Information Asymmetry and Corporate Cash Holdings

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Abstract

In this study we analyze the effect of information asymmetry on corporate cash holdings and whether the effect of cash holdings on firm value varies across firms with different levels of information asymmetry. Using various measures of information asymmetry, we show that companies that operate in higher information asymmetry environments hold less cash after controlling for corporate governance. We also show that cash adds less value to companies with higher levels of information asymmetry. On the whole, our results support the monitoring cost hypothesis of cash holdings over the investment opportunities hypothesis.

JEL Classification: G30, G32, G34

Keywords: Cash holdings, Information asymmetry, Monitoring cost, Firm value

I. Introduction

In this study we analyze the effect of information asymmetry on corporate cash holdings and whether the effect of cash holdings on firm value varies with information asymmetry. Although prior research sheds significant light on both the determinants and value implications of corporate cash holdings, there is only limited empirical evidence regarding the role of information asymmetry in corporate cash holdings. Given the critical role of information asymmetry in both corporate decision making and financial theories, analysis of corporate cash holdings from the perspective of information asymmetry seems overdue. We provide such evidence using various measures of information asymmetry.

U.S. corporations hold large amounts of liquid assets. For instance, cash and marketable securities account for 22.5% of total assets of publicly traded companies during the ten-year period from 2000 through 2009.[1] Corporate cash holdings allow firms to exploit profitable investment opportunities and make obligatory debt payments in case of cash flow shortfalls without having to access external capital markets. However, higher corporate cash holdings may prove a disadvantage if managers use them for their own benefit at the expense of shareholders.

Information asymmetry is likely to influence corporate cash holdings because it affects both managerial behavior and the ability of outsiders to understand that behavior. For example, higher information asymmetry might exacerbate the free cash flow problem (Jensen, 1986) because it would make it harder for outsiders to monitor and interpret managerial actions. Alternatively, higher information asymmetry might make both managers and shareholders more concerned about firms' future capital needs if higher information asymmetry makes it more likely that future equity offerings will be underpriced (Myers and Majluf, 1984).

[1] Nonfinancial U.S. companies hold $1.93 trillion in cash and other liquid assets at the end of September 2010. (Source: *Wall Street Journal*, December 10, 2010).

Prior studies of cash holdings may be clustered into two broad groups. The first strand of research analyzes the determinants of cash holdings. These studies suggest that firms hold cash for the transaction cost, precautionary, tax, and agency motives. Meltzer (1993) and Mulligan (1997) analyze the transaction cost motive for holding cash. Song and Lee (2012) find that firms in East Asian countries maintain large precautionary cash holdings even after the economy recovers from the 1997 financial crisis. Foley, Hartzell, Titman, and Twite (2007) provide evidence for the tax motive for cash holdings, while Bates, Kahle, and Stulz (2009) provide evidence against the tax motive. Dittmar, Mahrt-Smith, and Servaes (2003), Kalcheva and Lins (2007), and Harford, Mansi, and Maxwell (2008) analyze the agency motive for holding cash.[2]

The second strand of research examines the effect of cash holdings on firm performance and firm value. Mikkelson and Partch (2003) show that holding large cash reserves does not impair corporate performance. Faulkender and Wang (2006) show that the marginal value of cash declines with larger cash holdings, higher leverage, and better access to capital markets. Pinkowitz, Stulz, and Williamson (2006) find that the market valuation of corporate cash is smaller in countries with poorer investor protection. Pinkowitz and Williamson (2007) find that cash is more valuable for firms with greater and more volatile investment opportunities. Dittmar and Mahrt-Smith (2007) show that cash holdings are more valuable for companies with better governance structures, and Harford, Mansi, and Maxwell (2008) find that firms with poor shareholder rights and excess cash have lower profitability and smaller market valuations.[3]

[2] Pinkowitz and Williamson (2001) examine the effect of bank power on cash holdings and show that strong Japanese banks influence firms to hold large cash balances. Bates, Kahle, and Stulz (2009) find a significant increase in the average cash-to-assets ratio for U.S. industrial firms during 1980-2006 and attribute it to an increase in the overall riskiness of cash flows. Duchin (2010) and Subramaniam**,** Tang, Yue, and Zhou (2011) show that diversified firms hold less cash than single-division firms.

[3] More recently, Fresard and Salva (2010) find that the value of excess cash is greater for firms cross-listed on the U.S. market than their domestic peers. Fresard (2010) finds that larger cash reserves lead to future market share gains and interprets the result as evidence that corporate cash holdings strategically influence product market

Although prior research sheds light on the causes and consequences of cash holdings,[4] there is only limited evidence regarding the relation between information asymmetry and cash holdings. Opler, Pinkowitz, Stulz, and Williamson (1999) use the firm's R&D expenditure as a proxy for information asymmetry and show that firms with larger R&D expenditures hold more liquid assets. Although firms with larger R&D expenditures may have greater information asymmetry, larger R&D expenditures may also reflect greater growth opportunities. It is also possible that causality runs the other way around: firms with larger cash reserves spend more on R&D activities. Dittmar, Mahrt-Smith, and Servaes (2003) use the market-to-book ratio as a proxy for information asymmetry in their analysis of corporate cash holdings, which is subject to the same criticism as R&D expenditures. Furthermore, it is unclear how the market valuation of cash varies with the firm's information environment.

In this study we test two competing hypotheses for the effect of information asymmetry on cash holdings. The monitoring cost hypothesis of cash holdings predicts that the amount of cash that a firm holds is inversely related to the level of information asymmetry between the firm's managers and its outside shareholders. In contrast, the investment opportunities hypothesis predicts a positive relation between cash holdings and information asymmetry. [Section II provides a detailed description of these hypotheses.]

Our empirical results show that corporate cash holdings are negatively and significantly related to various measures of information asymmetry, after controlling for the effects of corporate governance and other firm characteristics. The results are robust to different estimation

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outcomes. Denis and Sibilkov (2010) show that cash holdings are more valuable for financially constrained firms because higher cash holdings allow them to undertake value-increasing projects that might otherwise be bypassed. Liu and Mauer (2011) find a positive relation between the sensitivity of CEO compensation to stock price volatility and cash holdings and a negative relation between CEO risk-taking incentive and the value of cash to shareholders. Tong (2011) shows that the value of cash is lower in diversified firms than in single-division firms, and that firm diversification reduces the value of cash among firms with poor corporate governance.

