting behavior (Opler et al., 1999).

3.4.2 Validity and Reliability

Extreme observations could possibly lead to biases. These biases are potentially more severe, since the sample, in comparison to other papers, is relatively small. Such biases can be mitigated by winsorizing the sample at both tails of the distribution. However, at this point of the analysis the outcome is strongly expected to show that cash targets do exist. Moreover, the results of this first step in the analysis is not going to bias any of the later results. Hence, manipulating the sample seems unnecessary here.

3.5 Determination of Cash Targets

After answering whether target cash levels exist, the imperative is to determine the exact level of target cash balances of the individual companies.

3.5.1 Methodology

In accordance with Opler et al. (1999) a univariate comparison of the predefined potential cash determinants is conducted. The estimation is run for the full sample, as well as for the separated samples of public and private firms. The regression model, including the TecDax variable as macroeconomic indicator, has the following form.

Equation 18: Univariate Regression

$$Cash_t = \alpha + \beta_1 FS_t + \beta_2 IO_t + \beta_3 CF_t + \beta_4 CFV_t + \beta_5 NWC_t + \beta_6 L_t + \beta_7 Tax_t + \beta_8 PoD_t + \beta_9 D_t + \beta_{10} CCC_t + \beta_{11} TecDax_t + \beta_{12} Pubic\_Private$$

In case of the separated samples, the $Pubic\_Private$ variable is, of course, not included.

The intention of this model is to find the specification that explains corporate cash holdings best. Since panel data are used in a pooled regression, it is tested if cross-sectional fixed or random effects improve the model.

The most important issue regarding the above model is that of endogeneity (Amess, Banerji & Lampousis, 2015). Possible solutions to the endogeneity problems are first, to omit variables causing the issue, second, an Instrumental Variable (IV) approach, or finally, a two-stage least squares regression. The benefits and drawbacks of each approach are discussed in section 3.5.2.

The underlying problem that could cause causality in the sample is that firms might decide on their capital structure – cash holdings, leverage – investment policy, and dividend payouts simultaneously (Amess, Banerji & Lampousis, 2015; Bigelli & Sánchez-Vidal, 2012; Ferreira & Vilela, 2004; Gao, Harford & Li, 2013; Gogineni, Linn & Yadav, 2012).

3.5.2 Validity and Reliability

As mentioned, there are different strategies in order to deal with endogeneity. Opler et al. (1999), for instance dropped variables to mitigate this problem. This approach might, however, bias the model by omitting significant variables (Amess, Banerji & Lampousis, 2015). Harford, Mansi and Maxwell (2008) instead, included a lagged variable. This approach needs thorough theoretical justification indicating the direction of causality (Amess, Banerji & Lampousis, 2015). Some authors, for example, argued that corporate governance causes cash holdings and not the other way around and thus could include this as a lagged variable (Gogineni, Linn & Yadav, 2012; Harford, Mansi & Maxwell, 2008).

Alternatively, an instrumental variable can be used, either by applying a two-stage least squares or a generalized method of moments estimation. The problem here is to find an appropriate proxy instrument that is correlated with the dependent variable but uncorrelated with the error term (Amess, Banerji & Lampousis, 2015).

Ferreira and Vilela (2004) took a rather pragmatic approach regarding endogeneity. They tested if after omitting certain variables – in their case the dividend dummy and the leverage variable – changes sign or significance of the remaining variables. Both remained the same and they went on using the unreduced form of their model. This paper follows the approach of Ferreira and Vilela (2004). In case the original model can be used no information will be missing. Otherwise, variables will be omitted, assuming that the restricted model is still sufficient in explaining cash holdings. The risk of using wrong lagged variables or instrumental variables is simply greater, since it might bias the model even further.

Another issue regarding the reliability of the model is of course the biases caused by differences in accounting standards. Unfortunately, there is no solution to this problem. Hence, when interpreting the results of the analyses, it must be reconsidered that the public firms' cash holdings are potentially biased downwards. This will certainly have an impact on the estimation outcomes and might also affect the interpretations. However, it is not clear for the latter. In case that the regression outcomes are conforming with the theoretical predictions from section 2.2, these concerns can be dismissed.

3.6 Sources of Agency Costs

Having developed the model of target cash levels, it is possible to determine the deviations of actual cash holdings from the predicted cash levels, that means excess cash. Given each com-

pany's excess cash holdings, it should be possible to analyze how it is composed, or put differently, which potential characteristics of agency contribute to excess cash in terms of significance and magnitude.

3.6.1 Methodology

Opler et al. (1999) and the papers based on their study usually simply add possible agency costs determinants to the model developed to explain cash targets. However, in most cases they seek to find evidence for which theory – trade-off, financing hierarchy, or agency costs theory – explains cash holdings best (Bigelli & Sánchez-Vidal, 2012; Gogineni, Linn & Yadav, 2012; Hall, Mateus & Mateus, 2014; Opler et al., 1999). The objective here is to scrutinize agency costs in particular, and therefore a different methodology is applied.

First of all, excess cash for each company is estimated. Excess cash is defined as the deviation from the predicted cash balances, hence the error term of each regression. Note that in this model excess cash is also allowed to be negative, which means that a company actually holds too low liquid assets, relative to what is predicted. This can have several reasons. One is that a company makes too large adjustments to the cash target, resulting in negative deviations from the cash targets. Another reason might be a very strict cash policy, caused by takeover threats, corporate governance or bank power. A combination of these reasons is, of course, possible as well. Further, unobserved effects may take a role. However, for these reasons, negative excess cash holdings are expected to correlate with agency costs sources and hence the analysis is not restricted to positive excess cash values.

Equation 19: Excess Cash

$$Excess\ Cash_t = Actual\ Cash_t - Predicted\ Cash_t = \varepsilon_t$$

The error terms are then analyzed in a further regression, with the potential explanatory variables as described in section 3.3.3. The model looks as follows:

Equation 20: Agency Costs Model

$$Excess\ Cash_t = \gamma_0 + \gamma_1 ToT_t + \gamma_2 ACI_t + \gamma_3 BP_t + \epsilon_t$$

The difference to other models is that the regression of only agency determinants on excess cash isolates the effects from standard explanatory variables. Therefore, correlations between the independent variables are possibly suppressed and the results are more distinct. Further, an interpretation of the influence of each agency determinant in comparison to the others can be given, explaining how much in contributes to agency costs.

Moreover, the estimation is more complete than in prior studies, since a proxy for bank power is added. Therefore, the different potential sources of agency costs are separated more thoroughly, resulting in a more insightful analysis.

3.6.2 Validity and Reliability

Again, endogeneity might affect the results. It is probably the case that higher free float decreases corporate governance and a higher bank dependence increases corporate governance. However, corporate governance quality in this thesis is measured by an efficiency ratio and should thus be unrelated to the other two variables. A connection between free float on the one hand and bank power, on the other hand, seems uncalled-for.

Nevertheless, to test for endogeneity a lagged variable is included. As described in section 3.5.2 such a lagged variable needs a thorough theoretical justification. Therefore, a possible solution to endogeneity is to introduce the ACI, as a measure of corporate governance quality, as a lagged variable. As mentioned before, it is reasonable to assume corporate governance to affect cash holdings and not vice versa (Gogineni, Linn & Yadav, 2012; Harford, Mansi & Maxwell, 2008). Then, in accordance with the reasoning of Ferreira and Vilela (2004), if the model with the lagged ACI does not change sign or significance of any explanatory variable, the original model can be used.

3.7 Interim Conclusion

The first issue in this thesis was collecting the data needed in order to perform the objected analyses. With respect to the restricting factors, location, industry, and size of the companies, the sample is relatively small, compared to prior works. Subsequently, the raw data had to be transformed into the variables as described in section 3.3. Especially because of some non-trivial proxies, the discussion needed to be very detailed. Unfortunately, this step already introduces the first biases through accounting differences in the model.

The methodology applied in this thesis is separated into three distinct models. The first two largely follow Opler et al. (1999) and a number of subsequent papers on corporate cash holdings. Hence, the methodology up to this point is well-tested and largely accepted by researchers. The third model differs from what other authors did. Namely, agency costs are estimated in a separately and moreover, a further potential source of agency costs is included, bank power.

While the first two models could be seen as simple necessities in order to determine excess cash, both also serve as some kind of quality measures. That means, as long as the outcomes of these models are consistent with prior research findings and theory, reassurance about the data quality, with regard to the sample size, and about the accounting biases can be given.

Concerning endogeneity problems, several solutions are offered. However, a complete mitigation of this issue is probably impossible.

4 Analysis and Discussion

This section describes the analysis and its subsequent outcomes. In addition to the simple description of the outcomes, the findings will be discussed and interpreted in accordance to the hypotheses and theories stated earlier.

This study set out to assess the impact of agency costs on corporate cash holdings by scrutinizing excess cash and its composition of agency effects. Therefore, the section is ordered following the line of action. That means, it starts by simply summarizing the raw data. In the second part, the mean reverting model is validated in order to sustain the assumption of target cash levels. The exact level is then determined in the third part by modelling a cash function based on certain predefined cash determinants. Investigating the estimation outcomes allows inferences about first, the validity of the data with regard to biases, and second, to determine the model that explains cash holdings in the best way. The fourth part deals with the main objective of the paper, agency costs. Finally, a comprehensive overview of the outcomes and discussions is given.

4.1 Descriptive Statistics

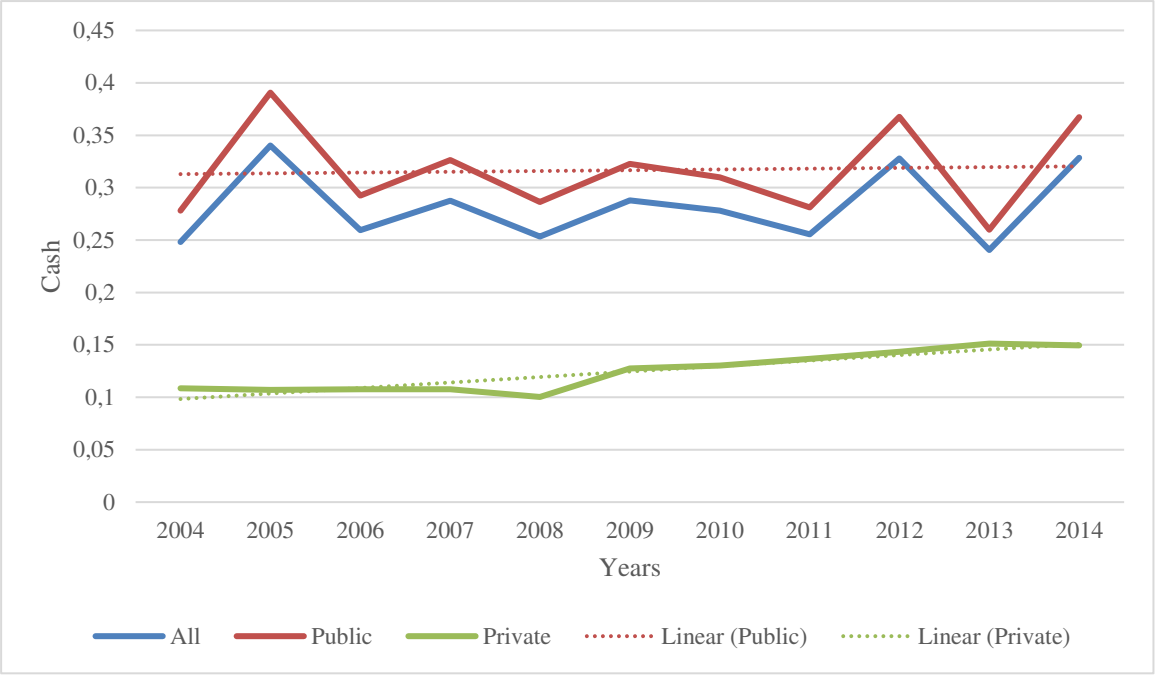
The purpose of this section is simply to give an overview of how cash holdings are distributed among firms. For the firms in the sample Figure 2 shows how cash holdings developed over the sample period. Cash holdings, measured as described in section 3.3.1, are depicted as mean values for the aggregated public and private firms, as well as for all firms aggregated. In each case a slightly positive trend can be observed, hence verifying prior claims of increasing cash holdings. This can be seen from the showcase of the positive sloped trend lines of cash holdings. The slopes of the trend lines seem relatively flat, but keep in mind that a large part of the sample period is influenced by the financial crisis.

Further, note that the cash holdings of all companies, public and private firms aggregated, very much follow the trend of public firms. This is caused by the much higher number of public firms in the sample, as well as by the on average higher cash holdings of public firms.

Another important issue that can be observed from Figure 2 is that public firms tend to hold more liquid assets than private firms do. This finding is consistent with Dittmar, Mahrt-Smith and Servaes (2003), Gao, Harford and Li (2013) and Gogineni, Linn and Yadav (2012). Further, the volatility of cash holdings appears to be much higher in public firms, but to revert to the trend line. This observation has two implications. First of all, as also found by Gogineni, Linn and Yadav (2012), the speed of adjustment of cash holdings seems to be higher in private firms, so that the volatility is relatively small in comparison to public firms. Second, it seems that

public and private firms both adjust their cash levels to a certain target level. However, the latter statement will be tested in section 4.2.

Figure 2: Evolution of Industry Mean Cash Holdings



Sorting public and private companies by firm size and dividing them into quartiles gives further insights into the nature of cash holdings. Table 1 shows the results for public firms. Obviously, and as already discussed in section 2.2.1, firm size has a negative effect on cash holdings. Both, the mean and median values become smaller for each consecutive quartile. Note here that in the first quartile, there is one distinct company with outstandingly high cash holdings, resulting in a relatively high mean value, compared to the median, and a relatively high standard deviation. Since only two observations show these extreme values, the sample is not winsorized.

