Regional Differences in the Determinants of Cash Holdings

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Abstract

This study investigates the existence of differences in the influence of firm characteristics on the level of cash across geographic regions. I tackle this question by undertaking a meta-regression analysis and find that geographic regions affect the association between firm characteristics and the level of cash. The influence of cash-determinants is similar in North America and Europe but different in Asia. The cause of this difference remains unclear. Results indicate that Asian firms are potentially affected by country-level agency concerns or a lack of financing alternatives. Regional differences persist after controlling for firm-level information asymmetries, country characteristics, and temporal trends. (*JEL* G31, G32, G34)

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1 Introduction

This article investigates whether the impact of individual firm-level characteristics on the level of cash holdings is affected by a firm's geographic region. The majority of existing results suggests that the association between a firm-level characteristic and corporate cash holdings depends on the respective firm's environment. Accordingly, regional factors such as investor protection, corruption, the development of the capital market, a countries economic situation or taxation are believed to affect how firm characteristics are associated to the cash ratio. However, Pinkowitz et al. (2016) object to this assumption by reporting that there is no difference in cash holdings when U.S. firms are compared to foreign firms with matching firm characteristics. This indicates that the relationship between a firm characteristic and the level of cash is persistent across geographic regions, i.e. different firm environments.

The cash hoarding behavior of firms has been in the focus of public media and academic research since 1999.[1] Various motives to hold cash have been discussed intensively. They constitute the theoretical basis for predicting the firm-level of cash. Accordingly, existing research documents that the corporate cash ratio depends on firm- as well as country-characteristics and the interaction of both. An example for the interaction of firm- and country-characteristics is the association between cash holdings and firm leverage. Acharya et al. (2008) and Chen et al. (2014) find the cash ratio to decline when leverage rises for a U.S. sample. This coincides with the trade-off, pecking-order, and the FCF-theory. However, Kalcheva/Lins (2007) and Chen et al. (2012) report a positive association, in non-U.S. settings. This positive association might be caused by debt covenants which enforce specific cash ratios. Alternatively, it could result from the sufficient control of managerial actions, in line with the shareholder power hypothesis. In the last case, the management's interests are

[1] Opler et al. (1999) and Harford (1999) initiate the continuing empirical trend of investigating corporate cash holdings.

aligned with shareholders', or in this case debt providers', interests. As a consequence, shareholders, or debt providers, allow high cash holdings.

A further example is the quality of corporate governance which is expected to be associated with a decline in the corporate cash level according to the FCF theory. This prediction is confirmed for various proxies of corporate governance. In a U.S. sample, Dittmar/Mahrt-Smith (2007) find cash to decrease when managers are less entrenched and Harford et al. (2008) report the cash level to decline when boards are independent and grow in size. In non-U.S. samples, Liu et al. (2015) report a positive association between cash and board independence, while Kalcheva/Lins (2007) and Yu et al. (2015) find a positive association between managerial ownership and the level of cash. This again coincides with predictions from shareholder power theory and indicates that country characteristics affect the implications of corporate governance characteristics.

These exemplary results suggest that the influence of one firm-level determinant may differ between countries. This also implies that the relevance of underlying theories varies across regions, which has been confirmed by Gungoraydinoglu/Öztekin (2011) for corporate leverage. In this case, the influence of a firm characteristic on the cash level changes if the respective firm, ceteris paribus, moves to another region. In contrast to this notion, Pinkowitz et al. (2016) show that the level of cash held by a U.S. firm does not differ from its international twin firm that has matching firm characteristics. They argue that differences in the mean country-level ratios of corporate cash holdings result from unique U.S. firms with high R&D ratios and are not caused by regional characteristics.

Overall, there is a debate in research. On the one hand most existing results implicitly suggest regional differences in the influence of individual firm-level determinants on the level of cash. Furthermore, such an interaction of regional- and

firm-characteristics has been confirmed to exist for corporate leverage by Gungoraydinoglu/Öztekin (2011). On the other hand, an explicit investigation by Pinkowitz et al. (2016) finds similar cash levels held by firms that have comparable characteristics, indicating the absence of regional differences.

There are studies that analyze broad international firm-level samples. However, these studies focus on the influence of different country-characteristics like investor protection (Huang et al. (2013), Iskandar-Datta/Jia (2014)), political uncertainty (Julio/Yook (2012)) or culture (Chen et al. (2015) on the level of cash but remain silent on regional differences in the association of firm characteristics with the cash level. This study contributes to existing research by addressing the conflict concerning regional differences in the influence of firm-level determinants in two central questions: What determines the level of cash, generally? Does this general effect of individual determinants depend on the geographic region?

I utilize the concept of meta-regression analysis (MRA) to undertake a quantitative review of the cash holding literature. MRA allows the empirical measurement of trends in research results by using the existing research as its sample. This approach derives the consensus association between the level of cash and each of the ten most frequently applied firm-level determinants. Moreover, it identifies how these consensus associations are influenced by the geographic region and the design of existing research.

MRA is better suited to determine general effects than a firm-level analysis. Cash holding research exhibits a large diversity of underlying theories that motivate empirical research. These theories provide partly conflicting, partly overlapping expectations on the impact of cash determinants. Because of the rich theoretical foundation, researchers take distinct perspectives when analyzing the corporate cash level. These diverging perspectives affect their study design and results. The

researchers' theoretical perspectives manifest themselves in various design choices such as the definition of variables, the inclusion of control variables, the scope of the underlying sample, and the econometric models used. MRA is an ideal tool to aggregate different perspectives and to take the effect of different design choices into account. Moreover, it avoids being biased by one particular theoretical perspective because it embraces all existing perspectives. Finally, MRA also permits controlling for publication selection, which is the selective reporting of results that is undertaken to increase the chance of being published. Such selective reporting distorts primary empirical results and causes publication bias.

Existing research provides a large set of firm-level determinants that influence the level of cash. I focus on the most prominent determinants, i.e. the determinants that are most frequently applied. Overall, I analyze ten determinants, namely: total assets, investment activities[2], the market-to-book ratio, R&D expenditures, net working capital, leverage, cash flow, dividends, financial distress and the quality of corporate governance.

In the first part of the analysis, I derive the consensus association between each determinant and the level of cash. Cash holdings decline when total assets, investment activities, net working capital, leverage, cash flow and dividends increase. The corporate cash reserves increase with an increasing market-to-book ratio, R&D expenditures, financial distress and corporate governance quality.

In the second part of my investigation, I analyze differences in the association of individual determinants with cash holdings between geographic regions. This analysis reveals that the determinants affect cash similarly in North America and

[2] Investment activities comprise capital expenditures and acquisition expenditures.

Europe but different in Asia or the global sample.[3] The Asian and global sample also do not feature uniform results. Consequently, there are differences in the overall influence of cash determinants depending on the geographic regions, specifically between North America and Asia. However, these differences are less pronounced than the conflicting primary results suggest. In case of North America and Europe there is even an uniform impact of the individual determinants.

Results indicate two potential explanations for the differences in Asia. First, information asymmetries might be smaller in North America and Europe than in Asia, because the legal system protects investors better and provides more external discipline. This suggests a greater relevance of the FCF-hypothesis in Asia, as information asymmetries are more pronounced. Secondly, Asian firms might lack alternatives in external financing; i.e. they have a more constrained access to capital markets, suggesting a greater relevance of the underinvestment problem.

Accordingly, the market-to-book ratio and investment activities, indicating high firm-level information asymmetries, are more positively associated to cash holdings in Asia than in North America or Europe. Furthermore, a growth in firm size does not provide alternative possibilities of external financing or external discipline to decrease the level of cash in Asia. Instead, the level of cash even increases with firm size, which might also indicate a greater trust of shareholders in larger firms. The Asian region also features by far the most pronounced negative association between net working capital and cash holdings as well as leverage and cash holdings. This indicates that Asian firms try to hold liquid assets that are different from cash, whenever possible, and debt providers are more effective in enforcing external discipline or provide the only alternative to financing via cash hoarding.

[3] These regions refer to geographical, not political regions. Thus, Europe also includes Switzerland. The global sample refers to primary samples comprising several geographic regions, see section 2.3.

Finally, I analyze the influence of high firm-level information asymmetries, country-characteristics, and time trends on the previously identified regional differences. Firm-level information asymmetries serve as a control for the presence of unique firms. The regional effects are mostly robust to all additional controls, consequently their cause remains unclear and offers an interesting starting point for future research.

The remainder of this study is structured as follows: section 1 reviews theories of cash hoarding and identifies the most common determinants used in previous research. Section 2 introduces the general methodology of MRA and my specific research design. Results, consisting of descriptive statistics, graphical, univariate and multivariate analyses as well as robustness checks, are presented in section 3. I conclude in section 4.

2 Theory and literature review

2.1 Theoretical foundation

The theoretical basis of cash holding research consists of two strands. These are the classic capital structure theories and cash holding-specific theories, each comprising various theories. The prior derive statements regarding a firm's entire financing decisions, the latter are derived exclusively to describe cash hoarding behavior under particular circumstances. This variety of theoretical viewpoints explains the great research interest in the decision to hold cash and the quantity of influencing determinants that has been investigated.

I identify three capital structure theories that are regarded in cash holding research. The trade-off theory originates from Modigliani/Miller (1963) who extend their original model by including taxes. Trade-off theory adds the danger of bankruptcy to the M/M-model and compares it to the benefits of tax-deductibility

corporate debt. The result of this trade-off is an optimal level of debt.[4] When applied in cash holding research, the trade-off theory regards the costs and benefits of holding cash and assumes that firms have an, optimal, target level of cash.

The pecking-order theory, introduced by Myers/Majluf (1984) who build on the work of Donaldson (1961), does not feature the assumption of an optimal level of debt or a target level of cash but suggests a strict hierarchy of financing that aims to avoid underinvestment. This hierarchy is induced by ex-ante information asymmetries that prevent potential investors from assessing a firm's true value. Consequently, signaling makes external financing costly and secondary to internal financing. Within external financing, debt financing is preferred over issuing equity.

The FCF-hypothesis, according to Jensen/Meckling (1976), regards cash holdings as the result of discretionary managerial behavior. Managers that are not controlled sufficiently act in self-interest. They build up cash from internal sources because this does not increase external discipline and can easily be used in their own interest.

Furthermore, I distinguish five theories that are specifically derived to explain the level of cash held by a firm. The shareholder power hypothesis, analyzed by Harford et al. (2008) and Kuan et al. (2011), shares central characteristics with the pecking-order theory. It stresses the avoidance of underinvestment as well as the influence of information asymmetries. The hypothesis regards a situation when shareholders are sufficiently protected from expropriation and discretionary managerial actions, for example by a strong legislation that favors the shareholders' perspective. Under such circumstances, shareholders allow increasing cash holdings because they do not fear exploitation by the management and acknowledge the benefits of avoiding costly external financing as well as underinvestment.

[4] See Frank/Goyal (2008) for a general introduction and Bradley et al. (1984) as a classic example.

The motive of constrained liquidity refers to situations when the level of cash is changed as a reaction to changes in the cost of external financing and constrained liquidity. There is a multitude of possible causes for the increase in the cost of external financing. Khieu/Pyles (2012) for example, focus on the effects of credit ratings changes and Steijvers/Niskanen (2013) analyze the impact of a firm's relationship to banks. Both report cash holdings to increase when external financing is constrained.

Faleye (2004) introduces the defense against hostile takeovers as a motive which expands the FCF-hypothesis by regarding how managers use cash holdings to guard their company against takeover threats. The FCF-hypothesis assumes that managerial discretion will ultimately attract external discipline in the form of a hostile takeover. According to Faleye (2004), managers anticipate this threat and respond by hoarding even more cash to facilitate the application of takeover provisions, such as buying back shares.

The hedging perspective by Acharya et al. (2007) perceives cash holdings as an instrument to hedge against a future shortage of funds that would lead to the dismissal of profitable investments. When future growth opportunities are not correlated with future cash flows, cash will be held to secure the financing of upcoming investments.

Finally, the costly contracting theory according to Liu/Mauer (2011) assumes cash holdings to be the result of debt covenants. Thus, risky firms are forced to build up or maintain a specific cash ratio. Otherwise, they cannot borrow capital or their credit conditions deteriorate.

2.2 Existing empirical results

Motivated by the diversity of the underlying theories, empirical research has derived various determinants that influence the corporate cash balance. The empirical results are often either heterogeneous or ambiguous across studies. In this section, I differentiate 9 determinants that are usually operationalized by different proxies and highlight conflicting empirical results, especially regarding regional differences. I chose these determinants because they are most frequently applied in models predicting the level of cash and provide sufficient observations for the MRA. In this literature review, I aggregate results on R&D expenditures and the market-to-book ratio into one category, namely “growth opportunities”, because their interpretation in the existing research overlaps. However, I focus the subsequent meta-regressions on 10 instead of 9 determinants by regarding R&D expenditures and the market-to-book ratio separately. Both proxies are used simultaneously in the primary models and thus do not exclude each other which justifies separate meta-regression analyses.