[4] See, for example, Dittmar and Mahrt-Smith (2007).

methods, including the fixed-effects and Fama-MacBeth regressions, and regressions using changes in the variables. Consistent with prior research, we show that a firm's market value is positively related to the amount of excess cash it holds. More important, we find that cash adds less value to companies with high levels of information asymmetry. We interpret these results as evidence that managers are more likely to misuse cash when it is difficult for outside shareholders to monitor their actions. On the whole, our results support the monitoring cost hypothesis of cash holdings.

Although information asymmetry and principal-agent conflicts are central to financial theories, prior research provides only limited empirical evidence regarding the effect of information asymmetry on principal-agent conflicts. Our study underscores the importance of information asymmetry in principal-agent conflicts by analyzing its effect on corporate asset (i.e., cash) that is highly vulnerable to managerial waste. Management has easy access to corporate cash and much of its use is discretionary. While the conflict of interest associated with corporate excess cash has been well recognized since Jensen (1986), how information asymmetry affects this conflict is not well understood. Our study makes an important contribution to the literature by providing evidence on how information asymmetry affects both the level and value implication of corporate cash holdings.

The rest of the paper is organized as follows. Section II describes our two hypotheses concerning the level of corporate cash holdings. Section III describes data sources, explains variable measurement methods, and presents summary statistics. Section IV analyzes the relation between cash holdings and various measures of information asymmetry using different estimation methods, samples, and variable measurements. This section also examines the effect of information asymmetry on corporate payout and share repurchase decisions. Section V

analyzes whether the effect of cash holdings on firm value varies with information asymmetry. Section VI provides a brief summary and concluding remarks.

II. Statement of Hypotheses

Jensen (1986) suggests that corporate managers may undertake value-decreasing projects when they have more cash than they can invest in profitable projects. Jensen argues that this agency problem could be minimized by reducing the amount of free cash flow available to managers.[5] Jensen (1986) and Stulz (1990) predict that shareholders will restrict managers' access to free cash flow to mitigate the agency problem. To the extent that managers' incentives and abilities to engage in value-destroying activities vary with the firm's information environment, the amount of cash that managers can hold (more precisely, the amount of cash that shareholders allow managers to hold) is likely to depend on the firm's information environment.

For instance, shareholders of companies operating in opaque information environments may not want managers to hold large amounts of cash because it is difficult and costly for them to monitor managerial actions in such environments. In contrast, if the firm's information environment is transparent, resulting in little information asymmetry between managers and outside shareholders, shareholders may allow managers to hold large amounts of cash because they can monitor managerial actions effectively and punish those managers who waste cash. These considerations suggest that, all things being equal, how much cash a firm holds is likely to be negatively related to the degree of information asymmetry between its managers and outside shareholders. We call this the monitoring cost hypothesis of cash holdings.

[5] Jensen (1986) holds that firms could minimize the agency cost of free cash flow by increasing future debt service requirements (i.e., interest payments) without keeping the proceeds from the new debt (e.g., by issuing debt in exchange for stock).

Myers and Majluf (1984) hold that corporate liquidity enables firms to undertake new projects without relying on external capital markets, thereby avoiding both flotation costs and information asymmetry costs (e.g., underpricing) that often accompany equity offerings. Hence, among firms with similar investment opportunities, cash holdings could be more valuable for firms that operate in more opaque informational environments. Therefore, it is in the interest of shareholders for the firm to maintain larger cash reserves when information asymmetry is higher. In contrast to the monitoring cost hypothesis, this scenario suggests a positive relation between the level of cash holdings and the level of information asymmetry. We call this the investment opportunities hypothesis of cash holdings.

Whether the level of cash holdings decreases or increases with the level of information asymmetry would depend on the relative sizes of the managerial monitoring cost and the cost of external financing. If the managerial monitoring cost dominates the cost of external financing, we'll find evidence in favor of the monitoring cost hypothesis, i.e., cash holdings decrease with information asymmetry. In contrast, if the cost of external financing dominates the managerial monitoring cost, we'll find evidence in favor of the investment opportunities hypothesis, i.e., cash holdings increase with information asymmetry.

III. Data Sources, Variable Measurement, and Descriptive Statistics

In this section we describe our data sources and variable measurement procedures, and present descriptive statistics.

A. Data Sources

We obtain data from the following sources: the NYSE's Trade and Quote (TAQ), the Center for Research in Security Prices (CRSP), the Institutional Brokers' Estimate System

(I/B/E/S), the CDA/Spectrum Institutional (13F) Holdings, the RiskMetrics (formerly the Investor Responsibility Research Center) Governance Database, and Standard & Poor's Compustat for the 17-year period from 1993 through 2009. Our initial sample includes all stocks listed on the NYSE, AMEX, and NASDAQ. We exclude financial companies (SIC Codes 6000-6999), utility companies (SIC Codes 4900-4999), companies with an average annual share price less than $5, and non-U.S. companies from the study sample.[6] We apply standard filters (see Huang and Stoll, 1996) to the TAQ data to remove outliers and minimize data errors.

B. Measures of Information Asymmetry

Agency theory (e.g., Myers and Majluf, 1984) concerns the conflict of interests and information asymmetry between corporate insiders (e.g., managers) and outsiders (e.g., existing and prospective shareholders), while market microstructure theory concerns the information asymmetry between informed and uninformed traders. Diamond (1985) shows that lower information asymmetry between corporate insiders and outsiders results in lower information asymmetry between traders because the public release of inside information to outsiders makes traders' beliefs more uniform and reduces the information asymmetry between informed and uninformed traders. Chung, Elder, and Kim (2010) provide empirical evidence that higher information asymmetry between corporate insiders and outsiders results in higher information asymmetry among traders.

