Journal of Banking & Finance 34 (2010) 2168–2184

Contents lists available at ScienceDirect

Journal of Banking & Finance

journal homepage: www.elsevier.com/locate/jbf

Information asymmetry and the value of cash

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ARTICLE INFO

Article history:
Received 8 March 2009
Accepted 2 February 2010
Available online 6 February 2010

JEL classification:
G32

Keywords:
Cash holdings
Value of cash
Information asymmetry
Analysts' forecasts

ABSTRACT

This study investigates the market value of corporate cash holdings in connection with firm-specific and time-varying information asymmetry. Analyzing a large international sample, we test two opposing hypotheses. According to the pecking order theory, adverse selection problems make external financing costly and imply a higher market value of a marginal dollar of cash in states with higher information asymmetry. In contrast, the free cash flow theory predicts that excessive cash holdings bundled with higher information asymmetry generate moral hazard problems and lead to a lower market value of a marginal dollar of cash. We use the dispersion of analysts' earnings per share forecasts as our main measure of firm-specific and time-varying information asymmetry. Extending the valuation regressions of Fama and French [Fama, E.F., French, K.R., 1998. Taxes, financing decisions, and firm value. Journal of Finance 53, 819–843], our results support the free cash flow theory and indicate that the value of corporate cash holdings is lower in states with a higher degree of information asymmetry.

1. Introduction

J.P. Morgan economists calculated that savings by corporations in rich countries increased by more than $1 trillion from 2000 to 2004.[1] Compared to the last 40 years, firms never hoarded so much cash as they did during this recent time period. A natural question is why firms accumulate such enormous amounts of liquidity. The standard textbook model suggests that cash holdings are irrelevant and cannot affect firm value. In perfect (frictionless) capital markets, external finance can always be obtained at fair terms. Looking at the corporate landscape, however, this cash irrelevancy is not supported. For example, the US software giant Microsoft presented a cash position amounting to $60.6 billion in its 2004 annual report. After growing investor pressure, in July 2004 Microsoft announced to pay a one-time dividend of $32 billion and to buy back up to $30 billion of the company's stock over the next 4 years. Upon the arrival of that news, Microsoft's stock price rose by 5.7% in the after-trading, indicating that cash should by no means be regarded as irrelevant in investors' eyes.[2]

In order to explain corporate cash holdings, it is necessary to relax the assumptions of frictionless capital markets. First, if transaction costs are incorporated into the model, the irrelevancy proposition of cash no longer holds and an optimal cash balance exists. Second, if information asymmetry is taken into account, adverse selection and moral hazard problems arise. Myers and Majluf (1984) model the adverse selection problem in financing decisions and consider the role of cash holdings in the presence of information asymmetry. Adverse selection induces managers to abstain from raising external capital because they are not willing to issue undervalued securities. A cash buffer may prevent managers from being forced to pass up positive net present value investment projects. In contrast, Jensen (1986) analyzes the moral hazard problem and emphasizes the agency costs of free cash flow. Instead of paying out the free cash flow to shareholders, managers tend to waste these funds on inefficient investments or on their own pet projects (empire building).

Corporate cash holdings and information asymmetry are strongly interrelated. This is the novel path that our study takes and how it contributes to the existing literature. Specifically, we measure the marginal value of cash holdings in the presence of firm-specific and time-varying information asymmetry. Previous studies also investigate the value consequences of corporate cash holdings, but they put their emphasis on corporate governance issues rather than on information asymmetry. These studies document that a weak corporate governance regime has detrimental effects on the value of cash (Dittmar et al., 2003; Pinkowitz et al., 2006; Dittmar and Mahrt-Smith, 2007). In this study, we analyze firm-specific and time-varying information asymmetry and its impact on the market value of cash. We test whether in states with a

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[1] J.P. Morgan Research: Corporates are driving the global saving glut, June 24, 2005.
[2] The Wall Street Journal, Microsoft to dole out its cash hoard, July 21, 2004, p. A.1.

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doi:10.1016/j.jbankfin.2010.02.002

higher degree of information asymmetry cash holdings contribute more or less to firm value than in states with a lower degree of information asymmetry. On the one hand, a positive relationship supports Myers and Majluf's (1984) hypothesis that external finance is costly and cash provides a valuable buffer. On the other hand, a negative relationship is consistent with Jensen's (1986) notion that increased managerial discretion induces managers to squander corporate liquidity. We test these two opposing hypotheses and investigate which effect outweighs the other. Our sample contains more than 8500 firms from 45 countries over the period from 1995 to 2005. The dispersion of analysts' earnings forecasts serves as our main proxy for information asymmetry. Extending the Fama–French (1998) valuation regressions, we include the cash ratio and compute its impact on firm valuation in connection with firm-specific and time-varying information asymmetry. Methodologically, we use fixed effects regressions and the Fama–MacBeth procedure.

Without considering information asymmetry, our results indicate that the value shareholders place on the marginal unit of cash is around one dollar, on average, depending on the estimation methodology. Most important, the marginal value of cash decreases with increasing severity of information asymmetry. This evidence supports Jensen's (1986) free cash flow theory, i.e., the costs from holding cash (creating moral hazard problems) outweigh the benefits (avoiding costly external finance). Incorporating a measure of excess cash in the valuation regressions instead of the actual cash ratio does not change our results qualitatively. In order to further distinguish between the two opposing hypotheses, we split the sample according to measures for the quality of corporate governance and the degree of financial constraints. We find that the value of cash is higher if corporate governance and investor protection are better, which reinforces the free cash flow hypothesis. In contrast, our results for the sample sorts based on financial constraints do not allow unambiguous conclusions.

We are unable to support the hypothesis that financial slack is valuable, as predicted by the pecking order theory. Our findings indicate that it may not be in the shareholders' interest that firms hoard liquidity due to problems induced by information asymmetry, and hence the precautionary motive to hold cash appears questionable. However, they do not generally contradict the pecking order theory. In particular, our results do not suggest that firms should not use internal funds in the first place before external funds are raised. We rather argue that it may not be optimal for firms to accumulate cash with the intention to avoid (costly) external finance in future states when information asymmetry is high.

The remainder of this paper is structured as follows. Section 2 introduces the theoretical background, presents our hypotheses, and reviews the related literature. Section 3 describes the data and explains our empirical methodology. Section 4 reports our main empirical results and a number of robustness tests. Finally, Section 5 provides concluding remarks and suggestions for further research.

2. Theoretical background, hypotheses, and related literature

2.1. Theoretical background and hypotheses

According to the pecking order theory (Myers, 1984; Myers and Majluf, 1984), firms prefer internal to external finance. This theory is based on the assumption that corporate insiders are better informed than shareholders. Managers may be forced to forgo profitable projects if internal funds are not sufficient to finance the optimal investment program and information asymmetry is prohibitive. In this situation, financial slack (cash) is valuable, and the only opportunity to issue equity without loss of market value occurs if information asymmetry is nonexistent or small. This idea captures the notion of time-varying adverse selection costs (Korajczyk et al., 1992; Viswanath, 1993). It can be optimal for firms to deviate from the strict pecking order and to finance a new investment project with fresh equity even if there are other financing options available. Specifically, there are states in which firms are not restricted to raise external capital, and there are other states in which the costs of external finance are excessive. In those states when external finance is prohibitively expensive, financial slack is valuable, and an additional dollar of cash will have a higher market value. This reasoning results in our first hypothesis:

Hypothesis 1. In states with a higher degree of information asymmetry cash is *more* valuable for a firm than in states with a lower degree of information asymmetry.

The opposite relationship could be expected based on Jensen's (1986) free cash flow theory. More internal funds allow managers to elude control of the capital market. In this case, they do not need shareholders' approval and are free to decide on investments according to their own discretion. Managers are reluctant to pay out funds, and they have an incentive to invest even when there are no positive net present value projects available. With increasing managerial discretion to misuse funds for value-destroying projects when cash reserves are high, corporate governance mechanisms, e.g., the market for corporate control, are supposed to limit self-serving behavior. However, the higher the degree of information asymmetry, the more difficult it becomes for firm outsiders to distinguish between value-destroying and value-increasing investments. Specifically, shareholders may be unable to determine whether high cash reserves are close to the amount required for the firm to operate or whether they are the result of managerial risk aversion (Fama and Jensen, 1983). This reasoning results in our second hypothesis:

Hypothesis 2. In states with a higher degree of information asymmetry cash is *less* valuable for a firm than in states with a lower degree of information asymmetry.

Our hypotheses contain opposing expectations concerning the influence of information asymmetry on the value of cash holdings. The main challenge in our empirical tests is to disentangle the effects of these two conflicting hypotheses. If no relationship is detected, we cannot rule out that both effects are at work and cancel each other out. Even if a relationship can be detected, we still cannot rule out that the opposite effect also exists, albeit to a lesser degree. Although we are ultimately interested in the overall (net) effect, we attempt to disentangle the two effects by splitting our sample into different subgroups. Specifically, Hypothesis 1 is related to the access to external finance. Splitting the sample according to the severity of financial constraints, one expects that in the subsample of constrained firms the value of cash is higher with more pronounced information asymmetry. This finding would support Hypothesis 1, regardless of the overall (net) effect. In contrast, Hypothesis 2 is more relevant for firms with weaker corporate governance structures. Splitting the sample according to the quality of corporate governance, the value of cash in combination with a high degree of information asymmetry should be lower in the subsample of firms with weaker corporate governance practices. This finding would support Hypothesis 2, regardless of the overall (net) effect.

2.2. Related literature

This section reviews research findings that are related to our hypotheses. One strand of the literature provides evidence for a dynamic version of the pecking order theory (related to Hypothesis

1). Bharat et al. (2008) and Autore and Kovacs (2010) document that firms prefer to access financial markets and issue equity when the level of information asymmetry is low. Similarly, Krishnaswami and Yaman (2007) study windows of opportunity in debt issues. In the spirit of Korajczyk et al. (1992), Choe et al. (1993) and Viswanath (1993), these studies document support for a time-varying adverse selection explanation of firms' financing decisions. Based on their findings, one would expect that cash is more important for firms and has a higher market value in states when information asymmetry is more pronounced. In contrast, Fama and French (2005) and Leary and Roberts (2007) report that the pecking order theory is not able to explain firms' financing decisions even in states when information asymmetry is high. D'Mello et al. (2008) analyze the initial cash allocation decision in spin-off firms. They document that spin-off firms with high information asymmetry hold more cash in order to reduce their dependence on costly external finance. However, an analysis of the excess cash ratio indicates that firms, on average, hold less cash than is suggested by the trade-off theory. Observing that the excess cash ratio is positively related to the cash flow in the current year, D'Mello et al. (2008) attribute this conservatism in cash holdings to pecking order effects.

Another strand of the literature that is important for our analysis tests the free cash flow hypothesis (related to Hypothesis 2). For example, Nohel and Tarhan (1998) investigate the impact of share repurchases on operating performance. Their findings reveal that operating performance improves after share repurchases, but only for firms with low growth opportunities. This improved performance does not result from higher growth opportunities but from the more efficient employment of assets. Nohel and Tarhan (1998) argue that their findings support the free cash flow hypothesis. D'Mello and Miranda (2010) provide more direct evidence on the agency costs of managerial discretion in connection with corporate cash holdings. They document that the introduction of debt in unlevered firms leads to a sharp decline in cash ratios, and this relation is stronger for firms with poor investment opportunities. Using international data, Dittmar et al. (2003) report that firms in countries with a low level of investor protection hold double the amount of cash compared to firms in countries with a high level of shareholder rights. Their results are even more pronounced when they control for the capital market development. Pinkowitz and Williamson (2004) and Pinkowitz et al. (2006) also focus on the influence of country-level investor protection on the value of cash holdings. Their results reveal that cash is worth less in countries where minority shareholder rights are poorer. Similarly, Fresard and Salva (forthcoming) document that the value investors attach to excess cash holdings is higher for foreign firms with US cross-listings than their domestic peers.

Harford et al. (2008) report that US firms with poor corporate governance tend to hold lower cash and contribute this result to the observation that they invest less internally but engage more frequently in acquisitions, often using cash as their method of payment.[3] These acquisitions, as well as the lower internal investment, destroy firm value through reduced future profitability. At first, these findings for US firms seem to be inconsistent with international studies that document decreasing cash balances as shareholder rights increase. As an explanation, Harford et al. (2008) suggest that true entrenchment requires low shareholder rights. The effect of country-level granting and enforcing of shareholder rights dominates the effect of firm-level variation in the control of agency conflicts. The level of entrenchment found in environments with poor shareholder protection is generally higher than that in the average entrenched firm in countries with higher shareholder protection. While managers can hoard cash with impunity in the former case, they are wary of opposing shareholder agitation in the latter case if entrenchment goes too far. Supporting this notion, Kalcheva and Lins (2007) document that firms with weak corporate governance structures at the firm-level hold more cash, and this effect becomes stronger for firms in countries with poor investor protection. Overall, these studies support the free cash flow hypothesis.[4] Poor protection of investor rights enables managers to dissipate cash for their own ends.

Finally, Lundstrum (2003) explicitly focuses on information asymmetry and corporate cash holdings. He investigates whether the benefits from accessing internal capital markets to avoid selling underpriced securities outweigh the agency costs from managerial money squandering created by the availability of cash. His results corroborate the free cash flow theory. Although access to internal capital markets can sometimes exert a positive effect on firm value, this effect only arises for firms with a low level of information asymmetry.