Table 1: Cash Holdings of the Public Firms by Firm Size

Quartile	Mean	Median	Minimum	Maximum	Std. Error
1st quartile	0,63158188	0,29702453	9,8425E-05	11,8411355	1,17515148
2nd quartile	0,24065791	0,16246478	0,00143425	1,98330196	0,26629253
3rd quartile	0,22729488	0,18367365	0,00957332	1,66495295	0,208736
4th quartile	0,16488415	0,11084711	0,00589966	2,0010602	0,18882027

However, for private firms, depicted in Table 2, the negative relation between firm size and cash holdings needs to be neglected. Looking at the median, rather the opposite is true, larger companies tend to hold higher levels of cash.

The only authors mentioning this relation are Ferreira and Vilela (2004), who argue that larger firms, with a more dispersed ownership structure, are more subject to managerial discretion and

that larger firms are less likely to be takeover targets, resulting in higher cash levels as well. However, this reasoning seems to be hardly fitting for the case of private firms.

Anyway, the results shown in Table 2 are potentially caused by different effects. Of course, there are more determinants of cash holdings than firm size, as discussed in section 2.2. Furthermore, the quite small number of private companies in the sample is potential source of bias and therefore, all interpretations of these numbers need to be drawn very carefully.

Table 2: Cash Holdings of the Private Firms by Firm Size

Quartile	Mean	Median	Minimum	Maximum	Std. Error
1st quartile	0,0799134	0,0303806	7,3235E-05	0,38239443	0,1131089
2nd quartile	0,13549042	0,06246373	0,00032156	0,72724959	0,16698124
3rd quartile	0,09796048	0,06649051	5,0437E-05	0,48595028	0,09531626
4th quartile	0,18451431	0,1841767	0,001424	0,36664086	0,09457608

However, this section is simply supposed to give a snapshot of the data used in the thesis and does not provide clearly interpretable results. More detailed analyses follow in the next sections.

4.2 Existence of Cash Targets

Now, in order to validate whether the sample companies do have cash targets, a first-order autoregressive regression is run for the full sample as well as for the separated samples of public and private firms. The detailed results can be viewed in Appendix A. In Table 3 and 4 the results are summarized for public and private firms respectively as a showcase.

The important coefficient in each regression is DELTACASH1, which is the same as $\Delta Cash_{t-1}$ in section 3.4.1. A negative coefficient means that companies do adjust their cash holdings to a predetermined target.

For the full sample and the public sample, the case is very distinct. In both mean reversion models the coefficients are both negative and highly significant. Therefore, the companies clearly pursue a target cash level. As such, the results are in line with the findings of prior authors as Opler et al. (1999).

Table 3: Public Companies' Mean Reversion Model

	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,00404	0,01649	-0,24513	0,8064
DELTACASH1	-0,71427	0,02699	-2,64679	0,0000
R-squared	0,44577			
Prob(F-statistic)	0,00000			

In the case of private firms, it is harder to tell if cash targets do exist. While the coefficient is negative, it is, unexpectedly, not significant, but slightly above the 10% significance level. Again, the results are potentially imprecise because of the small sample. However, to simply ignore the insignificance is not possible. Hence, for the remainder of the paper any further results on the private company sample cannot certainly said to be true. All interpretations must be viewed very critically.

Table 4: Private Companies' Mean Reversion Model

	Coefficient	Std. Error	t-Statistic	Prob.
C	0,00524	0,00462	1,13426	0,2581
DELTACASH1	-0,11106	0,07095	-1,56525	0,1192
R-squared	0,01293			
Prob(F-statistic)	0,11922			

The results are in line with the expectations for the public company sample. For this reason, there are no major concerns over the following step. Unfortunately, the same is not true for private companies, no matter if caused by a too small sample or not. However, if the cash target model in the next section fulfills the prediction made in section 2.2, it seems adequate to dismiss the concerns raised from the mean reverting model.

4.3 Determination of Cash Targets

In order to determine the best model to derive excess cash holdings, several different regressions are performed. The dependent variable, of course, is always cash, and the residuals generated by the estimations represent excess cash. There are three groups of regressions, distinct by the sample used. The first group comprises the full sample of public and private companies and includes a dummy variable (Public_Private) to distinct between the kinds of firms, which also measures access to capital markets. The second and third group consist exclusively of public and private firms, respectively.

Further, for each group six different regressions are run. The line of action, however, is the same for each group. The first regression always uses all the possible cash determinants that are presented in section 3.3.2, and is therefore equal to the unrestricted model presented in section 3.5.1. The second regression omits the TecDax variable, in order to investigate if the influence of this single external factor contributes to the overall quality of the estimation. This is, however, not formally tested but only judged by the different information criteria and the coefficient of determination. The third regression then uses year dummies in order to cover all external factors, as an opposition to the TecDax variable. As aforementioned, year dummies and the TecDax are supposed to measure the same, macroeconomic influences. The major difference is the number of estimators added to the model. The fourth regression is run using fixed-effects and the fifth model using random-effects.

From these five model specifications the best model of each group is chosen. In order to test for endogeneity in the same manner as Ferreira and Vilela (2004), as described in section 3.5.2, the best model is re-estimated but omitting insignificant regressors. The restricted model specification, hence, is the sixth regression. In case that neither significance, nor sign of the regressors in the restricted model change in comparison to the unrestricted model, endogeneity is no obstacle for the further analyses and the unrestricted model can be used to determine excess cash. The best model was chosen by its coefficient of determination (R^2) and by different information criteria, namely the Akaike Information Criterion (AIC), the Schwarz Criterion (SC), and the Hannan-Quinn Information Criterion (HQ).

The results of the estimations are summarized for each group, full sample, public companies, and private companies, in Tables 5 to 7, respectively. The detailed results can be viewed in Appendices B to D. The summary tables present the coefficients together with their p-value underneath. Further, the aforementioned measures of model quality are provided. Since the test for joint significance (F-test) was highly significant for every model specification in this section, it is not included in the tables. Note that in the summary tables, the best unrestricted model is marked by highlighting the p-value of insignificant variables within the model specification.

Another issue that cannot directly be read from the summary tables is that every regression was estimated using heteroscedasticity robust standard errors. The results of the Jarque-Bera tests performed for the three samples show that all of them are subject to this issue (see Appendix E).

The remainder of this section discusses and interprets the results for each sample group separately.

Starting with the full sample, one can see that there is a considerable difference between public and private companies with respect to cash holdings. The Public_Private variable is always highly significant, verifying the assumptions that cash levels differ between public and private firms. Further, note that neither the introduction of the TecDax variable, nor the introduction of year dummies improve the regressions too much. Even if the TecDax is significant, its overall effect is seemingly small in regard to its economic effect and its effect on the goodness of fit.

However, the first regression was chosen as the best model. Although the R^2 of the specification including year dummies is a bit higher, the model including the TecDax shows lower information criteria and is more effective due to its lower number of regressors.

Investigating the results of the restricted regression and comparing them to the first model, there are no changes in both signs and significance of the variables. Thus, the unrestricted model can be used to obtain the excess cash values of the firms.

To further assess the quality of the model the outcomes are compared to the predictions made in section 2.2. The predicted negative relationships between the variables FS, Tax, and CCC are clearly confirmed. Access to capital market, which is assumed to also have a negative effect on cash holdings is reflected by the Public_Private dummy variable, and hence this relationship can also be confirmed. Moreover, the positive correlation between TecDax, PoD, and partly the cash flows can be confirmed as well. In the case of the cash flows, the picture is a bit more

complex. Cash flow itself, represented by CF, has a negative impact on cash holdings. A possible reason is that with a higher cash flow firm risk decreases and the company does not need high cash levels. Another explanation could be that higher cash flows lead managers to spend more money, namely increase agency costs and thereby decrease cash holdings. Cash flow volatility, however, does show the expected positive effect on cash levels. In this case, the suggestion is that firm risk increases with CFV and therefore firms hoard more cash.

Table 5: Summary of Cash Models of the Full Sample

Independent Variable	Regression with TecDax	Regression without TecDax	Regression using year dummies	Regression with period fixed-effects	Regression with cross-section random-effects	Restricted Regression
Intercept	1,29327	1,38376	1,28284	1,37239	1,22396	1,40388
	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
FS	-0,03991	-0,03959	-0,04010	-0,04010	-0,02902	-0,04378
	0,0000	0,0000	0,0000	0,0000	0,0008	0,0000
IO	-0,14129	-0,14323	-0,14470	-0,14470	-0,26711	N.A.
	0,1712	0,1690	0,1677	0,1677	0,0453	
CF	-0,69501	-0,70277	-0,69731	-0,69731	-0,06250	-0,12996
	0,0571	0,0575	0,0549	0,0549	0,7730	0,0097
CFV	3,98818	3,85073	4,04533	4,04533	3,04591	N.A.
	0,1224	0,1329	0,1377	0,1377	0,2316	
NWC	-1,01085	-1,01314	-1,00501	-1,00501	-1,23160	-0,82320
	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
L	-1,06622	-1,06762	-1,05963	-1,05963	-1,10259	-1,07033
	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Tax	-0,00696	-0,00734	-0,00706	-0,00706	-0,00491	-0,00621
	0,0343	0,0388	0,0615	0,0615	0,0085	0,0082
PoD	0,05203	0,05160	0,05180	0,05180	0,05948	N.A.
	0,1536	0,1570	0,1584	0,1584	0,2498	
D	0,02848	0,03339	0,02646	0,02646	-0,03022	N.A.
	0,4690	0,3998	0,5369	0,5369	0,5483	
CCC	-0,00001	-0,00001	-0,00001	-0,00001	-0,00001	N.A.
	0,5069	0,5291	0,5099	0,5099	0,3472	
TecDax	0,00010	N.A.	N.A.	N.A.	0,00009	0,00008
	0,0108				0,0297	0,0354
Public_Private	-0,211459	-0,218761	-0,207431	-0,207431	-0,170135	-0,132525
	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
R^2	0,25533	0,25358	0,25864	0,25864	0,18259	0,19344
Adjusted R^2	0,24805	0,24689	0,24586	0,24586	0,17460	0,18906
AIC	1,54715	1,54789	1,55721	1,55721		1,58892
SC	1,60086	1,59747	1,64810	1,64810		1,62078
HQ	1,56735	1,56653	1,59139	1,59139		1,60088

The dividend coefficient is negative, which does actually not contradict the expectations, since the effect of this variable was discussed to be uncertain. The only variable opposing the prior expectations is IO, which was supposed to show a positive effect on cash holdings. While there is no direct answer to why this is the case, it should be considered that IO is also not significant, although it was frequently mentioned as an important factor in determining cash levels. An explanation for this outcome is possibly that the sample only contains technology companies. This implies that the growth opportunities should be similar for the single companies in the

sample. Furthermore, the technology industry differs from other industries especially in their investment opportunities, as shown in section 1.1.

Further, it needs to be said that the expectations stated in section 2.2 did not make assumptions about the significance of single cash determinants, but about their direction of effect. Therefore, it is not considered problematic that some of the estimators are insignificant.

Summarizing, in general the outcomes are aligned with theoretical considerations and prior research outcomes. The analogies strengthen the reliability of the results so far. While biases through sample size or industry selection cannot be neglected, the assumed bias through differing accounting methods does not seem to decrease the reliability of the model.

As a next step, the regression results of the public sample are evaluated. Judging the outcome by the alignment with prior research again leads to the same findings as in the case with the full sample. That means, concerns with regard to the accounting bias can be dismissed. However, the regression with the fixed-effects deserves more attention for two reasons. First of all, the coefficient of determination increases drastically. Secondly, the sign of the cash flow variable changes.

Running a redundant fixed-effects test (see Appendix F) shows that the largest impact on the regression outcome is driven by the cross-section fixed-effects. In fact, for the cross-sectional fixed effects the null hypothesis that the fixed-effects are redundant is strongly rejected. The period fixed-effects, on the other hand, are insignificant. However, the regression is not changed including solely cross-section fixed-effects since the cross-sectional and period fixed effects are jointly significant.

The test further reveals that it is the period fixed effects that turn around the sign of the CF variable. However, the CF variable in this model specification becomes insignificant and is left out in restricted model. Therefore, the sign of the variable is not of further interest.

Obviously, the fixed-effects model is chosen as the best fitting one with a R^2 more than two times higher than in the other specifications. Also the information criteria are in favor of the fixed effects model. Omitting the insignificant variables and comparing the restricted model to the original one, one sees that neither signs nor significance of the regressors changed. Thus, again endogeneity is no concern and the unrestricted fixed-effects model can be used to obtain excess cash values and estimate agency effects in the next section.

Scrutinizing the regression of the private company sample needs to be done carefully. The rather small sample makes it hard to generalize the outcomes and moreover is potentially more biased than a large sample would be. Also reconsider that the mean reversion model was rejected for private companies on a 10% level.