Following prior research (e.g., Bharath, Pasquariello, and Wu, 2009), we use various measures of information asymmetry that are commonly found in the market microstructure

[6] Following prior research (see Bates, Kahle, and Stulz, 2009), we exclude financial firms because they may hold cash to meet regulatory capital requirements and utilities because their cash holdings may be subject to regulatory supervision.

literature, including the price impact of a trade, the adverse selection component of the spread, and the probability of information-based trading, to examine the effect of information asymmetry on corporate cash holdings.[7] To assess the sensitivity of our results to different measures of information asymmetry, we also use the dispersion of financial analysts' earnings forecasts and an aggregate (composite) metric as additional measures.

The price impact of a trade measures the extent to which a trade alters the share price. Thus, it captures the value of private information held by informed traders. We measure the price impact of a trade for firm i by

$$\text{Price Impact}_{i,\tau} = Q_{i,\tau}[(M_{i,\tau+5} - M_{i,\tau}) / M_{i,\tau}]; \quad (1)$$

where $M_{i,\tau}$ and $M_{i,\tau+5}$ are quote midpoints at time τ and $\tau + 5$ minutes, respectively, and $Q_{i,\tau}$ equals 1 for buyer-initiated trades and –1 for seller-initiated trades.[8] We calculate the mean value of Price Impact$_{i,\tau}$ in each year from 1993 through 2009 by weighting each trade equally.

The adverse selection component of the bid-ask spread also captures the value of private information held by informed traders. We estimate the adverse selection component of the spread using the models developed by Lin, Sanger, and Booth (1995), Glosten and Harris (1988), and George, Kaul and, Nimalendran (1991).[9] Lin, Sanger, and Booth (LSB) (1995) use the following regression model to estimate the adverse-selection component of the spread:

$$\Delta\text{Quote}_t = \lambda S_{t-1} + \varepsilon_t. \quad (2)$$

[7] Many studies use these measures to analyze issues in corporate finance, investments, and asset pricing. See Lee, Mucklow, and Ready (1993), Brennan and Subrahmanyam (1995), Heflin and Shaw (2000), Easley, Hvidkjaer, and O'Hara (2002), Fuller (2003), Flannery, Kwan, and Nimalendran (2004), Graham, Koski, and Loewenstein (2006), Odders-White and Ready (2006), Chen, Goldstein, and Jiang (2007), Kang and Liu (2008), Fang, Noe, and Tice (2009), and Lipson and Mortal (2009). Madhavan (2000) and Lipson (2003) suggest that more interesting research can be generated by linking corporate finance and market microstructure.

[8] We estimate $Q_{i,\tau}$ using the Lee and Ready (1991) algorithm as modified by Bessembinder (2003).

[9] Van Ness, Van Ness, and Warr (2001) show that the models of Glosten and Harris (1988), George, Kaul and Nimalendran (1991), and Lin, Sanger and Booth (1995) yield more accurate estimates of the adverse selection cost than other models. We omit the firm subscript i for simplicity. We estimate the adverse selection cost for a stock only if the stock traded at least three times per day on average in each year.

In equation (2), $\Delta Quote_t = Quote_t - Quote_{t-1}$ and $S_{t-1} = P_{t-1} - Quote_{t-1}$, where $Quote_t$ is the quote midpoint at time t, P_{t-1} and $Quote_{t-1}$ are the transaction price and the quote midpoint at time t-1, respectively, and λ is the proportion of the adverse-selection component in the spread. We take the logarithm transformation of Quote, P, and S when we estimate λ.

In the Glosten and Harris (GH) (1988) model, the adverse-selection component and other components (such as inventory holding and order processing) are expressed as linear functions of transaction volume. The GH model uses the following regression model to estimate the adverse-selection component of the spread:

$$P_t - P_{t-1} = c_0(Q_t - Q_{t-1}) + c_1(Q_tV_t - Q_{t-1}V_{t-1}) + z_0Q_t + z_1Q_tV_t + \varepsilon_t; \quad (3)$$

where P_t is the transaction price at time t, V_t is the number of shares traded at time t, ε_t is the error term that captures both the rounding error and the arrival of public information, and Q_t equals 1 for buyer-initiated trades and –1 for seller-initiated trades. We estimate the adverse-selection component as $Z_0 = 2(z_0 + z_1V_t)$ and the transitory component as $C_0 = 2(c_0 + c_1V_t)$. The bid-ask spread in the GH model is the sum of Z_0 and C_0. We use the average share volume for stock i, $\overline{V}$ to estimate Z_0 and C_0. We measure the adverse-selection component (as a proportion of the spread) as $Z_0/(Z_0 + C_0)$.

George, Kaul, and Nimalendran (GKN) (1991) use the following regression model to estimate the adverse-selection component:

$$2(TR_t - MR_t) = \rho_0 + \rho_1 s_q (Q_t - Q_{t-1}) + \varepsilon_t; \quad (4)$$

where TR_t is the transaction return at time t, MR_t is the quote midpoint return calculated from the quote midpoint immediately following the transaction at time t, s_q is the percentage bid-ask spread, Q_t is 1 for buyer-initiated trades and –1 for seller-initiated trades, ρ_1 measures the order-processing component, and $(1 - \rho_1)$ measures the adverse-selection component.

We estimate the probability of information-based trading (PIN) for each firm in each year using the sequential trade model of Easley, Kiefer, O'Hara, and Paperman (EKOP) (1996). The EKOP model of trading for firm i during trading day j is represented by the following likelihood function:

$$\begin{aligned} L_i(B_{i,j}, S_{i,j} \mid \theta_i) = {} & (1-\alpha_i)e^{-\varepsilon_i T_{i,j}} \frac{(\varepsilon_i T_{i,j})^{B_{i,j}}}{B_{i,j}!} e^{-\varepsilon_i T_{i,j}} \frac{(\varepsilon_i T_{i,j})^{S_{i,j}}}{S_{i,j}!} \\ & + \alpha_i \delta_i e^{-\varepsilon_i T_{i,j}} \frac{(\varepsilon_i T_{i,j})^{B_{i,j}}}{B_{i,j}!} e^{-(\mu_i+\varepsilon_i)T_{i,j}} \frac{[(\mu_i+\varepsilon_i)T_{i,j}]^{S_{i,j}}}{S_{i,j}!} \\ & + \alpha_i (1-\delta_i) e^{-(\mu_i+\varepsilon_i)T_{i,j}} \frac{[(\mu_i+\varepsilon_i)T_{i,j}]^{B_{i,j}}}{B_{i,j}!} e^{-\varepsilon_i T_{i,j}} \frac{(\varepsilon_i T_{i,j})^{S_{i,j}}}{S_{i,j}!}; \end{aligned} \tag{5}$$