3. Data and empirical methodology

The starting point of our analysis is the valuation model of Fama and French (1998). They investigate how firm value is related to dividends and corporate debt. Pinkowitz and Williamson (2004), Pinkowitz et al. (2006) and Dittmar and Mahrt-Smith (2007) suggest modified versions of this valuation model to estimate the market value of a dollar of cash. We further extend their framework and test the impact of firm-specific and time-varying information asymmetry on the market value of cash holdings. Section 3.1.1 starts with a description of our international sample. Section 3.1.2 introduces different proxies for time-varying and firm-specific information asymmetry, and Section 3.1.3 suggests sample splits that are based on financial constraints and corporate governance structures. Finally, Section 3.2 explains our empirical methodology and introduces all other model variables.

3.1. Data description

3.1.1. The sample

Our data set covers the period from 1995 to 2005. We include all firms from the different countries for which I/B/E/S provides analysts' forecasts and for which we can retrieve company data from Worldscope. Given that our main proxy for information asymmetry is based on the standard deviation of analysts' earnings per share forecasts (analysts' forecasts dispersion), this measure can only be computed when the forecasts are at least based on two analysts. A firm is omitted from our sample if this dispersion measure cannot be calculated for at least one sample year, hence, if this firm is not covered by at least two analysts in at least one sample year. We use yearly data because for most countries quarterly accounting data are not available. Given the specific nature of their business, financial firms and utilities are omitted from the sample. Moreover, firms whose fiscal year does not end with the calendar year are excluded. This data restriction avoids that our financial data, especially the earnings estimates that are used to compute our information asymmetry measures, refer to different

[3] Because large cash holdings may lead to shareholder agitation in countries with high investor protection, managers prefer to convert the cash into real assets relatively quickly. Even if these transactions may be value-destroying, managers can execute them successfully as long as the costs are within the bounds of removing management.

[4] In contrast, examining a US sample, Bates et al. (2009) report that the recent increase in cash holdings can be explained by changing firm characteristics (and hence the precautionary demand for cash) rather than agency problems.

Table 1
Observations per country and index values.

Country	*N* Model 1	*N* Model 2	Anti-director rights index	Corruption index	Rule of law index	Common law	Civil law	Stock/GDP	Bond/GDP
Panel A: Developed markets									
Australia	355	292	4	2.00	1.89	1	0	1.04	0.28
Austria	331	283	2	1.88	1.94	0	1	0.17	0.35
Belgium	464	398	0	1.32	1.53	0	1	0.81	0.46
Canada	1699	1110	5	2.25	1.87	1	0	1.16	0.22
Denmark	517	82	2	2.31	1.87	0	1	0.68	1.03
Finland	743	658	3	2.49	2.02	0	1	2.70	0.24
France	2400	2084	3	1.41	1.36	0	1	1.13	0.40
Germany	2493	2119	1	1.67	1.84	0	1	0.73	0.62
Greece	758	176	2	0.84	0.66	0	1	1.42	0.00
Hong Kong	1061	89	5	1.43	1.44	1	0	3.76	0.18
Ireland	217	211	4	1.50	1.71	1	0	0.80	0.08
Italy	961	842	1	0.79	0.88	0	1	0.70	0.33
Japan	1103	0	4	1.28	1.66	0	1	0.82	0.47
The Netherlands	1078	950	2	2.30	1.89	0	1	1.81	0.47
New Zealand	45	34	4	2.31	1.89	1	0	0.45	·
Norway	657	91	4	2.07	1.90	0	1	0.39	0.20
Portugal	227	211	3	1.37	1.07	0	1	0.60	0.25
Singapore	840	654	4	2.44	1.91	1	0	1.93	0.18
Spain	678	586	4	1.62	1.29	0	1	0.84	0.15
Sweden	1146	116	3	2.43	1.87	0	1	1.47	0.43
Switzerland	940	863	2	2.17	2.11	0	1	3.03	0.43
United Kingdom	3003	2686	5	2.10	1.80	1	0	1.93	0.20
United States	14,419	12,234	5	1.73	1.79	1	0	1.64	1.02
Panel B: Emerging markets									
Argentina	156	145	4	−0.40	0.07	0	1	0.44	0.05
Brazil	540	382	3	−0.01	−0.21	0	1	0.38	0.09
Chile	478	78	5	1.50	1.23	0	1	0.86	0.17
China	917	0	·	−0.38	−0.42	0	1	0.42	0.09
Colombia	55	0	3	−0.51	−0.73	0	1	0.13	0.00
Czech Republic	65	0	·	0.39	0.51	0	1	0.21	0.07
Hungary	109	0	·	0.71	0.77	0	1	0.31	0.02
India	146	0	5	−0.31	0.15	1	0	0.37	0.00
Indonesia	636	0	2	−1.05	−1.03	0	1	0.28	0.01
Israel	186	89	3	1.11	0.96	1	0	0.56	·
Malaysia	1012	362	4	0.21	0.39	1	0	1.46	0.49
Mexico	655	181	1	−0.49	−0.45	0	1	0.24	0.02
Pakistan	55	0	5	−0.94	−0.75	1	0	0.09	·
Peru	107	77	3	−0.16	−0.60	0	1	0.23	0.04
Philippines	286	0	3	−0.53	−0.55	0	1	0.66	0.00
Poland	238	77	·	0.48	0.54	0	1	0.18	·
Russia	67	0	·	−1.04	−0.99	0	1	0.22	·
South Africa	191	52	5	0.49	0.15	1	0	1.77	0.09
South Korea	2534	0	2	0.33	0.52	0	1	0.56	0.40
Taiwan	2287	0	3	0.63	0.76	0	1	1.02	0.26
Thailand	1088	0	2	−0.37	0.30	1	0	0.36	0.12
Turkey	297	265	2	−0.36	−0.07	0	1	0.46	·

This table shows the number of firm-year observations (*N*) for the countries that are included in the main valuation regression (model 1) and the alternative specification that incorporates a target cash level (model 2). The table also presents the values of the indices for the year 2000 that are used to split the sample into subgroups based on country characteristics. The anti-director rights index measures the protection of shareholder rights, where higher index values indicate better protection of minority shareholder rights. The rule of law index and the corruption index both measure the quality of institutions that support the rights of investors. Firms in countries with lower or even negative index values operate under weaker corporate governance structures, and it is more difficult for investors to make use of their formal rights. A dummy variable indicates a country's law tradition (common law or civil law). All these measures are related to a country's overall quality of corporate governance. In order to measure financial constraints on a country-level, stock market capitalization to GDP (stock/GDP) is defined as the ratio of the market value of listed shares in a country to its gross domestic product. Private bond market capitalization to GDP (bond/GDP) is the ratio of a country's private domestic debt securities to its gross domestic product. A dot indicates that the value is not defined.

time periods.[5] To reduce the impact of outliers, we trim all variables at the 1% and the 99% tails. Finally, we exclude countries with fewer than 30 firm-year observations. In the most basic specification, our sample consists of 8661 firms with 48,240 firm-year observations from 45 countries. Table 1 contains a list of the countries contained in our sample together with descriptive statistics of the country-level variables. Panel B of Table 2 shows descriptive statistics of the firm-level variables that are used in our empirical models.

3.1.2. Measures of information asymmetry

In order to test the relationship between the value of cash and information asymmetry, a reliable proxy for information asymmetry is required. Based on Krishnaswami and Subramaniam (1999), we choose the dispersion of analysts' forecasts as our main proxy for information asymmetry.[6] This variable measures the standard deviation of earnings per share forecasts across analysts that cover

[5] This data restriction eliminates only about 1% of all firm-year observations from the sample. Most firms that drop out are from Japan, where the most popular fiscal year end is March 31. Our results are robust when these firms remain in the base sample.

[6] Krishnaswami and Subramaniam (1999) also discuss other proxy variables for information asymmetry, e.g., the volatility of abnormal returns around earnings announcements and the volatility of daily stock returns. While return volatility around earnings announcements is not a feasible measure of information asymmetry in a cross-country study, daily stock return volatility does not allow to distinguish between risk in a broader sense and the effect of information asymmetry.

Table 2
Descriptive statistics.

	N	p10	Mean	Median	p90	S.D.
Panel A: Dispersion measures						
Forecast dispersion (*DISPM*) on country-level						
Germany	1614	0.048	0.273	0.154	0.676	0.310
France	1837	0.042	0.202	0.115	0.450	0.255
Italy	757	0.069	0.241	0.165	0.525	0.238
United Kingdom	2267	0.023	0.129	0.060	0.266	0.214
United States	11,718	0.013	0.137	0.052	0.364	0.225
Canada	1302	0.037	0.275	0.156	0.716	0.316
Japan	658	0.033	0.197	0.116	0.503	0.237
Other developed markets	7706	0.044	0.214	0.129	0.477	0.252
All developed markets	27,859	0.019	0.179	0.091	0.446	0.250
Emerging markets	7017	0.070	0.285	0.192	0.627	0.285
All countries	34,876	0.022	0.202	0.112	0.487	0.261
Alternative measures for information asymmetry						
ERRORF	29,982	0.000	0.344	0.083	1.060	0.971
IA-INDEX	29,228	9.000	13.600	14.000	18.000	3.290
Panel B: Firm-level variables used in the main valuation regression						
V_t	48,240	0.504	1.250	0.945	2.310	1.010
dV_{t+1}	48,240	−0.394	0.159	0.042	0.795	0.885
E_t	48,240	−0.042	0.052	0.060	0.154	0.104
dE_t	48,240	−0.054	0.006	0.007	0.065	0.066
dE_{t+1}	48,240	−0.055	0.010	0.008	0.076	0.070
dNA_t	48,240	−0.120	0.062	0.052	0.280	0.185
dNA_{t+1}	48,240	−0.123	0.092	0.045	0.341	0.255
RD_t	48,240	0.000	0.016	0.000	0.053	0.042
dRD_t	48,240	−0.001	0.001	0.000	0.005	0.012
dRD_{t+1}	48,240	−0.001	0.001	0.000	0.006	0.012
I_t	48,240	0.002	0.020	0.016	0.043	0.019
dI_t	48,240	−0.008	0.001	0.000	0.010	0.010
dI_{t+1}	48,240	−0.008	0.001	0.000	0.011	0.011
D_t	48,240	0.000	0.018	0.008	0.048	0.027
dD_t	48,240	−0.010	0.002	0.000	0.016	0.020
dD_{t+1}	48,240	−0.011	0.003	0.000	0.019	0.023
C_t	48,240	0.009	0.126	0.073	0.314	0.148
dC_t	47,967	−0.065	0.005	0.002	0.082	0.082
dC_{t+1}	48,041	−0.065	0.012	0.002	0.091	0.094
Panel C: Firm-level variables used to measure the target cash level						
$\ln RealNA_t$	28,477	10.700	13.000	12.900	15.500	1.800
FCF_t	28,477	−0.078	0.015	0.034	0.118	0.149
NWC_t	28,477	−0.156	0.061	0.057	0.306	0.195
$VOLA_t$	28,477	0.055	0.125	0.106	0.221	0.073
$RD/SALES_t$	28,477	0.000	0.030	0.000	0.082	0.114
MV_t	28,477	0.864	2.338	13.100	2.780	1.070
$SALESG_t$	28,477	−7.510	40.072	9.230	46.300	34.100
$CAPEX_t$	28,477	0.016	0.074	0.055	0.154	0.068
$LEVERAGE_t$	28,477	0.014	0.249	0.237	0.477	0.179
$DIVDUMMY_t$	28,477	0.000	0.702	1.000	1.000	0.457

This table shows descriptive statistics of the model variables: number of observations (*N*), 10% and 90% percentiles, mean, median, and standard deviation (S.D.). Panel A describes the main proxy for information asymmetry, denoted as *DISPM*, on a country-level. *DISPM* measures the scaled dispersion (standard deviation) of 1-year analysts' earnings per share forecasts provided by I/B/E/S. A higher value of *DISPM* indicates more pronounced information asymmetry. As an alternative measure of information asymmetry, *ERRORF* denotes the difference between actual and forecasted earnings per share, scaled by the median earnings per share forecast. *IA-INDEX* is a comprehensive index of information asymmetry based on the various dimensions of the concept. In addition to *ERRORF*, this index is based on quintile rankings of firm size, R&D expenditure, Tobin's Q, and the number of analysts following the firm in a given year. The index values range from 5 (lowest information asymmetry) to 25 (highest information asymmetry). Panel B shows the variables that enter the main valuation regression in Eq. (4). The data set covers the period from 1995 to 2005. All firms from the different countries are included for which I/B/E/S provides analysts' forecasts and for which company data is available from Worldscope (except financial firms and utilities). The main proxy for information asymmetry, *DISPM*, is based on the standard deviation of analysts' earnings per share forecasts (analysts' forecasts dispersion), and this measure can only be computed when the forecasts are at least based on two analysts. A firm is omitted from the sample if *DISPM* cannot be calculated in at least one sample year, i.e., if this firm is not covered by at least two analysts in at least one sample year. All variables are trimmed at the 1% and the 99% tails. V_t denotes the total market value of the firm (market value of equity plus book value of debt); E_t is earnings before interest and extraordinary items (after depreciation and taxes); NA_t is net assets (book value of total assets minus cash); RD_t is research and development (R&D) expenditure; I_t is interest expense; D_t is total dividends paid; and C_t is cash holdings in year t. $dX_t = X_t - X_{t-1}$ denotes the past 1-year change of variable X_t, and $dX_{t+1} = X_{t+1} - X_t$ is the future 1-year change of variable X_t. All variables are scaled by total assets (A_t). Panel C shows the variables that are used to compute the target cash level (and hence excess cash) in the alternative specification of the valuation regression in Eq. (6). $\ln RealNA_t$ is the natural logarithm of net assets (book value of total assets minus cash) in US dollar terms for the year 2000; FCF_t is operating income after interest and taxes; NWC_t is working capital minus cash; $VOLA_t$ is the standard deviation of a firm's monthly stock returns over the prior 12 months; MV_t is the market value of the firm, computed as the number of shares outstanding times share price plus total liabilities; $SALESG_t$ is sales growth; $CAPEX_t$ is capital expenditure; and $LEVERAGE_t$ is total debt (interest bearing) divided by total assets. All variables are scaled as shown in the cash target model in Eq. (5). $DIVDUM_t$ denotes a dividend dummy variable, which is set equal to one if the firm paid dividends or engaged in share repurchases, and zero otherwise.

a firm. Greater disagreement among analysts indicates a higher level of information asymmetry. Supporting this notion, Diether et al. (2002) observe a negative relationship between the dispersion of analysts' forecasts and subsequent stock returns. They argue that the dispersion of analysts' forecasts is not merely a proxy for risk but rather a metric for differences of opinion. D'Mello and Ferris

(2000) report stronger announcement effects for firms whose forecasts exhibit higher dispersion, also suggesting that analysts' dispersion captures information asymmetry. Finally, Autore and Kovacs (2010) document that firms avoid to raise external funds in states with a high dispersion of analysts' forecasts.