Table 6: Summary of Cash Models of the Public Companies

Independent Variable	Regression with TecDax	Regression without TecDax	Regression using year dummies	Regression using cross-sectional and period fixed-effects	Regression using period random-effects	Restricted Regression using cross-sectional and period fixed-effects
Intercept	1,13265	1,23513	1,14893	0,21058	1,23513	0,22647
	0,0000	0,0000	0,0000	0,6263	0,0000	0,6538
FS	-0,03880	-0,03854	-0,03904	0,07173	-0,03854	0,10406
	0,0000	0,0000	0,0000	0,0021	0,0000	0,0670
IO	-0,15680	-0,15932	-0,15848	-0,33512	-0,15932	-0,25719
	0,1549	0,1532	0,1532	0,0837	0,1532	0,0918
CF	-0,72109	-0,72960	-0,72132	0,17063	-0,72960	N.A.
	0,0560	0,0566	0,0546	0,4309	0,0566	
CFV	3,90441	3,74983	3,93635	3,19345	3,74983	N.A.
	0,1472	0,1611	0,1666	0,2156	0,1611	
NWC	-1,17492	-1,17539	-1,16781	-1,49747	-1,17539	-1,44680
	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
L	-1,20377	-1,20213	-1,19706	-1,19983	-1,20213	-1,57648
	0,0000	0,0000	0,0000	0,0019	0,0000	0,0000
Tax	-0,01107	-0,01160	-0,01167	-0,00647	-0,01160	N.A.
	0,0470	0,0521	0,0674	0,1597	0,0521	
PoD	0,05466	0,05412	0,05439	0,06807	0,05412	N.A.
	0,1524	0,1564	0,1573	0,2727	0,1564	
D	0,03108	0,03728	0,02971	-0,03625	0,03728	N.A.
	0,4223	0,3415	0,4875	0,5580	0,3415	
CCC	-0,00001	-0,00001	-0,00001	-0,00002	-0,00001	N.A.
	0,5951	0,6209	0,5968	0,2144	0,6209	
TecDax	0,00013	N.A.	N.A.	N.A.	N.A.	N.A.
	0,0056					
R^2	0,26475	0,26241	0,26794	0,60803	0,26241	0,58786
Adjusted R^2	0,25689	0,25525	0,25358	0,55930	0,25525	0,53994
AIC	1,69019	1,69145	1,70314	1,26097	N.A.	1,28499
SC	1,74722	1,74373	1,80295	1,81232	N.A.	1,80620
HQ	1,71182	1,71128	1,74100	1,47011	N.A.	1,48255

Starting with a comparison of the model outcomes and prior research outcomes, most of the regressors show the predicted direction of effect on cash holdings. However, more coefficients are not aligned, as in case with the public companies, which might, again, partly be explained by the sample size. However, the fixed-effect model is seemingly more in line with the predicted outcomes. The standard regressions show unexpected directions of effect with regard to the variables IO, CF and CFV, FS, Tax, and CCC. In the fixed-effects model that is the case only for IO, CF and CFV, PoD and FS variable. Further, note that not a single private company in the sample paid dividends in the sample period and therefore this variable could not be included in the estimations.

In case of the IO variable, the reason for the unexpected sign could again be that investment opportunities are similar for the companies due to the industry restriction. Especially for CFV the outcome should have shown a positive effect on cash holdings, since in private firms cash flow risk should have an even greater effect on cash holdings than in public firms (see section

2.2.3). The argumentation is that because of higher financing frictions and financing constraints, riskier private firms should have a greater precautionary demand for cash. Finally, FS is strongly expected to have a negative effect on cash holdings, which is found by every study cited, not matter if these studies are conducted on public or private firms.

From this perspective, and remembering the outcome of the mean reversion model, the model for the private sample cannot be sustained. It is certainly imprecise because of the small number of companies included. However, for the sake of completeness the model is analyzes further as well, even with no or very little explanatory power.

Table 7: Summary of Cash Models of the Private Companies

Independent Variable	Regression with TecDax	Regression without TecDax	Regression using year dummies	Regression using cross-sectional and period fixed-effects	Regression using period random-effects	Restricted Regression using cross-sectional and period fixed-effects
Intercept	-0,22066	-0,20506	-0,29671	-0,76100	-0,22066	-0,45606
	0,0064	0,0071	0,0002	0,0057	0,0064	0,0271
FS	0,02474	0,02496	0,02454	0,11072	0,02474	0,08662
	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
IO	-0,05173	-0,05181	-0,06204	-0,06780	-0,05173	-0,03401
	0,0085	0,0107	0,0130	0,0000	0,0085	0,0044
CF	0,37130	0,36576	0,35476	0,19827	0,37130	0,18181
	0,0022	0,0019	0,0085	0,0837	0,0022	0,1093
CFV	-1,29241	-1,35758	-1,14740	-0,48413	-1,29241	N.A.
	0,0482	0,0266	0,1399	0,1133	0,0482	
NWC	-0,10029	-0,10103	-0,10032	-0,11714	-0,10029	-0,11748
	0,0332	0,0306	0,0401	0,0021	0,0332	0,0023
L	-0,05970	-0,06213	-0,05151	-0,26458	-0,05970	-0,36504
	0,2038	0,1869	0,2819	0,0137	0,2038	0,0000
Tax	0,00110	0,00102	0,00096	-0,00024	0,00110	N.A.
	0,1116	0,1454	0,1734	0,6827	0,1116	
PoD	0,02283	0,02304	0,02265	-0,02598	0,02283	-0,02832
	0,0027	0,0023	0,0050	0,0164	0,0027	0,0038
D	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
CCC	0,00054	0,00053	0,00055	0,00000	0,00054	N.A.
	0,0000	0,0000	0,0000	0,9982	0,0000	
TecDax	0,00002	N.A.	N.A.	N.A.	0,00002	N.A.
	0,2260				0,2260	
R^2	0,30037	0,29936	0,30649	0,78392	0,30037	0,76795
Adjusted R^2	0,26316	0,26600	0,23288	0,73091	0,26316	0,72205
AIC	-1,48389	-1,49249	-1,40222	-2,36731		-2,38667
SC	-1,30184	-1,32700	-1,07124	-1,70534		-1,81408
HQ	-1,41021	-1,42552	-1,26827	-2,09939		-2,15542

Again the fixed-effects model shows the by far highest R^2. Consequently, it is chosen as the best fitting model. The redundant fixed-effects test (see Appendix G) also provides the same results as for the public sample. That means the cross-sectional fixed-effects are highly significant. The same is true for the joint significance while the redundancy of period fixed-effects, in isolation, cannot be rejected.

Again, signs and significances do not change in the rejected model with one exception. The CF variable, significant at a 10% level in the unrestricted fixed-effects model shows a p-value of 0,1093 in the restricted model. Being strict, there appears to be a problem with endogeneity in this case, even if the regressor is very much on the verge to insignificance.

In this section, it was shown that the data used in thesis largely confirm the expectations drawn in section 2.2. While this is, as discussed, not the case for the private sample model, it is even more true for the full sample model. It therefore seems that the Public_Private variable is very important in supporting the model's explanatory power. And since the concerns of accounting bias and endogeneity could be disregarded for the full sample model, it reasonable to not undermine this model's validity and reliability because of the private sample model.

While receiving indications of model reliability, this section's main purpose was to find a model that determines the exact level of companies' cash targets. This was done for all three sample groups, even if only for the sake of completeness in case of the private sample. Since the private sample model appears to be rather unreliable, a separation of the full sample seems to lose its justification. This, and the fact that the Public_Private variable appears to very important, in terms of significance and magnitude, points to the full sample as being most suitable to explain cash targets, and in turn excess cash and potentially the sources of agency costs that are pursued.

This, however, is only an assumption at this point and is tested in the next section.

4.4 Sources of Agency Costs

Since the residuals of the cash target models from section 4.3 reflect excess cash of the sample companies, the goal of this section is to find a model that explains those residuals. Hence, the model is supposed to provide hints of how agency costs influence cash holding decisions in the direction of the effect and in magnitude.

As already discussed in section 2.3 there are three different hypotheses underlying this analysis. First of all, the threat of takeover is expected to lower agency costs and hence excess cash holdings in public firms. On private firms, there should be no effect, which is already true by the definition of the variable ToT, which is set to zero for private firms. Secondly, corporate governance quality, measured by the ACI index, should have a negative effect on agency costs. To not confuse things, note that the ACI is defined in a way that higher values mean less quality in corporate governance. Thus, the ACI coefficient is expected to be positive. Finally, Bank Power is assumed to lower agency costs, and hence the amount of excess cash a company holds. For private firms BP is set to one with the underlying assumption that because of no capital market access banks are the only source of external financing for these companies. Therefore, bank power has no effect in the private sample as well.

In order to verify or neglect these hypotheses several estimations are performed. The different models which are estimated are summarized in Table 8. The detailed regression statistics for the full sample, the public company sample, and the private company sample can be viewed in the Appendices H to J, respectively.

With regard to the full sample and public company sample, as discussed in section 4.3, endogeneity should be of no concern in the further analysis and there the unrestricted models are used to estimate excess cash. However, in addition the same analyses are performed using the restricted models. The reason for that is simply to have a comparison to the unrestricted model and obtain a range of different parameter values. Only because endogeneity is denied, does not mean that there is no influence of that issue. Furthermore, the restricted models should be more effective in estimating excess cash, since they use less regressors.

Table 8: Summary of the Agency Costs Models

	Full Sample			**Public Companies**		**Private Companies**	
Independent Variable	**Regression on Excess Cash derived from unrestricted model**	**Regression on Excess Cash derived from unrestricted model with lagged ACI variable**	**Regression on Excess Cash derived from restricted model**	**Regression on Excess Cash derived from unrestricted model**	**Regression on Excess Cash derived from restricted model**	**Regression on Excess Cash derived from unrestricted model**	**Regression on Excess Cash derived from restricted model**
Intercept	0,06796	0,06204	0,12676	0,01251	0,01493	-0,00072	-0,00096
	0,0063	0,0143	0,0000	0,4110	0,4295	0,8295	0,6960
ToT	-0,16022	-0,13378	-0,17180	-0,01307	-0,00670	N.A.	N.A.
	0,0010	0,0105	0,0004	0,6726	0,8468		
ACI	0,07606	0,07197	-0,01172	-0,00276	-0,01179	0,00227	0,00318
	0,0040	0,0038	0,6375	0,9188	0,6874	0,8295	0,6965
BP	-0,14887	-0,14467	-0,17563	-0,02999	-0,03171	N.A.	N.A.
	0,0000	0,0000	0,0000	0,6245	0,5871		
R^2	0,01520	0,01400	0,01362	0,00035	0,00041	0,00036	0,00077
Adjusted R^2	0,01281	0,01140	0,01133	-0,00255	-0,00244	-0,00471	-0,00384
Prob. (F-Stat)	0,00028	0,00109	0,00050	0,94885	0,93353	0,78954	0,68358
AIC	1,51732	1,49525	1,56905	1,04545	1,08212	-2,74958	-2,70707
SC	1,53384	1,51288	1,58497	1,06446	1,10090	-2,71648	-2,67612
HQ	1,52353	1,50191	1,57502	1,05266	1,08924	-2,73618	-2,69457

Starting the analysis with the private company models, one can see that only one explanatory variable is used. The problem with the other two variables, ToT and BP is that they are vectors of only zeros and ones, respectively. Hence, they cannot be included in the estimation, so that these variables only contribute to the model when the full sample is used.

The public company and the private company models are both not at all sufficient in explaining excess cash holdings. The coefficients of determination in all four models is less than one per cent. Further, each model's F-statistics show no joint significance of the model. Also, none of the coefficients are significant. Reconsidering the outcomes of section 4.3, especially with regard to the private sample, this result is not unexpected. As one can see, the three full sample models are all significant, even if the R^2 is still small. This can be taken as a proof for the assumption made in section 4.3 that the full sample model is better suitable to explain excess cash and agency costs.

Therefore, the focus is now on the full sample model. The first and second model both use the residuals from the unrestricted full sample model form section 4.3. The difference is that the second model uses a lagged ACI variable. This is done in order to check if any endogeneity problems occur, as was argued in section 3.6.2. Since nor sign neither significance of any of the estimators change, the concern of endogeneity can be dismissed.

The third model, which uses the residuals from the restricted full sample from section 4.3, shows an insignificant negative effect of the ACI variable, in opposition to the other two models. However, since this estimation is only for comparative reasons and not based on the best cash target model, the whole regression is of less importance and so is the change in the variable.

For all the above reasons, it is obvious that the first full sample model, namely the one based on the unrestricted full sample cash target model is most suitable to explain excess cash and in turn, to provide insights to the agency costs. Hence, the remainder of this section focuses on this model.

Investigating the estimation results verifies the hypotheses developed in section 2.3, since the signs of each of the three variables is conforming with the hypotheses. That means, an increasing threat of takeover decreases excess cash holdings, and hence agency costs. Lower corporate governance quality, or an increasing ACI, increases excess cash holdings, allowing more managerial discretion. And finally, higher bank power seemingly lowers excess cash holdings and therefore inhibits managements own interests. Moreover, the regressors do not only indicate the suggested direction of effect, but they are also highly significant.

The threat of takeovers and corporate governance were already shown to constitute agency costs in prior studies. However, to the author's best knowledge, this is the first paper to proof that bank power is another important explanatory A possible concern is that bank power could simply be another factor of corporate governance, since a bank's formal power might substitute weak corporate governance mechanisms. However, as a redundant variable test shows (see Appendix K), the BP variable significant for the estimation and cannot be omitted. This leads to the conclusion that bank power works independently from other corporate governance mechanisms.

As Pinkowitz and Williamson (2001) suggest, decreased information asymmetries between a company's managers and a strong bank can result in less managerial discretion. Since this study focuses on German companies, where apart from banks usually another large blockholder of the company can monitor the bank, opposing effects on cash holdings through discretionary bank behavior are ruled out. Hence, this thesis explicitly shows the impact bank power has on a company's cash holdings.

Therefore, the existence of an additional determinant of agency costs is proven, as well as its negative effect on excess cash and consequently on corporate cash holdings.

Ultimately, since the hypotheses could be verified and concerns about endogeneity and biases through differing accounting standards could be dismissed, the model can be accepted as reliable, even if there have been some doubts casted by the private company sample.

4.5 Interim Conclusion

In this section it was first shown that the trend of increasing corporate cash holdings is also observable in the German technology industry.

Following this finding, it is generally proven that firms do have cash targets and adjust their cash levels to these targets. Unexpectedly, this is not true for the private sample. This could be due to the very small sample size, but whatever the reason is, the reliability of this model cannot be assured.

In the next step, models here searched that determine the level of those cash targets. Finding these cash targets was necessary to obtain excess cash holdings. At the same time, the results could be used to undermine or support the analyses of this thesis by comparing the results to theories and prior research outcomes. In general, apart from the private sample, the results verified the expectations and thus reassured the quality of the data and model of this paper.

The last step and research goal was to find out whether different measures of agency costs can explain excess cash holdings, and if so, how exactly these factors influence the excess cash levels. Even if the explanatory power of the models is very low, they are significant and deliver the desired insights. Moreover, it was proven that bank power is a significant agency costs driver and influences cash decisions together with the threat of takeovers and corporate governance quality. Hence, bank power is clearly not just an increment of corporate governance.