where $B_{i,j}$ is the number of buyer-initiated trades for the day, $S_{i,j}$ is the number of seller-initiated trades for the day, α_i is the probability that an information event has occurred, δ_j is the probability of a low signal given that an event has occurred, μ_i is the probability that a trade comes from an informed trader given that an event has occurred, ε_i is the probability that uninformed traders will actually trade, $T_{i,j}$ is the total trading time for the day, and $\theta_i = (\alpha_i, \delta_i, \varepsilon_i, \mu_i)$ represents the vector of parameters to be estimated. We estimate the parameters θ_i for firm i for each year by maximizing the joint likelihood over the J observed trading days in a calendar year:

$$L_i(M_i \mid \theta_i) = \prod_{j=1}^{J} L_i(B_{i,j}, S_{i,j} \mid \theta_i). \tag{6}$$

We then estimate the probability of information-based trading (PIN) for firm i for each year as

$$PIN_i = \frac{\hat{\alpha}_i \hat{\mu}_i}{\hat{\alpha}_i \hat{\mu}_i + 2\hat{\varepsilon}_i}. \tag{7}$$

We use the dispersion of analysts' earnings forecasts (DISP) as an additional measure of information asymmetry.[10] Following prior studies, we obtain DISP by dividing the standard deviation of analysts' one-year earnings forecasts by the previous year-end share price.[11]

Finally, we construct a composite score of information asymmetry (SCORE). In each year, we sort firms according to each information asymmetry (IA) measure and group them into deciles, where Decile 1 includes firms with the lowest information asymmetry and Decile 10 includes firms with the highest information asymmetry. Next, we assign an IA score of 1 to all firms in Decile 1 and an IA score of 10 to all firms in Decile 10. We then obtain the composite information asymmetry score of each firm in each year by averaging its IA score across our six information asymmetry measures (i.e., Price Impact, LSB, GH, GKN, PIN, and DISP). Thus, the value of SCORE ranges from 1 (the lowest information asymmetry) to 10 (the highest information asymmetry).

C. Cash Holdings and Control Variables

Following Opler, Pinkowitz, Stulz, and Williamson (1999) and Harford, Mansi, and Maxwell (2008), we measure corporate cash holdings by the ratio of cash and marketable securities to non-cash assets (NCA) (NCA = total assets – cash and marketable securities). We also employ an alternative measure of cash holdings, the ratio of cash and marketable securities to total assets, to assess the robustness of our results with respect to different definitions of cash holdings. Prior studies [see Harford, Mansi, and Maxwell (2008), Bates, Kahle, and Stulz (2009),

[10] Drobetz, Gruninger, and Hirschvogl (2010) show that the market valuation of corporate cash holdings decreases with the dispersion of analysts' earnings forecasts. However, they do not examine how corporate cash holdings are related to the dispersion of earnings forecasts.

[11] See Kinney, et al. (2002), Bailey, et al. (2003), Gu and Wu (2003), Heflin, et al. (2003), Zhang (2006), Guntay and Hackbarth (2010), and Chordia, Roll, and Subrahmanyam (2011).

and references therein] show that a significant portion of cross-sectional variation in corporate cash holdings can be explained by various firm characteristics. Following these studies, we include a number of firm characteristics as control variables in our regression analysis. These variables include: analyst following, stock market liquidity, institutional ownership, corporate governance quality, non-cash assets, cash flow ratio, net working capital ratio, market-to-book ratio, R&D expenditure ratio, debt ratio, a dummy variable for dividend payout, acquisition expenditure ratio, capital expenditure ratio, and a measure of industry risk.

We measure analyst following by the number of financial analysts covering a firm; stock liquidity by the time-weighted quoted bid-ask spread;[12] institutional ownership by the percentage of shares held by institutions; and governance quality by the governance index developed by Gompers, Ishii, and Metrick (GIM) (2003). We obtain cash flow ratio by dividing earnings after interest, dividend, and taxes, but before depreciation by NCA; net working capital ratio by dividing current assets net of cash minus current liabilities by NCA; market-to-book ratio by dividing the book value of assets minus book value of equity plus the market value of equity by NCA; R&D expenditure ratio by dividing R&D expenditures by NCA; debt ratio by dividing total debt (short- and long-term debt) by NCA; acquisition expenditure ratio by dividing acquisition expenditures by NCA; capital expenditure ratio by dividing capital expenditure by NCA; and industry risk as the ratio of the industry average of the standard deviation of cash flow for the past ten years to NCA.[13]

[12] We measure the quoted bid-ask spread of stock i at time τ by Quoted $\text{Spread}_{i,\tau} = (\text{Ask}_{i,\tau} - \text{Bid}_{i,\tau})/M_{i,\tau}$, where $\text{Ask}_{i,\tau}$ is the ask price of stock i at time τ, $\text{Bid}_{i,\tau}$ is the bid price of stock i at time τ, and $M_{i,\tau}$ is the mean of $\text{Ask}_{i,\tau}$ and $\text{Bid}_{i,\tau}$. For each stock, we then calculate the time-weighted average quoted spread in each year from 1993 through 2009.

[13] We use the Fama and French 48-industry classification method when we calculate industry risk.