To compute the dispersion of analysts' forecasts, we use 1-year consensus forecasts of the earnings per share provided by I/B/E/S. The dispersion of these forecasts (defined as the firm-level standard deviation of all forecasts across covering analysts) is not updated in each month for every firm. If we took the data only for one specific month, we would lose all firm-year observations for which no (updated) estimate for this particular month is available. Therefore, we calculate the average of the monthly dispersions in each year. In order to make this measure comparable across firms, the standard deviation of forecasts needs to be scaled. As our dependent variable (the firm value) is related to the stock price, we scale by the median forecast rather than the stock price in order to avoid an endogeneity problem. By adding one and taking the natural logarithm, our measure converges to a normal distribution. Therefore, our main proxy for information asymmetry, denoted as *DISPM*, is:

$$DISPM = \ln\left(1 + \frac{Standard\ deviation\ of\ analysts'\ forecasts}{|Median\ forecast|}\right), \quad (1)$$

where the standard deviation is the mean of the monthly standard deviations taken over the entire year. A more detailed version of this formula is presented in the Appendix. A caveat with this variable is that there could be systematic differences in the level of dispersion across countries. Harford et al. (2008) argue that country-effects (e.g., their legal settings and transparency standards) in international studies may dominate firm-level limitations on shareholder rights. For example, in our setup high asymmetric information levels in the United States or the United Kingdom could be similar to low levels of information asymmetry in countries with poor shareholder rights or high corruption. Panel A of Table 2 presents descriptive statistics of the variable *DISPM* for different countries. The most important observation is that mean dispersion is higher in emerging stock markets compared to developed stock markets. However, there are even large differences across G-7 countries, with mean dispersion being very high in Germany and Italy and the lowest in the United States and the United Kingdom. These findings seem consistent with Capstaff et al. (2001), who argue that differences in the performance of analysts' forecasts are due to differences in earnings behavior, accounting practices, and influences of securities markets. In their European sample, analysts' forecasts are most accurate in the United Kingdom and least accurate in Italy. The high mean dispersion in Germany could be consistent with the findings in Bessler and Stanzel (2009). They document that equity research in a universal banking system suffers from particularly pronounced conflicts of interest. More generally, Harford et al. (2008) argue that country-level effects dominate firm-level effects in international corporate governance studies. Therefore, to account for potential biases that may result from country-level effects in our analysis, we construct a dummy variable which takes the value of one (high information asymmetry) if a firm exhibits a value of *DISPM* above its country median in a given year or if the firm is not covered by at least two analysts, and hence we cannot compute *DISPM*, and zero (low information asymmetry) otherwise. This variable is denoted as *DISPM-DUMMY*. When there are few or no analysts following a firm, then little information is generated, and hence the level of information asymmetry is high (Chang et al., 2006). Therefore, an appealing property of the *DISPM-DUMMY* variable is that it exploits the full sample of 48,240 firm-year observations rather than the 34,876 firm-year observations for which we are able to compute our dispersion measure.

As another robustness test, we follow Cai et al. (2009) and use a comprehensive measure by constructing an index of information asymmetry based on the various dimensions of the concept. For example, Krishnaswami and Subramaniam (1999) suggest the error in analysts' forecasts, defined as the difference between the mean forecast and the actual earnings per share, as a measure of information asymmetry. In addition, the empirical literature has introduced various simpler measures of information asymmetry. For example, information asymmetry tends to decrease with firm size (Vermaelen, 1981), increase with R&D expenditure (Aboody and Lev, 2000), increase with growth opportunity (Smith and Watts, 1992) and decrease with analyst coverage (Krishnaswami and Subramaniam, 1999). Although these measures might be partially correlated, each contains unique information. Specifically, our information asymmetry index is based on the rankings of the error in analysts' forecasts, firm size, R&D expenditure, Tobin's Q, and the number of analysts following a firm:

Error in analysts' forecasts: Elton et al. (1984) provide evidence that most of the forecast error in the last month of the fiscal year can be explained by misestimation of firm-specific factors rather than by misestimation of economy-wide or industry factors. We use the following measure of the error in analysts' forecasts:

$$ERRORF = \ln\left(1 + \frac{|EPS_{Forecast} - EPS_{Actual}|}{|Median\ EPS|}\right), \quad (2)$$

where the forecast of earnings per share, labeled $EPS_{Forecast}$, is the average of all forecasts for a firm provided by analysts in November and December of the previous year. The difference between actual and forecasted earnings per share is scaled by the median earnings per share forecast.

Firm size: Large firms may face less information asymmetry because they tend to be more mature, have established disclosure policies, and receive more attention from the market (Diamond and Verrecchia, 1991; Ozkan and Ozkan, 2004). We use total assets to measure firm size.

R&D expenditure: Analyzing insider trading gains in firms with high and low R&D expenses, Aboody and Lev (2000) argue that R&D is related to information asymmetry. In order to measure a firm's R&D intensity, we use a dummy variable that takes the value of one if the firm reports R&D expenses, and zero if they are zero or missing.

Tobin's Q: Information asymmetry is more severe for firms with significant growth opportunities (Smith and Watts, 1992). Therefore, proxies for firms' investment opportunities have been used to measure information asymmetry (McLaughlin et al., 1998). We use Tobin's Q to measure growth opportunities, computed as book value of assets minus book value of equity plus market value of equity divided by book value of assets.

Number of analysts following the firm: The number of analysts is another proxy for the supply of information about a firm. Presumably, the more analysts follow a firm, the more information is discovered and revealed to the public, and hence asymmetric information is limited (Chang et al., 2006). Brennan and Subrahmanyam (1995) argue that greater analyst coverage tends to reduce the adverse selection costs as measured by the inverse of market depth.

In order to construct the information asymmetry index, denoted as *IA-INDEX*, we first calculate a firm's quintile ranking over all firms for each dimension of information asymmetry in a given year. A higher score indicates a greater degree of information asymmetry. For example, a firm receives a score of 5 (1) if it belongs to the 20% smallest (largest) firms in a given year. We then

add up the ranks along all five dimensions of information asymmetry.[7] Therefore, the largest (smallest) value the variable *IA-INDEX* can take is 25 (5) for the firms with the highest (lowest) degree of information asymmetry. Panel A of Table 2 shows descriptive statistics of this information asymmetry index.

3.1.3. Sample splits

We divide our sample into several subgroups to test whether financial constraints and corporate governance structures have an impact on how information asymmetry influences the value of cash. This approach allows us to differentiate between Hypothesis 1 (related to costly external finance due to adverse selection) and Hypothesis 2 (related to the free cash flow problem).

In order to investigate the influence of financial constraints, we use two measures at the country-level (stock market capitalization to GDP and private bond market capitalization to GDP) and one variable at the firm-level (firm size) to split the sample. Specifically, stock market capitalization to GDP is the ratio of the market value of listed shares in a country to its gross domestic product. Private bond market capitalization to GDP is the ratio of a country's private domestic debt securities (issued by financial institutions and corporations) to its gross domestic product. Countries with higher ratios tend to have more developed capital markets, where firms have better access to capital and are less constrained. Both ratios of the stock market capitalization to GDP and the private bond market capitalization to GDP are taken from the website of Ross Levine.[8] According to Almeida et al. (2004), small firms also tend to be constrained. Therefore, in addition to the country-level measures, we use firm size as a firm-level variable to split the sample; it is measured by the firm's equity market capitalization.

In order to investigate the influence of corporate governance, we use four measures at the country-level (anti-director rights index, rule of law index, corruption index, and legal system classification) and one variable at the firm-level (percentage of closely held shares) to split the sample. The three country-level indices are related to the two components of investor protection. The first is a legal component, where investors are granted legal rights, and the second is an enforcement component, where the quality of a country's institutions determines the extent to which these rights are respected and enforced. The anti-director rights index is a measure of shareholder protection. It consists of six components, of which three are concerned with shareholder voting (voting by mail, voting without blocking of shares, and calling an extraordinary meeting), and three with minority protection (proportional board representation, preemptive rights to new issues, and judicial remedies). Depending on the fulfillment of these criteria, the index ranges from zero to six, where higher index values indicate better protection of minority shareholder rights. The anti-director rights index is provided on the website of Rafael La Porta.[9] The rule of law index and the corruption index both measure the quality of institutions that support the rights of investors. The rule of law index captures the extent to which agents have confidence in the rules of society, the quality of contract enforcement, and the courts. The corruption index measures the extent to which public power is used to extract private gains. Index levels range from negative to positive, where firms in countries with lower or even negative index values generally operate under weaker corporate governance structures, and it is more difficult for investors to make use of their formal rights. The rule-of-law index and the corruption index are constructed by the Worldbank. In addition, La Porta et al. (1998) document that in common law countries minority shareholders are better protected against expropriation by insiders compared to civil law countries. The legal system classification is again provided on the website of Rafael La Porta. Finally, to mitigate the problems associated with managerial opportunism, Jensen and Meckling (1976) suggest that firms increase managerial equity ownership. Therefore, in addition to the country-level measures, we use the percentage of closely held shares as a firm-level variable to split the sample. Following Morck et al. (1988) and Opler et al. (1999), we choose three cut-off levels for ownership of corporate insiders: 0–5%, 5–25%, and 25% or more.

In our main model specification, we use median-splits (where applicable) of our sample based on data for the year 2000, which is the year in the middle of our sample period. In robustness tests, we also use different years at the beginning and the end of the sample period to split the sample. A limitation of our analysis is that there is not always a clear-cut distinction between the variables that are used to split the sample according to the corporate governance structure and those that are used to classify firms as financially constrained. The legal system is used as a proxy for the quality of corporate governance. Civil law countries generally have narrower capital markets than common law countries (La Porta et al., 1998), and hence the legal system could also be associated with the degree of financial constraints.

3.2. Empirical methodology

While our study is, to the best of our knowledge, the first that investigates the influence of information asymmetry on the value of cash, it is not the first one that analyzes the value of cash in different settings. Fama and French (1998) study the impact of debt and dividends on firm value. Pinkowitz et al. (2006) and Dittmar and Mahrt-Smith (2007) modify their valuation model to estimate the marginal value of cash. Both studies put the emphasis on the relationship between cash and corporate governance. In our main regression specification, we extend the model of Pinkowitz et al. (2006) to test the impact of information asymmetry on the value of cash. In order to check the robustness of our results, we also build on the approach of Dittmar and Mahrt-Smith (2007).[10] This section describes these two methods and shows how we modify them to estimate the relationship between the market value of cash and firm-specific and time-varying information asymmetry.

3.2.1. Main valuation regression

The starting point is the valuation model in Fama and French (1998), who examine the influence of debt and dividends on firm value. To estimate the value of cash, Pinkowitz et al. (2006) adapt their framework. Most important, they split up the changes in assets into its cash and non-cash components. To estimate the relationship between market value and cash holdings, they use the following valuation model:

$$\begin{aligned} V_t = {} & \alpha + \beta_1 E_t + \beta_2 dE_t + \beta_3 dE_{t+1} + \beta_4 dNA_t + \beta_5 dNA_{t+1} + \beta_6 RD_t \\ & + \beta_7 dRD_t + \beta_8 dRD_{t+1} + \beta_9 I_t + \beta_{10} dI_t + \beta_{11} dI_{t+1} + \beta_{12} D_t \\ & + \beta_{13} dD_t + \beta_{14} dD_{t+1} + \beta_{15} dV_{t+1} + \beta_{16} C_t + \varepsilon_t, \end{aligned} \tag{3}$$

where V_t denotes the total market value of the firm (market value of equity plus book value of debt); E_t is earnings before interest and extraordinary items (after depreciation and taxes); NA_t is net assets

[7] This procedure follows Peyer and Vermaelen (2009), who construct an undervaluation index to examine the motives for share repurchases. They argue that the rule of equally weighting the characteristics is arbitrary. However, the idea is to test whether the correlation between the factors leads to a significant improvement in identifying firms with high information asymmetry by taking into account some potential for cross-correlation.