Firm size

Firm size is one of the most frequently used determinants in empirical cash holding research since it is one of the most common control variables. The determinant is in general estimated by a firm’s total assets or their logarithm. Overall, the corporate cash ratio decreases with increasing firm size as Opler et al. (1999), and Qiu/Wan (2015) report for U.S. samples as well as Lins et al. (2010) in an international survey. This is consistent with all major theories since a firm is believed to face cheaper possibilities of external financing and decreasing information asymmetries when it grows in size. However, there are deviations, which find a positive association between firm size and the level of cash. Examples include

Ozkan/Ozkan (2004) and Liu et al. (2015) for UK and U.S. samples, indicating ambiguity and regional differences. According to the shareholder power hypothesis, shareholders allow greater cash holdings to the management when their interests are sufficiently secured as it might be the case in large firms that are subject to increased external discipline. Alternatively, a growth in size might not cause a change in financing possibilities or external discipline and has therefore no negative effect on cash holdings.

Investment Activity

Investment activities comprise capital expenditures as well as a firm's acquisition expenditures. The prior are a frequent control variable, while the latter are analyzed specifically by some studies. The cash level is mostly observed to decline when investment activity increases. Dittmar et al. (2003) and Hoberg et al. (2014) report this result for capital expenditures as well as Bates et al. (2009) and Oler/Picconi (2014) for acquisition expenditures, mostly for U.S. samples. However, Opler et al (1999) and Huang et al. (2013) find a positive coefficient for capital expenditures in a U.S., respectively an international, sample. This sheds doubt on the direction of the association and suggests regional differences.

The result of a negative association seems to conflict in particular with the pecking-order theory and the FCF-hypothesis. The prior expects cash holdings to rise with the number of investments available. The latter assumes cash holdings to cause an increase in investment activity as cash reserves are associated to less external control than debt or equity. However the negative association is likely to be the result of the empirical set up that uses cash holdings as dependent and investment activities as explanatory variable. This model recognizes the cash that is spent in the course of an investment and does not regard the association between

the likelihood of undertaking an investment and the corporate cash level. This likelihood is investigated in specific investment models. Harford (1999), Mikkelson/Partch (2003) and Harford et al. (2008) find an increased investment activity in firms with high cash holdings when applying investment models.

Growth opportunities

A firm's growth opportunities represent intangible investments, i.e. factors like innovation and know-how. They complement the aforementioned investment activities, which are investments in tangible, "hard" assets. They are usually measured by the market-to-book ratio or R&D expenditures. Both proxies are commonly found to be positively associated to the cash level, according to Foley et al. (2007), Iskandar-Datta/Jia (2014) and Chen et al. (2015). Therefore, cash appears to be hoarded to finance corporate growth. This finding is consistent with the all major theories because high-growth firms are usually subject to high information asymmetries and aim to avoid underinvestment. Deviations from the prior observation are found by Khieu/Pyles (2012) and Bigelli/Sanchez-Vidal (2012) who point out that growth opportunities do not increase cash holdings in mature and private companies. It is unsettled which relation between growth opportunities and the level of cash is more common. Furthermore, it is questionable if both proxies equally measure growth opportunities or if they have different meanings.

Net working capital

An alternative to hoarding cash, without relying on external financing, is the maintenance of liquidity substitutes. These can be converted into cash easily, as long as the transaction costs are not severe. Such liquidity substitutes are commonly measured by the net working capital, which equals current assets less cash less current liabilities. In general, cash holdings are found to decrease with an increase in

net working capital as stated by Almeida et al. (2004), Subramaniam et al. (2011) and Liu et al. (2014). This corresponds to the trade-off theory because liquidity substitutes are able to avoid the costs of hoarding cash, unless the liquidation of these substitutes is associated to high transaction costs, while preserving its benefits, i.e. financial flexibility. The negative association between cash holdings and net working capital is doubted by Horioka/Terada-Hagiwara (2013) and Bates et al. (2009) who report a positive association for Asian firms and U.S. firms in the period of 2000 to 2006. This indicates ambiguity regarding the influence of net working capital on the cash level as well as a regional dependence of the effect.

Leverage

Another alternative to financing via cash holdings is debt financing. The degree of debt financing is measured by the relation of total debt to total assets or total equity. Empirical results are congruent with the influence of net working capital. As Kim et al. (1998), Acharya et al. (2008) and Chen et al. (2014) report, cash declines when leverage rises. This is predicted by all major theories as leverage reduces the danger of underinvestment and imposes incremental external monitoring on the management. However, a positive association between the level of cash and leverage is found in non-U.S. firms by Kalcheva/Lins (2007) and Chen et al. (2012), again indicating ambiguity and a regional dependence of the leverage sensitivity of cash holdings.

Cash Flow

Kalcheva/Lins (2007) and D'Mello et al. (2008) correspond to the majority of research by reporting a positive association between operating cash flow and the level of cash. This is in accordance with the financing hierarchy of the pecking-order theory but can also be explained in the spirit of the FCF-hypothesis by increased

discretionary potential induced by increased cash flows. Duchin (2010) and Chen et al. (2012) object to prior results and find a negative relationship. This observation suggests that the need to hoard cash declines with increased cash flows, either because the cost of external financing diminish or because investments can be financed directly from current cash flows.

Dividends

Payouts to shareholders constitute the opposite of holding cash. Accordingly, the majority of research, such as Khieu/Pyles (2012) and Julio/Yook (2012), finds a negative association between the corporate cash level and dividend payments. However, there are also observations of a positive relationship (Chen et al. (2012) and Hill et al. (2014)). The signaling power of dividends might indicate the alignment of managerial and shareholder interests which encourages investors to allow a higher cash ratio to the management as proposed by the shareholder power hypothesis. The general sign of the cash level's dividend sensitivity remains ambiguous.

Financial distress and constrained liquidity

A central determinant under analysis in cash holding research is financial distress which is defined as the probability of insolvency, respectively factors that constrain a firm's liquidity. This determinant comprises many proxies such as the volatility of cash flows, credit ratings and Altman's Z-score. Two general trends are observed: First, financial distress (especially when estimated by cash flow uncertainty and credit ratings) increases the level of cash according to Opler et al. (1999), Harford et al. (2008) and Subramaniam et al. (2011). Second, according to Lins et al. (2010) and Khieu/Pyles (2012), the influence of the Altman Z-score on the

corporate cash level cannot be determined unambiguously. This indicates a non-linear influence of financial distress on the level of cash. Firms that face an increased but not yet severe danger of insolvency tend to hoard more cash to avoid increases in the cost of external financing. Firms that are closer to actual insolvency are unable to hoard incremental cash and exhaust their existing cash ratio because they do not have another option of financing.

Corporate governance

Another central determinant that is focused by research is the quality of corporate governance. Like financial distress, it consists of a broad set of proxies including board and ownership characteristics as well as measures of shareholder and takeover protection and governance indices. The general notion is that rising governance quality is associated with a decline in the corporate cash level. This corresponds to the FCF-hypothesis that expects cash holdings to decline when the management's discretionary leeway is reduced. This is confirmed by Yu et al. (2015) for CEO duality, Harford et al. (2008) for board independence and by Ozkan/Ozkan (2004) for both indicators. Dittmar et al. (2003) and Steijvers/Niskanen (2013) report cash to increase with increasing family ownership and Kalcheva/Lins (2007) as well as Kuan et al. (2011) find it to decrease with increasing managerial ownership. Furthermore, the cash level declines with increasing shareholder rights (Chen et al. (2014)) and increased governance quality according to governance indices (Elyasiani/Zhang (2015)). However, results are not uniform. Liu et al. (2015) find cash to increase with increasing board independence in China. Kalcheva/Lins (2007) and Yu et al. (2015) report a positive association between managerial ownership and the level of cash for an international, respectively Taiwanese, sample. Thus, the effect of

individual governance instruments is unclear and potentially affected by the geographic region.

3 Methodology

3.1 The approach of meta-regression analysis

Meta-regression analysis is well known in medical as well as psychological research. It allows the quantitative aggregation of results from distinct primary studies concerning the same research question (Stanley/Doucouliagos (2012)). This aggregation of results accounts for differences in the research design of the respective primary studies and structures conflicting results (Feld et al. (2013)). The systematic procedure of MRA allows deriving new insights regarding the influence of primary study characteristics (Stanley/Jarrell (1989)).

Empirical results regarding the determinants of cash holdings are diverse: theoretical perspectives and consequently variable definitions, econometric specifications, and the directions of estimated effects vary greatly which makes a comparison of results a challenge. Moreover, it is difficult to obtain firm-level data for all variables in an international sample for a long time period. Even if such a sample would be available, the estimated results depend on the respective econometric methods and variable definitions used. MRA is especially suited to resolve these issues by estimating the general effect of each of the most common cash holding determinants. It comprises existing cash holding studies into one meta-sample, consisting of various time periods, countries and firm characteristics. Moreover, the MRA approach pools existing results from different primary samples that were derived using different econometric methods and different variable definitions. Thus, meta-regressions identify the relation between the level of cash and specific determinants across modelling choices. This enables an estimation that is robust to

the modelling of a determinant and allows predicting the impact of the study characteristics such as the geographic region.

Economic research already picked up the instrument of MRA to investigate contrary results in individual areas of research.[5] Examples include Efendic et al. (2011) who analyze the effect of institutions on economic performance, Doucouliagos et al. (2014) who investigate the income elasticity of the value of a statistical life and Zigraiova/Havranek (2015) who regard the impact of bank competition on financial stability. However, the MRA method is not yet widespread in business and finance research, a scarce example is Feld et al. (2013) who analyze results regarding the effect of corporate taxes on capital structure.

MRA uses the association between one explanatory variable and the dependent variable found in primary studies as the dependent variable. Thus, MRA is the regression analysis of regression analyses. The economic association that serves as the dependent variable in a MRA is called “effect size” and can be estimated by various proxies like a regression coefficient, t-value or elasticity. The explanatory variables of a meta-regression describe the characteristics of the primary studies from which the effect sizes were derived. These characteristics include, amongst others, the econometric models used, the calculation of the dependent variable, the sample size, time period under analysis or the regional setting. Accordingly, a meta-regression model takes the following basic linear functional form,

$$Y_{it} = \beta_0 + \sum_{k=1}^{K} \beta_k \times Z_{ikt} + \varepsilon_{it}, \quad (1)$$

where Y_{it} is the effect size of study i in publication-year t. Z_{ikt} is a vector of k explanatory variables describing characteristics of the primary studies.

[5] See Stanley/Doucouliagos (2012) for a general introduction into MRA and its areas of application.

3.2 Publication Selection Bias

An important challenge of MRA is publication selection. This describes the selective reporting of results to increase a study's chance of being published. As Card/Krueger (1995) note, the main sources of publication selection are the intent of being compatible to the current conventions of the respective field of research and the preference of significant over insignificant results. Publication selection leads to results that are distorted towards current conventions and that disregard insignificant results. This distortion is referred to as publication bias. There are numerous ways to account for this bias in MRAs. The funnel-asymmetry test (FAT) and the precision-effect test (PET), derived by Stanley/Doucouliagos (2007) and Stanley (2008), appear to be superior according to simulations undertaken by Stanley/Doucouliagos (2014) and Moreno et al. (2009). Their intuition, introduced by Egger et al. (1997), is that the standard errors associated with an effect size should vary symmetrically around the most precise effect size and should be independent of the respective effect sizes. In the presence of publication selection, standard errors will vary asymmetrically, i.e., unprecise effect sizes will be distorted towards the conventional mainstream expectation and not symmetrically around the most precise estimates (Egger et al. (1997) and Stanley/Doucouliagos (2014)). The FAT-PET MRA accounts for this dependence and takes the following basic linear functional form:

$$Y_{it} = \beta_0 + \beta_1 \times ErrorTerm_{it} + \varepsilon_{it}. \quad (2)$$

$ErrorTerm_{it}$ is the standard error of the economic relation estimated in the respective primary study, which is used to calculate the effect size Y_{it}. If Y_{it} in eq. (2) is a regression coefficient, $ErrorTerm$ equals the standard error of this regression coefficient reported in the respective primary study. In this univariate set-up β_0 indicates the economic association in the primary study if publication bias was

absent. Thus, β_0 is also referred to as the precision-effect test (PET). Accordingly, β_1 determines the magnitude as well as the sign of publication selection. It is called funnel-asymmetry test (FAT). Despite its simple construction, especially the PET has been proven to be “surprisingly effective in separating the wheat from the chaff” (Stanley (2008)).

3.3 Model design

I follow the approach of Stanley/Doucouliagos (2012) in designing this MRA. A first indication of the effects of distinct cash holding determinants is provided by a graphical analysis. I derive funnel plots and box plots for each effect size. Subsequently, the impact of publication bias is controlled for, in univariate FAT-PET models that correspond to eq. (2). These models derive estimates for the individual association between the level of cash and each of the ten determinants, the so-called consensus association, leading to a total of ten distinct FAT-PET models. The univariate analysis is repeated on two sets of sub-samples to identify situations that alter the general influence of the cash holding determinants. The first set of sub-samples reflects the geographical setting of the primary studies. The second set regards whether primary studies were restricted to firms facing high information asymmetries. The construction of both samples is discussed in the subsequent section on the explanatory variables of the multivariate MRAs.