D. Descriptive Statistics

Table I shows descriptive statistics for cash holdings, seven information asymmetry measures, and other stock attributes of our study sample.[14] The mean and median ratios of cash and marketable securities to non-cash assets (NCA) are 0.6625 and 0.1134, respectively.[15] When we measure cash holdings by the ratio of cash and marketable securities to total assets, the mean and median values are 0.2029 and 0.1018. These results suggest that both measures of cash holdings are highly skewed.[16]

Panel A in Table II shows time-series variations in cash holdings and non-cash assets (NCA). Consistent with the result in Bates, Kahle, and Stulz (2009), the mean and median cash to total assets ratios during 2000-2009 are around 20-24% and 8-15%, respectively, which are larger than the corresponding figures during the 1990s. The median cash to non-cash assets ratio is about 6.7-9.5% during 1993-2000 and 12.4-18% during 2001-2009.[17] The corresponding mean values are much higher because some firms have high cash to non-cash assets ratios. Panel B in Table II shows significant variations in cash holdings and non-cash assets across industries. For example, firms in medical equipment, pharmaceutical products, business services, computers, and electronic equipment industries hold more cash than firms in other industries. We include both year and industry dummy variables in our regression analysis to account for the variation in cash holdings over time and across industries.

[14] All variables are winsorized at the 0.5% and 99.5% to reduce the effect of outliers.
[15] We checked our data for accuracy and confirmed that the large mean value is due to some firms with large cash ratios that remain in the sample even after winsorization.
[16] In our regressions, we use the logarithm of the variables with a skewed distribution (e.g., the ratio of cash and marketable securities to non-cash assets) to reduce the influence of extreme observations.
[17] The results indicate that although the subprime crisis significantly reduced corporate cash holdings in 2008, the level of cash holdings quickly rebounded to the pre-crisis level in 2009.

IV. Empirical Results

In this section we conduct regression analysis to examine the relation between corporate cash holdings and information asymmetry and perform a number of robustness tests using different variable measurements, sample selections, and estimation methods.

A. Information Asymmetry and Corporate Cash Holdings

To examine whether the level of cash holdings is related to information asymmetry after controlling for the effects of other variables, we estimate the following regression model:

$$\begin{aligned}\text{Log}(1 + \text{Cash}_{i,t}/\text{NCA}_{i,t}) = \beta_0 &+ \beta_1(\text{Price Impact}_{i,t}, \text{LSB}_{i,t}, \text{GH}_{i,t}, \text{GKN}_{i,t}, \text{PIN}_{i,t}, \text{DISP}_{i,t}, \text{or SCORE}_{i,t}) \\ &+ \beta_2\text{Analyst Following}_{i,t} + \beta_3\,\text{Quoted Spread}_{i,t} + \beta_4\,\text{Institutional Ownership}_{i,t} \\ &+ \beta_5\text{Log(GIM-Index}_{i,t}) + \beta_6\,\text{Log(NCA}_{i,t}) + \beta_7\,\text{Cash Flow Ratio}_{i,t} \\ &+ \beta_8\,\text{Net Working Capital Ratio}_{i,t} + \beta_9\,\text{Market-to-Book Ratio}_{i,t} \\ &+ \beta_{10}\text{R\&D Expenditure Ratio}_{i,t} + \beta_{11}\,\text{Debt Ratio}_{i,t} + \beta_{12}\,\text{Dividend Dummy}_{i,t} \\ &+ \beta_{13}\text{Acquisition Expenditure Ratio}_{i,t} + \beta_{14}\,\text{Capital Expenditure Ratio}_{i,t} \\ &+ \beta_{15}\text{Industry Risk}_{i,t} + \text{Year Dummy Variables} \\ &+ \text{Industry Dummy Variables using Two-Digit SIC Industry Code} + \varepsilon_{i,t}; \qquad (8)\end{aligned}$$

where $\text{Cash}_{i,t}/\text{NCA}_{i,t}$ is the ratio of cash and marketable securities to non-cash assets (NCA) for firm i in year t; $\text{Price Impact}_{i,t}$ is the mean price impact of trades; $\text{LSB}_{i,t}/\text{GH}_{i,t}/\text{GKN}_{i,t}$ are the Lin, Sanger, and Booth (LSB), Glosten and Harris (GH), and George, Kaul and Nimalendran (GKN) adverse selection components of the spread; $\text{PIN}_{i,t}$ is the probability of information-based trading; $\text{DISP}_{i,t}$ is the dispersion of analysts' earnings forecasts; $\text{SCORE}_{i,t}$ is the composite information asymmetry score; $\text{Analyst Following}_{i,t}$ is the number of financial analysts following the firm;

Quoted $\text{Spread}_{i,t}$ is the time weighted proportional quoted bid-ask spread; Institutional $\text{Ownership}_{i,t}$ is the percentage of shares held by institutions; $\text{GIM-Index}_{i,t}$ is the GIM governance index; Cash Flow $\text{Ratio}_{i,t}$ is the ratio of earnings to NCA; Net Working Capital $\text{Ratio}_{i,t}$ is the ratio of current assets net of cash minus current liabilities to NCA; Market-to-Book $\text{Ratio}_{i,t}$ is the ratio of the book value of assets minus book value of equity plus the market value of equity to NCA; R&D Expenditure $\text{Ratio}_{i,t}$ is the ratio of R&D expenditures to NCA;[18] Debt $\text{Ratio}_{i,t}$ is the ratio of total debt to NCA; Dividend Dummy equals one for firms that paid a common dividend and zero otherwise; Acquisition Expenditure $\text{Ratio}_{i,t}$ is the ratio of acquisition expenditures to NCA; Capital Expenditure Ratio $_{i,t}$ is the ratio of capital expenditures to NCA; Industry $\text{Risk}_{i,t}$ is the ratio of the industry average of the standard deviation of cash flow for the past ten years to NCA; and $\varepsilon_{i,t}$ is the error term.

Table III shows the results of the ordinary least squares (OLS) regressions with clustered standard errors at the firm level using the pooled data of cross-sectional and time-series observations.[19] Because the number of observations for the GIM governance index is much smaller than the number of observations for all other variables, we estimate the regression model with and without the GIM governance index to fully use our data as well as to assess the sensitivity of our results with respect to different samples. Panel A shows the results when we exclude Log(GIM-Index) from the regression model and Panel B shows the results when we include Log(GIM-Index) in the regression model.