[8] See http://www.econ.brown.edu/fac/Ross_Levine/Publications.html.

[9] See http://www.mba.tuck.dartmouth.edu/pages/faculty/rafael.laporta/publications.html and La Porta et al. (1998).

[10] Another approach to estimate the value of cash (not used in this study) is the method of Faulkeneder and Wang (2006). They regress the cash ratio (in levels and differences) on excess stock returns.

(book value of total assets minus cash); RD_t is research and development (R&D) expenditure; I_t is interest expense; D_t is total dividends paid; and C_t is cash holdings at time t. $dX_t = X_t - X_{t-1}$ denotes the past 1-year change of variable X_t, and $dX_{t+1} = X_{t+1} - X_t$ is the future 1-year change of variable X_t. All variables are scaled by total assets (A_t). The dependent variable is the spread of value over cost. The control variables (in levels and differences) are included into the model to capture expectations about future earnings and other effects that potentially influence the value of the firm.[11] The most important coefficient is β_{16} on the level of cash, which measures the sensitivity of firm value to a one-dollar increase in cash holdings. Assuming that the impact of a change in cash on future cash flows is measured by the lead variables that capture investors' expectations, the coefficient on cash holdings is an estimate of the market value of a marginal dollar of cash.

As specified in our hypotheses, we are ultimately interested in the value of cash in connection with firm-specific and time-varying information asymmetry. In order to measure this dynamic effect, an additional interaction term is included into the valuation model. This variable is calculated by multiplying the cash level ($C_{i,t}$) by the dispersion of analysts' earnings forecasts ($DISPM_{i,t}$). Dispersion itself is also used as an explanatory variable to control for a direct influence of information asymmetry on firm value. We use a fixed effects estimator to focus on the within-dimension of the data. To control for macroeconomic effects, we also include time dummy variables into the model. This results in our main testable model:

$$\begin{aligned} V_{i,t} = {} & \alpha + \beta_1 E_{i,t} + \beta_2 dE_{i,t} + \beta_3 dE_{i,t+1} + \beta_4 dNA_{i,t} + \beta_5 dNA_{i,t+1} \\ & + \beta_6 RD_{i,t} + \beta_7 dRD_{i,t} + \beta_8 dRD_{i,t+1} + \beta_9 I_{i,t} + \beta_{10} dI_{i,t} \\ & + \beta_{11} dI_{i,t+1} \beta_{12} D_{i,t} + \beta_{13} dD_{i,t} + \beta_{14} dD_{i,t+1} + \beta_{15} dV_{i,t+1} \\ & + \beta_{16} C_{i,t} + \beta_{17} (C \times DISPM)_{i,t} + \beta_{18} DISPM_{i,t} + \alpha_i + \mu_t \\ & + \varepsilon_{i,t}, \end{aligned} \tag{4}$$

where α_i and μ_t denote entity- and time-fixed effects. The coefficient of interest in our main valuation regression is β_{17}. This coefficient on the interaction term measures the market value of a marginal dollar of cash in connection with firm-specific and time-varying information asymmetry. While a positive coefficient would support Hypothesis 1 (related to the pecking order theory), a negative one would support Hypothesis 2 (related to the free-cash flow theory).

Statistical inference of the model is based on Driscoll and Kraay (1998) standard errors. Höchle (2007) documents that these standard errors are robust to very general forms of cross-sectional and temporal dependence. Alternatively, we also estimate the model using the Fama–MacBeth approach. While this latter method is commonly used in the empirical corporate finance literature, Petersen (2009) forcefully shows that it cannot control for cross-sectional dependence. The reduced model in Eq. (3) exploits the full sample of 48,240 firm-year observations. As firm-year observations for which *DISPM* is not defined drop out of the sample, the number of firm-year observations decreases to 34,876 in the model in Eq. (4) that includes the interaction term. Panel B of Table 2 presents the descriptive statistics of all model variables. The values are similar to those in Pinkowitz et al. (2006).

3.2.2. An alternative specification: Incorporating the target cash level

As a robustness test, we estimate an extended version of the model in Dittmar and Mahrt-Smith (2007). Instead of the actual cash level, they use the level of excess cash as the independent variable. Therefore, we follow Opler et al. (1999) and predict the normal level of cash that is needed for operations or investments. In order to control for the transaction costs motive in the estimation of the target cash level, we include net assets (total assets minus cash), net working capital, and a proxy for cash flow volatility. In addition, in order to account for the precautionary motive (Myers and Majluf, 1984), we use investment opportunities (market-to-book ratio), cash flow, and access to external capital as measured by firm size (book value of assets in US dollars terms for the year 2000). As suggested by Dittmar and Mahrt-Smith (2007), an endogeneity problem occurs if the raw market-to-book ratio is used to predict the normal or target level of cash in order to calculate excess cash, and excess cash is then taken to predict the market-to-book ratio. They instrument the market-to-book ratio with past sales growth (*SALESG*) and use this instrumented market-to-book ratio to predict cash holdings. We instrument the market-to-book ratio using the average of last year's and current year's sales growth. Following Opler et al. (1999), we also include capital expenditures, leverage, and a dividend dummy variable. The regression model to estimate the normal level of cash is:

$$\begin{aligned} \ln\left(\frac{C_t}{NA_t}\right) = {} & \alpha + \beta_1 \ln(RealNA_t) + \beta_2 \frac{FCF_t}{NA_t} + \beta_3 \frac{NWC_t}{NA_t} + \beta_4 VOLA_t \\ & + \beta_5 \frac{\widehat{MV}_t}{TA_t} + \beta_6 \frac{RD_t}{SALES_t} + \beta_7 \frac{CAPEX_t}{NA_t} + \beta_8 \frac{DEBT_t}{TA_t} \\ & + \beta_9 DIVDUM_t + SECTDUM + \alpha_i + \varepsilon_t, \end{aligned} \tag{5}$$

where NA_t is net assets (book value of total assets minus cash); $\ln(RealNA_t)$ is the natural logarithm of net assets in US dollar terms for the year 2000; FCF_t is operating income after interest and taxes; NWC_t is working capital minus cash; $VOLA_t$ is the standard deviation of a firm's monthly stock returns over the prior 12 months; $\widehat{MV}_t$ is the market value of the firm, computed as the number of shares outstanding times share price plus total liabilities (instrumented with the average of last year's and current year's sales growth, $SALESG_t$); $CAPEX_t$ is capital expenditure; and $DEBT_t$ is total (interest bearing) debt. $DIVDUM_t$ denotes a dividend dummy variable, which is set equal to one if a firm paid dividends or engaged in share repurchases, and zero in all other cases. *SECTDUM* denotes sector dummy variables.[12] The predictive regression is estimated using a fixed effects approach, where α_i denotes entity-fixed effects. Because firms from different countries will have different reasons to hold cash (e.g., due to legal differences that require cash buffers against adverse events), we follow Fresard and Salva (forthcoming) and estimate the target cash level independently for each country in our sample. The residual from these regressions, i.e., the difference between the actual and the exponential of the predicted log cash level, is defined as excess cash and labeled *EXCASH*. This variable is used to calculate the market value of excess cash in connection with firm-specific and time-varying information asymmetry:

$$\begin{aligned} V_{i,t} = {} & \alpha + \beta_1 E_{i,t} + \beta_2 dE_{i,t} + \beta_3 dE_{i,t+1} + \beta_4 dNA_{i,t} + \beta_5 dNA_{i,t+1} \\ & + \beta_6 RD_{i,t} + \beta_7 dRD_{i,t} + \beta_8 dRD_{i,t+1} + \beta_9 I_{i,t} + \beta_{10} dI_{i,t} \\ & + \beta_{11} dI_{i,t+1} + \beta_{12} D_{i,t} + \beta_{13} dD_{i,t} + \beta_{14} dD_{i,t+1} + \beta_{15} dV_{i,t+1} \\ & + \beta_{16} EXCASH_{i,t} + \beta_{17} (EXCASH \times DISPM)_{i,t} + \beta_{18} DISPM_{i,t} \\ & + \alpha_i + \mu_t + \varepsilon_{i,t}, \end{aligned} \tag{6}$$

where α_i and μ_t again denote entity- and time-fixed effects. Following Dittmar and Mahrt-Smith (2007), all variables are scaled by net assets, and the regression is estimated for positive values of excess cash using fixed effects and Driscoll and Kraay (1998) standard errors. Again, the main coefficient of interest is β_{17}. A positive

[11] In an alternative setting, Pinkowitz et al. (2006) use changes of cash instead of the cash level. However, they note that an increase in cash holdings could also lead to changes in expectations about future growth.

[12] There is some variance in the within dimension of the sample firms' sector classification, and hence *SECTDUM* does not drop out in a fixed effects regression. Our results are robust when we exclude the sector dummy variables.

coefficient on the interaction term supports Hypothesis 1 (related to the pecking order theory), and a negative one supports Hypothesis 2 (related to the free-cash flow theory).

We use the alternative model in Eq. (6) only as a robustness test of our main valuation regression in Eq. (4) for two reasons. First, Hypothesis 1 is based on the pecking order theory. In a strict pecking order world, there is no optimal level of cash. However, this alternative approach requires calculating excess cash as the deviation from a normal cash level. Excess cash encompasses the components of cash that cannot be directly related to operational needs or investment opportunities. It refers to the amount of cash holdings that can neither be justified based on the transaction cost motive nor on the precautionary motive. One would expect that it is held for discretionary purposes and is especially prone to managerial squandering. Therefore, excess cash may be strongly related to Jensen's (1986) free cash flow hypothesis, making it more difficult to disentangle our two opposing hypotheses. Second, the calculation of excess cash requires variables that are not available for all firms, thereby reducing our sample size. Due to data availability in the estimation of the normal cash level, our sample reduces to 28,477 firm-year observations (and even further in the interaction model). To save space, descriptive statistics of this reduced sample are omitted. The values are in line with those reported in Dittmar and Mahrt-Smith (2007). Panel C of Table 2 shows descriptive statistics of the variables used to predict target cash levels.

4. Empirical tests of the hypotheses

4.1. Main empirical results

Table 3 presents the results of our reduced valuation regression in Eq. (3) without information asymmetry. These results provide the basis for a comparison with previous studies that do not incorporate the influence of information asymmetry. The main coefficients of interest in Table 3 are those on cash (C_t) and on changes in cash (dC_t). We focus on the fixed effects model that includes the level of cash as an explanatory variable. Using all firms in the sample, the estimated coefficient on cash in Panel A is 0.661; it is highly significant and can be interpreted as the market value of an additional dollar of cash. One reason why the market value of a dollar of cash is below one could be the impact of taxes on payouts (in particular, for firms with few investment opportunities). The comparable coefficient in Pinkowitz and Williamson (2004) is 1.05, but they only analyze a US sample. Pinkowitz et al. (2006) use international data, but they only report the corresponding coefficient for subgroups based on country characteristics rather than for their whole sample. Moreover, they only apply the Fama–MacBeth approach. Depending on the subgroup, they report coefficients that range between −0.03 and 1.24.[13] Overall, our estimated coefficients fall into this range, although they are higher (and well above one) in the Fama–MacBeth approach.

Continuing with the results in Panel A, most other coefficients have the expected signs, and many are similar in magnitude to those in Pinkowitz and Williamson (2004) and Pinkowitz et al. (2006). Nevertheless, there are several differences. For example, Pinkowitz and Williamson (2004) present a positive coefficient on the earnings variable (E_t) in the Fama–MacBeth model compared to a negative one in the fixed effects specification. In contrast, we report positive coefficients in both specifications. Another observation is that the coefficient on earnings changes (dE_t) is negative in the fixed effects model and positive when the Fama–MacBeth approach is used. However, only the positive coefficient is statistically significant. An explanation is that the Fama–MacBeth approach cannot control for firm-fixed effects.