Finally, I employ multivariate MRAs to examine the effect of other study characteristics on the consensus associations and to rule out potential sources of endogeneity. Most importantly, this approach tests if the geographic regions persist to influence the effect size or if differences in the effect size rather relate to specific firm characteristics, in this case firm-level information asymmetries. The individual multivariate MRAs are determined according to the general-to-specific approach recommended by Stanley/Doucouliagos (2012) and their econometric specification is

determined according to Feld/Heckemeyer (2011). A general version of these multivariate MRAs with a control for publication selection, based on eq. (1), is depicted in eq. (3):

$$Y_{it} = \beta_0 + \beta_1 \times ErrorTerm_{it} + \sum_{k=2}^{K} \beta_k \times Z_{ikt} + \varepsilon_{it} \quad (3)$$

Heteroscedasticity, which is a frequent problem of MRA, is accounted for by using a weighted least squares (WLS) estimator. These WLS-MRAs use the standard errors of the effect size in the respective primary study as weights. I chose to include all estimates of the effect size that can be found in a primary study in my meta-sample. This allows me to refer to a higher quantity of observations per determinant and avoids a selection bias resulting from choosing only one specific effect size from each primary study. Consequently, there is unobserved heterogeneity, resulting from study-level effects, that needs to be accounted for. I rely on fixed effects WLS estimators and standard errors clustered on the study-level to mitigate this dependence, as advised by Stanley/Doucouliagos (2012).

Dependent variable

Each of my models uses the effect size of an individual cash holding determinant as dependent variable, which leads to 10 distinct models. I chose the elasticity E_*_{it} as the measure of effect size Y_{it}. Elasticities are comparable across studies because they account for differences in the scaling of variables and they can be interpreted intuitively (Stanley/Doucouliagos (2012)). Exemplarily, when total assets are used to explain cash holdings in a regression model, the specification of the total assets-variable, either as the balance sheet value or its log, influences its regression coefficient. However, the total asset-elasticity of cash holdings remains unaffected by this modelling choice. It denotes the percental change of the level of cash when total

assets change by 1%. The individual elasticities are calculated by the subsequent formula:

$$Y_{it} = E\_*_{it} = B\_* \times \frac{M\_*}{M\_CH} \quad (4)$$

In eq. (4), B_* is the regression coefficient of the respective cash holding determinant, taken from a primary study. In each of the ten models, the asterisk is replaced by the name of the respective cash holding determinant, as shown in Appendix A. Consequently, B_TA is the regression coefficient of total assets. M_CH denotes the mean value of cash holdings and M_* the mean value of the respective determinant in a primary study, which makes M_TA the mean of total assets of one primary study. The determinants under consideration are total assets (E_TA), investment activity (E_Inv), market-to-book ratio (E_MB), R&D expenditures (E_RD), net working capital (E_NWC), leverage (E_Lev), cash flow (E_CF), dividends (E_Div), financial distress ($E\_TotalFinDistr$) and corporate governance quality ($E\_TotalGoodGov$). Each becomes the dependent variable in a distinct MRA and is measured as an elasticity according to eq. (4).

E_Inv comprises two proxies, capital expenditures and acquisition expenditures. This means, when a primary model uses capital expenditures or acquisition expenditures, I calculate the capital expenditure-elasticity respectively the acquisition expenditure-elasticity of cash according to eq. (4) but denote it in either case as E_Inv.[6] I proceed in the same way for $E\_TotalFinDistr$, which consists of proxies such as Altman's Z-score, cash flow volatility or credit ratings as well as $E\_TotalGoodGov$, which consists of proxies such as managerial ownership, board independence or CEO duality. These distinct proxies are treated as observations of

[6] Therefore E_Inv_{it} can result from two equations: $E\_Inv_{it} = B\_Capx \times \frac{M\_Capx}{M\_CH}$ and $E\_Inv_{it} = B\_Acqu \times \frac{M\_Acqu}{M\_CH}$.

the same variable, $E\_TotalFinDistr$ respectively $E\_TotalGoodGov$. Proxies for financial distress and the quality of corporate governance are adjusted to guarantee that a high value of each proxy indicates a high probability of financial distress, respectively a high quality of corporate governance. This is achieved by multiplying the primary study regression coefficient of the respective proxy with -1 whenever high values of a proxy in a primary study indicate a low probability of financial distress, respectively a low quality of corporate governance. This is exemplarily the case for entrenchment indices as in Harford (2008). A high value for this variable indicates that CEOs are entrenched and protect themselves from external discipline, which is a sign for corporate governance of low quality

This approach is difficult to undertake for proxies of ownership because of its potential non-linear influence on the level of cash according to Drobetz/Grüninger (2007). I disregard this non-linearity of ownership proxies and assume high values to indicate high quality corporate governance. First, there is no consensus on the non-linearity of ownership and the general influence of different ownership variables. Second, it is my goal to investigate the general influence of corporate governance and not the specific implications of ownership. Finally, ownership variables are just one set out of various proxies that constitute $E\_TotalGoodGov$, therefore a potential maladjustment of few ownership observations is absorbed by the unambiguous results of the remaining majority of governance variables.

Explanatory variables

The vector Z_{ikt} represents the characteristics of primary studies, these are mostly coded as dummies. I include dummies for each type of fixed effects considered in the primary study. There are four options: either no fixed effects (the reference category), time-fixed effects only ($OnlyTime\_FE_{it}$), industry-fixed effects only

($OnlyIndustry\_FE_{it}$), or time- and industry-fixed effects ($Industry\&Time\_FE_{it}$) are considered. These dummy take the value of 1 if the respective type of fixed effects was controlled for in a primary model and 0 otherwise. The initial general model featured further dummies describing the primary econometric model. These, for example, indicated the application of specific estimators but had to be dropped because of multicollinearity. Furthermore, dummies for the specification of the cash holding variable are included. They indicate that cash holdings are calculated either as cash plus short-term investments scaled by net assets (the reference category),[7] cash scaled by total assets ($CHtoTA_{it}$) or cash scaled by net assets ($CHtoNetA_{it}$). The dummies take the value of 1 if the cash holding variable was calculated accordingly, otherwise 0. I also include a dummy that takes the value 1 if a determinant was in the central focus of the respective primary study ($VarCentral_{it}$). The underlying intuition is that determinants which are in the central focus of a study are potentially subject to more publication bias than the control variables of the same study. A determinant is assumed to be in the central focus if it is mentioned in the abstract, the introduction or the conclusion of a study.

Other explanatory variables are the log of the average sample year ($LogAvgSampleYear_{it}$), log of the number of observations ($LogObservations_{it}$) and dummies for the geographical region which the primary study's sample stems from. These regional dummies indicate whether the samples of primary studies focus exclusively on North America (the reference category), exclusively on Asia ($Asian\ sample_{it}$) or exclusively on Europe ($EU\ sample_{it}$). Whenever a primary study investigates firms from different regions jointly, e.g. Asian and European firms, and it is therefore impossible to identify a region-specific determinant-elasticity, the dummy $Global\ sample_{it}$ equals 1.

[7] Net assets equal total assets less cash.

Another dummy indicates if the primary study's sample is restricted to firms that are especially subject to information asymmetries ($HighInfoAsym_{it}$). It takes the value of 1 when a primary study, i.e. its sample, exclusively focusses on high-tech, young, financially constrained, R&D-intensive, non-diversified, risky, badly-governed, small firms, firms with a high market-to-book ratio, firms with a non-investment credit rating, firms with a high standard deviation of cash flows, firms with entrenched managers, firms with CEOs that do not hold options of the respective firms, firms whose CEO compensation is highly sensitive to the stock price volatility (high vega),[8] or firms with a high product fluidity, otherwise it takes the value 0. Thus, I do not measure information asymmetries myself but rely on the measurement of primary studies that restrict their samples to firms with specific features indicating the presence of information asymmetries. Consequently, my dummy for information asymmetries is independent from individual problems of modelling information asymmetries. This also implies that I only regard information asymmetries resulting from firm characteristics and not from country characteristics like investor protection.

I also employ a set of dummies indicating the control variables used in a primary model. The dummies take the value of 1 if a determinant was used as a control variable in the respective primary study, otherwise 0. I use the following dummies to account for the use of control variables: firm size ($Firmsize_{it}$), the market-to-book ratio (MB_{it}), R&D expenditures (RD_{it}), capital expenditures ($Capx_{it}$), net working capital (NWC_{it}), leverage (Lev_{it}), cash flow (CF_{it}), financial distress ($FinDistr_{it}$) and governance quality ($TotalGov_{it}$). Such control variable dummies are only included if the respective determinant is not the dependent variable of the MRA, because this automatically means that the determinant was part of the primary regression model. Due to multicollinearity, the multivariate MRAs do not contain all of the dummies.

[8] This high vega indicates a high incentive for managers to take risks (Liu/Mauer (2011).

However, exchanging the aforementioned dummies does not alter the regression results.

I do not include dummies for the journals in which the primary studies were published. The underlying intuition is that the quality or precision of results is not affected by the publishing journal. Qualitative differences in results are caused by differences in the underlying models. Thus, low quality journals do not cause low quality studies. Instead, the quality of a study and its results is determined by the design choice of the respective researchers. The multivariate MRA takes the general form of eq. (6), where * is replaced by the respective variable, i.e. E_TA is the total asset-elasticity of the cash level: [9]

$$
\begin{aligned}
E\_*_{it} = {} & \beta_0 + \beta_1 \times ErrorTerm_{it} + \beta_2 \times OnlyIndustry\_FE_{it} + \beta_3 \times OnlyTime\_FE_{it} \\
& + \beta_4 \times Industry\&Time\_FE_{it} + \beta_5 \times CHtoTA_{it} + \beta_6 \times CHtoNetA_{it} \\
& + \beta_7 \times VarCentral_{it} + \beta_8 \times LogAvgSampleYear_{it} + \beta_9 \times LogObservations_{it} \\
& + \beta_{10} \times Asian\ sample_{it} + \beta_{11} \times EU\ sample_{it} + \beta_{12} \times Global\ sample_{it} \\
& + \beta_{13} \times HighInfoAsym_{it} + \beta_{14} \times Firmsize_{it} + \beta_{15} \times Capx_{it} + \beta_{16} \times MB_{it} + \beta_{17} \times RD_{it} \\
& + \beta_{18} \times NWC_{it} + \beta_{19} \times Lev_{it} + \beta_{20} \times CF_{it} + + \beta_{21} \times Div_{it} + \beta_{22} \times FinDistr_{it} \\
& + \beta_{23} \times TotalGov_{it} + \varepsilon_{it} \qquad (6)
\end{aligned}
$$

Since there are 10 determinants under analysis, model (6) exists in 10 specifications, each with a different elasticity as dependent variable.

3.4 Sample construction

I identify relevant studies by a comprehensive literature research. First, all journals in the field of finance and accounting, ranked A+, A, or B, according to the journal ranking “Jourqual 2.1” of the German Academic Association for Business

[9] All dependent and explanatory variables and their abbreviations are introduced in Appendix A.

Research (VHB) as well as working papers from the NBER database are considered. These sources are searched for studies containing the term “cash holding” in their titles. Subsequently, the references of the studies found in the first scanning-routine are searched for additional studies related to cash holdings.

The initial, hand-collected, sample of regression coefficients, associated standard errors and other study characteristics embraces 61 studies. Since this meta-study focuses exclusively on the influence of the most frequent determinants on the level of cash, only observations using a measure of the cash level as their dependent variable are kept in the final sample. Thus, estimates related to the influence of cash holdings or specific determinants on excess cash, the change of cash holdings or firm value are dropped. Furthermore, I drop studies that do not report mean values of the cash holding variable and the explanatory variables because these values are necessary to calculate elasticities. I also do not include interaction terms from the primary studies in my sample because these would inflate the number of explanatory variables in the meta-regression excessively and encounter problems of multicollinearity. Consequently, the final sample contains 45 studies, which equals 3439 effect sizes (elasticity-observations). I winsorize all elasticities at 1% and 99%.

3.5 Descriptive statistics

Table 1 provides the descriptive statistics for all dependent and explanatory variables. Panel A depicts summary statistics for the determinant-elasticities of cash holdings. According to the median-value, cash holdings are inelastic to cash flows, dividends and financial distress; exhibiting elasticities of 0.001, -0.003 and approximately 0.00. In absolute terms, the market-to-book ratio and total assets are the determinants to which the cash level reacts most elastic (-0.074 and 0.087).

However, in case of total assets this high median-value is tied to a standard deviation of 1.663, hinting a high variability in this elasticity.

Distinguishing the market-to-book ratio and R&D expenditures, instead of treating them as one proxy, seems reasonable since the respective median-elasticities of 0.087 and 0.007 differ substantially.