5 Conclusion

The Conclusion is separated in two distinct parts. The first one recapitulates and combines the study proceedings and outcomes to provide an integrated overview of the paper. The second part deals with implications of the paper for future research.

5.1 Research Approach and Outcomes

Cash holdings of companies all around the world have increased over the last two decades. This development has drawn the attention of several researchers. However, in the beginning these papers tended to focus on the U.S. market and public companies. More recently other markets and private companies were examined. In accordance with this later strand of literature, this paper examines German companies. Further, studies on corporate cash holdings usually comprise companies of all kinds of industries. By focusing on technology companies in this paper the effects that are tested can be investigated under isolation. Another advantage of the selected sample is that the TecDax can be used as a macroeconomic indicator. The assumed benefit of the TecDax is that it comprises exogenous effects but adds only one variable to the regression models, remaining the models effectiveness in comparison to year dummies.

With this sample definition, German technology companies, a sample consisting of 97 public companies and 21 private companies is created. Public companies were identified through the main German stock exchange, Deutsche Börse AG. Private companies were identified using the Bureau van Dijk database Orbis. The financial and non-financial needed were then drawn from CapitalIQ. Obviously, the number of private companies in the sample is seemingly small, resulting in several problems throughout the analysis, including conformity with theory and prior research and hence also reliability. However, these problems are mainly restricted to analyses solely investigating the private sample. Another problem arises by the comparison of public and private firms. Different accounting standards of these companies bias the cash values of public companies downwards.

The main objective of the thesis is to examine the influence agency costs have on corporate cash holding decisions. In order to achieve this goal, several steps are undertaken. The first of which is to provide a thorough theoretical and empirical foundation in order to construct a model suitable for the research approach. The model itself then consists of three distinct submodels. The first is constructed to prove that firms do have cash targets. Without this confirmation the remainder of the study would be invalid, since companies without a cash target would not have too much or too low cash on hand. The second model then determines the level of the cash targets. This is, of course, necessary to obtain values for the excess cash companies hold. Finally, the third model builds on excess cash, which is defined as positive or negative

deviations from the cash targets. By theory, deviations form cash targets are caused by agency costs. Therefore, the third model estimates the influence of agency costs on excess cash holdings.

The literature review introduces different theories on the constitution of corporate cash holdings. The transaction and precautionary motive form the trade-off model, which assumes that an optimal amount of cash in a company exists and maximizes shareholder value. Deviations from this optimal amount of cash are then explained by agency theory. In contrast, the financing hierarchy theory dismisses the idea of optimal cash holdings.

Empirical research, however, consistently prove the existence of cash targets, which is largely confirmed in this paper. The only doubt is casted by the private sample, but only when investigated dissolved from the public sample. With the proof of existing cash targets, the second part of the analysis is conducted.

Relying on theoretical considerations and discussing several studies on cash holdings a set of potential cash determinants are obtained. For each determinant an expectation of its direction of effect on cash holdings is stated. Following this, proxies for these determinants are defined, based on financial and non-financial company data. The cash target model verifies all the expectations with one exception, investment opportunities. However, this exception might be caused by the sample, since there is no variation in the industry and therefore investment opportunities might be very similar for the companies in the sample. Thanks to the conformance of expectations and the model outcomes, the concern that the accounting bias could impair the analysis of this paper is dismissed. As a sideshow of the cash target model, it is further shown that the TecDax actually is capable of substituting year dummies and act as more effective macroeconomic variable.

Yet, the main purpose of the cash target model is to provide the excess cash values for each company which, in turn, are needed to finally investigate agency costs and their potential impact on cash holdings. Potential sources of agency costs are discussed on a theoretical basis and with prior research papers. Three different sources are identified, the threat of takeovers, corporate governance quality, and bank power. Hypotheses are developed with regard to how these agency costs influence cash holdings. Cash holdings are assumed to increase with lower takeover probability, lower corporate governance quality, and less bank power in the company. Measures are then developed to proxy these agency costs drivers. To the author's best knowledge, two things are new in the then taken research approach. First, in other researcher usually include agency costs simply as another explanatory variable in what is called the cash target model in this thesis. Secondly, bank power so far was not treated as a further source of agency costs in studies on cash holdings. Only the paper of Pinkowitz and Williamson (2001) described the effect of bank power, but not in combination with other agency costs drivers.

The model finally verifies all three hypotheses. Even if the overall explanatory power, measured in terms of the coefficient of determination is very low, all single coefficients and the model itself are significant. Further, there is proof that bank power is not just an increment of other agency costs, but an important driver itself. At least in Germany, where usually besides banks another large blockholder exists in the company, higher bank power over the company seems to decrease information asymmetries between the firm's management and the bank, resulting

in cash holdings closer to the optimal, value maximizing, level. In absence of a large non-bank blockholder, banks might actually expropriate rents form the firm which leads to larger cash holdings.

These results are drawn from a very special sample. Therefore, the findings might hardly be generalizable. However, they still contribute to the literature of cash holdings and agency costs in several regards. First, by providing further proof of agency costs themselves, which is doubted by some academics. Secondly, bank power is proven to be another essential source of agency costs, at least under the conditions of the German market. And finally, it is so far the first study on this special sample of German technology companies.

5.2 Future Research

Considering the focus of the sample, future research should test the findings of this thesis on different markets and in different industries. The German market differs to great extent to Anglo-American markets by depending more on bank financing than on capital markets. Moreover, in other bank-based markets large non-bank blockholders might be an exception while they are the rule in Germany. Therefore, bank power might have very different, if not opposing results under different market circumstances.

Another limitation of this study is of course the private company sample. Not just because of the sample size, but also because of the restricted financial information of these companies. Both the threat of takeover and bank power are assumed to be the same for each private firm at the extreme values zero and one, respectively. While these assumptions are justified by the nature of private firms, in the sense that the takeover decision is in the hand of the few shareholders, which often are also the managers of the firm, and that due to no capital market access bank financing is the only source of external capital. However, this does certainly not reflect reality. Shareholder dispersion varies between private firms as well and, of course, not every company is owner-managed. Hence shareholders are still able to impose incentives to behave on managers by takeover considerations. External capital is actually not restricted to bank financing and also not restricted to debt. Private equity firms, for instance, are a potential source of external debt, equity, or mezzanine financing as well. Private equity firms then might impose even more disciplining covenants on a firm's management. Other external capital sources, however, might have less power over the management than banks or private equity firms. Therefore, future research should try to disentangle potential takeover threats and effects of different sources of non-capital market external financing.

References

Acharya, V., Almeida, H. & Campello, M. (2007). Is Cash Negative Debt? A hedging perspective on corporate financial policies. *Journal of Financial Intermediation*, vol. 16, no. 4, pp.515-554.

Aggarwal, R. & Goodell, J. (2009a). Markets and Institutions in Financial Intermediation: National characteristics as determinants. *Journal of Banking & Finance*, vol. 33, no. 10, pp.1770-1780.

Aggarwal, R. & Goodell, J. (2009b). Markets Versus Institutions in Developing Countries: National attributes as determinants. *Emerging Markets Review*, vol. 10, no. 1, pp.51-66.

Almeida, H., Campello, M. & Weisbach, M. (2004). The Cash Flow Sensitivity of Cash. *The Journal of Finance*, vol. 59, no. 4, pp.1777-1804.

Almeida, H. & Wolfenzon, D. (2006). A Theory of Pyramidal Ownership and Family Business Groups. *The Journal of Finance*, vol. 61, no. 6, pp.2637-2680.

Amess, K., Banerji, S. & Lampousis, A. (2015). Corporate Cash Holdings: Causes and consequences. *International Review of Financial Analysis*, vol. 42, pp.421-433.

Amihud, Y. & Mendelson, H. (1986). Liquidity and Stock Returns. *Financial Analysts Journal*, vol. 42, no. 3, pp.43-48.

Anderson, R., Mansi, S. & Reeb, D. (2003). Founding Family Ownership and the Agency Cost of Debt. *Journal of Financial Economics*, vol. 68, no. 2, pp.263-285.

Anderson, R., Duru, A. & Reeb, D. (2012). Investment Policy in Family Controlled Firms. *Journal of Banking & Finance*, vol. 36, no. 6, pp.1744-1758.

Ang, J. (1991). Small Business Uniqueness and the Theory of Financial Management. *Journal of Small Business Finance*, vol. 1, no. 1, pp.1-13.

Ang, J. (1992). On the Theory of Finance for Privately Held Firms. *The Journal of Small Business Finance,* vol. 1, no. 3, pp.185-203.

Ang, J., Cole, R. & Lin, J. (2000). Agency Costs and Ownership Structure. *The Journal of Finance*, vol. 55, no. 1, pp.81-106.

Antunovich, P. (1996). Optimal Slack Policy Under Asymmetric Information. Unpublished Working Paper. Northwestern University, Evanston, IL.

Barclay, M. & Smith, C. (1995). The Maturity Structure of Corporate Debt. *The Journal of Finance*, vol. 50, no. 2, pp.609-631.

Barclay, M., Smith, Jr., C. & Morellec, E. (2006). On the Debt Capacity of Growth Options. *The Journal of Business*, vol. 79, no. 1, pp.37-60.

Bates, T., Kahle, K. & Stulz, R. (2009). Why Do U.S. Firms Hold So Much More Cash than They Used To?. *The Journal of Finance*, vol. 64, no. 5, pp.1985-2021.

Bebchuk, L., Cohen, A. & Ferrell, A. (2009). What Matters in Corporate Governance?. *Review of Financial Studies*, vol. 22, no. 2, pp.783-827.

Bertrand, M., Mehta, P. & Mullainathan, S. (2002). Ferreting out Tunneling: An Application to Indian Business Groups. *The Quarterly Journal of Economics*, vol. 117, no. 1, pp.121-148.

Bigelli, M. & Sánchez-Vidal, J. (2012). Cash Holdings in Private Firms. *Journal of Banking & Finance*, vol. 36, no. 1, pp.26-35.

Brav, A., Graham, J., Harvey, C. & Michaely, R. (2005). Payout Policy in the 21st Century. *Journal of Financial Economics*, vol. 77, no. 3, pp.483-527.

Brav, O. (2009). Access to Capital, Capital Structure, and the Funding of the Firm. *The Journal of Finance*, vol. 64, no. 1, pp.263-308.

Brisker, E., Çolak, G. & Peterson, D. (2013). Changes in Cash Holdings Around the S&P 500 Additions. *Journal of Banking & Finance*, vol. 37, no. 5, pp.1787-1807.

Brown, J. & Petersen, B. (2011). Cash Holdings and R&D Smoothing. *Journal of Corporate Finance*, vol. 17, no. 3, pp.694-709.

Bruinshoofd, W. & Kool, C. (2004). Dutch Corporate Liquidity Management: New evidence on aggregation. *Journal of Applied Economics,* vol. 7, no. 2, pp.195-230.

Burkart, M., Panunzi, F. & Shleifer, A. (2003). Family Firms. *The Journal of Finance*, vol 58, no. 5, pp.2167-2201.

Campello, M., Graham, J. & Harvey, C. (2010). The Real Effects of Financial Constraints: Evidence from a Financial Crisis. *Journal of Financial Economics*, vol. 97, no. 3, pp.470-487.

Corbetta, G. & Montemerlo, D. (1999). Ownership, Governance, and Management Issues in Small and Medium-Size Family Businesses: A comparison of Italy and the United States. *Family Business Review*, vol 12, no. 4, pp.361-374.

Demiroglu, C. & James, C. (2011). The Use of Bank Lines of Credit in Corporate Liquidity Management: A review of empirical evidence. *Journal of Banking & Finance*, vol. 35, no. 4, pp.775-782.

Devalle, A., Onali, E. & Magarini, R. (2010). Assessing the Value Relevance of Accounting Data After the Introduction of IFRS in Europe. *Journal of International Financial Management & Accounting*. vol. 21, no. 2, pp.85-119.

Dittmar, A., Mahrt-Smith, J. & Servaes, H. (2003). International Corporate Governance and Corporate Cash Holdings. *The Journal of Financial and Quantitative Analysis*, vol. 38, no. 1, p.111.

Dittmar, A. & Mahrt-Smith, J. (2007). Corporate Governance and the Value of Cash Holdings. *Journal of Financial Economics*, vol. 83, no. 3, pp.599-634.

Dixit, A. & R. Pindyck, (1994). Investment Under Uncertainty. *Princeton University Press*, Princeton, NJ.

Duchin, R. (2010). Cash Holdings and Corporate Diversification. *The Journal of Finance*, vol. 65, no. 3, pp.955-992.

Duchin, R., Ozbas, O. & Sensoy, B. (2010). Costly External Finance, Corporate Investment, and the Subprime Mortgage Credit Crisis. *Journal of Financial Economics*, vol. 97, no. 3, pp.418-435.

Duchin, R., Gilbert, T., Harford, J. & Hrdlicka, C. (2014). Precautionary Savings with Risky Assets: When cash is not cash. Unpublished Working Paper. University of Washington.

Easterbrook F. (1984). Two Agency-Cost Explanations of Dividends, *American Economic Review,* vol. 74, 650-659.

Elyasiani, E. & Zhang, L. (2015). CEO Entrenchment and Corporate Liquidity Management. *Journal of Banking & Finance*, vol. 54, no. 5, pp.115-128.

Faccio, M. (2006). Politically Connected Firms. *American Economic Review*, vol. 96, no. 1, pp.369-386.

Faulkender, M. & Wang, R. (2006). Corporate Financial Policy and the Value of Cash. *The Journal of Finance*, vol. 61, no. 4, pp.1957-1990.

Fazzari, S., Hubbard, R., Petersen, B., Blinder, A. & Poterba, J. (1988). Financing Constraints and Corporate Investment. *Brookings Papers on Economic Activity*, vol. 1988, no. 1, pp.141-195.

Ferreira, M. & Vilela, A. (2004). Why Do Firms Hold Cash? Evidence from EMU Countries. *European Financial Management*, vol. 10, no. 2, pp.295-319.