Panels B and C of Table 3 presents the results for subsamples of firms from developed stock markets and emerging stock markets. Presumably, firms from the latter subgroup suffer from poor investor protection and generally lower corporate governance standards. In line with expectations, the coefficients on C_t and dC_t are lower for firms in emerging markets than in developed markets. This supports the notion in Pinkowitz et al. (2006) that cash is worth less in countries with a low level of development because these countries suffer from poor investor protection.[14]

The main research question of our analysis is to assess whether the impact of firm-specific and time-varying information asymmetry on the market value of a dollar of cash is positive or negative. Panel A of Table 4 presents the results of our main valuation regression in Eq. (4) that includes the dispersion of analysts' earnings forecasts (*DISPM*), a measure of firm-specific and time-varying information asymmetry, and its interaction term with cash holdings. The most important observation is that the coefficient on the interaction term is significantly negative. We interpret this result as support for Hypothesis 2, suggesting that cash holdings have less value for a firm in states with a high degree of information asymmetry. The free cash flow problem seems to be more relevant for cash holdings in connection with information asymmetry than the advantage of having a liquidity reserve in states when the adverse selection costs of raising external funds are prohibitive. In order to examine whether this negative effect of information asymmetry on liquidity is also economically significant, we calculate the marginal value of cash conditional on the level of information asymmetry. Including an interaction term into the analysis, the market value of an additional dollar of cash is:

$$\frac{V}{A} = \alpha + \cdots + \beta_{16}\frac{C}{A} + \beta_{17}\left(\frac{C}{A} \times DISPM\right) + \beta_{18}DISPM, \tag{7}$$

$$\frac{\partial \frac{V}{A}}{\partial \frac{C}{A}} = \frac{\partial V}{\partial C} = \beta_{16} + \beta_{17}DISPM. \tag{8}$$

Considering the results of the fixed effects model, the coefficient on cash is 0.786 and that on the interaction term is −0.465. Based on the median value of *DISPM* (0.112; Panel A of Table 2), the market value of an additional dollar of cash is 0.734 (= 0.786 − 0.465× 0.112). An increase in *DISPM* by one standard deviation (0.261; Panel A of Table 2) results in a marginal value of cash that is 0.121 dollar (or 16.5%) lower, and hence the market value of an additional dollar of cash decreases to 0.613. Accordingly, the negative effect of information asymmetry on the market value of cash is also economically significant.

Our results are confirmed when we use *DISPM-DUMMY* and *IA-INDEX* as alternative proxy variables for information asymmetry; the former accounts for biases that result from country-level effects of information asymmetry, and the latter serves as a comprehensive measure of information asymmetry along several dimensions of the concept. As shown in Panels B and C of Table 4, the coefficient on the interaction term is significantly negative in all specifications involving these two alternative measures. This result again supports Hypothesis 2, which posits that cash is less valuable in states with a high degree of information uncertainty. For example, the coefficient on the interaction term in the fixed effects model using *DISPM-DUMMY* indicates that being a high information asymmetry firm lowers the market value of the marginal dollar of cash by roughly 25 cents to 0.583 (= 0.827 − 0.244). In the spirit of Harford et al. (2008), this finding suggests that we do not simply capture country-level effects of granting and enforcing shareholder rights but also the effect of firm-level variation in

[13] See Pinkowitz et al. (2006, Table V, p. 2742f).

[14] We analyze the impact of investor protection in our sample splits in Table 5.

Table 3
Estimated value of cash without information asymmetry.

	Panel A: All countries				Panel B: Developed markets				Panel C: Emerging markets			
	Fixed effects		Fama–MacBeth		Fixed effects		Fama–MacBeth		Fixed effects		Fama–MacBeth	
	Level	Diff.	Level	Diff.	Level	Diff.	Level	Diff.	Level	Diff.	Level	Diff.
E_t	2.782***	2.596***	1.460***	1.050***	2.916***	2.708***	1.524***	0.891***	2.140***	1.943***	2.242***	2.081***
	(30.07)	(18.20)	(9.45)	(6.36)	(29.95)	(18.57)	(9.53)	(4.82)	(11.65)	(10.53)	(4.67)	(4.33)
dE_t	−0.070	−0.141***	0.851***	0.798***	−0.041	−0.108*	0.911***	0.943***	−0.111	−0.143**	−0.109	−0.219
	(−1.17)	(−3.13)	(4.63)	(4.42)	(−0.53)	(−1.76)	(4.36)	(4.36)	(−1.44)	(−2.18)	(−0.39)	(−0.75)
dE_{t+1}	1.631***	1.437***	1.598***	1.280***	1.739***	1.538***	1.752***	1.354***	1.253***	1.087***	1.031***	0.832***
	(34.90)	(27.63)	(10.20)	(10.09)	(19.69)	(17.02)	(9.23)	(8.12)	(13.29)	(10.86)	(5.69)	(5.45)
dNA_t	0.312***	0.292***	0.760***	0.665***	0.413***	0.380***	0.975***	0.862***	−0.018	−0.009	0.119**	0.096**
	(13.63)	(14.97)	(8.40)	(7.91)	(13.25)	(12.54)	(9.19)	(8.81)	(−1.02)	(−0.44)	(2.47)	(2.32)
dNA_{t+1}	0.573***	0.636***	0.467***	0.555***	0.595***	0.675***	0.483***	0.599***	0.483***	0.514***	0.357***	0.397***
	(8.61)	(10.28)	(4.91)	(5.40)	(7.61)	(9.55)	(4.77)	(5.41)	(11.38)	(12.12)	(4.60)	(5.30)
RD_t	3.590***	3.391***	5.295***	7.005***	3.706***	3.497***	4.773***	6.683***	−1.342	−1.105	10.508***	10.927***
	(15.02)	(10.20)	(14.93)	(14.26)	(14.98)	(10.54)	(14.18)	(13.72)	(−1.03)	(−0.81)	(4.97)	(5.36)
dRD_t	1.345***	1.251***	3.011***	2.995**	1.270***	1.199***	2.937**	3.005**	2.824***	2.709***	0.573	0.088
	(3.95)	(4.78)	(3.35)	(3.05)	(3.57)	(4.23)	(3.22)	(2.90)	(4.14)	(3.82)	(0.25)	(0.04)
dRD_{t+1}	5.629***	4.880***	8.561***	9.233***	5.519***	4.755***	7.949***	8.837***	3.128***	2.788***	11.568***	11.256***
	(14.01)	(26.53)	(9.18)	(11.76)	(13.53)	(20.61)	(8.46)	(11.05)	(3.39)	(2.67)	(6.00)	(6.43)
I_t	−0.351	−0.968***	1.159*	−1.708**	−0.122	−1.631**	3.586***	−1.184*	−0.703	−0.573	−0.744	−1.019
	(−1.46)	(−4.03)	(1.95)	(−2.54)	(−0.17)	(−2.29)	(7.78)	(−1.96)	(−0.98)	(−0.78)	(−0.76)	(−1.01)
dI_t	−0.964***	−0.876***	−0.688	−0.034	−1.963***	−1.681***	−1.793	−1.040	−0.457	−0.474	0.023	0.280
	(−2.71)	(−2.79)	(−0.65)	(−0.05)	(−4.24)	(−3.18)	(−1.51)	(−0.84)	(−0.59)	(−0.61)	(0.03)	(0.39)
dI_{t+1}	−2.681***	−3.445***	−2.617**	−4.251***	−3.988***	−5.350***	−3.234**	−6.108***	−1.452***	−1.628***	−1.076	−1.342
	(−10.01)	(−13.51)	(−3.07)	(−4.86)	(−4.52)	(−6.47)	(−2.64)	(−4.37)	(−3.69)	(−3.61)	(−1.24)	(−1.47)
D_t	1.214***	1.991***	7.236***	7.976***	1.305***	2.115***	7.521***	8.100***	0.910**	1.391***	6.078***	6.862***
	(3.07)	(5.63)	(28.06)	(31.19)	(3.01)	(5.97)	(22.74)	(30.04)	(2.04)	(3.18)	(6.16)	(7.55)
dD_t	−0.338*	−0.375**	−2.248***	−1.871***	−0.322	−0.345	−2.129***	−1.618***	−0.025	−0.084	−1.920**	−1.894**
	(−1.93)	(−2.32)	(−5.52)	(−4.37)	(−1.35)	(−1.63)	(−4.89)	(−3.62)	(−0.10)	(−0.39)	(−3.21)	(−3.23)
dD_{t+1}	0.659***	0.969***	2.921***	3.664***	0.840***	1.164***	3.318***	4.094***	0.400**	0.615***	2.260**	2.709***
	(5.38)	(9.21)	(9.51)	(10.58)	(7.13)	(12.69)	(11.93)	(12.31)	(2.40)	(3.78)	(3.15)	(3.71)
dV_{t+1}	−0.244***	−0.286***	−0.125	−0.169	−0.234***	−0.281***	−0.115	−0.163	−0.304***	−0.327***	−0.201*	−0.252*
	(−5.97)	(−6.33)	(−1.31)	(−1.61)	(−5.62)	(−6.04)	(−1.24)	(−1.54)	(−6.78)	(−6.81)	(−1.84)	(−2.04)
C_t	0.661***		1.792***		0.821***		2.098***		0.172**		0.611***	
	(6.11)		(10.05)		(6.69)		(10.09)		(2.39)		(8.89)	
dC_t		0.744***		1.238***		0.860***		1.432***		0.288***		0.550***
		(15.92)		(5.15)		(15.22)		(4.78)		(5.07)		(4.09)
dC_{t+1}		0.962***		1.093***		1.092***		1.225***		0.555***		0.710***
		(8.17)		(4.62)		(8.05)		(4.63)		(8.39)		(5.86)
Const.	0.832***	1.026***	0.566***	0.796***	0.866***	0.970***	0.515***	0.821***	1.090***	1.069***	0.648***	0.698***
	(33.40)	(78.95)	(44.99)	(29.72)	(43.98)	(90.94)	(27.86)	(31.71)	(54.17)	(60.62)	(13.17)	(13.82)
R^2	0.279	0.312	0.376	0.355	0.286	0.323	0.390	0.362	0.305	0.318	0.345	0.354
N	48,240	47,807	48,240	47,807	35,295	34,881	35,295	34,881	12,945	12,926	12,945	12,926
Groups	8661	8604	10	10	6404	6348	10	10	2264	2263	10	10

This table shows the estimation results of the reduced valuation regression in Eq. (3). The dependent variable in all specifications is the total market value of the firm (market value of equity plus book value of debt), denoted as V_t. E_t is earnings before interest and extraordinary items (after depreciation and taxes); NA_t is net assets (book value of total assets minus cash); RD_t is research and development (R&D) expenditure; I_t is interest expense; D_t is total dividends paid; and C_t is cash holdings in year t. $dX_t = X_t - X_{t-1}$ denotes the past 1-year change of variable X_t, and $dX_{t+1} = X_{t+1} - X_t$ is the future 1-year change of variable X_t. All variables are scaled by total assets (A_t). We estimate regressions using fixed effects and Driscoll and Kraay (1998) standard errors. Alternatively, we also estimate the model using the Fama–MacBeth approach, where each regression includes 10 cross-sections. Year dummy variables are included in all specifications. The data set covers the period from 1995 to 2005. All firms from the different countries are included for which I/B/E/S provides analysts' forecasts and for which company data is available from Worldscope (except financial firms and utilities). The main proxy for information asymmetry, *DISPM*, is based on the standard deviation of analysts' earnings per share forecasts (analysts' forecasts dispersion), and this measure can only be computed when the forecasts are at least based on two analysts. A firm is omitted from the sample if *DISPM* cannot be calculated in at least one sample year, i.e., if this firm is not covered by at least two analysts in at least one sample year. All variables are trimmed at the 1% and the 99% tails. t-values are presented in parentheses. The R^2 of the fixed effects regression refers to the within-dimension. The R^2 of the Fama–MacBeth regression is the average value of the R-squares of the single years.

* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

the control of agency conflicts.[15] In results not reported, we estimate a model where we omit all observations for *DISPM-DUMMY* if our dispersion measure *DISPM* cannot be computed due to lack of data. Presumably, this approach eliminates firms with the highest degree of information asymmetry from the sample. In fact, with this smaller sample of 34,876 firm-year observations the coefficient on the interaction term increases to −0.198, which implies a slightly higher market value of an additional dollar of cash in connection with high information asymmetry (albeit still with a large discount).

In order to control for the direct influence of information asymmetry on firm value, we also include *DISPM*, *DISPM-DUMMY*, and *IA-INDEX* in levels into the corresponding models. The coefficients are significantly negative in most specifications, suggesting that

[15] Based on the median value of *IA-INDEX* (14; Panel A of Table 2), the market value of an additional dollar of cash in Panel C of Table 4 is 0.555 ($= 4.475 - 0.280 \times 14$). An increase in *IA-INDEX* by one standard deviation would even imply a negative market value of an additional dollar of cash. However, the limitations of this interpretation become apparent when the scaling of variables is changed (e.g., using net assets instead of total assets). In results not reported, we find similar results, although the coefficients on C_t and dC_t change considerably in some specifications.

Table 4
Estimated value of cash in connection with information asymmetry.