Regardless of whether or not we include Log(GIM-Index) in the regression model, Log(Cash/NCA) is negatively and significantly related to all seven measures of information

[18] When R&D is missing, we set it equal to zero.
[19] We obtain qualitatively similar results when we estimate the model using standard errors that are robust to simultaneous correlation along two dimensions, firms and time, suggested in Thompson (2011).

asymmetry, indicating that firms with higher information asymmetry tend to hold less cash and that information asymmetry has the ability to explain cross-firm variations in cash holdings beyond that of corporate governance.[20] These results support the monitoring cost hypothesis of cash holdings over the investment opportunities hypothesis, suggesting that the managerial monitoring cost may be larger than the information asymmetry cost considered in Myers and Majluf (1984).[21]

Our results are consistent with the finding of Helwege and Liang (1996) and Graham and Harvey (2001) that corporate managers do not consider information asymmetry important in financing decisions. For instance, Helwege and Liang (1996, p. 457) find that "asymmetric information variables have no power to predict the relative use of public bonds over equity." Similarly, Graham and Harvey (2001, p. 219) conclude that "In general, these findings are not consistent with the pecking-order idea that informationally induced equity undervaluation causes firms to avoid equity financing."

Consistent with the findings of Opler, Pinkowitz, Stulz, and Williamson (1999), Harford, Mansi, and Maxwell (2008), and Bates, Kahle, and Stulz (2009), we find larger cash holdings in firms with greater growth opportunities (e.g., higher market-to-book ratio and R&D expenditure

[20] The results are also economically significant. For example, an increase in Price Impact from the 25th percentile to 75th percentile value results in a 21% decrease in cash holdings (i.e., Cash/NCA). Note that (-11.9562) * (0.0024 – 0.0006) = -0.0215, where -11.9562 is the regression coefficient on Price Impact in Table III, 0.0024 is the 75th percentile value of Price Impact, and 0.0006 is the 25th percentile value of Price Impact. The percentage change in Cash/NCA would equal [exp(Log(1 + 0.1134) – 0.0215) – 1 – 0.1134]/0.1134 = -0.2090, where 0.1134 is the mean value of Cash/NCA. Likewise, an increase in LSB from the 25th percentile to the 75th percentile results in a 22% decrease in cash holdings (i.e., Cash/NCA). Note that (-0.0860) * (0.3916 – 0.1288) = -0.0226, where -0.0860 is the regression coefficient on LSB in Table III, 0.3916 is the 75th percentile value of LSB, and 0.1288 is the 25th percentile value of LSB. The percentage change in Cash/NCA would equal [exp(Log(1 + 0.1134) – 0.0226) – 1 – 0.1134]/0.1134 = -0.2195, where 0.1134 is the mean value of Cash/NCA.

[21] One may argue that the lower cash holdings for firms with greater information asymmetries is because it is easier for their managers to spend cash, leaving little cash in their firms. However, La Porta, Lopez-de-Silanes, Shleifer, and Vishny (2000) and Dittmar, Mahrt-Smith, and Servaes (2003) suggest that shareholder interests rather than managerial self-interest determine corporate cash holdings in countries with good legal protections for shareholders. We address this issue in Section IV.D.

ratio), smaller NCA, lower GIM governance index, larger institutional ownership, larger analyst following, lower debt ratio, lower net working capital ratio, no dividend payout, and lower acquisition expenditure ratio.[22] We find no significant relation between cash holdings and industry risks when we include GIM governance index.[23] The positive relation between cash holdings and growth opportunities may be driven by the transaction cost and precautionary motives for holding cash–firms with larger investment opportunities would find it optimal to hold greater cash reserves to minimize potential transaction costs.[24] Larger firms may hold less cash because they have better access to capital markets.[25] Larger cash holdings for less leveraged firms suggest that variables that make debt costly make cash advantageous. The negative relation between cash holdings and the net working capital ratio suggests that cash and working capital are substitutes. Companies that pay dividends may have less cash because they can raise funds at low cost by cutting their dividends, whereas companies that do not pay dividends have to rely on capital markets to raise funds.

The results show that firms with lower stock market liquidity (larger quoted bid-ask spreads) hold less cash. To the extent that the bid-ask spread reflects the level of information asymmetry (because the quoted bid-ask spread includes the adverse selection component of the spread), the negative relation between cash holdings and spreads is also consistent with the monitoring cost hypothesis.

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[22] Lins, Servaes, and Tufano (2010) find that firms use lines of credit instead of non-operational (excess) cash to exploit future business opportunities.

[23] Bates, Kahle, and Stulz (2009) find that cash holdings are significantly related to industry risks. The difference between their and our results may be attributable to the fact that our regression model includes industry dummy variables whereas theirs does not.

[24] It is important to note that the negative relation between cash holdings and information asymmetry discussed above is not necessarily inconsistent with the precautionary demand theory of cash holdings, which posits that firms hold cash for unforeseen contingencies. Precautionary cash holdings would increase with information asymmetry only if outside financing costs increase with information asymmetry. If outside financing costs do not increase with information asymmetry, precautionary cash holdings would not be related to information asymmetry.

[25] Harford, Mansi, and Maxwell (2008) consider firm size a proxy for takeover deterrent.

B. Regression Results using Different Measures of Analyst Following and Cash Holdings

The sample used in the previous sections comprises only those firms that are included in the TAQ, CRSP, Institutional Brokers' Estimate System (I/B/E/S), CDA/Spectrum Institutional (13F) Holdings, and Compustat databases. Because the number of firms in the I/B/E/S database is much smaller than the number of firms in other databases,[26] our sample size is smaller than it could have been had we not included analyst following in our regression models. To assess the sensitivity of our results with respect to how we select our sample and measure analyst coverage, we re-estimate regression model (8) using the expanded sample that also includes firms that are not in the I/B/E/S database (we assume that these firms have no analyst following). As we did earlier, we obtain the regression results with and without the GIM index in the model and find qualitatively similar results. Hence we report only the results with the GIM index in the model. The results (see Panel A in Table IV) show that the estimated regression coefficients for all seven measures of information asymmetry are again negative and significant. The results for other variables are also qualitatively similar to those presented in Table III.