Table 1 Descriptive Statistics

Panel A - Overview of Elasticities

Elasticity of Determinant	Mean	Min.	25% Percentile	Median	75% Percentile	Max.	Std. Dev.	Obs.
E_TA	0,042	-3,785	-0,625	-0,074	0,691	6,911	1,663	390
E_Inv	-0,072	-0,661	-0,094	-0,053	0,008	0,307	0,159	301
E_MB	0,131	-0,805	-0,002	0,087	0,223	1,234	0,330	343
E_RD	0,026	-0,930	-0,046	0,007	0,131	0,460	0,180	236
E_NWC	-0,010	-0,725	-0,166	-0,043	-0,009	0,282	1,869	319
E_Lev	-0,188	-3,884	-0,372	-0,021	0,174	1,038	0,800	410
E_CF	-0,009	-0,522	-0,031	0,001	0,027	0,267	0,110	364
E_Div	0,120	-0,546	-0,038	-0,003	0,260	2,852	0,538	243
E_TotalFinDistr	-0,044	-1,776	-0,089	0,000	0,059	0,743	0,266	536
E_TotalGoodGov	-0,014	-1,789	-0,052	-0,011	0,035	0,763	0,267	297
Total								3439

Panel B - Overview of Study Characteristics

	Mean	Min.	25% Percentile	Median	75% Percentile	Max.	Std. Dev.	Obs.
ErrorTerm	0,311	0,000	0,006	0,030	0,114	19,030	1,130	3439
CHsectoNetA	0,395	0	0	0	1	1	0,489	3439
CHtoTA	0,573	0	0	1	1	1	0,495	3439
CHtoNetA	0,031	0	0	0	0	1	0,174	3430
OnlyIndustry_FE	0,094	0	0	0	0	1	0,291	3439
OnlyTime_FE	0,176	0	0	0	0	1	0,381	3439
Industry&Time_FE	0,333	0	0	0	1	1	0,471	3439
AvgSampleYear	1997,5	1979	1994	1998,5	2002	2008,5	6,677	3439
Observations	19438.87	7	2180	5100	13864	209036	34647,6	3206
HighInfoAsym	0,121	0	0	0	0	1	0,326	3439
Firmsize	0,966	0	1	1	1	1	0,182	3439
M/B	0,942	0	1	1	1	1	0,233	3439
R&D	0,740	0	0	1	1	1	0,439	3439
NWC	0,845	0	1	1	1	1	0,362	3439
Lev	0,926	0	1	1	1	1	0,263	3439
CF	0,883	0	1	1	1	1	0,321	3439
CFuncer	0,834	0	1	1	1	1	0,372	3439
FinDistr	0,074	0	0	0	0	1	0,262	3439
TotalGov	0,605	0	0	1	1	1	0,489	3439
Infl	0,104	0	0	0	0	1	0,305	3439

The variables tabulated in table 1 are defined in Appendix A.

This is contrasted by the investment activities-elasticity, reported with a median of -0.053, indicating that tangible and intangible investments are financed differently.

The median of the corporate governance-elasticity, -0.011, confirms the FCF-hypothesis, which assumes cash holdings to be the result of managerial discretion and thus to decrease with an increasing quality of governance. Furthermore, the elasticities of cash holdings to its potential substitutes, net working capital and leverage, are negative. Panel B reports summary statistics for all explanatory variables.

Table 2 reports the observations of each determinant-elasticity split by geographic regions. Half of the observations stem from studies that focus exclusively on North America. The other half is evenly split between Asian, European and global studies. The small number of Australian observations is not included in the analysis of regional sub-samples because Australia only features 4 observations per determinant. However, Australia is included in the total sample.

Table 2 Regional Sample Characteristics

Region	Observations										Total
	E_TA	E_Inv	E_MB	E_RD	E_NWC	E_Lev	E_CF	E_Div	E_TotalFinDistr	E_TotalGoodGov	
Asia	55	59	48	36	59	63	66	62	95	129	672
EU	81	9	52	25	30	92	28	40	54	25	436
Global	69	43	32	40	59	59	55	13	84	8	462
Australia	4	4	4	0	4	4	12	0	8	0	40
North America	181	186	207	135	167	192	203	128	295	135	1829
Total	390	301	343	236	319	410	364	243	536	297	3439

The variables tabulated in table 2 are defined in Appendix A.

4 Results

4.1 Graphical analysis

Figure 1 depicts the funnel plot of each determinant-elasticity. Funnel plots visualize the idea of testing for publication selection by investigating the distribution of elasticities with respect to their standard errors. Since the y-axis represents the precision of an elasticity, which equals the inverse of the standard error, the

distribution of elasticities should ideally mirror a funnel. This funnel is centered on the most precise estimates. Deviations from the symmetrical funnel indicate the presence of publication bias that leads to skewed results (Egger et al. (1997)). However, highly precise elasticities that deviate from the funnel represent leverage points (Stanley/Doucouliagos (2012)). Such leverage points suggest situations when the general influence of a determinant on the cash level changes. Thus, they are not unprecise outliers but rather indicate that the determinant-elasticity of cash strongly deviates as a reaction to an influencing factor. The funnel plots complement many of the observations from the summary statistics and suggest the differences in individual determinant-elasticities by various leverage points.

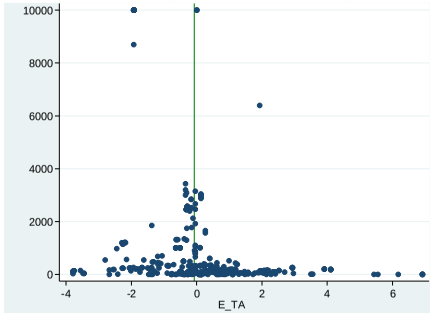
The plots of the total asset-elasticity and of the net working capital-elasticity of cash holdings exhibit great outliers, as already indicated by their standard deviation. The outliers are in general quite large across all plots. While the median elasticities are, in absolute terms, all smaller than - 0.1, the extreme values often exceed 1. Thus, the utilization of WLS estimator appears reasonable to account for these outliers.

All plots roughly resemble the shape of funnels. However, in all cases the distribution of elasticities with respect to their precision is skewed. This can especially be seen in the plots of net-working capital-elasticity, leverage-elasticity, cash flow-elasticity and dividend-elasticity of cash. The number of estimates is also skewed to the right from the median in the plots of investment-activity-elasticity and market-to-book-elasticity. Thus, publication selection is in general present but it remains impossible to determine its effect on the overall trend.

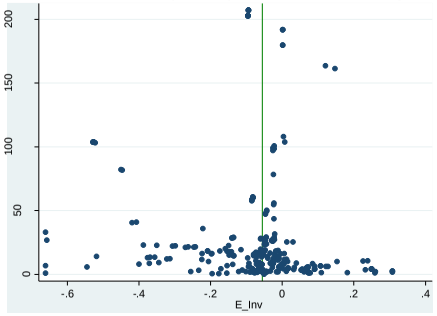
Figure 1 Funnel Plots of Determinant-Elasticities of Cash Holdings

Figure 1 exhibits the determinant-elasticities of cash holdings and their respective precisions in funnel plots. Precision is defined as the inverse of the standard error associated to a specific elasticity observation. Each of the panels A-K illustrates the funnel characteristics of a different determinant. The y-axis, i.e. the precision (1/SE), is restricted not to exceed 10000 (0.0001), respectively 1000 (0.001). This is done when extremely high precisions distort the scaling of the y-axis. The green line marks the median. All variables are defined in Appendix A.

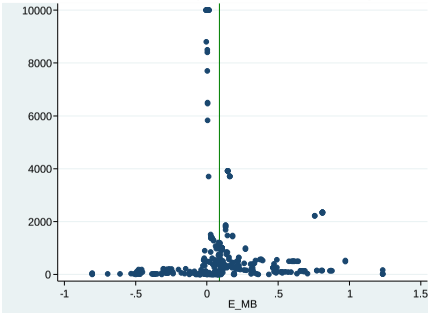
Panel A: Total Asset Elasticity of the Level of Cash Holdings



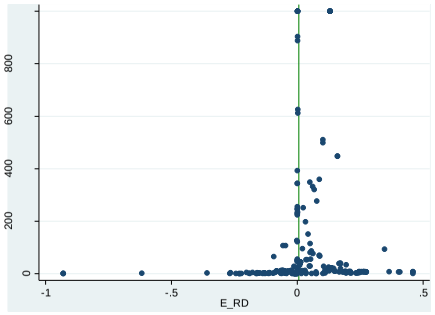
Panel B: Investment Activity Elasticity of the Level of Cash Holdings



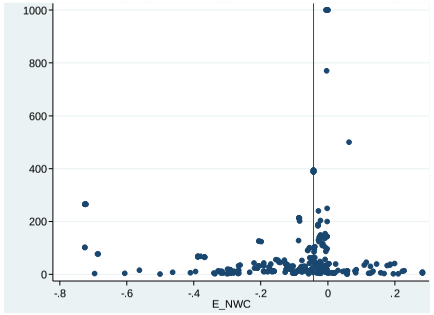
Panel C: Market-to-book Elasticity of the Level of Cash Holdings



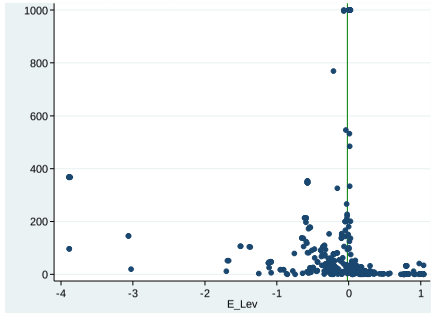
Panel D: R&D Expenditure Elasticity of the Level of Cash Holdings



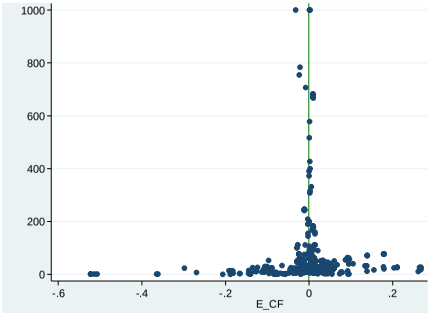
Panel E: Net Working Capital Elasticity of the Level of Cash Holdings



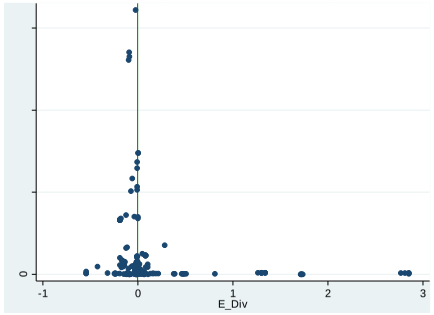
Panel F: Leverage Elasticity of the Level of Cash Holdings



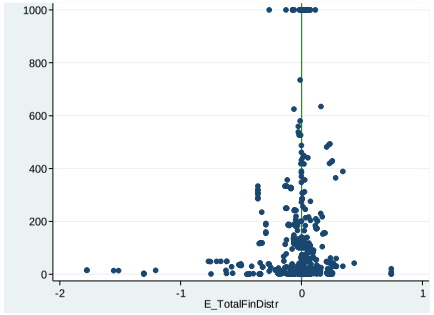
Panel G: Cash Flow Elasticity of the Level of Cash Holdings



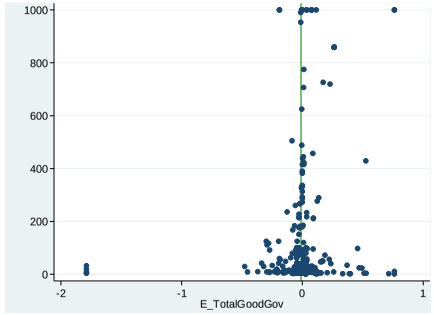
Panel H: Dividend Elasticity of the Level of Cash Holdings



Panel I: Financial Distress Elasticity of the Level of Cash Holdings



Panel J: Corporate Governance Elasticity of the Level of Cash Holdings



Furthermore, many plots exhibit leverage points indicating meaningful deviations from the general trends. Examples include the total assets-elasticity, investment activity-elasticity, R&D expenditure-elasticity, financial distress-elasticity and corporate governance-elasticity of cash holdings.

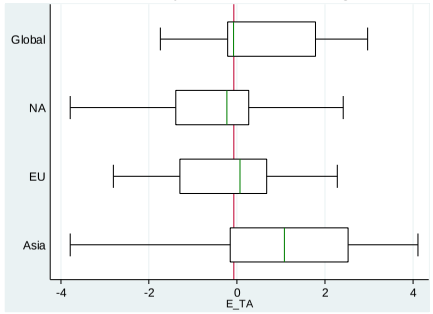
In order to provide further insights into these deviations, I compute box plots of the determinant-elasticities by geographic regions. This allows comparing the quartiles, dispersion, and skewness of determinant-elasticities across regions. Figure 2 reports these box plots and reveals that various elasticities differ depending on geographic regions. The total asset-elasticity of cash is negative in North America but positive in the EU and Asia. However, the elasticities in North America and the EU are, unlike the elasticity in Asia, still close to each other. The investment activity-elasticity is negative across all regions. However, cash reacts more strongly in North America, exhibiting a median elasticity close to -0.2, compared to all other regions, which have median elasticities smaller than -0.1. North America takes another distinct position when the R&D-elasticity of cash is regarded. European and Global studies report negative elasticities and object strongly to the positive results that are derived from North America. Corporate cash ratios in Asia appear to be rather inelastic to R&D expenditures.

The difference in median-elasticities is small in absolute terms when leverage is concerned. However, the sign of the elasticities switches. Global and North American results are reported to be negative but European and Asian results are positive. As the box plots and the scaling of the x-axis show, the elasticities have large outliers and especially observations from the Asian sample are split broadly between -1 and +1. The cash flow-elasticity of the cash ratios reports another switch of signs in elasticities. In this case, Global and Asian samples tabulate a positive median-elasticity but North American and European results are negative.