	Panel A: *IA* = *DISPM*				Panel B: *IA* = *DISPM* − *DUMMY*				Panel C: *IA* = *IA* − *INDEX*			
	Fixed effects		Fama–MacBeth		Fixed effects		Fama–MacBeth		Fixed effects		Fama–MacBeth	
	Level	Diff.	Level	Diff.	Level	Diff.	Level	Diff.	Level	Diff.	Level	Diff.
E_t	3.694***	3.438***	1.876***	1.359***	2.699***	2.529***	1.205***	0.817***	3.991***	3.948***	2.005***	1.776***
	(23.42)	(14.31)	(9.54)	(6.33)	(32.19)	(18.01)	(7.51)	(4.61)	(20.28)	(13.51)	(9.63)	(6.86)
dE_t	−0.228**	−0.284**	0.882***	0.846**	−0.045	−0.118**	0.923***	0.867***	−0.206	−0.349**	0.945**	0.918**
	(−2.29)	(−2.51)	(3.56)	(3.22)	(−0.70)	(−2.41)	(4.92)	(4.72)	(−1.38)	(−2.28)	(2.84)	(2.43)
dE_{t+1}	2.168***	1.880***	1.938***	1.422***	1.632***	1.437***	1.563***	1.227***	2.487***	2.222***	2.145***	1.756***
	(19.47)	(22.02)	(10.30)	(8.48)	(33.69)	(27.89)	(10.74)	(10.65)	(32.65)	(31.45)	(10.17)	(8.32)
dNA_t	0.332***	0.307***	0.812***	0.695***	0.302***	0.284***	0.721***	0.632***	0.339***	0.339***	0.827***	0.734***
	(12.58)	(15.18)	(8.00)	(7.27)	(13.38)	(14.93)	(8.03)	(7.54)	(13.08)	(14.48)	(8.08)	(6.82)
dNA_{t+1}	0.606***	0.673***	0.489***	0.602***	0.571***	0.632***	0.460***	0.548***	0.556***	0.652***	0.443***	0.580***
	(8.00)	(9.90)	(4.62)	(5.36)	(8.56)	(10.17)	(4.75)	(5.26)	(6.83)	(9.15)	(4.42)	(5.01)
RD_t	4.190***	3.542***	5.398***	7.183***	3.575***	3.371***	5.250***	6.915***	5.193***	3.524***	7.352***	7.613***
	(16.21)	(10.05)	(12.41)	(13.11)	(14.97)	(10.25)	(14.38)	(14.46)	(30.63)	(10.21)	(12.73)	(12.39)
dRD_t	1.121**	1.331***	2.572**	2.664**	1.272***	1.184***	2.879**	2.776**	1.193**	1.328***	2.433**	2.659**
	(2.42)	(3.06)	(3.01)	(2.56)	(3.87)	(4.54)	(3.23)	(2.88)	(2.53)	(2.68)	(2.35)	(2.45)
dRD_{t+1}	6.110***	5.292***	8.535***	9.365***	5.607***	4.879***	8.609***	9.215***	6.217***	5.103***	8.067***	9.396***
	(8.69)	(12.96)	(9.16)	(10.90)	(13.61)	(25.59)	(9.26)	(12.03)	(9.19)	(10.06)	(8.88)	(9.85)
I_t	−0.849	−1.447**	1035	−2.402***	−0.260	−0.811***	1.471**	−1.333*	−0.825	−1.845**	0.134	−3.342***
	(−1.58)	(−2.40)	(1.80)	(−4.29)	(−1.06)	(−3.33)	(2.41)	(−1.93)	(−1.26)	(−2.09)	(0.22)	(−5.33)
dI_t	−1.016**	−0.951**	−1066	−0.121	−1.005***	−0.929***	−0.884	−0.195	−1.327**	−0.982	−2.382*	−0.409
	(−2.34)	(−2.29)	(−0.84)	(−0.15)	(−2.81)	(−3.01)	(−0.86)	(−0.29)	(−2.43)	(−1.55)	(−1.93)	(−0.48)
dI_{t+1}	−3.138***	−4.002***	−3.038**	−4.984***	−2.694***	−3.443***	−2.643**	−4.252***	−3.234***	−4.362***	−4.509***	−6.302***
	(−8.07)	(−11.84)	(−2.94)	(−4.51)	(−10.24)	(−13.52)	(−3.18)	(−5.06)	(−8.80)	(−10.03)	(−4.75)	(−5.16)
D_t	0.428	1.440***	7.217***	7.939***	1.107***	1.917***	6.841***	7.649***	−0.083	1.144***	6.317***	7.766***
	(1.00)	(4.16)	(19.90)	(23.66)	(2.84)	(5.52)	(24.48)	(27.90)	(−0.20)	(3.12)	(18.68)	(22.26)
dD_t	−0.248	−0.303*	−2.381***	−1.793***	−0.348**	−0.375**	−2.244***	−1.847***	−0.264	−0.378*	−2.348***	−1.875***
	(−1.24)	(−1.78)	(−5.29)	(−3.93)	(−1.98)	(−2.34)	(−5.47)	(−4.29)	(−1.30)	(−1.84)	(−5.45)	(−3.78)
dD_{t+1}	0.378**	0.829***	2.883***	3.789***	0.594***	0.909***	2.676***	3.393***	−0.054	0.570***	2.166***	3.632***
	(2.01)	(4.64)	(9.90)	(10.47)	(4.53)	(8.27)	(9.15)	(10.47)	(−0.30)	(3.27)	(6.99)	(8.60)
dV_{t+1}	−0.269***	−0.304***	−0.149	−0.188	−0.243***	−0.285***	−0.121	−0.166	−0.253***	−0.305***	−0.130	−0.180
	(−5.95)	(−6.31)	(−1.54)	(−1.74)	(−5.93)	(−6.31)	(−1.29)	(−1.61)	(−5.68)	(−6.34)	(−1.48)	(−1.65)
IA_t	−0.011	−0.065***	−0.026	−0.059	−0.039***	−0.062***	−0.142***	−0.154***	−0.070***	−0.072***	−0.061	−0.043
	(−0.55)	(−5.40)	(−0.87)	(−1.65)	(−3.55)	(−7.40)	(−9.88)	(−9.92)	(−3.85)	(−3.89)	(−1.52)	(−0.89)
C_t	0.786***		2.089***		0.827***		2.002***		4.475***		7.530***	
	(5.44)		(11.16)		(5.64)		(12.27)		(8.32)		(13.32)	
dC_t		0.978***		1.902***		1.059***		2.402***		1.495***		5.057***
		(14.34)		(6.31)		(11.53)		(8.76)		(5.86)		(6.20)
dC_{t+1}		1.031***		1.205***		0.963***		1.083***		1.018***		1.313***
		(7.36)		(4.90)		(8.18)		(4.68)		(6.00)		(4.80)
$C_t \times IA_t$	−0.465***		−0.504***		−0.244***		−0.313**		−0.280***		−0.397***	
	(−3.37)		(−3.56)		(−3.48)		(−2.47)		(−8.48)		(−12.14)	
$dC_t \times IA_t$		−0.922***		−2.710***		−0.438***		−1.646***		−0.051***		−0.267***
		(−7.17)		(−6.10)		(−5.88)		(−8.44)		(−2.84)		(−6.67)
Const.	0.801***	1.044***	0.557***	0.829***	0.865***	1.066***	0.675***	0.908***	0.969***	1.041***	0.576***	0.818***
	(28.89)	(75.15)	(30.78)	(34.29)	(29.74)	(87.25)	(48.37)	(41.19)	(33.56)	(66.87)	(22.58)	(29.20)
R^2	0.334	0.366	0.406	0.383	0.281	0.314	0.384	0.366	0.362	0.370	0.471	0.399
N	34,876	34,555	34,876	34,555	48,240	47,807	48,240	47,807	29,039	28,769	29,039	28,769
Groups	8661	8589	10	10	8661	8604	10	10	7696	7630	10	10

This table shows the estimation results of the main valuation regression in Eq. (4). The dependent variable in all specifications is the total market value of the firm (market value of equity plus book value of debt), denoted as V_t. E_t is earnings before interest and extraordinary items (after depreciation and taxes); NA_t is net assets (book value of total assets minus cash); RD_t is research and development (R&D) expenditure; I_t is interest expense; D_t is total dividends paid; and C_t is cash holdings in year t. $dX_t = X_t - X_{t-1}$ denotes the past 1-year change of variable X_t, and $dX_{t+1} = X_{t+1} - X_t$ is the future 1-year change of variable X_t. All variables are scaled by total assets (A_t). The model also includes interaction terms between cash holdings and three measures for information asymmetry, denoted as *IA*. *DISPM* measures the scaled dispersion (standard deviation) of 1-year analysts' earnings per share forecasts provided by I/B/E/S. *DISPM-DUMMY* is a dummy variable which takes the value of one (high information asymmetry) if a firm exhibits a value of *DISPM* above its country median in a given year or if the firm is not covered by at least two analysts, and hence we cannot compute *DISPM*, and zero (low information asymmetry) otherwise. *IA-INDEX* is a comprehensive index of information asymmetry based on the various dimensions of the concept; it is based on quintile rankings of firm size, R&D expenditure, Tobin's Q, the error in analysts' forecasts, and the number of analysts following the firm in a given year. We estimate regressions using fixed effects and Driscoll and Kraay (1998) standard errors. Alternatively, we also estimate the model using the Fama–MacBeth approach, where each regression includes 10 cross-sections. Year dummy variables are included in all specifications. The data set covers the period from 1995 to 2005. All firms from the different countries are included for which I/B/E/S provides analysts' forecasts and for which company data is available from Worldscope (except financial firms and utilities). The main proxy for information asymmetry, *DISPM*, is based on the standard deviation of analysts' earnings per share forecasts (analysts' forecasts dispersion), and this measure can only be computed when the forecasts are at least based on two analysts. A firm is omitted from the sample if *DISPM* cannot be calculated in at least one sample year, i.e., if this firm is not covered by at least two analysts in at least one sample year. All variables are trimmed at the 1% and the 99% tails. t-values are presented in parentheses. The R^2 of the fixed effects regression refers to the within-dimension. The R^2 of the Fama–MacBeth regression is the average value of the R-squares of the single years.

* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

information asymmetry is generally unfavorable from an investor's perspective. Given that some coefficients are insignificant, an opposing positive effect may also be at work. A higher divergence of opinions among investors tends to increase the market value of

securities as only the most optimistic investors engage in trading (Miller, 1977).[16]

To be able to differentiate between our opposing hypotheses, Table 5 contains the results from estimating the valuation regression when the full sample is split into different subsamples. For the sake of brevity, we only report the coefficients that are of direct interest and omit the coefficients on all other model variables. Panels A–D in Table 5 report the results when the sample is split using measures for the quality of corporate governance at the country-level. These models are based on the anti-director rights index, the rule of law index, the corruption index, and a country's law tradition.[17] For the three corporate governance indices the sample is divided into two groups according to higher or lower index values than the median country. A high index value indicates that a country either has higher minority shareholder rights or a stricter enforcement of investors' rights, or more generally, that its corporate governance practices are better. In line with Jensen's (1986) free cash flow hypothesis, the coefficient on cash is higher for firms in common law countries and in countries with higher index values. These results confirm previous findings in Pinkowitz et al. (2006), who document that in countries with poor investor protection a dollar of cash is worth less than in countries with high investor protection. In a broader sense, they are also consistent with the finding in Fresard and Salva (forthcoming) that a cross-listing in the US, a country with high investor protection, tends to increase the valuation of excess cash compared to similar domestic firms. Most important, the negative influence of information asymmetry on the market value of cash tends to be stronger for firms in civil law countries and in countries with lower index values. For each fixed effects model we report the results of a Chow-test. The null hypothesis posits that the coefficients on the interaction term estimated over two groups in a model are equal. Although the χ^2-test statistic indicates that the coefficients on the interaction term vary significantly only in the subsamples that refer to the law tradition, the differences in all sample splits are large in absolute magnitude. These findings again support Hypothesis 2, implying that the problems in the interplay between cash holdings and information asymmetry are more pronounced for firms that operate in countries with more severe agency problems due to poor corporate governance.

Panel E presents the results from sample splits according to the proportion of closely held shares, which is our firm-level corporate governance measure. We follow Morck et al. (1988) and Opler et al. (1999) and choose three cut-off levels for insider ownership: 0–5%, 5–25%, and 25% or more. Presumably, cash has less value and information asymmetry has a more negative impact on firm value when insider ownership falls into the range between 5% and 25% due to an entrenchment effect that dominates an incentive-alignment effect. However, cash tends to have a higher market value in this subsample. This result may be consistent with McConnell and Servaes (1990), who report a positive relationship between firm value and insider ownership up to a fraction of about 45%. The relationship between the coefficient on the interaction term and closely held shares is hard to interpret. The null hypothesis of the Chow-test that all three coefficients on the interaction term are equal cannot be rejected. If anything, the negative influence of information asymmetry on the marginal value of cash is stronger with low insider shareholdings.

The next two sample splits in Panels F and G in Table 5 are based on country-level financing practices. We use the ratio of both stock and private bond market capitalization to GDP as measures of financial constraints. Presumably, in countries with lower ratios internal finance is of particular importance and cash holdings are highly valuable because firms incur heavy costs of accessing capital markets. A less negative coefficient on the interaction term or even a positive relationship between cash holdings and information asymmetry for firms in constrained countries would support Hypothesis 1, suggesting that cash has a higher market value when information asymmetry is more pronounced. However, we observe the opposite result, where both coefficients on cash and on the interaction term are smaller for firms in countries with lower ratios. One obvious explanation for this result is based on the correlation of a country's financing and corporate governance practices. For example, common law countries are typically market-based countries, and one would expect that these countries exhibit higher financial development than civil law countries, as indicated by a higher ratio of stock and bond market capitalization to gross domestic product. La Porta et al. (2000b) document that minority shareholders are better protected in common law countries. Similarly, Pinkowitz et al. (2006) suggest that cash is worth less in countries with a low level of financial development because these countries have poor investor protection. Another explanation is based on the role of financial intermediaries and their impact on information asymmetry. Civil law countries tend to be bank-based economies, where financial intermediaries play a major role. Leland and Pyle (1977) suggest that financial intermediaries should be considered as a natural response to information asymmetry. In contrast to shareholders and bondholders, they have privileged access to information and know more about a firm's prospects than minority shareholders. Presumably, the adverse selection problem is less important for banks than for other investors. In market-based countries, where firms tend to access financial markets to raise funds, information asymmetry could be more pronounced than in bank-based countries. Overall, Hypothesis 1 could be more important for firms in common law countries, which implies a higher (albeit still negative) coefficient on the interaction term in these countries.