Some prior studies scale both the dependent and relevant independent variables by total assets instead of non-cash assets (NCA). To determine whether our results are sensitive to how we scale variables, we reproduce Table III using Log(Cash/Total Assets) instead of Log(Cash/ NCA) as the dependent variable, Log(Total Assets) instead of Log(NCA), and all other relevant independent variables scaled by total assets. The results (see Panel B in Table IV) show that the estimated regression coefficients on LSB, GH, GKN, and SCORE are all negative and significant

[26] Chung (2000) shows that only 1,947 (62.9%) of the 3,097 NYSE/AMEX companies included in the Compustat database are covered by the I/B/E/S database and only 1,782 (44.1%) of the 4,042 NASDAQ companies include in the Compustat database are covered by the I/B/E/S database in 1996.

at the 1% level. The coefficients on Price Impact, PIN, and DISP are also negative, but insignificant. As in Panel A of Table IV, the results for other variables are also qualitatively similar to those presented in Table III. Overall, these results suggest that our main results are robust to different measures of analyst following and cash holdings.

C. Further Robustness Checks

To further assess the robustness of our results, we examine whether they are sensitive to different estimation methods. Specifically, we employ the following three estimation methods: (1) the fixed-effects regression, (2) the Fama-MacBeth (1973) regression, and (3) regression using changes in the variables. Panel A in Table V shows the results of the fixed-effects regression and Panel B shows the results of the Fama-MacBeth regression. Both the fixed-effects and Fama-MacBeth regression results show that cash holdings are negatively and significantly related to information asymmetry variables. The results for other variables are generally similar to those in Table III.

Table VI presents the results of regressions using changes in the variables. The results show that regression coefficients on all seven information asymmetry variables are negative and statistically significant. The results for other variables are qualitatively similar to those from the level variables in Table III. We also find that the coefficients on Δ Information Asymmetry are qualitatively similar to those in Table VI when lagged changes in the information asymmetry measures (i.e., Lag(Δ Information Asymmetry)) are added to the regression model.[27] Overall, our regression results in Table III through Table VI indicate that firms hold less cash when they operate in higher information asymmetry environments.

[27] The results are available from the authors upon request.

D. Additional Evidence on the Monitoring Cost Hypothesis from Dividend Payout and Share Repurchase Decisions

Although we show that firms with higher information asymmetry hold smaller cash balances and interpret the result as evidence in support of the monitoring cost hypothesis, we cannot rule out the possibility that the result may be driven by other reasons. For instance, the lower level of cash holdings in firms with higher information asymmetry may result from the managerial spending of cash on pet projects.[28] To shed some light on this issue, we consider two likely channels through which the monitoring cost hypothesis might operate–dividend payout and share repurchase. If the monitoring cost hypothesis were true, firms with higher information asymmetry would be more likely to pay out their residual cash as dividends or repurchase their shares, resulting in lower cash holdings.[29] On the other hand, if the negative relation between cash holdings and information asymmetry were driven by the managerial spending of cash on pet projects, we would not observe a higher propensity to pay dividends or repurchase stock in firms with higher information asymmetry.

To examine how information asymmetry affects the firm's dividend payout and share repurchase decisions, we estimate the following regression model:

$$\text{Dividend Increase}_{i,t} \text{ or Repurchase Change}_{i,t} = \beta_0 + \beta_1 \text{ Residual Cash}_{i,t-1}$$
$$+ \beta_2 (\text{Price Impact}_{i,t}, \text{LSB}_{i,t}, \text{GH}_{i,t}, \text{GKN}_{i,t}, \text{PIN}_{i,t}, \text{DISP}_{i,t}, \text{ or SCORE}_{i,t})$$
$$+ \beta_3 \text{Residual Cash}_{i,t-1} * (\text{Price Impact}_{i,t}, \text{LSB}_{i,t}, \text{GH}_{i,t}, \text{GKN}_{i,t}, \text{PIN}_{i,t}, \text{DISP}_{i,t}, \text{ or SCORE}_{i,t})$$

[28] We call this the managerial spending hypothesis. Harford, Mansi, and Maxwell (2008) provide evidence that supports this hypothesis. For example, they show that firms with poor shareholder rights tend to spend more cash on acquisitions. In contrast, Pinkowitz, Sturgess, and Willamson (2012) show that cash-rich firms do not use their cash stockpiles to finance acquisitions.

[29] Prior research finds a positive relation between cash holdings and cash payout. See, e.g., Brown, Liang, and Weisbenner (2007) and Lee and Suh (2011).

$$+ \beta_4 \text{Institutional Ownership}_{i,t} + \beta_5 \text{ Idiosyncratic Risk}_{i,t} + \beta_6 \text{ Firm Age}_{i,t}$$

$$+ \beta_7 \text{Sales Growth}_{i,t} + \beta_8 \text{ Market-to-Book Ratio}_{i,t} + \beta_9 \text{Price-Earning Ratio}_{i,t}$$

$$+ \beta_{10} \text{ Annual Return}_{i,t-1} + \beta_{11} \text{ Log(MVE}_{i,t-1})$$

$$+ \text{Industry Dummy Variables using Two-Digit SIC Industry Code} + \varepsilon_{i,t}; \qquad (9)$$

where Dividend $\text{Increase}_{i,t}$ is the percentage increase in the annual cash dividend;[30] Repurchase $\text{Change}_{i,t}$ is the change in the annual repurchase amount from year t-1 to year t scaled by the market value of equity at the beginning of year t;[31] Residual $\text{Cash}_{i,t-1}$ is the residual from a modified version of regression model (8);[32] Idiosyncratic Risk is $\log[(1- R^2)/ R^2]$, where R^2 is the coefficient of determination estimated from an expanded market model (see Morck, Yeung, and Yu, 2000);[33] Firm Age is the number of years since the firm first appeared in the CRSP database; Sales Growth is the percentage change in annual sales; Price-Earnings Ratio is the ratio of stock price to net income per share; Annual Return is the logarithm of the continuously compounded annual stock return; MVE is the market value of equity; and all other variables are the same as defined in regression model (8).