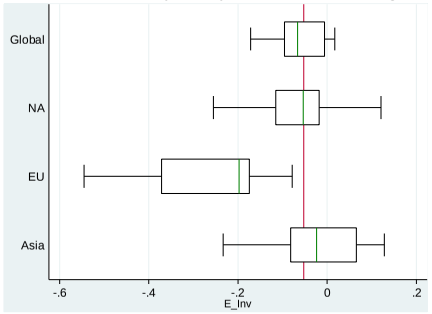
Figure 2: Box Plots of the Determinant-Elasticities of Cash Holdings by Regions

Figure 2 exhibits box plots of the determinant-elasticities of cash holdings split by geographic regions. Panel A-K show the determinant- elasticity of the level of corporate cash holdings for 10 distinct determinants. Geographic regions are defined in section 3.2 – explanatory variables. Red lines mark the overall median of a determinant-elasticity, green lines indicate the median within a geographic region. All variables are defined in Appendix A.

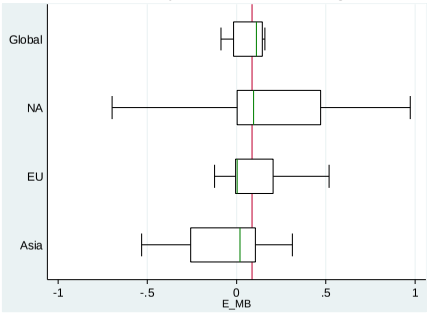
Panel A: Total Asset Elasticity of the Level of Cash Holdings



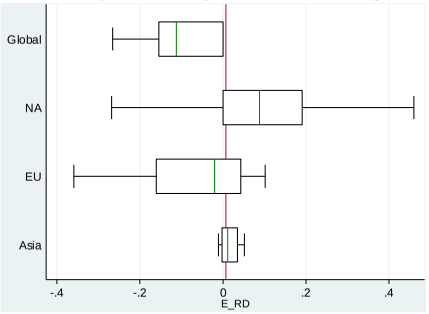
Panel B: Investment Activity Elasticity of the Level of Cash Holdings



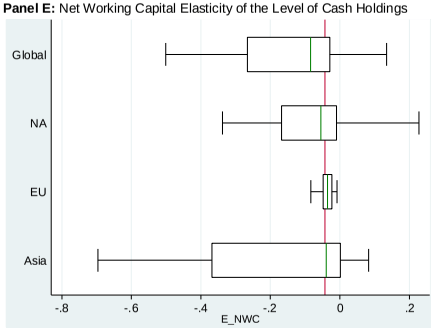
Panel C: Tobin's Q Elasticity of the Level of Cash Holdings



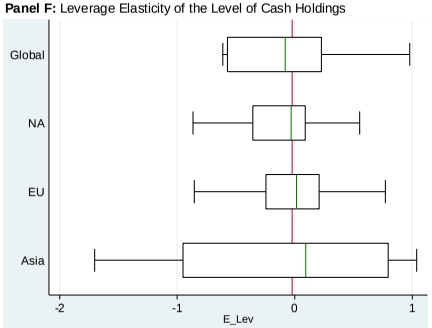
Panel D: R&D Expenditure Elasticity of the Level of Cash Holdings



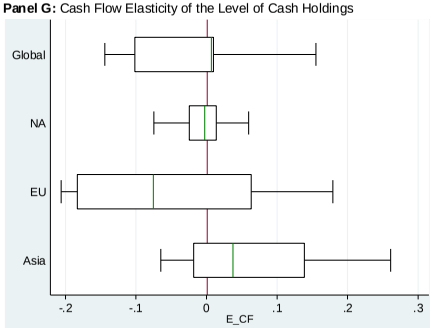
Panel E: Net Working Capital Elasticity of the Level of Cash Holdings



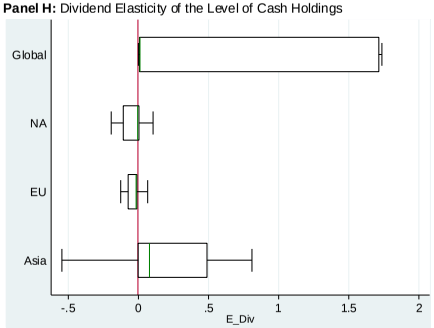
Panel F: Leverage Elasticity of the Level of Cash Holdings



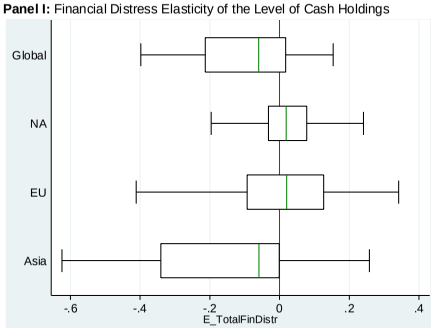
Panel G: Cash Flow Elasticity of the Level of Cash Holdings



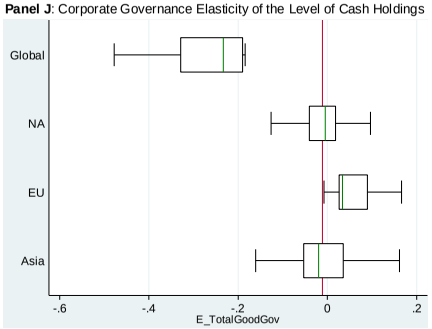
Panel H: Dividend Elasticity of the Level of Cash Holdings



Panel I: Financial Distress Elasticity of the Level of Cash Holdings



Panel J: Corporate Governance Elasticity of the Level of Cash Holdings



The same differences are confirmed for the financial distress- and the corporate governance-elasticity. Asian and Global samples report negative median-values, when results from North American and European are positive.

This is especially interesting regarding the corporate governance-elasticity of cash holdings because a positive elasticity conflicts with predictions from the FCF-theory. Accordingly, declining information asymmetries that are caused by increases in the quality of corporate governance, decrease cash holdings in Global and Asian studies, but increase them in European and North American studies. A possible explanation is country-level corporate governance consisting of shareholder protection and legal enforcement, that is on average stronger in purely North American and European samples than in Asian and Global samples (La Porta et al (1997) and Leuz et al. (2008). Thus, strongly protected shareholders might acknowledge a firms need for cash to avoid costly external financing as suggested by the shareholder power hypothesis. Results that are uniform across geographic regions are derived for the market-to-book-, net working capital- and dividend-elasticity.

4.2 Univariate analysis

Table 3 reports the consensus associations between each determinant and the level of cash resulting from the univariate MRAs. In this table and subsequent tables, β_0 is the PET which indicates the consensus association, in this paper the elasticity, between one specific determinant and the level of cash. The FAT, which indicates how publication bias affects the consensus elasticity, is represented by β_1. Each column is a different MRA-model that analyzes the association between one specific determinant and the level of cash. Panel A tabulates WLS-MRA models with heteroscedasticity-robust standard errors, panel B reports fixed effects WLS-MRAs

with standard errors clustered at the study-level, and panel C exhibits the results of random effects WLS-MRA models with standard errors modified as suggested by Knapp/Hartung (2003). The Hausman test reveals that correlated unobserved heterogeneity affects the all univariate models variables. Thus, the fixed effects models (panel B) derive the most robust results.

Table 3 Univariate FAT-PET MRA

This table presents results from the basic univariate FAT-PET regressions. Panel A uses WLS-regressions and heteroscedasticity-robust standard errors. Panel B uses fixed effects WLS-regressions, clustered at the study level and standard errors which are also clustered at the study level. Finally, Panel C uses random effects WLS-regressions and standard errors modified as suggested by Knapp/Hartung (2003). All variables are defined in Appendix A. ***, **, and * represent significance at the 0.01, 0.05, and 0.10 levels. The t-statistics are shown in parantheses.

Panel A - FAT-PET WLS										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable:	E_TA	E_Inv	E_MB	E_RD	E_NWC	E_Lev	E_CF	E_Div	E_Total FinDistr	E_Total GoodGov
Intercept: $\hat{\beta}_1$ (**FAT**)	895.7***	-0.514*	108.9***	10.03***	-8.403***	-45.02***	0.656***	3.340*	-9.545**	55.38**
	(7.50)	(-2.13)	(6.75)	(3.71)	(-5.29)	(-5.04)	(3.59)	(2.01)	(-2.71)	(2.63)
1/SE: $\hat{\beta}_0$ (**PET**)	-1.916***	-0.0885***	0.000677	0.000986***	-0.00592	-0.0127	-0.00106	-0.0644***	0.0324***	0.0398***
	(-143.71)	(-4.49)	(1.11)	(5.85)	(-1.25)	(-0.74)	(-0.46)	(-4.82)	(5.71)	(4.26)
Adj. R-sq	0.081	-0.000	0.112	0.049	0.062	0.041	0.021	0.009	0.002	-0.000
Panel B - Fixed Effects FAT-PET WLS										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept: $\hat{\beta}_1$ (**FAT**)	206.8	-1.444	2.401	0.443	-0.620	-2.443	1.338	4.605	-1.948	114.6
	(0.76)	(-2.05)	(0.27)	(1.10)	(-1.26)	(-0.71)	(1.18)	(1.37)	(-0.17)	(0.93)
1/SE: $\hat{\beta}_0$ (**PET**)	-1.902***	-0.0796***	0.00215***	0.00123***	-0.0110***	-0.0347***	-0.00204	-0.0655***	0.0320***	0.0395***
	(-352.52)	(-11.70)	(17.75)	(119.48)	(-34.45)	(-19.41)	(-1.26)	(-23.47)	(59.15)	(70.56)
Adj. R-sq	0.807	0.933	0.966	0.995	0.990	0.996	0.676	0.609	0.753	-0.057
Panel C - Random Effects FAT-PET WLS										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept: $\hat{\beta}_1$ (**FAT**)	0.450**	0.427***	-0.213	0.0673	0.253	0.594***	-0.264*	0.424	-0.115	-0.173
	(2.61)	(3.42)	(-1.32)	(0.67)	(1.41)	(4.14)	(-2.50)	(1.92)	(-1.17)	(-0.85)
1/SE: $\hat{\beta}_0$ (**PET**)	-0.0662	-0.129***	0.151***	0.0549***	-0.118***	-0.334***	0.0247***	0.0753*	-0.0254*	-0.0105
	(-0.81)	(-9.66)	(7.75)	(7.36)	(-8.81)	(-7.53)	(4.51)	(2.06)	(-2.08)	(-0.59)
Adj. R-sq	0.017	0.032	0.005	0.007	0.007	0.044	-0.002	0.014	0.002	0.006
# observations	390	302	343	236	319	410	364	243	536	297
# studies	38	27	36	21	34	39	33	25	38	21

Overall, cash holdings increase when the market-to-book ratio, R&D expenditures, financial distress and the quality of corporate governance increase. The corporate level of cash declines when total assets, investments expenditures, net working capital, leverage, cash flow and dividends diminish.

The determinant-elasticities are mostly robust across all econometric specifications. According to panel A, the market-to-book ratio (model 3), net working capital (model

5) and leverage (model 6) do not have a significant influence on the corporate cash reserves. However, all these determinants turn out to have significant influence on the level of cash after controlling for the study-level dependence of results in panel B and C. Dividends (model 8), financial distress (model 9) and corporate governance (model 10) are reported to have significant influence in panel A and B but this significance decreases and their sign switches in the random effects model. Consequently, all determinants, except cash flow, significantly impact the corporate cash level in the fixed effects models.

Furthermore, only corporate governance affects cash differently than the median-value suggests in table 2. The PET reports corporate governance to be positively associated to cash holdings (0.0395 in panel B) while table 2 tabulates a negative governance-elasticity of cash (-0.011). This confirms the controversial role of the corporate governance-elasticity of cash that is already indicated by the presence of leverage points in the funnel plot and the geographic differences found in the box plot analysis.

4.2.1 *Sub-sample by regions*

In the next step, the previous fixed-effects univariate MRAs are repeated for the geographic sub-samples. In case of the Global region, it is not possible to derive estimates for the corporate governance-elasticity of cash holdings because there are too few observations. The results are tabulated in table 4.

I derive two key observations from the sub-sample analysis. Both indicate that the association between individual determinants and the level of cash differs between geographical regions.

Table 4 Univariate FAT-PET MRA split by Region

This table presents results from the basic univariate FAT-PET regressions on samples that are split up by region. Panel A-D use fixed effects WLS-regressions, clustered at the study level, and standard errors also clustered at the study level. Panel A regards studies that focus exclusively on North America, panel B regards an exclusively Asian sample, panel C considers an exclusively European sample. Finally, Panel D covers studies that analyze samples from different regions. All variables are defined in Appendix A. ***, **, and * represent significance at the 0.01, 0.05, and 0.10 levels. The t-statistics are shown in parantheses.