Foley, C., Hartzell, J., Titman, S. & Twite, G. (2007). Why Do Firms Hold So Much Cash? A tax-based explanation. *Journal of Financial Economics*, vol. 86, no. 3, pp.579-607.

Gao, H., Harford, J. & Li, K. (2013). Determinants of Corporate Cash Policy: Insights from private firms. *Journal of Financial Economics*, vol. 109, no. 3, pp.623-639.

Gogineni, S., Linn, S. &Yadav, P. (2012). Evidence on the Determinants of Cash Holdings By Private and Public Companies. *University of Wyoming and University of Oklahoma*.

Gogineni, S., Linn, S. & Yadav, P. (2013). Ownership Structure, Management Control and Agency Costs: Direct Empirical Evidence. *University of Wyoming and University of Oklahoma*.

Gompers, P., Ishii, J. & Metrick, A. (2003). Corporate Governance and Equity Prices. *The Quarterly Journal of Economics*, vol. 118, no. 1, pp.107-156.

Guney, Y., Ozkan, A. & Ozkan, N. (2007). International Evidence on the Non-Linear Impact of Leverage on Corporate Cash Holdings. *Journal of Multinational Financial Management*, vol. 17, no. 1, pp.45-60.

Hall, T., Mateus, C. & Mateus, I. (2014). What Determines Cash Holdings at Privately Held and Publicly Traded Firms? Evidence from 20 emerging markets. *International Review of Financial Analysis*, vol. 33, pp.104-116.

Han, S. & Qiu, J. (2007). Corporate Precautionary Cash Savings. *Journal of Corporate Finance*, vol. 13, pp.43–57.

Harford, J., Mansi, S. & Maxwell, W. (2008). Corporate Governance and Firm Cash Holdings in the US. *Journal of Financial Economics*, vol. 87, no. 3, pp.535-555.

Holmström, B. & Tirole, J. (1998). Private and Public Supply of Liquidity. *Journal of Political Economy*, vol. 106, no. 1, pp.1-40.

Jensen, M. & Meckling, W. (1976). Theory of The Firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, vol. 3, no. 4, pp.305-360.

Jensen, M. (1986). Agency Cost of Free Cash Flow, Corporate Finance, and Takeovers. *American Economic Review*, vol. 76, no. 2, pp.323-329.

Kalcheva, I. & Lins, K. (2007). International Evidence on Cash Holdings and Expected Managerial Agency Problems. *Review of Financial Studies*, vol. 20, no. 4, pp.1087-1112.

Keynes, J. (1936). The General Theory of Employment, Interest and Money. *Journal of the American Statistical Association*, vol. 31, no. 196, pp.791-795.

Khanna, T. & Yafeh, Y. (2007). Business Groups in Emerging Markets: Paragons or Parasites?. *Journal of Economic Literature*, vol. 45, no. 2, pp.331-372.

Kim, C., Mauer, D. & Sherman, A. (1998). The Determinants of Corporate Liquidity: Theory and evidence. *The Journal of Financial and Quantitative Analysis*, vol. 33, no. 3, pp.335-359.

Lang, L., Poulsen, A. & Stulz, R. (1995). Asset Sales, Firm Performance, and the Agency Costs of Managerial Discretion. *Journal of Financial Economics*, vol. 37, no. 1, pp.3-37.

Lins, K., Servaes, H. & Tufano, P. (2010). What Drives Corporate Liquidity? An international survey of cash holdings and lines of credit. *Journal of Financial Economics*, vol. 98, no. 1, pp.160-176.

Lins, K., Volpin, P. & Wagner, H. (2013). Does Family Control Matter? International evidence from the 2008–2009 financial crisis. *Review of Financial Studies*, vol. 26, no. 10, pp.2583-2619.

Liu, Y. & Mauer, D. (2011). Corporate Cash Holdings and CEO Compensation Incentives. *Journal of Financial Economics*, vol. 102, no. 1, pp.183-198.

Mantecon, T. (2008). An Analysis of the Implications of Uncertainty and Agency Problems on the Wealth Effects to Acquirers of Private Firms. *Journal of Banking & Finance*, vol. 32, no. 5, pp.892-905.

Masulis, R., Wang, C. & Xie, F. (2009). Agency Problems at Dual-Class Companies. *The Journal of Finance*, vol. 64, no. 4, pp.1697-1727.

Matsusaka, J. & Nanda, V. (2002). Internal Capital Markets and Corporate Refocusing. *Journal of Financial Intermediation*, vol. 11, no. 2, pp.176-211.

McDonald, R. & Siegel, D. (1986). The Value of Waiting to Invest. *The Quarterly Journal of Economics*, vol. 101, no. 4, pp.707-727.

Michaely, R. & Roberts, M. (2011). Corporate Dividend Policies: Lessons from private firms. *Review of Financial Studies*, vol. 25, no. 3, pp.711-746.

Mikkelson, W. & Partch, M. (2003). Do Persistent Large Cash Reserves Hinder Performance?. *The Journal of Financial and Quantitative Analysis*, vol. 38, no. 2, pp.275-294.

Miller, M. & Orr, D. (1966). A Model of the Demand for Money by Firms. *The Quarterly Journal of Economics*, vol. 80, no. 3, pp.413-435.

Morck, R., Stangeland, D. & Yeung, B. (2000). Inherited Wealth, Corporate Control, and Economic Growth: The Canadian disease. In R. Morck (Ed.), *Concentrated Corporate Ownership,* pp.319–369. Chicago, IL: University of Chicago Press.

Morck, R. & Yeung, B. (2004). Family Control and the Rent-Seeking Society. *Entrepreneurship Theory and Practice*, vol. 28, no. 4, pp.391-409.

Myers, S. (1977). Determinants of Corporate Borrowing. *Journal of Financial Economics*, vol. 5, no. 2, pp.147-175.

Myers, S. & Majluf, N. (1984). Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have. *Journal of Financial Economics*, vol. 13, no. 2, pp.187-221.

Nagar, V., Petroni, K. & Wolfenzon, D. (2011). Governance Problems in Closely Held Corporations. *Journal of Financial and Quantitative Analysis*, vol. 46, no. 4, pp.943-966.

Nikolov, B. & Whited, T. (2014). Agency Conflicts and Cash: Estimates from a Dynamic Model. *The Journal of Finance*, vol. 69, no. 5, pp.1883-1921.

Opler, T. & Titman, S. (1994). Financial Distress and Corporate Performance. *The Journal of Finance*, vol. 49, no. 3, pp.1015-1040.

Opler, T., Pinkowitz, L., Stulz, R. & Williamson, R. (1999). The Determinants and Implications of Corporate Cash Holdings. *Journal of Financial Economics*, vol. 52, no. 1, pp.3-46.

Ozkan, A. & Ozkan, N. (2004). Corporate Cash Holdings: An empirical investigation of UK companies. *Journal of Banking & Finance*, vol. 28, no. 9, pp.2103-2134.

Pinkowitz, L. & Williamson, R. (2001). Bank Power and Cash Holdings: Evidence from Japan. *Review of Financial Studies*, vol. 14, no. 4, pp.1059-1082.

Pinkowitz, L. & Williamson, R. (2007). What is the Market Value of a Dollar of Corporate Cash?. *Journal of Applied Corporate Finance*, vol. 19, no. 3, pp.74-81.

Rajan, R. & Zingales, L. (1995). What Do We Know about Capital Structure? Some evidence from international data. *The Journal of Finance*, vol. 50, no. 5, pp.1421-1460.

Rajan, R., Servaes, H. & Zingales, L. (2000). The Cost of Diversity: The Diversification Discount and Inefficient Investment. *The Journal of Finance*, vol. 55, no. 1, pp.35-80.

Rudolph, C. & Schwetzler, B. (2013). Conglomerates on the Rise Again? A cross-regional study on the impact of the 2008–2009 financial crisis on the diversification discount. *Journal of Corporate Finance*, vol. 22, pp.153-165.

Scharfstein, D. & Stein, J. (2000). The Dark Side of Internal Capital Markets: Divisional rent-seeking and inefficient investment. *The Journal of Finance*, vol. 55, no. 6, pp.2537-2564.

Schwartz, E., Dixit, A. & Pindyck, R. (1994). Investment Under Uncertainty. *The Journal of Finance*, vol.49, no. 5, pp.1924-1928.

Shin, H. & Stulz, R. (1998). Are Internal Capital Markets Efficient?. *The Quarterly Journal of Economics*, vol. 113, no. 2, pp.531-552.

Shleifer, A. & Vishny, R. (1986). Large Shareholders and Corporate Control. *Journal of Political Economy*, vol. 94, no.3, pp.461-488.

Shleifer, A. & Vishny, R. (1992). Liquidation Values and Debt Capacity: A market Equilibrium approach. *The Journal of Finance*, vol. 47 no. 4, pp.1343-1366.

Shyam-Sunder, L. & Myers, S. (1999). Testing Static Tradeoff Against Pecking Order Models of Capital Structure. *Journal of Financial Economics*, vol. 51, no. 2, pp.219-244.

Stein, J. (1997). Internal Capital Markets and the Competition for Corporate Resources. *The Journal of Finance*, vol. 52, no. 1, pp.111-133.

Stulz, R. (1988). Managerial Control of Voting Rights. *Journal of Financial Economics*, vol. 20, no. 1-2, pp.25-54.

Subramaniam, V., Tang, T., Yue, H. & Zhou, X. (2011). Firm Structure and Corporate Cash Holdings. *Journal of Corporate Finance*, vol. 17, no. 3, pp.759-773.

Tirole, J. (2006). *The Theory of Corporate Finance*. Princeton, N.J.: Princeton University Press.

Tong, Z. (2011). Firm Diversification and the Value of Corporate Cash Holdings. *Journal of Corporate Finance*, vol. 17, no. 3, pp.741-758.

Zakrzewska-Bielawska, A. (2010). High Technology Company–concept, nature, characteristics. *In Proceedings of the 8th WSEAS International Conference on Management, Marketing and Finance, Recent Advances in Management, Marketing and Finances*, pp. 93-98.

Appendix A: Mean Reversion Models

Full Sample

Dependent Variable: DELTACASH
Method: Panel Least Squares
Sample (adjusted): 2006 2014
Periods included: 9
Cross-sections included: 118
Total panel (balanced) observations: 1062

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,00188	0,01359	-0,13853	0,8898
DELTACASH1	-0,71276	0,02450	-29,09835	0,0000

R-squared	0,44407	Mean dependent var	-0,00129
Adjusted R-squared	0,44355	S.D. dependent var	0,59361
S.E. of regression	0,44281	Akaike info criterion	1,21051
Sum squared resid	207,84150	Schwarz criterion	1,21987
Log likelihood	-640,78090	Hannan-Quinn criter.	1,21406
F-statistic	846,71380	Durbin-Watson stat	2,29137
Prob(F-statistic)	0,00000		

Public Companies

Dependent Variable: DELTACASH
Method: Panel Least Squares
Sample (adjusted): 2006 2014
Periods included: 9
Cross-sections included: 97
Total panel (balanced) observations: 873

	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,00404	0,01649	-0,24513	0,8064
DELTACASH1	-0,71427	0,02699	-26,46789	0,0000

R-squared	0,44577	Mean dependent var	-0,00259
Adjusted R-squared	0,44513	S.D. dependent var	0,65411
S.E. of regression	0,48724	Akaike info criterion	1,40218
Sum squared resid	206,78070	Schwarz criterion	1,41311
Log likelihood	-610,05250	Hannan-Quinn criter.	1,40636
F-statistic	700,54910	Durbin-Watson stat	2,29271
Prob(F-statistic)	0,00000		

Private Companies

Dependent Variable: DELTACASHT
Method: Panel Least Squares
Sample (adjusted): 2006 2014
Periods included: 9
Cross-sections included: 21
Total panel (balanced) observations: 189

	Coefficient	Std. Error	t-Statistic	Prob.
C	0,00524	0,00462	1,13426	0,2581
DELTACASH1	-0,11106	0,07095	-1,56525	0,1192

R-squared	0,01293	Mean dependent var	0,00471
Adjusted R-squared	0,00765	S.D. dependent var	0,06354
S.E. of regression	0,06329	Akaike info criterion	-2,67156
Sum squared resid	0,74912	Schwarz criterion	-2,63726
Log likelihood	254,46270	Hannan-Quinn criter.	-2,65767
F-statistic	2,45001	Durbin-Watson stat	2,01597
Prob(F-statistic)	0,11922		

Appendix B: Cash Target Models of the Full Sample

Regression with TecDax

Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 117
Total panel (unbalanced) observations: 1240
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1,29327	0,16541	7,81849	0,0000
FS	-0,03991	0,00670	-5,95600	0,0000
IO	-0,14129	0,10319	-1,36918	0,1712
CF	-0,69501	0,36497	-1,90430	0,0571
CFV	3,98818	2,57970	1,54598	0,1224
NWC	-1,01085	0,12203	-8,28375	0,0000
L	-1,06622	0,11203	-9,51771	0,0000
TAX	-0,00696	0,00328	-2,11874	0,0343
POD	0,05203	0,03644	1,42777	0,1536
D01	0,02848	0,03931	0,72432	0,4690
CCC	-0,00001	0,00001	-0,66388	0,5069
TECDAX	0,00010	0,00004	2,55274	0,0108
PUBLIC_PRIVATE	-0,21146	0,03662	-5,77462	0,0000

R-squared	0,25533	Mean dependent var	0,28817
Adjusted R-squared	0,24805	S.D. dependent var	0,60168
S.E. of regression	0,52175	Akaike info criterion	1,54715
Sum squared resid	334,01070	Schwarz criterion	1,60086
Log likelihood	-946,23370	Hannan-Quinn criter.	1,56735
F-statistic	35,05935	Durbin-Watson stat	1,08558
Prob(F-statistic)	0,00000		