Finally, Panel H in Table 5 presents the results from sample splits according to firm size (measured as equity market capitalization) as our firm-level characteristic of financial constraints. Based on the fixed effects model, cash tends to have a higher market value in the group of small firms compared to large firms. This finding is consistent with the notion that large firms are less constrained. Moreover, the coefficients on the interaction term suggest that the negative effect of information asymmetry on the market value of cash is weaker for small firms; the Chow-test rejects the null hypothesis of equal coefficients across groups in the fixed effects model. Accordingly, at least for constrained firms both effects of our conflicting hypotheses seem to be at work. The overall negative effect of information asymmetry on the market value of an additional dollar of cash (Hypothesis 2) is to some extent canceled out by an opposing effect that cash is relatively more valuable in periods with pronounced information asymmetry due to high adverse selection costs (Hypothesis 1). This result is all the more important as firm size is a proxy variable for both financial constraints and information asymmetry, where small firms are more constrained and suffer from higher information asymmetry (see Section 3.1.2).

4.2. Robustness tests

In this section, we undertake a number of robustness tests that provide additional evidence in support of Hypothesis 2, suggesting that liquid assets are valued at a discount with increasing information asymmetry. For the ease of comparison, Panel A of Table 6 presents the base case coefficients on cash holdings and on the

[16] Diether et al. (2002) provide empirical evidence for this model. They argue that prices tend to reflect the views of the most optimistic investors whenever there is a disagreement about a stock's value because the pessimistic investors' views are often not revealed due to short-sale constraints.

[17] The two sample splits based on the rule of law index and the corruption index are identical, and hence they deliver the same estimation results.

Table 5
Sample splits.

	Fixed effects	Fama–MacBeth	Fixed effects	Fama–MacBeth		Fixed effects	Fama–MacBeth	Fixed effects	Fama–MacBeth
	Panel A: Anti-director rights index					Panel B: Rule of law index			
	High		Low			High		Low	
C_t	1.059***	2.435***	0.196	1.246***	C_t	0.883***	2.390***	0.376***	0.910***
	(6.40)	(11.11)	(1.63)	(5.13)		(5.87)	(11.08)	(2.77)	(5.31)
$C_t \times DISPM_t$	−0.243	−0.310	−0.683***	−0.532**	$C_t \times DISPM_t$	−0.391**	−0.404**	−0.990***	−1.197**
	(−1.56)	(−1.55)	(−5.23)	(−2.37)		(−2.53)	(−2.38)	(−8.21)	(−3.22)
N	19,958	19,958	14,006	14,006	N	26,831	26,831	8045	8045
Groups	4844	10	3573	10	Groups	6304	10	2364	10
Chow-test	$\chi^2(1) = 1.44$				Chow-test	$\chi^2(1) = 1.74$			
	Panel C: Corruption index					Panel D: Law tradition			
	High		Low			Common law		Civil law	
C_t	0.883***	2.390***	0.376**	0.910***	C_t	1.063***	2.438***	0.225***	1.281***
	(5.87)	(11.08)	(2.77)	(5.31)		(5.92)	(10.72)	(2.30)	(5.98)
$C_t \times DISPM_t$	−0.391**	−0.404**	−0.990***	−1.197*	$C_t \times DISPM_t$	−0.158	−0.269	−0.757***	−0.493*
	(−2.53)	(−2.38)	(−8.21)	(−3.22)		(−0.88)	(−1.04)	(−6.95)	(−2.02)
N	26,831	26,831	8045	8045	N	18,510	18,510	16,366	16,366
Groups	6304	10	2364	10	Groups	4565	10	4109	10
Chow-test	$\chi^2(1) = 1.74$				Chow-test	$\chi^2(1) = 3.05^*$			
	Panel E: Percentage of closely held shares								
	< 5%		5–25%		> 25%				
C_t	0.968***	2.288***	1.079***	2.586***	0.310***	1.938***			
	(7.45)	(6.04)	(4.12)	(9.69)	(3.02)	(11.64)			
$C_t \times DISPM_t$	−1.097***	0.764	−0.378*	−0.183	−0.137	−0.884***			
	(−2.86)	(0.63)	(−1.78)	(−0.68)	(−0.73)	(−4.62)			
N	3502	3502	7366	7366	17,490	17,490			
Groups	1236	10	2862	10	5585	10			
Chow-test	$\chi^2(2) = 1.79$								
	Panel F: Stock/GDP					Panel G: Bond/GDP			
	High		Low			High		Low	
C_t	0.844***	2.319***	0.373***	0.956***	C_t	0.817***	2.395***	0.649***	1.066***
	(5.31)	(11.24)	(6.18)	(9.60)		(4.80)	(11.57)	(3.71)	(6.34)
$C_t \times DISPM_t$	−0.317**	−0.332***	−1.040**	−0.991	$C_t \times DISPM_t$	−0.375**	−0.556***	−0.634**	−1.047
	(−2.04)	(−2.00)	(−6.79)	(−3.77)		(−2.51)	(−4.57)	(−2.22)	(−1.69)
N	28,788	28,788	6088	6088	N	26,045	26,045	8259	8259
Groups	6859	10	1810	10	Groups	6400	10	2071	10
Chow-test	$\chi^2(1) = 3.22^*$				Chow-test	$\chi^2(1) = 0.28$			
	Panel H: Firm size								
	Large		Small						
C_t	0.547***	2.235***	0.789***	1.845***					
	(−3.73)	(−9.58)	(−5.10)	(−9.44)					
$C_t \times DISPM_t$	−1.252***	−0.729	−0.135	−0.435					
	(−6.32)	(−1.07)	(−0.90)	(−1.59)					
N	17,435	17,435	17,441	17,441					
Groups	4397	10	5438	10					
Chow-test	$\chi^2(1) = 7.03^{***}$								

This table shows the estimation results of the main valuation regression in Eq. (4) for subsamples when the full sample is split using measures for the quality of corporate governance and financial constraints. The dependent variable in all specifications is the total market value of the firm (market value of equity plus book value of debt), denoted as V_t. For the sake of brevity, the table only reports the coefficients that are of direct interest. C_t is cash holdings in year t, and *DISPM* in the interaction term with cash measures the scaled dispersion (standard deviation) of 1-year analysts' earnings per share forecasts provided by I/B/E/S. We estimate regressions using fixed effects and Driscoll and Kraay (1998) standard errors. Alternatively, we also estimate the model using the Fama–MacBeth approach, where each regression includes 10 cross-sections. Year dummy variables are included in all specifications. Panels A–D show the results when the sample is split based on the anti-director rights index, the rule of law index, the corruption index, and a country's law tradition. For the three governance indices, the sample is divided into two groups according to higher or lower index values than the median country using data for the year 2000. A high index value indicates that a country either has higher minority shareholder rights or stricter enforcement of investors' rights, or more generally, that its corporate governance practices are better. Panel E splits the sample based on the percentage of insider ownership, which is taken as a proxy for firm-level corporate governance. The sample splits in Panels F and G are based on financing practices at the country-level. The ratios of both stock and private bond market capitalization to GDP (using data for the year 2000) are measures for financial constraints. Firms in countries with lower ratios tend to be constrained. Finally, in Panel H the sample is split based on firm size, measured as equity market capitalization, which is taken as a proxy for financial constraints on the firm-level. The data set covers the period from 1995 to 2005. All firms from the different countries are included for which I/B/E/S provides analysts' forecasts and for which company data is available from Worldscope (except financial firms and utilities). The main proxy for information asymmetry, *DISPM*, is based on the standard deviation of analysts' earnings per share forecasts (analysts' forecasts dispersion), and this measure can only be computed when the forecasts are at least based on two analysts. A firm is omitted from the sample if *DISPM* cannot be calculated in at least one sample year, i.e., if this firm is not covered by at least two analysts in at least one sample year. All variables are trimmed at the 1% and the 99% tails. t-values are presented in parentheses. For each fixed effects model the result of a Chow-test is reported. The null hypothesis is that the coefficients on the interaction term estimated over the groups in a model are equal. The test statistic is χ^2-distributed, with the number of degrees of freedom shown in brackets.

* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

interaction variable between cash and our main proxy variable for information asymmetry (*DISPM*), as they have been shown in Table 4 for the full sample. Again, for the sake of brevity, we only report the coefficients that are of direct interest. Moreover, we focus on the results of the fixed effects model including the level of cash. In addition to the results for the full sample, we follow the setup in Table 3 and report the results for the subsamples of firms from developed and emerging markets. As one would expect, the coefficient on the interaction term is larger in absolute value for firms in emerging markets than in developed markets. While the negative coefficients generally support Hypothesis 2, the valuation discount on an additional dollar of cash with increasing information asymmetry is more pronounced in emerging markets. These findings extend the result in Pinkowitz et al. (2006) that cash is worth less in countries with a low level of financial development because these countries have poor investor protection. They are in line with our own results on the relationship between the market value of cash and information asymmetry when the sample is split according to the quality of corporate governance (see Table 5).

The sample splits on a country-level allow us to disentangle the effects of our two conflicting hypotheses. In Table 5 we use median-splits (where applicable) based on data for the year 2000, which is the year in the middle of our sample period. Kaufmann et al. (2008) document that while the changes of corporate governance in most countries were small over the last decade, some countries exhibited significant changes. To check the robustness of our results, we split the sample using the data from Kaufmann et al. (2008) for the rule of law index and the corruption index for 1998 and 2005.[18] There is no time series for the anti-director rights index. We also use the relative sizes of the stock and bond markets for 1995 and 2005 in these robustness tests. In results not reported, our findings remain robust irrespective of whether we use data from the beginning, the middle, or the end of our sample period for the splits. While some countries exhibit changes in the index levels, the relative ranking of countries and hence the regression results often do not change.

In another robustness test, we make three changes to the specification of our main model. The results are shown in Panels B–D of Table 6. Our main regression is based on the valuation model of Fama and French (1998). While they use 2-year changes for the explanatory variables in differences to model investors' expectations in their original model, we follow Pinkowitz et al. (2006) and Dittmar and Mahrt-Smith (2007) and only use 1-year changes. As shown in Panel B, using 2-year changes reduces our sample, but we still observe a negative influence of information asymmetry on the market value of cash holdings. Moreover, Panel C shows that the coefficients and their statistical inference do not change qualitatively when we estimate the valuation regressions omitting time dummy variables. Finally, in Panel D we estimate the model using ordinary least squares with cluster robust standard errors rather than fixed effects. While the coefficient on the level of cash changes considerably, that on the interaction term is more stable and remains significant.

To compute our main measure of information asymmetry, *DISPM*, we use the average of monthly dispersions in each year. If we took the data only for one specific month, we lose all firm-year observations for which no (updated) estimate for this particular month is available. Towards the end of a year dispersion decreases because unexpected events become less probable and uncertainty will be resolved. As we cannot measure dispersion for each firm in every month, this monthly average may underestimate the dispersion of firms for which we have no observations in the first months of the year. In fact, forecasts are only available for a small propor-

[18] The data are available at http://www.govindicators.org.

Table 6
Robustness tests.