Panel A - North America **-** FE										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable:	E_TA	E_Inv	E_MB	E_RD	E_NWC	E_Lev	E_CF	E_Div	E_Total FinDistr	E_Total GoodGov
Intercept: $\hat{\beta}_1$ (**FAT**)	598.8	-1.667	-7.921	1.890	-0.187	3.149	0.385	0.592	-2.795	-12.90
	(0.88)	(-1.78)	(-0.61)	(1.88)	(-0.38)	(0.91)	(1.10)	(0.40)	(-0.13)	(-1.41)
1/SE: $\hat{\beta}_0$ (**PET**)	-1.913***	-0.144***	0.00200***	0.00119***	-0.00945***	-0.567***	-0.00382***	-0.0695***	0.0327***	0.255***
	(-151.83)	(-8.90)	(14.29)	(47.01)	(-41.90)	(-79.76)	(-9.33)	(-25.91)	(31.93)	(24.00)
Adj. R-sq	0.779	0.928	0.968	0.995	0.999	0.998	0.847	0.964	0.735	0.968
Panel B - Asia - FE										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept: $\hat{\beta}_1$ (**FAT**)	-53.89	-1.898	26.51	0.707	-1.395	-26.56*	6.646*	13.92*	14.04	-1.397*
	(-1.42)	(-1.65)	(1.05)	(2.61)	(-1.28)	(-2.61)	(2.51)	(2.58)	(1.15)	(-3.35)
1/SE: $\hat{\beta}_0$ (**PET**)	1.818***	-0.0138	0.0357	0.00237	-0.165***	0.0379	-0.0112	-0.00788	-0.185***	-0.00142
	(9.99)	(-0.57)	(1.82)	(0.48)	(-9.12)	(0.45)	(-0.72)	(-1.23)	(-33.07)	(-0.50)
Adj. R-sq	0.826	0.334	0.284	0.810	0.623	0.579	0.598	0.526	0.023	0.151
Panel C - Europe - FE										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept: $\hat{\beta}_1$ (**FAT**)	-41.10	-3.198***	9.635	-0.791	-0.595	-0.657	-1.404	2.684	-10.06	1160.7
	(-0.86)	(-2.50e+15)	(0.79)	(-0.99)	(-2.30)	(-0.86)	(-1.31)	(0.59)	(-0.60)	(2.58)
1/SE: $\hat{\beta}_0$ (**PET**)	-1.723***	0.00561***	-0.000365	0.0211	-0.0216**	0.0161***	0.0633	-0.0702***	0.191**	0.0349**
	(-33.75)	(3.45e+13)	(-0.46)	(3.75)	(-9.14)	(67.09)	(3.13)	(-34.11)	(4.14)	(17.54)
Adj. R-sq	0.705	1.000	0.209	-0.106	0.444	0.839	0.688	-0.094	0.193	-0.081
Panel D - Global - FE										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept: $\hat{\beta}_1$ (**FAT**)	21.76	-0.0347	-19.53	-0.237	0.873	0.355	0.613	1.931	-9.759	
	(0.78)	(-0.58)	(-0.91)	(-2.47)	(0.87)	(0.35)	(1.77)	(4.97)	(-1.51)	
1/SE: $\hat{\beta}_0$ (**PET**)	-0.212***	-0.0666***	0.150***	0.00113	-0.0483***	-0.550***	0.00812***	-0.0264	0.000824	
	(-17.26)	(-212.32)	(20.72)	(2.16)	(-14.04)	(-141.88)	(12.72)	(-4.47)	(0.43)	
Adj. R-sq	0.734	0.998	0.811	0.611	0.458	0.983	0.102	0.891	0.260	
					North American Sample					
# observations	181	187	207	135	167	192	203	128	295	135
# studies	22	16	24	16	20	22	19	13	22	10
					Asian Sample					
# observations	55	59	48	36	59	63	66	62	95	129
# studies	7	7	6	3	7	8	8	8	8	7
					European Sample					
# observations	81	9	52	25	30	92	28	40	54	25
# studies	6	2	5	3	4	6	4	4	6	3
					Global Sample					
# observations	69	43	32	40	59	59	55	13	84	8
# studies	6	4	4	3	6	6	5	2	5	1

Firstly, the North American sample is characterized by several unique features that partly suggest that the association between individual determinants and the cash level in Asia is to a stronger extent driven by agency issues. Accordingly, I find the investment-elasticity of cash (model 2) to be negative and significant in all regions, except Europe, with North America exhibiting the most negative investment-elasticity

(-0.144). The market-to-book ratio has a significant positive association with cash in North American and Global studies but no significant relation in European and Asian studies. Furthermore, North America differs from all other regions regarding the R&D- (model 4), the cash flow-, and the financial distress-elasticity of cash holdings. Cash holdings increase with increasing R&D expenditures (0.00119) and financial distress (0.0327) but decrease with increasing cash flows (-0.00382) in North America.

R&D expenditures do not have a significant association to cash in any other region, which indicates a unique role of R&D expenditures in North America. This confirms the observation by Pinkowitz et al. (2016) which report country-level differences in level of cash to result from highly R&D-intensive U.S. firms

The total asset-elasticity of cash reserves (model 1) is negative in regions except for the Asian sample (1.818). An increase in firm size is usually associated with an increase in financing opportunities and external discipline, limiting the extent of cash hoarding motivated by managerial discretion. Asian firms either do not face incremental opportunities of external financing or increased external discipline when growing in size. Corporate governance does not affect the level of cash in Asia but it has a positive influence on the cash hoarding behavior in Europe (0.0349) and North America. A cash-increasing effect of good corporate governance is in line with predictions from the shareholder power hypothesis. It signals a lower risk of expropriation for shareholders, respectively lower country-level information asymmetries, in North America and Europe compared to Asia.

Secondly, A substitutive relation between cash holding and net working capital and leverage, shown by negative elasticities, is most consistently reported in North America. The direction of net working capital-elasticity (model 5) remains constant across all regions and model variations, varying between -0.00945 and -0.165. The most negative association between net working capital and cash holdings is found in

Asia. This suggests that Asians firms strongly tend to transform cash into liquid non-cash assets, potentially to hide their cash reserves. A positive association between leverage and cash holdings is found in Europe (0.0161) and Asia. The substitutive relation between cash and leverage is most pronounced in North America (panel A). Overall, this observation indicates a greater relevance of pecking-order and trade-off considerations in North America since net working capital and leverage act as alternatives to cash in this region.

In summary, I find that determinant-elasticity differ regionally. North America exhibits determinant-elasticities of cash that indicate low information asymmetries and a greater relevance of pecking-order and trade-off thoughts. Asian determinant-elasticities appear to be influenced by stronger agency issues.

4.2.2 *Sub-sample by information asymmetry*

The observation of a positive relationship between governance quality and cash holdings in North America and Europe suggests that the country-level of investor protection makes shareholders allow the management to hold more cash when firm-level governance quality increases in the these regions. However, as Pinkowitz et al. (2016) argue, country-level differences in the impact of specific determinants on the level of cash can as well result from the existence of unique firms in a country. I repeat the univariate fixed-effects MRAs on a sub-sample split by firm-level information asymmetry. This is undertaken to differentiate the previously identified country-level effects from firm-level effects. This means I run the MRA separately for results derived from samples that exclusively contain firms believed to be subject to high information asymmetries and for elasticities from broad samples.[10] Table 5 reports the results for the sub-samples split by information asymmetry. There are two

[10] For an illustration of the sample construction see the explanation of the high information asymmetry dummy in section 2.3 – explanatory variables.

general observations from this sub-sample analysis. Overall, they suggest that the country-level differences found in table 5 only partly correspond to firm-level characteristics, in the spirit of Pinkowitz et al. (2016). The analysis indicates that there are country-level differences in the association between determinants and the cash level that do not result from firms that are exclusively present in certain countries.

Table 5 Univariate FAT-PET MRA split by Information Asymmetry

This table presents results from the basic univariate FAT-PET regressions run on a sample of studies that focus on firms subject to high information asymmetries.Table 6 uses fixed effects WLS-regressions, clustered at the study level and standard errors clustered at the study level. All variables are defined in Appendix A. ***, **, and * represent significance at the 0.01, 0.05, and 0.10 levels. The t-statistics are shown in parantheses.

Fixed Effects FAT-PET WLS										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable:	E_TA	E_Inv	E_MB	E_RD	E_NWC	E_Lev	E_CF	E_Div	E_Total FinDistr	E_Total GoodGov
Sample of Firms Subject to High Information Asymmetry										
Intercept: $\hat{\beta}_1$ (**FAT**)	-24.58	-3.468	-18.48*	-7.072	-0.000429	-1.445	-0.193	0.0801	30.67	169.2
	(-0.48)	(-1.84)	(-2.47)	(-1.32)	(-0.00)	(-0.65)	(-1.06)	(0.26)	(0.78)	(0.80)
1/SE: $\hat{\beta}_0$ (**PET**)	-1.926***	0.153	0.00145***	0.0706*	-0.0141***	-0.00213	0.00769	-0.00691	0.0302***	0.0381***
	(-1052.97)	(1.00)	(20.90)	(3.07)	(-7.08)	(-0.67)	(1.67)	(-1.80)	(13.49)	(50.99)
Adj. R-sq	0.992	0.380	0.628	0.568	0.943	0.887	0.860	0.893	-0.036	-0.082
Sample of Firms Not Subject to High Information Asymmetry										
Intercept: $\hat{\beta}_1$ (**FAT**)	226.9	-1.391	5.171	0.566	-0.874	-2.706	1.387	4.707	-3.831	104.8
	(0.74)	(-1.79)	(0.52)	(1.27)	(-1.36)	(-0.66)	(1.05)	(1.36)	(-0.36)	(0.89)
1/SE: $\hat{\beta}_0$ (**PET**)	-1.900***	-0.0804***	0.00272***	0.00123***	-0.0108***	-0.0360***	-0.00202	-0.0655***	0.0321***	0.0403***
	(-335.66)	(-11.21)	(16.13)	(108.43)	(-27.18)	(-18.39)	(-1.12)	(-23.54)	(63.49)	(66.46)
Adj. R-sq	0.806	0.936	0.968	0.995	0.990	0.996	0.679	0.609	0.769	-0.070
				Firms subject to High Information Asymmetry						
# observations	38	35	41	16	36	48	52	24	61	66
# studies	8	6	10	6	7	9	7	4	10	6
				Firms not subject to High Information Asymmetry						
# observations	352	267	302	220	283	362	312	219	475	231
# studies	36	26	35	21	32	37	32	24	36	19

First, the reaction of the investment activity-, the R&D-, the leverage-, and the dividend-elasticity of cash holdings suggests that the influence of firm level information asymmetries corresponds to observations from table 4. Consequently, the country-level differences of these determinant-elasticities might be due to the presence of unique firms in specific regions. This means that differences in the effect of these determinants may not be based on country- but firm-characteristics.

Investments activities lose their significant negative association to cash in the high firm-level information asymmetry sample. This association between firm-level information asymmetries and the significance of the investment expenditure-elasticity of cash resembles differences found between the North American sample and the other regions in table 5.

North America exhibits the most negative investment-elasticity, compared to the residual regions. Thus, the regional differences in the magnitude and direction of the investment-elasticity could actually be caused by specific firm types that exist in only one country or region.

The significance of the R&D-elasticity of cash decreases in the presence of high information asymmetries. This sheds doubt on the simultaneous usage of the market-to-book ratio and R&D expenditures as proxies for growth opportunities, because the market-to-book-elasticity is not affected by firm-level information asymmetries. Furthermore, the observation of highly significant, positive, R&D-elasticities in North America might be caused by country-specific highly R&D-intensive firms. Such firms are usually expected to face increased firm-level information asymmetries. Thus, I would expect the R&D-elasticity to become more significant in the sub-sample of high firm-level information asymmetries and not vice versa as table 6 suggests. The evidence on the changes in the consensus R&D-elasticity are puzzling and might be caused by firm- as well as country-level characteristics.

The leverage-elasticity of cash is in general found to be highly significant and negative. However, the elasticity loses its significance when high firm-level information asymmetries are present. This suggests that the cash and leverage behave less strongly as substitutes when shareholders have more difficulties to assess firm policies. Again, this corresponds to observations from table 5. Thus, differences in the leverage-elasticity might not be the result of strong shareholder

protection in North America compared to Asia, but reflect the financing behavior of highly R&D-intensive firms that are only present in the U.S. as Pinkowitz et al. (2016) suggest.

Dividends are shown to lose their influence on the corporate cash ratio in firms that are subject to high information asymmetries. This corresponds to the observation of negative significant dividend-elasticities in North America as well as Europe compared to a lack of significance in Asian and global studies.

Second, the total assets-, net working capital-, cash flow-, financial distress- and corporate governance-elasticity of cash holdings is not affected by firm-level information asymmetries. The highly significant positive association between total assets and the cash ratio (1.818), the negative financial distress-elasticity (-0.185) and the insignificant corporate governance-elasticity (-0.00142) is not influenced firm-level information asymmetries. This emphasizes that the regional differences of these determinants found in table 5 are not the result of firms that are exclusively present in one country.

4.3 Multivariate analysis

I complement previous analyses by a fixed-effects multivariate MRA reported in table 6. In these multivariate models, the constant cannot easily be interpreted as the elasticity after controlling for heterogeneity. It is difficult to derive statements on the general determinant-elasticity and its significance. Thus, I focus on the influence of the geographic regions and high information asymmetries on the individual determinant-elasticities. These regional and firm effects are compared to the univariate results to improve the identification of regional differences in the determinants of cash holdings.