Regression without TecDax

Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 117
Total panel (unbalanced) observations: 1240
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1,38376	0,15642	8,84618	0,0000
FS	-0,03959	0,00673	-5,88366	0,0000
IO	-0,14323	0,10407	-1,37623	0,1690
CF	-0,70277	0,36965	-1,90116	0,0575
CFV	3,85073	2,56079	1,50373	0,1329
NWC	-1,01314	0,12314	-8,22735	0,0000
L	-1,06762	0,11179	-9,55011	0,0000
TAX	-0,00734	0,00355	-2,06804	0,0388
POD	0,05160	0,03643	1,41618	0,1570
D01	0,03339	0,03964	0,84231	0,3998
CCC	-0,00001	0,00001	-0,62962	0,5291
PUBLIC_PRIVATE	-0,21876	0,03725	-5,87359	0,0000

R-squared	0,25358	Mean dependent var	0,28817
Adjusted R-squared	0,24689	S.D. dependent var	0,60168
S.E. of regression	0,52215	Akaike info criterion	1,54789
Sum squared resid	334,79680	Schwarz criterion	1,59747
Log likelihood	-947,69120	Hannan-Quinn criter.	1,56653
F-statistic	37,92572	Durbin-Watson stat	1,08438
Prob(F-statistic)	0,00000		

Regression using year dummies

Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 117
Total panel (unbalanced) observations: 1240
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1,28284	0,17470	7,34330	0,0000
FS	-0,04010	0,00680	-5,89298	0,0000
IO	-0,14470	0,10482	-1,38036	0,1677
CF	-0,69731	0,36291	-1,92143	0,0549
CFV	4,04533	2,72372	1,48522	0,1377
NWC	-1,00501	0,11890	-8,45271	0,0000
L	-1,05963	0,11116	-9,53262	0,0000
TAX	-0,00706	0,00377	-1,87171	0,0615
POD	0,05180	0,03670	1,41126	0,1584
D01	0,02646	0,04283	0,61775	0,5369
CCC	-0,00001	0,00001	-0,65918	0,5099
PUBLIC_PRIVATE	-0,20743	0,04052	-5,11869	0,0000
YEAR05	0,13146	0,01607	8,18058	0,0000
YEAR06	0,05981	0,02014	2,96951	0,0030
YEAR07	0,09705	0,01703	5,69946	0,0000
YEAR08	0,05706	0,01831	3,11663	0,0019
YEAR09	0,07137	0,01545	4,61971	0,0000
YEAR10	0,11159	0,04686	2,38162	0,0174
YEAR11	0,06478	0,03825	1,69362	0,0906
YEAR12	0,13728	0,02437	5,63397	0,0000
YEAR13	0,07714	0,03202	2,40914	0,0161
YEAR14	0,16720	0,03196	5,23172	0,0000

R-squared	0,25864	Mean dependent var	0,28817
Adjusted R-squared	0,24586	S.D. dependent var	0,60168
S.E. of regression	0,52250	Akaike info criterion	1,55721
Sum squared resid	332,52460	Schwarz criterion	1,64810
Log likelihood	-943,46900	Hannan-Quinn criter.	1,59139
F-statistic	20,23506	Durbin-Watson stat	1,07756
Prob(F-statistic)	0,00000		

Regression with period fixed-effects

Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 117
Total panel (unbalanced) observations: 1240
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1,37239	0,16404	8,36630	0,0000
FS	-0,04010	0,00680	-5,89298	0,0000
IO	-0,14470	0,10482	-1,38036	0,1677
CF	-0,69731	0,36291	-1,92143	0,0549
CFV	4,04533	2,72372	1,48522	0,1377
NWC	-1,00501	0,11890	-8,45271	0,0000
L	-1,05963	0,11116	-9,53262	0,0000
TAX	-0,00706	0,00377	-1,87171	0,0615
POD	0,05180	0,03670	1,41126	0,1584
D01	0,02646	0,04283	0,61775	0,5369
CCC	-0,00001	0,00001	-0,65918	0,5099
PUBLIC_PRIVATE	-0,20743	0,04052	-5,11869	0,0000

Effects Specification

Period fixed (dummy variables)

R-squared	0,25864	Mean dependent var	0,28817
Adjusted R-squared	0,24586	S.D. dependent var	0,60168
S.E. of regression	0,52250	Akaike info criterion	1,55721
Sum squared resid	332,52460	Schwarz criterion	1,64810
Log likelihood	-943,46900	Hannan-Quinn criter.	1,59139
F-statistic	20,23506	Durbin-Watson stat	1,07756
Prob(F-statistic)	0,00000		

Regression with cross-section random-effects

Dependent Variable: CASH
Method: Panel EGLS (Cross-section random effects)
Sample: 2004 2014
Periods included: 11
Cross-sections included: 117
Total panel (unbalanced) observations: 1240
Swamy and Arora estimator of component variances
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1,22396	0,22825	5,36241	0,0000
FS	-0,02902	0,00863	-3,36087	0,0008
IO	-0,26711	0,13328	-2,00412	0,0453
CF	-0,06250	0,21664	-0,28847	0,7730
CFV	3,04591	2,54520	1,19673	0,2316
NWC	-1,23160	0,16884	-7,29448	0,0000
L	-1,10259	0,24269	-4,54316	0,0000
TAX	-0,00491	0,00186	-2,63587	0,0085
POD	0,05948	0,05165	1,15146	0,2498
D01	-0,03022	0,05033	-0,60048	0,5483
CCC	-0,00001	0,00001	-0,94041	0,3472
TECDAX	0,00009	0,00004	2,17702	0,0297
PUBLIC_PRIVATE	-0,17014	0,03710	-4,58586	0,0000

Effects Specification

	S.D.	Rho
Cross-section random	0,28278	0,33340
Idiosyncratic random	0,39984	0,66660

Weighted Statistics

R-squared	0,18259	Mean dependent var	0,11365
Adjusted R-squared	0,17460	S.D. dependent var	0,45295
S.E. of regression	0,41170	Sum squared resid	207,97110
F-statistic	22,84052	Durbin-Watson stat	1,54177
Prob(F-statistic)	0,00000		

Unweighted Statistics

R-squared	0,21621	Mean dependent var	0,28817
Sum squared resid	351,55600	Durbin-Watson stat	0,91207

Restricted Regression

Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 118
Total panel (balanced) observations: 1298
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1,40388	0,12685	1,10669	0,0000
FS	-0,04378	0,00388	-1,12916	0,0000
CF	-0,12996	0,05016	-2,59094	0,0097
NWC	-0,82320	0,07404	-1,11185	0,0000
L	-1,07033	0,14266	-7,50289	0,0000
TAX	-0,00621	0,00235	-2,64617	0,0082
TECDAX	0,00008	0,00004	2,10618	0,0354
PUBLIC_PRIVATE	-0,13253	0,02517	-5,26621	0,0000

R-squared	0,19344	Mean dependent var	0,28244
Adjusted R-squared	0,18906	S.D. dependent var	0,59288
S.E. of regression	0,53390	Akaike info criterion	1,58892
Sum squared resid	367,71160	Schwarz criterion	1,62078
Log likelihood	-1023,21100	Hannan-Quinn criter.	1,60088
F-statistic	44,19806	Durbin-Watson stat	1,07326
Prob(F-statistic)	0,00000		

Appendix C: Cash Target Models of the Public Companies

Regression with TecDax

Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 96
Total panel (unbalanced) observations: 1041
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1,13265	0,15106	7,49826	0,0000
FS	-0,03880	0,00698	-5,56043	0,0000
IO	-0,15680	0,11015	-1,42357	0,1549
CF	-0,72109	0,37689	-1,91327	0,0560
CFV	3,90441	2,69178	1,45049	0,1472
NWC	-1,17492	0,13456	-8,73172	0,0000
L	-1,20377	0,13198	-9,12089	0,0000
TAX	-0,01107	0,00557	-1,98909	0,0470
POD	0,05466	0,03817	1,43200	0,1524
D01	0,03108	0,03871	0,80283	0,4223
CCC	-0,00001	0,00001	-0,53165	0,5951
TECDAX	0,00013	0,00005	2,77374	0,0056

R-squared	0,26475	Mean dependent var	0,31870
Adjusted R-squared	0,25689	S.D. dependent var	0,64978
S.E. of regression	0,56014	Akaike info criterion	1,69019
Sum squared resid	322,85110	Schwarz criterion	1,74722
Log likelihood	-867,74180	Hannan-Quinn criter.	1,71182
F-statistic	33,68453	Durbin-Watson stat	1,09224
Prob(F-statistic)	0,00000		

Regression without TecDax

Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 96
Total panel (unbalanced) observations: 1041
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1,23513	0,13726	8,99856	0,0000
FS	-0,03854	0,00698	-5,52001	0,0000
IO	-0,15932	0,11146	-1,42942	0,1532
CF	-0,72960	0,38235	-1,90819	0,0566
CFV	3,74983	2,67401	1,40233	0,1611
NWC	-1,17539	0,13624	-8,62747	0,0000
L	-1,20213	0,12992	-9,25283	0,0000
TAX	-0,01160	0,00597	-1,94492	0,0521
POD	0,05412	0,03816	1,41845	0,1564
D01	0,03728	0,03918	0,95156	0,3415
CCC	-0,00001	0,00001	-0,49471	0,6209

R-squared	0,26241	Mean dependent var	0,31870
Adjusted R-squared	0,25525	S.D. dependent var	0,64978
S.E. of regression	0,56076	Akaike info criterion	1,69145
Sum squared resid	323,87970	Schwarz criterion	1,74373
Log likelihood	-869,39750	Hannan-Quinn criter.	1,71128
F-statistic	36,64408	Durbin-Watson stat	1,09081
Prob(F-statistic)	0,00000		

Regression using year dummies

Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 96
Total panel (unbalanced) observations: 1041
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1,14893	0,15897	7,22742	0,0000
FS	-0,03904	0,00710	-5,49784	0,0000
IO	-0,15848	0,11086	-1,42951	0,1532
CF	-0,72132	0,37481	-1,92449	0,0546
CFV	3,93635	2,84395	1,38411	0,1666
NWC	-1,16781	0,13075	-8,93134	0,0000
L	-1,19706	0,13179	-9,08326	0,0000
TAX	-0,01167	0,00637	-1,83125	0,0674
POD	0,05439	0,03843	1,41520	0,1573
D01	0,02971	0,04277	0,69462	0,4875
CCC	-0,00001	0,00001	-0,52911	0,5968
YEAR05	0,12470	0,01336	9,33351	0,0000
YEAR06	0,05057	0,01788	2,82855	0,0048
YEAR07	0,10114	0,01523	6,63905	0,0000
YEAR08	0,05370	0,01751	3,06696	0,0022
YEAR09	0,06811	0,01482	4,59511	0,0000
YEAR10	0,09949	0,04495	2,21319	0,0271
YEAR11	0,05261	0,04189	1,25589	0,2094
YEAR12	0,14054	0,02392	5,87460	0,0000
YEAR13	0,07677	0,03359	2,28560	0,0225
YEAR14	0,18628	0,03299	5,64656	0,0000

R-squared	0,26794	Mean dependent var	0,31870
Adjusted R-squared	0,25358	S.D. dependent var	0,64978
S.E. of regression	0,56138	Akaike info criterion	1,70314
Sum squared resid	321,45240	Schwarz criterion	1,80295
Log likelihood	-865,48200	Hannan-Quinn criter.	1,74100
F-statistic	18,66627	Durbin-Watson stat	1,08378
Prob(F-statistic)	0,00000		

Regression using cross-sectional and period fixed-effects

Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 96
Total panel (unbalanced) observations: 1041
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0,21058	0,43227	0,48715	0,6263
FS	0,07173	0,02326	3,08332	0,0021
IO	-0,33512	0,19357	-1,73127	0,0837
CF	0,17063	0,21652	0,78805	0,4309
CFV	3,19345	2,57704	1,23920	0,2156
NWC	-1,49747	0,16792	-8,91799	0,0000
L	-1,19983	0,38568	-3,11092	0,0019
TAX	-0,00647	0,00460	-1,40716	0,1597
POD	0,06807	0,06202	1,09754	0,2727
D01	-0,03625	0,06186	-0,58602	0,5580
CCC	-0,00002	0,00002	-1,24238	0,2144

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0,60803	Mean dependent var	0,31870
Adjusted R-squared	0,55930	S.D. dependent var	0,64978
S.E. of regression	0,43136	Akaike info criterion	1,26097
Sum squared resid	172,11560	Schwarz criterion	1,81232
Log likelihood	-540,33430	Hannan-Quinn criter.	1,47011
F-statistic	12,47725	Durbin-Watson stat	1,71035
Prob(F-statistic)	0,00000		

Regression using period random-effects

Dependent Variable: CASH
Method: Panel EGLS (Period random effects)
Sample: 2004 2014
Periods included: 11
Cross-sections included: 96
Total panel (unbalanced) observations: 1041
Swamy and Arora estimator of component variances
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1,23513	0,13726	8,99856	0,0000
FS	-0,03854	0,00698	-5,52001	0,0000
IO	-0,15932	0,11146	-1,42942	0,1532
CF	-0,72960	0,38235	-1,90819	0,0566
CFV	3,74983	2,67401	1,40233	0,1611
NWC	-1,17539	0,13624	-8,62747	0,0000
L	-1,20213	0,12992	-9,25283	0,0000
TAX	-0,01160	0,00597	-1,94492	0,0521
POD	0,05412	0,03816	1,41845	0,1564
D01	0,03728	0,03918	0,95156	0,3415
CCC	-0,00001	0,00001	-0,49471	0,6209

Effects Specification	S.D.	Rho
Period random	0,00000	0,00000
Idiosyncratic random	0,56138	1,00000

Weighted Statistics			
R-squared	0,26241	Mean dependent var	0,31870
Adjusted R-squared	0,25525	S.D. dependent var	0,64978
S.E. of regression	0,56076	Sum squared resid	323,87970
F-statistic	36,64408	Durbin-Watson stat	1,09081
Prob(F-statistic)	0,00000		

Unweighted Statistics			
R-squared	0,26241	Mean dependent var	0,31870
Sum squared resid	323,87970	Durbin-Watson stat	1,09081