	All countries	Developed markets	Emerging markets
Panel A (base case)			
C_t	0.786***	0.893***	0.276**
	(5.44)	(5.63)	(2.54)
$C_t \times DISPM_t$	−0.465***	−0.363**	−1.170***
	(−3.37)	(−2.39)	(−7.65)
N	34,876	27,859	7017
Groups	8661	6551	2116
Panel B (2-year lags)			
C_t	0.440**	0.551**	−0.212
	(1.98)	(2.42)	(−1.09)
$C_t \times DISPM_t$	−0.700***	−0.689***	−0.661***
	(−3.35)	(−3.08)	(−3.35)
N	24,820	20,125	4695
Groups	6576	5041	1539
Panel C (no time dummies)			
C_t	0.841***	0.931***	0.365***
	(5.43)	(5.60)	(2.76)
$C_t \times DISPM_t$	−0.458***	−0.314*	−1.335***
	(−3.01)	(−1.92)	(−6.24)
N	34,876	27,859	7017
Groups	8661	6551	2116
Panel D (pooled OLS)			
C_t	2.215***	2.494***	1.042***
	(20.35)	(21.03)	(3.90)
$C_t \times DISPM_t$	−0.607***	−0.593**	−1.101**
	(−2.73)	(−2.51)	(−2.31)
N	34,876	27,859	7017
Groups	8661	6551	2116
Panel E (volatility)			
C_t	0.563***	0.681***	−0.232
	(2.79)	(3.23)	(−0.77)
$C_t \times DISPM_t$	−0.533***	−0.426***	−1.413***
	(−3.94)	(−2.85)	(−9.03)
$VOLA_t$	−0.238*	−0.335**	−0.128
	(−1.71)	(−2.57)	(−0.79)
$C_t \times VOLA_t$	1.548*	1.480*	3.862**
	(1.82)	(1.69)	(2.38)
N	34,383	27,466	6917
Groups	8579	6489	2096
Panel F (excess cash)			
$EXCASH_t$	2.141***	2.113***	3.023***
	(7.60)	(7.35)	(4.65)
$EXCASH_t \times DISPM_t$	−0.513*	−0.488*	−1.235
	(−1.81)	(−1.70)	(−1.27)
N	12,900	11,195	705
Groups	3564	3315	249
Panel G (payout ratio)			
D_t	1.196**	1.347***	0.296
	(2.42)	(2.87)	(0.39)
$POR_t \times DISPM_t$	0.139***	0.172***	0.296
	(7.93)	(6.18)	(0.39)
N	34,598	27,639	6959
Groups	8646	6540	2112

This table shows results of different robustness tests based on the main valuation regression in Eq. (4). The dependent variable in all specifications is the total market value of the firm (market value of equity plus book value of debt), denoted as V_t. For the sake of brevity, the table only shows the coefficients that are of direct interest. C_t is cash holdings in year *t*, and *DISPM* in the interaction term with cash measures the scaled dispersion (standard deviation) of 1-year analysts' earnings per share forecasts provided by I/B/E/S. Moreover, only the results of the fixed effects model including the level of cash are reported. Panel A reports the results of the base model specification. Changes in the model specification involve using 2-year changes for the explanatory variables in differences (Panel B), omitting time dummy variables (Panel C), and using ordinary least squares with cluster robust standard errors rather than fixed effects (Panel D). The model in Panel E incorporates the standard deviation of monthly stock returns over the accounting year as a direct measure of risk as well as the interaction term between cash and stock return volatility. Panel F reports the results from the alternative specification of the valuation regression in Eq. (6). This model uses excess cash instead of cash, where excess cash is computed as the difference between actual cash holdings and the target cash level in Eq. (5). Only positive values of excess cash are included. Panel G shows a variant of the valuation regression, where *DISPM* is interacted with the payout ratio (*POR*), defined as the ratio of total dividends and share repurchases to operating income, instead of cash. The data set covers the period from 1995 to 2005. All firms from the different countries are included for which I/B/E/S provides analysts' forecasts and for which company data is available from Worldscope (except financial firms and utilities). The main proxy for information asymmetry is based on the standard deviation of analysts' earnings per share forecasts (analysts' forecasts dispersion), and this measure can only be computed when the forecasts are at least based on two analysts. A firm is omitted from the sample if this dispersion measure cannot be calculated in at least one sample year, i.e., if this firm is not covered by at least two analysts in at least one sample year. All variables are trimmed at the 1% and the 99% tails. *t*-values are presented in parentheses.

* Significance at the 10% level.

** Significance at the 5% level.

*** Significance at the 1% level.

tion of our sample firms during the first quarter, and dispersion varies widely. Therefore, as an additional robustness check (not reported), we compute the average dispersion in each quarter. When we use the average dispersion in the second, third, and fourth quarter instead of all available months, our main results do not change qualitatively. However, when we use the average dispersion in the first quarter, the interaction term (albeit still negative) becomes insignificant, probably indicating that these far-distant forecasts have little predictive value (Capstaff et al., 2001).

Another concern is a potential correlation between risk (in a broader sense) and information asymmetry. In the spirit of Diether et al. (2002), we include two additional variables into the valuation regression. First, we add the standard deviation of monthly stock returns over the accounting year as a direct measure of risk. Second, we include the interaction term between cash and stock return volatility. As documented in Panel E of Table 6, we find a significantly negative coefficient on the interaction term between cash and information asymmetry. In contrast, the estimated coefficient on the interaction term between cash and risk is significantly positive. This result can be explained by the notion that cash is more valuable when a firm's business risk is higher. Most important, the influences of risk and information asymmetry run into opposite directions, and hence we conclude that our results cannot be explained by a positive correlation between our measure of information asymmetry and risk.

The alternative valuation regression in Eq. (6) proposed by Dittmar and Mahrt-Smith (2007) includes a measure of excess cash, as specified in the model in Eq. (5). Panel F of Table 6 presents the results when only positive values of excess cash (*EXCASH*) are included. The coefficient on *EXCASH* is statistically significant. However, it is as large as 2.141, which implies that one dollar put into excess cash increases firm value by more than double its par value. The finding that the coefficient on excess cash is much larger than that on cash in our main model in Table 4 is clearly surprising. However, it is comparable in magnitude to that in Dittmar and Mahrt-Smith (2007), who report that a dollar of excess cash increases firm value by two to three dollars, depending on the corporate governance measure they use. An immediate explanation is the endogeneity between excess cash and firm value, which may lead to biased coefficients. The market-to-book ratio, as a proxy for investment opportunities, determines cash holdings. However, cash holdings themselves affect the market value of the firm and the market-to-book ratio. As in Dittmar and Mahrt-Smith (2007), we use an instrumented market-to-book ratio to compute the normal cash level. However, they only focus on the interpretation of the interaction term.[19]

Most important, our results in Panel F reveal that the coefficient on the interaction term is significantly negative. More pronounced information asymmetry decreases the benefit of holding excess cash. This finding again corroborates Hypothesis 2, which is related to the free cash flow theory. In order to illustrate the detrimental value effect of information asymmetry, we again calculate the market value of an additional dollar of excess cash in connection with information asymmetry. The coefficient on excess cash is 2.141. If information asymmetry is taken into account, the marginal value of excess cash reduces slightly to 2.084 (based on the median value of *DISPM* of 0.112 in Panel A of Table 2). Increasing information asymmetry by one standard deviation (0.261; Panel A of Table 2), the market value of one additional dollar of excess cash decreases by 0.134 (or 6.9%) to 1.950. Overall, we again conclude that the market value of excess cash is both statistically and economically lower in states with high information asymmetry. According to Hypothesis 2, the agency costs from hoarding liquidity dominate the potential savings from the availability of internal funds when the degree of information asymmetry is high. As in our main model in Panel A, the decrease in the market value of an additional dollar of cash with increasing information asymmetry is more pronounced in emerging markets than in developed markets. However, the coefficient on the interaction term is estimated insignificantly for the emerging markets' subsample, which may be attributable to the small number of firm-year observations. In oder to capture country-specific effects, the target cash level is estimated separately for each country (Fresard and Salva, forthcoming). Due to small sample sizes for some of the emerging markets, the estimation of the target cash level (and hence excess cash) may be imprecise. When we estimate the coefficients for the target cash level in Eq. (5) using all emerging markets' observations together, the coefficient on the interaction term in Eq. (6) for this subsample becomes significantly negative at the 5% level. This reinforces the findings from our main model in Panel A.[20]

In a final robustness test, we examine the contribution of payouts to firm value in connection with information asymmetry. Cash and dividend decisions are closely related. Private benefits create a wedge between the value of a dollar inside the firm and the value of a dollar paid out. No private benefits can be consumed from a dollar paid out, while a dollar kept within the firm potentially induces insiders to consume private benefits. As argued by Pinkowitz et al. (2006), if investors discount the value of cash holdings because they expect the cash to be partly wasted in perquisites, they should value dividends in that country at a premium compared to a country where private benefits are less important. With stickiness in dividends, high current dividends predict high future dividends and a lower consumption of private benefits. Similarly, La Porta et al. (2000a) document that firms experience more pressure to pay dividends in countries with poor investor protection because firms' resources are more likely to be consumed as private benefits. If investor protection is sufficiently weak, limiting private benefits through dividend payments will more than offset a tax disadvantage of dividends. Using the reduced valuation model in Eq. (3), Pinkowitz et al. (2006) document that dividends contribute more to firm value in countries with poorer investor protection.[21] While we also report significantly positive coefficients on D_t in Table 3, we cannot find that the coefficients are higher in emerging markets with poor investor protection and low financial development. More important, Panel G of Table 6 presents the results of our main valuation regression in Eq. (4) when *DISPM* is interacted with the payout ratio, denoted as *POR*, instead of cash. Dividends are paid out from earnings rather than from assets, and hence *POR* is computed as the ratio of total dividends and share repurchases to operating income. For the full sample the coefficient on the interaction term is significantly positive, implying that the market value of an additional dollar paid out from earnings increases when information asymmetry is high. We interpret this finding as indirect support for Hypothesis 2, indicating that in states with a higher degree of information asymmetry cash is less valuable if kept inside the firm rather than being paid out to shareholders. However, the hypothesis that this effect is more pronounced in emerging markets than in developed markets is not confirmed by our data, as shown by the coefficients on the interaction term in the subsamples.

[19] In order to avoid an omitted variables bias from excluding the target cash level, we test alternative models that include $(C - EXCASH)$ and $(C - EXCASH) \times DISPM$. However, the coefficient on excess cash remains very high.

[20] In other results not reported, these findings are even more pronounced when we estimate the target cash level using all sample firms rather than on a country-specific basis or for a group of countries (i.e., developed and emerging markets).

[21] In a related analysis, Ferris et al. (2009) show that when the legal regime and the level of investor protection permit, investors force dividends from managers, but they also extract such payouts indirectly by placing a higher value on dividend paying firms.

5. Conclusions

This study examines the value effects of corporate cash holdings in a novel setting. Previous literature on cash holdings explores the valuation effects by differentiating firms along their quality of corporate governance. We take a different perspective and focus on the valuation effects of cash in connection with firm-specific and time-varying information asymmetry. Specifically, we test two conflicting hypotheses. First, based on Myers and Majluf (1984), cash holdings in combination with a higher level of information asymmetry have a positive influence on firm value because the adverse selection costs that arise from external finance can be avoided. Second, Jensen's (1986) free cash flow theory coupled with a higher level of information asymmetry leads to extreme moral hazard. If this effect dominates, the market value of cash incurs a discount with more severe information asymmetry.

$$DISPM_{i,t} = \ln\left(1 + \frac{1}{M_{i,t}} \times \sum_{m_{i,t}=1}^{M_{i,t}} \sqrt{\left(\frac{\frac{1}{A_{m_{i,t}}-1} \times \sum_{a_{m_{i,t}}=1}^{A_{m_{i,t}}} \left(EPS_{a_{m_{i,t}}} - \frac{1}{A_{m_{i,t}}} \times \sum_{a_{m_{i,t}}=1}^{A_{m_{i,t}}} EPS_{a_{m_{i,t}}}\right)^2}{Med_{m_{i,t}}}\right)}\right),$$

In order to examine these two opposing hypotheses, we examine a data set covering more than 8500 firms from 45 countries over the period from 1995 to 2005. We use an extended version of the valuation regression of Fama and French (1998) and take the dispersion of analysts' earnings forecasts as our main measure of firm-specific and time-varying information asymmetry. Our results indicate that the market value of one dollar is on average around one (albeit with a wide variation across models). Most important, the market value of cash is significantly reduced when a firm faces a higher level of information asymmetry. This evidence suggests that the agency costs of free cash flow outweigh the benefits of cash as an internal source of finance. To further distinguish between the two opposing hypotheses, we split the sample according to the quality of corporate governance and financial constraints. These sample splits reinforce our finding that agency costs due to moral hazard decrease the market value of an additional dollar of cash. Given high information asymmetry, the market value of cash is higher if investor protection is better and the quality of corporate governance is higher. In contrast, the hypothesis that cash is valued higher if a firm is financially constrained is only partly confirmed.

In summary, our results indicate that the agency costs based on the free cash flow theory outweigh the benefits of financial slack in mitigating adverse selection costs when raising external funds. Put differently, it may not be in the shareholders' interest that firms hoard liquidity due to problems induced by higher levels of information asymmetry. The precautionary motive to keep funds within the firm seems questionable. However, our findings do not contradict the pecking order theory in general. We do not suggest that firms should not use internal funds in the first place before external funds are raised. Instead, we argue that it may not be optimal for firms to accumulate cash rather than pay it out with the intention to avoid external finance in future states when information asymmetry is high.

Acknowledgements

We thank an anonymous referee, Marco Becht, Alice Bonaime, Francesca Cornelli, Daniel Höchle, Ben Jann, Ike Mathur (the editor), David Yermack, Heinz Zimmermann, Josef Zechner, and participants of workshops at the University of Basel, the University of Innsbruck, the University of Vienna, the 2007 CFS Summer School in Eltville, the 2009 Midwest Finance Association (MFA) Meeting in Chicago, the 2009 Financial Management Association (FMA) Meeting in Turin, and the 2009 European Financial Management Association (EFMA) Meeting in Milan for helpful comments. We thank Rebekka Haller for her excellent research assistance. The views and opinions expressed herein are those of the author and do not necessarily represent the views and opinions of KPMG LLP (UK). The information contained is of a general nature and is not intended to address the circumstances of any particular individual or entity.

Appendix

The detailed formula for our main measure of information asymmetry ($DISPM_{i,t}$) is:

where $Med_{m_{i,t}}$ is the absolute median earnings per share forecast in month m in year t for firm i; $A_{m_{i,t}}$ is the number of analysts that cover firm i in year t in month m; $M_{i,t}$ is the number of months during which more than two analysts cover firm i in year t; and the $EPS_{a_{m_{i,t}}}$ is earnings per share estimate of analyst a for firm i in year t in month m.

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