Table 6 Multivariate FAT-PET MRA using WLS

This table presents results from multivariate FAT-PET MRAs. Table 6 uses fixed effects WLS-regressions and standard errors clustered at the study-level. All variables are defined in Appendix A. ***, **, and * represent significance at the 0.01, 0.05, and 0.10 levels. The t-statistics are shown in parantheses.

FAT-PET WLS-FE										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable:	E_TA	E_Inv	E_MB	E_RD	E_NWC	E_Lev	E_CF	E_Div	E_Total FinDistr	E_Total GoodGov
Publication selection										
ErrorTerm	-41.82	-1.192*	4.613	0.325	-0.781	-3.647	2.821	6.012	-10.28	106.7
	(-1.07)	(-2.23)	(0.38)	(0.81)	(-0.98)	(-0.93)	(1.46)	(1.26)	(-1.33)	(0.91)
Model characteristics										
OnlyIndustry_FE	-0.211	-0.000497	-0.00700	-0.00704	-0.00529		-0.00471	-0.0325	-0.0327***	-0.140
	(-1.15)	(-0.03)	(-0.12)	(-1.05)	(-0.26)		(-0.55)	(-0.32)	(-168.97)	(-0.76)
OnlyTime_FE	-0.444***	0.134*	-0.00000415	0.00526	0.0341		-0.00340	-0.0220***	0.0777***	-0.532*
	(-7.32)	(2.35)	(-0.00)	(1.84)	(1.11)		(-0.45)	(-29.42)	(10.20)	(-2.52)
Industry&Time_FE	-0.459***	0.144*	0.00107	0.00487	0.0339		-0.00331	-0.0421***	0.0640***	-0.482*
	(-8.39)	(2.36)	(0.40)	(1.70)	(1.10)		(-0.44)	(-27.30)	(6.10)	(-2.47)
Sample characteristics										
LogAvgSampleYear	-234.4*	88.26**	-34.00		5.735	-53.51*	17.78	-5.620	-61.43	
	(-2.30)	(3.12)	(-0.45)		(0.39)	(-2.69)	(1.33)	(-0.18)	(-1.47)	
LogObservations	0.0561***	-0.0160*	0.00761	-0.00229	-0.0165	-0.0531	0.00389	0.01000	0.00335***	0.0488***
	(3.95)	(-2.67)	(1.12)	(-1.70)	(-1.12)	(-1.23)	(0.97)	(0.67)	(71.39)	(1056.01)
Asian sample	1.064***	0.258***	0.294***	-0.516	-0.0796***	-0.898***	-0.343	-0.0101	9.369	
	(14.09)	(6.47)	(3.72)	(-0.74)	(-4.84)	(-11.37)	(-1.37)	(-1.19)	(1.36)	
EU sample	0.610	-0.0455	-0.342	-0.401	0.0372	0.549	-2.220	-0.554	33.24	
	(0.63)	(-0.24)	(-0.44)	(-0.73)	(0.31)	(0.53)	(-1.44)	(-1.42)	(1.32)	
Global sample	0.441***	0.00504	-0.0535***	0.00144	0.144***	0.0824***	-0.00861**		0.00869	
	(26.02)	(0.57)	(-15.46)	(1.51)	(18.93)	(4.58)	(-2.84)		(0.35)	
HighInfoAsym	0.190	-0.0125	-0.0388	-0.0158***	0.0197	0.0176	0.0106	0.127***	-0.0270	0.0320***
	(1.45)	(-0.41)	(-0.98)	(-8.10)	(0.74)	(0.22)	(0.49)	(6.96)	(-0.58)	(222.90)
Moderating variables of primary study										
Firmsize					-0.0138***		-0.00138			
					(-6.06)		(-0.48)			
Capx			-0.000820***	0.0181	0.00314	0.0270	0.0402***			
			(-7.60)	(0.81)	(0.83)	(0.50)	(7.66)			
MB				-0.00703	0.0212***	0.445	0.00937*			-1.519
				(-0.81)	(31.99)	(0.49)	(2.23)			(-0.96)
NWC			-0.0646				0.469		-0.512***	
			(-0.21)				(1.56)		(-5.29)	
Lev		0.103***		-0.0181	-0.00730		-0.0396***			
		(21.84)		(-0.81)	(-1.99)		(-7.53)			
CF										
FinDistr			4.636			-8.314	-3.945	-3.146		
			(0.39)			(-0.98)	(-1.53)	(-1.26)		
TotalGov	1.389**	-0.0263	0.0187	-0.00184*	-0.00476	-0.0667	-0.412*	0.00405	0.00139	
	(3.56)	(-0.27)	(0.87)	(-2.43)	(-0.47)	(-0.82)	(-2.45)	(0.59)	(1.32)	
Constant	1779.8*	-670.8**	258.6	0.0289	-43.44	413.6*	-135.4	43.31	466.0	1.245
	(2.30)	(-3.12)	(0.45)	(1.81)	(-0.39)	(2.70)	(-1.33)	(0.18)	(1.47)	(0.79)
# observations	366	258	339	236	295	406	352	243	507	297
# studies	36	25	35	21	32	38	32	25	36	21
Adj. R-sq	0.894	0.962	0.971	0.996	0.994	0.997	0.711	0.656	0.947	0.259

Overall, results confirm the observation of regional differences in the impact of individual cash determinants. However, the differences are less pronounced than existing research suggests. They are only found between North America, Asia and the global sample. There is no indication of differences in determinant-elasticities

between North America and Europe. Specifically, the results suggest that differences in Asia are the result of country-level agency issues or a lack of financing alternatives. This means that Asian legal regulations are less effective in protecting investors than their international counterparts and Asian firms do not rely on the capital market, especially equity investors. Overall, this points to a greater relevance of the FCF-hypothesis and the underinvestment problem in Asia, whereas trade-off considerations and a more moderate financing hierarchy are prevalent in North America and Europe.

I observe regional differences that do not stem from firm-level information asymmetries for six determinants. North America differs from Asia as well as the global sample regarding the total asset-, market-to-book-, net working capital- and leverage-elasticity of the cash level. Asia is the only region that features an investment-elasticity that differs from North America and the Global sample exclusively derives an alternative cash flow-elasticity.

The total asset- and investment-elasticity increases in Asia compared to North America, while the net working capital- and leverage-elasticity decline. This confirms univariate results suggesting that a growth in firm size is not accompanied by increasing financing opportunities or external discipline in Asia which would limit cash holdings. The negative leverage-elasticity found in univariate analysis, confirmed by the multivariate investigation, indicates that debt providers are more efficient than the legal regime in enforcing external discipline or offer the only financing alternative.

The negative effect of the Asian region on the net working capital-elasticity indicates that Asian firms tend to transform cash into other liquid assets. This might be motivated by the intent to hide large liquidity reserves and the potential for discretionary managerial actions.

The regional differences observed between North America and the global sample do mostly not match the differences between North America and Asia. The only elasticity that is similarly influenced by Asia and the gobal smaple is the total asset-elasticity of cash. The influence of the global sample is difficult to interpret because the composition of individual primary samples contained in the global sample cannot be taken into account. Thus, I regard the differences resulting from the global sample as a general indication of regional differences but refrain from deducing their source on basis of the results shown in table 7.

The geographic characteristics of the R&D-elasticity are lost in the multivariate model. The R&D-elasticity of cash is only affected by firm-level information asymmetries. This complements the finding of a lacking significance of the R&D-elasticity in the univariate sub-sample analysis of high firm-level information asymmetries. Apparently, the distinct influence of R&D expenditures on cash in North America is rather associated to specific firm characteristics in North America instead of regional-characteristics. This confirms Pinkowitz et al. (2016) who relate difference between U.S. and foreign cash levels to unique U.S. firms hoarding large amounts of cash.

Regional differences in the effect of dividend-, financial distress- and corporate governance-elasticity on cash, which were found in the univariate analysis, do not persist in the multivariate model, respectively cannot be analyzed due to a lack of observations. In accordance with the univariate analysis, high firm-level information asymmetries do not affect the financial distress-elasticity. However they significantly increase the dividend- and corporate governance-elasticity, which conflicts with prior univariate evidence. Thus, firm-level information asymmetries seem to affect the dividend- and corporate governance-elasticity of cash holdings but the direction of

the effect is unclear. Furthermore, regional differences cannot be ruled out for the corporate governance-elasticity.

4.4 Robustness, limitations, future research

I conduct two sets of robustness checks on the multivariate analysis presented in table 6. Firstly, I alter the control for publication selection by exchanging the estimate's standard error with the squared standard error. According to Stanley/Doucouliagos (2007 and 2014) and Moreno et al. (2009), this measure provides an improved correction for publication selection, when there actually is a publication bias. Secondly, I vary the effect size by using the t-values of the primary regression coefficients instead of its elasticities. T-values are, like elasticities, robust to differences in scaling across estimates but are not as easy to interpret from an economic viewpoint.

The results from my previous analysis are essentially confirmed by both robustness checks.[11] The alternative control for publication bias stresses the difference between the Asian and Global samples on the one side and the North American and European sample on the other side even stronger. Additionally, significant differences between these regions for the dividend and financial distress-elasticity are found.

The multivariate fixed effects WLS using the t-value confirms the results of its counterpart which uses elasticities. However, it stresses the influence of high information asymmetries.

This study suffers from some limitations that result from the character of meta-regressions and my specific sample. Meta-regressions estimate general trends in research results and the impact of the design of primary studies. Accordingly, I estimate consensus associations between individual firm characteristics and the level

[11] Results are available upon request.

of cash as well as the impact of geographic regions and firm-level information asymmetries. This approach provides evidence for the existence of regional differences in the effect of prominent firm-level determinants of cash holdings. Unfortunately, the cause of the identified regional differences remains unclear. Due to limitations of the meta-sample, exploring the impact of individual regional characteristics on the consensus associations between specific firm-characteristics and the level of cash mainly is outside of the scope of this study.

I try to shed some light on the cause of the regional differences by investigating the influence of country characteristics. This requires me to focus exclusively on elasticities that are derived from studies that analyze single countries. There are several studies that investigate the U.S. individually, but very few studies focus exclusively on one Asian or European country. Since only the comparison of North America and Asia derived regional differences, I focus on single-country studies set in the U.S. and Asia. China and Japan are the sole Asian countries that offer enough individual results to undertake an analysis. I determine two variables that describe country characteristics of the U.S, China and Japan: GDP growth ($GDPgrowth$) and the change in the capitalization of the capital market ($MarketCapGrowth$). GDP growth indicates the economic state of the respective country, $MarketCapGrowth$ suggests the size and relevance of the equity market and are treated as substitutes.

The sample is restricted to results from studies that focus exclusively on either the U.S., China or Japan. I apply the multivariate model presented in table 6 on this sub-sample and add the previously discussed country characteristics. The value of the respective country characteristics are assigned based on the average sample year of the sample from which an elasticity is derived. This means, if an elasticity is derived from a U.S. sample and the average sample year is 1990, $GDPgrowth$ and $MarketCapGrowth$ take the value associated to the year 1990.

Moreover, dummy variables are included, indicating the decades over which the primary studies' samples span. I employ five time dummies ($60s$, $70s$, $80s$, $90s$ and $2000s$,). They equal 1 if at least one year of the respective decade is covered by the sample period of a primary study; otherwise 0. This provides insights about time trend of individual consensus associations. The 60s are used as the reference category. Thus the individual time dummies indicate how a switch from a sample period spanning to the 60s to one that spans, for example, over the 80s impacts the consensus associations. The time dummy for the 90s is dropped because there is too little variation, as the 90s are covered by all studies. The results are presented in table 7, the control variables from table 6 are included but not tabulated.

Results show that most regional differences are not explained by differences in the economic condition of a country or the relevance of the equity market. The total asset-, investment activity-, net working capital-, and leverage-elasticity of cash are unaffected by the additional control variables. Regional differences in the market-to-book-elasticity of cash holdings disappear after including the country characteristics and time dummies, although these variables do not have a significant impact.

From the 70s to the 80s, the total asset-, investment activity- and net working capital-elasticity of cash became more negative. During the same period, the leverage-elasticity either stayed constant or became more positive. These trends reversed in the 2000s. This indicates that the substitutive relationship between cash and leverage became more pronounced in recent years, while the substitutive relation between cash and net working capital decreased. Finally, increasing cash stockpiles in large firms are also shown to be a characteristic of the 2000s.

Table 7 Single-Country Studies Multivariate FAT-PET MRA using WLS

This table presents results from multivariate FAT-PET MRAs using a sample consisting only of studies foucssing on single countries. Table 7 uses fixed effects WLS-regressions and standard errors clustered at the study-level. Models 1-10 include the same control variables as the corresponding models in table 6. For the sake of brevity, these control variables are not tabulated. All variables are defined in Appendix A. ***, **, and * represent significance at the 0.01, 0.05, and 0.10 levels. The t-statistics are shown in parantheses.