Restricted Regression using cross-sectional and period fixed-effects

Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 97
Total panel (unbalanced) observations: 1057
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0,22647	0,50477	0,44867	0,6538
FS	0,10406	0,05675	1,83365	0,0670
IO	-0,25719	0,15240	-1,68765	0,0918
NWC	-1,44680	0,16648	-8,69082	0,0000
L	-1,57648	0,14452	-10,90850	0,0000

Effects Specification
Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0,58786	Mean dependent var	0,31539
Adjusted R-squared	0,53994	S.D. dependent var	0,64547
S.E. of regression	0,43780	Akaike info criterion	1,28499
Sum squared resid	181,32220	Schwarz criterion	1,80620
Log likelihood	-568,11770	Hannan-Quinn criter.	1,48255
F-statistic	12,26689	Durbin-Watson stat	1,79697
Prob(F-statistic)	0,00000		

Appendix D: Cash Target Models of the Private Companies

Regression with TecDax

Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 21
Total panel (unbalanced) observations: 199
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,22066	0,08007	-2,75581	0,0064
FS	0,02474	0,00482	5,13740	0,0000
IO	-0,05173	0,01944	-2,66140	0,0085
CF	0,37130	0,11949	3,10728	0,0022
CFV	-1,29241	0,64998	-1,98837	0,0482
NWC	-0,10029	0,04673	-2,14595	0,0332
L	-0,05970	0,04682	-1,27526	0,2038
TAX	0,00110	0,00069	1,59873	0,1116
POD	0,02283	0,00752	3,03691	0,0027
CCC	0,00054	0,00012	4,49677	0,0000
TECDAX	0,00002	0,00001	1,21473	0,2260

R-squared	0,30037	Mean dependent var	0,12842
Adjusted R-squared	0,26316	S.D. dependent var	0,13068
S.E. of regression	0,11217	Akaike info criterion	-1,48389
Sum squared resid	2,36550	Schwarz criterion	-1,30184
Log likelihood	158,64660	Hannan-Quinn criter.	-1,41021
F-statistic	8,07136	Durbin-Watson stat	0,35534
Prob(F-statistic)	0,00000		

Regression without TecDax

Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 21
Total panel (unbalanced) observations: 199
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,20506	0,07537	-2,72086	0,0071
FS	0,02496	0,00483	5,16838	0,0000
IO	-0,05181	0,02011	-2,57649	0,0107
CF	0,36576	0,11630	3,14508	0,0019
CFV	-1,35758	0,60750	-2,23468	0,0266
NWC	-0,10103	0,04637	-2,17884	0,0306
L	-0,06213	0,04691	-1,32447	0,1869
TAX	0,00102	0,00070	1,46192	0,1454
POD	0,02304	0,00745	3,09215	0,0023
CCC	0,00053	0,00012	4,44162	0,0000

R-squared	0,29936	Mean dependent var	0,12842
Adjusted R-squared	0,26600	S.D. dependent var	0,13068
S.E. of regression	0,11196	Akaike info criterion	-1,49249
Sum squared resid	2,36891	Schwarz criterion	-1,32700
Log likelihood	158,50320	Hannan-Quinn criter.	-1,42552
F-statistic	8,97265	Durbin-Watson stat	0,35780
Prob(F-statistic)	0,00000		

Regression using year dummies

Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 21
Total panel (unbalanced) observations: 199
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,29671	0,07931	-3,74108	0,0002
FS	0,02454	0,00504	4,86584	0,0000
IO	-0,06204	0,02473	-2,50867	0,0130
CF	0,35476	0,13325	2,66246	0,0085
CFV	-1,14740	0,77383	-1,48276	0,1399
NWC	-0,10032	0,04851	-2,06780	0,0401
L	-0,05151	0,04772	-1,07942	0,2819
TAX	0,00096	0,00070	1,36669	0,1734
POD	0,02265	0,00797	2,84129	0,0050
CCC	0,00055	0,00012	4,60100	0,0000
YEAR05	0,08810	0,02224	3,96093	0,0001
YEAR06	0,08811	0,02646	3,32954	0,0011
YEAR07	0,07636	0,02548	2,99634	0,0031
YEAR08	0,06616	0,02105	3,14303	0,0020
YEAR09	0,08799	0,01945	4,52427	0,0000
YEAR10	0,09973	0,02053	4,85696	0,0000
YEAR11	0,08867	0,02536	3,49662	0,0006
YEAR12	0,09324	0,02101	4,43834	0,0000
YEAR13	0,09882	0,02047	4,82664	0,0000
YEAR14	0,08725	0,02129	4,09741	0,0001

R-squared	0,30649	Mean dependent var	0,12842
Adjusted R-squared	0,23288	S.D. dependent var	0,13068
S.E. of regression	0,11445	Akaike info criterion	-1,40222
Sum squared resid	2,34480	Schwarz criterion	-1,07124
Log likelihood	159,52130	Hannan-Quinn criter.	-1,26827
F-statistic	4,16362	Durbin-Watson stat	0,35461
Prob(F-statistic)	0,00000		

Regression using cross-sectional and period fixed-effects

Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 21
Total panel (unbalanced) observations: 199
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,76100	0,27180	-2,79983	0,0057
FS	0,11072	0,02116	5,23283	0,0000
IO	-0,06780	0,01622	-4,18079	0,0000
CF	0,19827	0,11390	1,74078	0,0837
CFV	-0,48413	0,30403	-1,59239	0,1133
NWC	-0,11714	0,03753	-3,12147	0,0021
L	-0,26458	0,10611	-2,49342	0,0137
TAX	-0,00024	0,00058	-0,40948	0,6827
POD	-0,02598	0,01071	-2,42525	0,0164
CCC	0,00000	0,00025	-0,00232	0,9982

Effects Specification
Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0,78392	Mean dependent var	0,12842
Adjusted R-squared	0,73091	S.D. dependent var	0,13068
S.E. of regression	0,06779	Akaike info criterion	-2,36731
Sum squared resid	0,73060	Schwarz criterion	-1,70534
Log likelihood	275,54700	Hannan-Quinn criter.	-2,09939
F-statistic	1,47903	Durbin-Watson stat	0,94598
Prob(F-statistic)	0,00000		

Regression using period random-effects

Dependent Variable: CASH
Method: Panel EGLS (Period random effects)
Sample: 2004 2014
Periods included: 11
Cross-sections included: 21
Total panel (unbalanced) observations: 199
Swamy and Arora estimator of component variances
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,22066	0,08007	-2,755808	0,0064
FS	0,02474	0,00482	5,13740	0,0000
IO	-0,05173	0,01944	-2,66140	0,0085
CF	0,37130	0,11949	3,10728	0,0022
CFV	-1,29241	0,64998	-1,98837	0,0482
NWC	-0,10029	0,04673	-2,14595	0,0332
L	-0,05970	0,04682	-1,27526	0,2038
TAX	0,00110	0,00069	1,59873	0,1116
POD	0,02283	0,00752	3,03691	0,0027
CCC	0,00054	0,00012	4,49677	0,0000
TECDAX	0,00002	0,00001	1,21473	0,2260

Effects Specification		
	S,D,	Rho
Period random	2,25E-08	0,0000
Idiosyncratic random	0,11445	1,0000

Weighted Statistics			
R-squared	0,30037	Mean dependent var	0,12842
Adjusted R-squared	0,26316	S.D. dependent var	0,13068
S.E. of regression	0,11217	Sum squared resid	2,36550
F-statistic	8,07136	Durbin-Watson stat	0,35534
Prob(F-statistic)	0,00000		

Unweighted Statistics			
R-squared	0,30037	Mean dependent var	0,12842
Sum squared resid	2,36550	Durbin-Watson stat	0,35534

Restricted Regression using cross-sectional and period fixed-effects

Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 21
Total panel (unbalanced) observations: 219
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

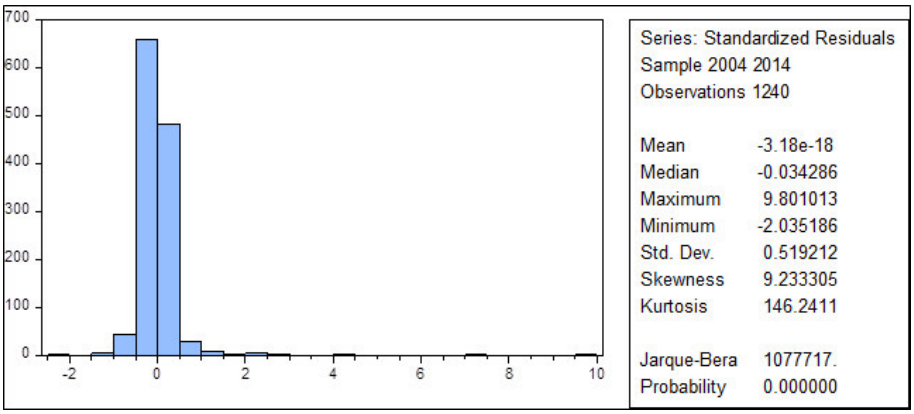
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,45606	0,20472	-2,22773	0,0271
FS	0,08662	0,01606	5,39355	0,0000
IO	-0,03401	0,01179	-2,88548	0,0044
CF	0,18181	0,11298	1,60923	0,1093
NWC	-0,11748	0,03796	-3,09503	0,0023
L	-0,36504	0,06852	-5,32750	0,0000
POD	-0,02832	0,00965	-2,93322	0,0038

Effects Specification
Cross-section fixed (dummy variables)
Period fixed (dummy variables)

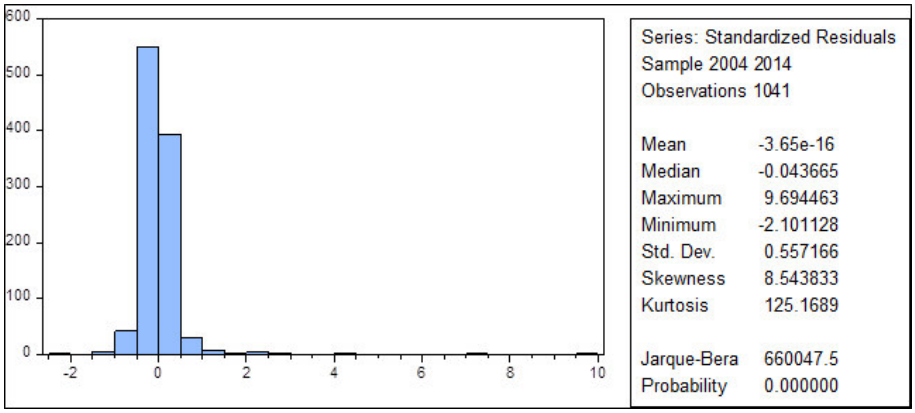
R-squared	0,76795	Mean dependent var	0,12709
Adjusted R-squared	0,72205	S.D. dependent var	0,12893
S.E. of regression	0,06797	Akaike info criterion	-2,38667
Sum squared resid	0,84083	Schwarz criterion	-1,81408
Log likelihood	298,34000	Hannan-Quinn criter.	-2,15542
F-statistic	16,73117	Durbin-Watson stat	0,97550
Prob(F-statistic)	0,00000		

Appendix E: Jarque-Bera Tests

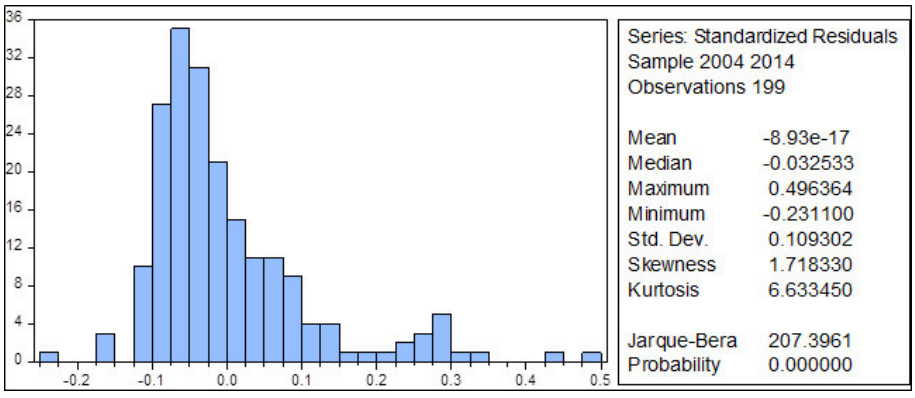
Jarque-Bera Test for Heteroscedasticity of the Full Sample



Jarque-Bera Test for Heteroscedasticity of the Public Sample



Jarque-Bera Test for Heteroscedasticity of the Private Sample



Appendix F: Redundant Fixed Effects Test of the Public Companies

Redundant Fixed Effects Tests
Equation: DET_UNREST_NOTEC_FIX
Test cross-section and period fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	8,44821	(95925)	0,0000
Cross-section Chi-square	650,29525	95	0,0000
Period F	1,06233	(10925)	0,3888
Period Chi-square	11,88733	10	0,2927
Cross-Section/Period F	7,76786	(105925)	0,0000
Cross-Section/Period Chi-square	658,12640	105	0,0000

Cross-section fixed effects test equation:
Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 96
Total panel (unbalanced) observations: 1041
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1,23554	0,14491	8,52624	0,0000
FS	-0,03904	0,00710	-5,49784	0,0000
IO	-0,15848	0,11086	-1,42951	0,1532
CF	-0,72132	0,37481	-1,92449	0,0546
CFV	3,93635	2,84395	1,38411	0,1666
NWC	-1,16781	0,13075	-8,93134	0,0000
L	-1,19706	0,13179	-9,08326	0,0000
TAX	-0,01167	0,00637	-1,83125	0,0674
POD	0,05439	0,03843	1,41520	0,1573
D01	0,02971	0,04277	0,69462	0,4875
CCC	-0,00001	0,00001	-0,52911	0,5968

Effects Specification

Period fixed (dummy variables)

R-squared	0,26794	Mean dependent var	0,31870
Adjusted R-squared	0,25358	S.D. dependent var	0,64978
S.E. of regression	0,56138	Akaike info criterion	1,70314
Sum squared resid	321,45240	Schwarz criterion	1,80295
Log likelihood	-865,48200	Hannan-Quinn criter.	1,74100
F-statistic	18,66627	Durbin-Watson stat	1,08378
Prob(F-statistic)	0,00000		