FAT-PET WLS-FE										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable:	E_TA	E_Inv	E_MB	E_RD	E_NWC	E_Lev	E_CF	E_Div	E_Total FinDistr	E_Total GoodGov
Asian sample	5.159***	0.304**	-0.0520	-5.924	-0.157***	-2.466**	-0.175		12.08	
	(5.47)	(3.48)	(-0.03)	(-1.53)	(-23.43)	(-2.85)	(-0.75)		(1.09)	
70s	-4.335*	-0.135	0.481	9.162	-0.00866	0.825	0.332	0.0234	-15.24	
	(-2.12)	(-0.61)	(0.50)	(1.54)	(-0.71)	(1.40)	(0.89)	(0.29)	(-1.09)	
80s	-9.844**	-0.507*	0.807	-2.757	-0.228***	3.136*	0.105	-0.144	3.473	
	(-3.58)	(-2.55)	(0.20)	(-1.43)	(-300.69)	(2.24)	(1.28)	(-0.54)	(1.07)	
2000s	12.21***	0.731**	-1.559	1.021	0.184***	-3.492*	-0.183	0.267		
	(3.99)	(3.24)	(-0.28)	(1.14)	(41.94)	(-2.28)	(-1.10)	(0.79)		
GDPgrowth	-103.3***	-3.092**	13.48	50.43	0.194*	30.59	2.794	-0.907		
	(-6.64)	(-3.28)	(0.28)	(1.61)	(2.30)	(2.02)	(0.83)	(-0.63)		
MarketCapGrowth	0.0791***	0.0150***	0.0271	-0.0181	-0.00139	-0.0502*	-0.00235	0.00101	-0.831	
	(10.21)	(5.04)	(0.50)	(-1.85)	(-1.15)	(-2.63)	(-0.46)	(1.34)	(-1.09)	
HighInfoAsymmetry	0.462*	0.00892	-0.0220	-0.00959***	0.0280	0.189***	0.0183	0.138***	0.0363	-0.113***
	(2.44)	(0.11)	(-0.50)	(-5.03)	(1.29)	(8.77)	(1.58)	(76.65)	(2.02)	(-27.41)
Constant	15408.3***	318.1*	-2133.7	-8347.0	-10.98	-4693.8*	-483.2	109.7	16839.3	3.232
	(5.64)	(2.69)	(-0.31)	(-1.59)	(-0.59)	(-2.11)	(-0.99)	(0.53)	(1.08)	(1.49)
Controls	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.
# observations	183	172	212	127	172	200	182	135	334	201
# studies	23	17	25	15	21	24	21	16	24	13
Adj. R-sq	0.699	0.957	0.973	0.998	0.999	0.998	0.850	0.977	0.948	0.969

Although this additional test provides some insights, it is also strongly limited. I am unable to include more country characteristics, for example the corporate tax rate, the level of investor protection or the origin of the legal system, because my sample features either too few observations or too little variation. Moreover, I need to partly sacrifice the strength of MRA, namely its broad sample and independence of individual modelling choices, to undertake the analysis of country characteristics.

It is an interesting goal for future research, to provide more insights on differences in the impact of firm characteristics on cash holdings. The interaction of firm and country characteristics stills needs to be investigated more thoroughly. This requires a more extensive investigation of various country characteristics in a broad international sample and especially a switch of focus from the level of cash to the association of the cash ratio with underlying firm characteristics.

5 Conclusion

This article addresses the question whether the impact of individual firm characteristics on the level of cash is affected by regional characteristics. Existing research implicitly suggests the presence of regional differences. This would mean that the influence of a firm-level determinant changes if the respective firm, ceteris paribus, relocates to a different region. Pinkowitz et al. (2016) object to this expectation by reporting that there is no difference in cash holdings when U.S. firms are compared with their foreign counter-parts.

I contribute to existing research by tackling this conflict and directly analyzing the regional differences in the influence of specific firm-level determinants on the cash level. In the first step, this study derives general statements regarding the determinants of the corporate cash level, which are not bound to specific situations, time periods, sample characteristics, the econometric modelling of primary studies or variable definitions. These so-called consensus estimates are obtained by aggregating the quantitative results from primary research in a meta-regression analysis. In the second step, I investigate regional differences in the consensus estimates and further control for the influence of firm-level information asymmetries, country- characteristics, and time trends.

I analyze the influence of 10 determinants on the level of cash, respectively the determinant-elasticity of cash. These determinants are total assets, investment activities, the market-to-book ratio, R&D expenditures, net working capital, leverage, cash flow, dividends, financial distress and corporate governance. In summary, cash holdings decrease with increases in total assets, investment activities, net working capital, leverage, cash flow and dividends. Moreover, the corporate cash ratio increases with the market-to-book ratio, R&D expenditures, financial distress and the quality of corporate governance.

Graphical and univariate sub-sample analysis as well as multivariate MRAs reveal regional differences in the influence of cash holdings determinants. However, these differences are less pronounced than existing research suggests. In general, determinant-elasticities are shown to be comparable in North America and the EU but differ between North America and Asia as well as the Global sample. The influence of determinants on the level of cash in Asia appears to be affected by the country-level governance quality or a lack of financing alternatives. This suggests a greater relevance of the FCF-hypothesis and the underinvestment problem in Asia.

The difference between North America and the EU on the one hand and Asia and the Global sample on the other hand persists for the impact of total assets, investment activities, the market-to-book ratio, net working capital, and leverage on cash holdings. Cash holdings in the Global and Asian sample are reported to have a less negative, in case of Asia even a positive, total asset-elasticity. The investment activity-elasticity of cash increases in Asia in comparison to North America and the EU. Thus, a growth in firm size does not provide Asian firms with incremental possibilities of external financing or expose them to increased external discipline which would lower cash holdings.

The market-to-book ratio increases in Asia and decreases in the Global sample, in comparison to the North American and the European sample. The net working capital and the leverage-elasticity of cash decrease in Asia in comparison to North America and the EU. The latter two observations indicate, first, that Asian firms tend to transform cash into liquid non-cash assets, potentially to cover the size of their cash reserves. Second, debt providers either discipline Asian firms more effectively than the legal regime and investors or provide the only sufficient financing alternative to hoarding cash. The aforementioned regional effects are robust to controlling for firm-level information asymmetries, country characteristics, and time trends. Thus,

the cause of the regional effects remains unclear and is a promising subject for future research.

6 Appendix

Appendix A Variable Descriptions

Variable	Description
Data-variants of cash holding determinants *- always combined with one of the suffixes below*	
B_*	Regression coefficient of the respective determinant in the primary study.
E_*	Determinant-elasticity of cash holdings. The determinant is specified by the suffix that replaced the asterisk
M_*	Mean value of the respective determinant in the primary study.
Cash holding determinants - always combined with one of the prefixes above	
*CF	Cash flow
*CFuncer	Cash flow uncertainity
*CH	Cash holdings
*Div	Dividends
*Inv	Investment expenditures
*Lev	Leverage
*MB	Market-to-book ratio
*NWC	Net working capital
*RD	Research & development expenditures
*TA	Total assets
*TotalGoodGov	Total good corporate governance
*TotalFinDistr	Total financial distress
Explanatory variables	
Asian sample	Dummy variable that takes the value 1 if a primary regression analysis considered exclusively Asian firms and 0 otherwise.
CHsectoNetA	Dummy variable that takes the value 1 if cash holdings were calculated as cash + short-term investment scaled by net assets (total assets less cash), in the respective primary regression model, and 0 otherwise
CHtoNetA	Dummy variable that takes the value 1 if cash holdings were calculated as cash scaled by net assets (total assets less cash), in the respective primary regression model, and 0 otherwise
CHtoTA	Dummy variable that takes the value 1 if cash holdings were calculated as cash scaled by total assets, in the respective primary regression model, and 0 otherwise
ErrorTerm	Standard error of a determinant's regression coefficient, taken from primary studies
EU sample	Dummy variable that takes the value 1 if a primary regression analysis considered exlusviely firms that are geographically located in Europe and 0 otherwise.
Global sample	Dummy variable that takes the value 1 if a primary regression analysis did not focus exclusively on one of the defined regions (NA, Asia, EU) and 0 otherwise.
HighInfoAsym	Dummy variable that takes the value 1 if a primary regression analysis focusses exlcusively on firms that are subject to high information asymmetries and 0 otherwise.
Industry&Time_FE	Dummy variable indicating that the regression model of the primary study contained industry- and
LogAvgSampleYear	Logarithm of the average sample year of a primary regression analysis.
LogObservations	Logarithm of the observations (firm years) of a primary regression analysis.
OnlyIndustry_FE	Dummy variable indicating that the regression model of the primary study only contained industry-fixed effects.
OnlyTime_FE	Dummy variable indicating that the regression model of the primary study only contained time-fixed effects.

Appendix A Continued

Variable	Description
VarCentral	Dummy variable that takes the value 1 if a determinant was a treatment variable and the value 0 if a determinants was a control variable, in the respective primary study.
Capx	Dummy variable that takes the value 1 if a primary regression model contained a measure of capital expenditures as control variable and 0 otherwise.
CF	Dummy variable that takes the value 1 if a primary regression model contained a measure of cash flow as control variable and 0 otherwise.
Database Dummies	Various Dummy variables that take the value 1 if a primary regression analysis used data from a specific database and 0 otherwise.
Div	Dummy variable that takes the value 1 if a primary regression model contained a measure of dividends as control variable and 0 otherwise.
FinDistr	Dummy variable that takes the value 1 if a primary regression model contained a measure of financial distress as control variable and 0 otherwise.
Firmsize	Dummy variable that takes the value 1 if a primary regression model contained a measure of firm size, usually total assets, as control variable and 0 otherwise.
Lev	Dummy variable that takes the value 1 if a primary regression model contained a measure of leverage as control variable and 0 otherwise.
MB	Dummy variable that takes the value 1 if a primary regression model contained the market-to-book ratio as control variable and 0 otherwise.
NWC	Dummy variable that takes the value 1 if a primary regression model contained a measure of net working capital as control variable and 0 otherwise.
RD	Dummy variable that takes the value 1 if a primary regression model contained a measure of R&D expenditures as control variable and 0 otherwise.
TotalGov	Dummy variable that takes the value 1 if a primary regression model contained a measure of corporate governance as control variable and 0 otherwise.

Appendix A briefly describes all variables used in this study. The construction of the cash holding determinants is explained in more detail in section 3.2.

Appendix B Final Sample of Primary Studies

Study	Countries	Region	Period
Kim/Mauer/Sherman (1998)	US	NA	1975-1994
Opler/Pinkowitz/Stulz/Williamson (1999)	US	NA	1971-1994
Pinkowitz/Williamson (2001)	US, Ger, Japan	Global, EU, Asia, NA	1971-1994
Ozkan/Ozkan (2004)	UK	EU	1998-1995
Acharya/Almeida/Campello (2007)	US	NA	1971-2001
Dittmar/Mahrt-Smith/Servaes (2007)	US	NA	1990-2003
Drobetz/Grüninger (2007)	Swiss	EU	1995-2004
Foley/Hartzell/Titman/Twite (2007)	US	NA	1982-2004
Kalcheva/Lins (2007)	Broad international sample	Global	1996
Chen (2008)	US	NA	2000-2004
D'Mello/Krishswami/Larkin (2008)	US	NA	1985-2000
García-Teruel/Martínez-Solano (2008)	Spain	EU	1996-2001
Harford/Mansi/Maxwell (2008)	US	NA	1993-2004
Bates/Kahle/Stulz (2009)	US	NA	1980-2006
Chen/Chuang (2009)	US	NA	1997-2003
Lee/Lee (2009)	UK	EU	2001-2005
Duchin (2010)	US	NA	1990-2006
Tong (2010)	US	NA	1993-2000
Al-Najjar/Belghitar (2011)	UK	EU	1991-2008
Kuan/Li/Chu (2011)	UK	EU	1997-2008
Kusnadi (2011)	Malaysia, Singapore	Asia	2000-2005
Lee/Powell (2011)	Australia	Australia	1990-2008
Subramaniam/Tang/Yue/Zhou (2011)	US	NA	1988-2006
Álvarez/Sagner/Valdivia (2012)	Chile	Global	1986-2009
Chen/Chen/Schipper/Xu/Xue (2012)	China	Asia	2000-2008
Julio/Yook (2012)	Broad international sample	Global	1980-2005
Khieu/Pyles (2012)	US	NA	1985-2009
Brisker/Colak/Peterson (2013)	US	NA	1971-2006
Huang/Elkiwy/Jain (2013)	Broad international sample	Global	1992-2009
Steijvers/Niskanen (2013)	US	NA	1998
Sun/Yung/Rahman (2013)	US	NA	1980-2005
Yu/Sopranzetti/Lee (2015)	Taiwan	Asia	1991-2005
Belghitar/Clark (2014)	UK	EU	2000-2004
Chen/Li/Xiao/Zou (2014)	China	Asia	2005-2007
Harford/Klasa/Maxwell (2014)	US	Asia	1980-2008
Hill/Fuller/Kelly/Washam (2014)	US	Asia	1999-2006
Hoberg/Phillips/Prabhala (2014)	US	Asia	1997-2008
Iskandar-Datta/Jia (2014)	Broad international sample	Global	1985-2008
Liu/Mauer/Zhang (2014)	US	NA	2006-2011
Neamtiu/Shroff/White/Williams (2014)	US	NA	1987-2009
Oler/Picconi (2014)	US	NA	1989-2008
Qiu/Wan (2014)	US	NA	1982-2001
Chen/Dou/Rhee/Truong/ Veeraraghavan (2015)	Broad international sample	Global, NA	1989-2009
Elyasiani/Zhang (2015)	US	NA	1996-2008
Liu/Luo/Tian (2015)	China	Asia	2004-2011

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