Period fixed effects test equation:
Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 96
Total panel (unbalanced) observations: 1041
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0,23982	0,44369	0,54052	0,5890
FS	0,06810	0,02911	2,33894	0,0195
IO	-0,33236	0,19130	-1,73738	0,0826
CF	0,16437	0,21157	0,77692	0,4374
CFV	3,35029	2,46963	1,35659	0,1752
NWC	-1,48324	0,16757	-8,85168	0,0000
L	-1,18967	0,38598	-3,08219	0,0021
TAX	-0,00603	0,00350	-1,72113	0,0856
POD	0,06741	0,06150	1,09625	0,2733
D01	-0,04219	0,05889	-0,71642	0,4739
CCC	-0,00002	0,00001	-1,24050	0,2151

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0,60353	Mean dependent var	0,31870
Adjusted R-squared	0,55901	S.D. dependent var	0,64978
S.E. of regression	0,43150	Akaike info criterion	1,25318
Sum squared resid	174,09230	Schwarz criterion	1,75700
Log likelihood	-546,27800	Hannan-Quinn criter.	1,44429
F-statistic	13,55535	Durbin-Watson stat	1,72159
Prob(F-statistic)	0,00000		

Cross-section and period fixed effects test equation:
Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 96
Total panel (unbalanced) observations: 1041
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1,23513	0,13726	8,99856	0,0000
FS	-0,03854	0,00698	-5,52001	0,0000
IO	-0,15932	0,11146	-1,42942	0,1532
CF	-0,72960	0,38235	-1,90819	0,0566
CFV	3,74983	2,67401	1,40233	0,1611
NWC	-1,17539	0,13624	-8,62747	0,0000
L	-1,20213	0,12992	-9,25283	0,0000
TAX	-0,01160	0,00597	-1,94492	0,0521
POD	0,05412	0,03816	1,41845	0,1564
D01	0,03728	0,03918	0,95156	0,3415
CCC	-0,00001	0,00001	-0,49471	0,6209

R-squared	0,26241	Mean dependent var	0,31870
Adjusted R-squared	0,25525	S.D. dependent var	0,64978
S.E. of regression	0,56076	Akaike info criterion	1,69145
Sum squared resid	323,87970	Schwarz criterion	1,74373
Log likelihood	-869,39750	Hannan-Quinn criter.	1,71128
F-statistic	36,64408	Durbin-Watson stat	1,09081
Prob(F-statistic)	0,00000		

Appendix G: Redundant Fixed Effects Test of the Private Companies

Redundant Fixed Effects Tests
Equation: DET_UNREST_NOTEC_FIX
Test cross-section and period fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	17,56481	(20159)	0,0000
Cross-section Chi-square	232,05132	20	0,0000
Period F	0,49219	(10159)	0,8933
Period Chi-square	6,06664	10	0,8096
Cross-Section/Period F	11,88482	(30159)	0,0000
Cross-Section/Period Chi-square	234,08759	30	0,0000

Cross-section fixed effects test equation:
Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 21
Total panel (unbalanced) observations: 199
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,20975	0,08502	-2,46714	0,0146
FS	0,02454	0,00504	4,86584	0,0000
IO	-0,06204	0,02473	-2,50867	0,0130
CF	0,35476	0,13325	2,66246	0,0085
CFV	-1,14740	0,77383	-1,48276	0,1399
NWC	-0,10032	0,04851	-2,06780	0,0401
L	-0,05151	0,04772	-1,07942	0,2819
TAX	0,00096	0,00070	1,36669	0,1734
POD	0,02265	0,00797	2,84129	0,0050
CCC	0,00055	0,00012	4,60100	0,0000

Effects Specification

Period fixed (dummy variables)

R-squared	0,30649	Mean dependent var	0,12842
Adjusted R-squared	0,23288	S.D. dependent var	0,13068
S.E. of regression	0,11445	Akaike info criterion	-1,40222
Sum squared resid	2,34480	Schwarz criterion	-1,07124
Log likelihood	159,52130	Hannan-Quinn criter.	-1,26827
F-statistic	4,16362	Durbin-Watson stat	0,35461
Prob(F-statistic)	0,00000		

Period fixed effects test equation:
Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 21
Total panel (unbalanced) observations: 199
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,57869	0,21598	-2,67939	0,0081
FS	0,09294	0,01755	5,29707	0,0000
IO	-0,04438	0,01505	-2,94805	0,0037
CF	0,23119	0,09312	2,48267	0,0140
CFV	-0,14061	0,32379	-0,43425	0,6647
NWC	-0,09926	0,03862	-2,57025	0,0110
L	-0,27497	0,08886	-3,09450	0,0023
TAX	-0,00002	0,00054	-0,03586	0,9714
POD	-0,02610	0,00899	-2,90257	0,0042
CCC	-0,00008	0,00022	-0,35303	0,7245

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0,77723	Mean dependent var	0,12842
Adjusted R-squared	0,73900	S.D. dependent var	0,13068
S.E. of regression	0,06676	Akaike info criterion	-2,43732
Sum squared resid	0,75322	Schwarz criterion	-1,94085
Log likelihood	272,51370	Hannan-Quinn criter.	-2,23639
F-statistic	20,33158	Durbin-Watson stat	0,95807
Prob(F-statistic)	0,00000		

Cross-section and period fixed effects test equation:
Dependent Variable: CASH
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 21
Total panel (unbalanced) observations: 199
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,20506	0,07537	-2,72086	0,0071
FS	0,02496	0,00483	5,16838	0,0000
IO	-0,05181	0,02011	-2,57649	0,0107
CF	0,36576	0,11630	3,14508	0,0019
CFV	-1,35758	0,60750	-2,23468	0,0266
NWC	-0,10103	0,04637	-2,17884	0,0306
L	-0,06213	0,04691	-1,32447	0,1869
TAX	0,00102	0,00070	1,46192	0,1454
POD	0,02304	0,00745	3,09215	0,0023
CCC	0,00053	0,00012	4,44162	0,0000

R-squared	0,29936	Mean dependent var	0,12842
Adjusted R-squared	0,26600	S.D. dependent var	0,13068
S.E. of regression	0,11196	Akaike info criterion	-1,49249
Sum squared resid	2,36891	Schwarz criterion	-1,32700
Log likelihood	158,50320	Hannan-Quinn criter.	-1,42552
F-statistic	8,97265	Durbin-Watson stat	0,35780
Prob(F-statistic)	0,00000		

Appendix H: Excess Cash Models of the Full Sample

Regression on Excess Cash derived from unrestricted model

Dependent Variable: RESID_UNREST
Method: Panel Least Squares
Sample (adjusted): 2005 2014
Periods included: 10
Cross-sections included: 116
Total panel (unbalanced) observations: 1144
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0,06796	0,02483	2,73734	0,0063
TOT	-0,16022	0,04877	-3,28551	0,0010
ACI	0,07606	0,02637	2,88414	0,0040
BP	-0,14887	0,03004	-4,95626	0,0000

R-squared	0,015202	Mean dependent var	5,35E-17
Adjusted R-squared	0,01281	S.D. dependent var	0,51921
S.E. of regression	0,51588	Akaike info criterion	1,51732
Sum squared resid	328,93300	Schwarz criterion	1,53384
Log likelihood	-936,73600	Hannan-Quinn criter.	1,52353
F-statistic	6,36001	Durbin-Watson stat	1,10493
Prob(F-statistic)	0,00028		

Regression on Excess Cash derived from unrestricted model with lagged ACI variable

Dependent Variable: RESID_UNREST
Method: Panel Least Squares
Sample (adjusted): 2005 2014
Periods included: 10
Cross-sections included: 116
Total panel (unbalanced) observations: 1144
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0,06204	0,02529	2,45322	0,0143
TOT	-0,13378	0,05221	-2,56211	0,0105
ACI1	0,07197	0,02479	2,90371	0,0038
BP	-0,14467	0,03074	-4,70641	0,0000

R-squared	0,01400	Mean dependent var	0,00476
Adjusted R-squared	0,01140	S.D. dependent var	0,51308
S.E. of regression	0,51015	Akaike info criterion	1,49525
Sum squared resid	296,68310	Schwarz criterion	1,51288
Log likelihood	-851,28220	Hannan-Quinn criter.	1,50191
F-statistic	5,39504	Durbin-Watson stat	1,16048
Prob(F-statistic)	0,00109		

Regression on Excess Cash derived from restricted model

Dependent Variable: RESID_REST
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 118
Total panel (balanced) observations: 1298
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0,12676	0,02701	4,69371	0,0000
TOT	-0,17180	0,04869	-3,52837	0,0004
ACI	-0,01172	0,02488	-0,47126	0,6375
BP	-0,17563	0,03316	-5,29715	0,0000

R-squared	0,01362	Mean dependent var	0,00000
Adjusted R-squared	0,01133	S.D. dependent var	0,53246
S.E. of regression	0,52943	Akaike info criterion	1,56905
Sum squared resid	362,70320	Schwarz criterion	1,58497
Log likelihood	-1014,31000	Hannan-Quinn criter.	1,57502
F-statistic	5,95606	Durbin-Watson stat	1,09424
Prob(F-statistic)	0,00050		

Appendix I: Excess Cash Models of the Public Companies

Regression on Excess Cash derived from unrestricted model

Dependent Variable: RESID_UNREST
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 96
Total panel (unbalanced) observations: 1041
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0,01251	0,01521	0,82238	0,4110
TOT	-0,01307	0,03090	-0,42277	0,6726
ACI	-0,00276	0,02707	-0,10201	0,9188
BP	-0,02999	0,06125	-0,48964	0,6245

R-squared	0,00035	Mean dependent var	0,00000
Adjusted R-squared	-0,00255	S.D. dependent var	0,40681
S.E. of regression	0,40733	Akaike info criterion	1,04545
Sum squared resid	172,05630	Schwarz criterion	1,06446
Log likelihood	-540,15490	Hannan-Quinn criter.	1,05266
F-statistic	0,11918	Durbin-Watson stat	1,71031
Prob(F-statistic)	0,94885		

Regression on Excess Cash derived from restricted model

Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 97
Total panel (unbalanced) observations: 1057
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0,01493	0,01889	0,79032	0,4295
TOT	-0,00670	0,03467	-0,19329	0,8468
ACI	-0,01179	0,02930	-0,40245	0,6874
BP	-0,03171	0,05838	-0,54318	0,5871

R-squared	0,00041	Mean dependent var	0,00000
Adjusted R-squared	-0,00244	S.D. dependent var	0,41438
S.E. of regression	0,41488	Akaike info criterion	1,08212
Sum squared resid	181,24780	Schwarz criterion	1,10090
Log likelihood	-567,90090	Hannan-Quinn criter.	1,08924
F-statistic	0,14401	Durbin-Watson stat	1,79669
Prob(F-statistic)	0,93353		

Appendix J: Excess Cash Models of the Private Companies

Regression on Excess Cash derived from unrestricted model

Dependent Variable: RESID_UNREST
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 21
Total panel (unbalanced) observations: 199
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,00072	0,00334	-0,21569	0,8295
ACI	0,00227	0,01054	0,21560	0,8295

R-squared	0,00036	Mean dependent var	0,00000
Adjusted R-squared	-0,00471	S.D. dependent var	0,06075
S.E. of regression	0,06089	Akaike info criterion	-2,74958
Sum squared resid	0,73034	Schwarz criterion	-2,71648
Log likelihood	275,58310	Hannan-Quinn criter.	-2,73618
F-statistic	0,07144	Durbin-Watson stat	0,94643
Prob(F-statistic)	0,78954		

Regression on Excess Cash derived from restricted model

Dependent Variable: RESID_REST
Method: Panel Least Squares
Sample: 2004 2014
Periods included: 11
Cross-sections included: 21
Total panel (unbalanced) observations: 219
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,00096	0,00245	-0,39123	0,6960
ACI	0,00318	0,00813	0,39060	0,6965

R-squared	0,00077	Mean dependent var	0,00000
Adjusted R-squared	-0,00384	S.D. dependent var	0,06211
S.E. of regression	0,06222	Akaike info criterion	-2,70707
Sum squared resid	0,84018	Schwarz criterion	-2,67612
Log likelihood	298,42410	Hannan-Quinn criter.	-2,69457
F-statistic	0,16658	Durbin-Watson stat	0,97897
Prob(F-statistic)	0,68358		

Appendix K: Redundant Variables Test

Redundant Variables Test
Null hypothesis: BP are jointly insignificant
Equation: EC_UNREST_NOPUBPRI
Specification: RESID_UNREST C TOT ACI BP
Redundant Variables: BP

	Value	df	Probability
t-statistic	3,27132	1236	0,0011
F-statistic	10,70155	(1, 1236)	0,0011
Likelihood ratio	10,68997	1	0,0011

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	2,84797	1	2,84797
Restricted SSR	331,78100	1237	0,26821
Unrestricted SSR	328,93300	1236	0,26613

LR test summary:

	Value	df
Restricted LogL	-942,08100	1237
Unrestricted LogL	-936,73600	1236

Restricted Test Equation:
Dependent Variable: RESID_UNREST
Method: Panel Least Squares
Date: 08/15/16 Time: 18:41
Sample: 2004 2014
Periods included: 11
Cross-sections included: 117
Total panel (unbalanced) observations: 1240
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,01279	0,01260	-1,01466	0,3105
TOT	-0,08637	0,04049	-2,13288	0,0331
ACI	0,09085	0,02719	3,34119	0,0009

R-squared	0,00668	Mean dependent var	0,00000
Adjusted R-squared	0,00507	S.D. dependent var	0,51921
S.E. of regression	0,51789	Akaike info criterion	1,52432
Sum squared resid	331,78100	Schwarz criterion	1,53672
Log likelihood	-942,08100	Hannan-Quinn criter.	1,52899
F-statistic	4,15665	Durbin-Watson stat	1,09297
Prob(F-statistic)	0,01588		