Because Dividend $\text{Increase}_{i,t}$ is a left-censored variable, we use the Tobit regression model and report the results in Panel A of Table VII. Column 1 shows that the estimated coefficient on Residual Cash is positive and significant, suggesting that firms with greater

[30] We obtain the annual cash dividend payment by adding all regular cash dividends (i.e., CRSP Distribution Code between 1222 and 1252) within each year. We assume that Dividend $\text{Increase}_{i,t}$= 0 if there is no increase in dividends.

[31] We measure the annual repurchase amount by the sum of quarterly repurchase amounts, where quarterly repurchase amount is obtained by multiplying the quarterly number of repurchased shares (Compustat data item CSHOPQ) by the average repurchase price (Compustat data item PRCRAQ). Data on CSHOPQ and PRCRAQ are available only after 2004. Hence our analysis of share repurchase is based on the 2004-2009 data.

[32] We drop the information asymmetry variables, Analyst Following, Quotes Spread, Institutional Investors, and Log(GIM-Index) from regression model (8). Residual Cash is the residual from this modified version of the regression model (8). Harford, Mansi, and Maxwell (2008) use the same model to estimate residual cash.

[33] We follow Morck, Yeung, and Yu (2000) and use the following expanded market model: $r_{j,t}= \alpha_j + \beta_{1,j} r_{m,t-1} + \beta_{2,j} r_{i,t-1} + \beta_{3,j} r_{m,t} + \beta_{4,j} r_{i,t} + \beta_{5,j} r_{m,t+1} + \beta_{6,j} r_{i,t+1} + \varepsilon_{j,t}$, where $r_{j,t}$ is stock j's return in week t, $r_{m,t}$ is the CRSP value-weighted market index, and $r_{i,t}$ is the Fama and French value-weighted 48-industry index.

residual cash pay larger dividends. Columns 2 through 8 show the results when we add both Information Asymmetry and the interaction term between Residual Cash and Information Asymmetry to the regression model. The results show that all of the seven regression coefficients on the interaction term are positive and significant, indicating that firms with higher information asymmetry are more likely to pay their residual cash to shareholders as dividends. The estimated coefficients for Residual Cash are positive and significant only in two regressions (when we measure information asymmetry by Price Impact and GH). These results suggest that the positive relation between Residual Cash and Dividend Increase is likely to exist mainly in firms with high information asymmetry.

Panel B in Table VII shows the OLS regression results for Repurchase Change. Similar to the result in Panel A, Column 1 shows that the estimated coefficient for Residual Cash is positive and significant, suggesting that firms with more residual cash repurchase more shares. The coefficients on the interaction variables between Residual Cash and Information Asymmetry are all positive and significant except for the regression using Price Impact as information asymmetry measure (i.e., Column 2). These results indicate that firms with high information asymmetry also increase share repurchases to pay out surplus cash. Overall, we interpret the results in Table VII as evidence that shareholders of firms with high information asymmetry want managers to increase cash dividends or share repurchases to distribute surplus cash, which is consistent with the monitoring cost hypothesis of cash holdings.

V. Does the Effect of Cash Holdings on Firm Value Vary with Information Asymmetry?

In the previous section we found evidence that supports the monitoring cost hypothesis. An implicit assumption underlying this hypothesis is that managers are more likely to misuse

cash when it is harder for outsiders to monitor and interpret their actions. In this section we test the assumption by examining (after controlling for other known determinants of firm value) whether cash adds less value to companies that operate in more opaque information environments. Specifically, we estimate the following regression model, which is a modified version of the models used in prior studies of the effect of cash holdings on the firm's market value [see Pinkowitz, Stulz, and Williamson (2006), Dittmar and Mahrt-Smith (2007), and Bates, Kahle, and Stulz (2009)]:[34]

$$\frac{MV_{i,t}}{NCA_{i,t}} = \beta_0 + \beta_1 \frac{E_{i,t}}{NCA_{i,t}} + \beta_2 \frac{dE_{i,t+2}}{NCA_{i,t}} + \beta_3 \frac{dE_{i,t-2}}{NCA_{i,t}} + \beta_4 \frac{RD_{i,t}}{NCA_{i,t}} + \beta_5 \frac{dRD_{i,t+2}}{NCA_{i,t}} + \beta_6 \frac{dRD_{i,t-2}}{NCA_{i,t}} + \beta_7 \frac{D_{i,t}}{NCA_{i,t}} + \beta_8 \frac{dD_{i,t+2}}{NCA_{i,t}}$$
$$+ \beta_9 \frac{dD_{i,t-2}}{NCA_{i,t}} + \beta_{10} \frac{I_{i,t}}{NCA_{i,t}} + \beta_{11} \frac{dI_{i,t+2}}{NCA_{i,t}} + \beta_{12} \frac{dI_{i,t-2}}{NCA_{i,t}} + \beta_{13} \frac{dNCA_{i,t+2}}{NCA_{i,t}} + \beta_{14} \frac{dNCA_{i,t-2}}{NCA_{i,t}} + \beta_{15} \frac{dMV_{i,t+2}}{NCA_{i,t}}$$
$$+ \beta_{16}\text{Excess Cash}_{i,t} + \beta_{17}\text{HIA Dummy}_{i,t} + \beta_{18}\left(\text{Excess Cash}_{i,t} * \text{HIA Dummy}_{i,t}\right) + \varepsilon_{i,t}; \quad (10)$$

where X_t is the value of variable X in year t; dX_{t+2} is the change in X from year t to year t + 2 (i.e., $X_{t+2} - X_t$); dX_{t-2} is the change in X from year t – 2 to year t (i.e., $X_t - X_{t-2}$); MV is the market value of the firm (i.e., the sum of the market value of equity, the book value of short-term debt, and the book value of long-term debt); NCA is non-cash assets (NCA = total assets – cash and marketable securities); E is earnings before extraordinary items plus interest, deferred tax credits, and investment tax credits; RD is research and development spending;[35] D is common dividends paid; and I is interest expense. We estimate Excess $\text{Cash}_{i,t}$ for each firm in each year using the 2SLS method of Dittmar and Mahrt-Smith (2007). The dummy variable for high information asymmetry, HIA $\text{Dummy}_{i,t}$, equals one for firms that belong to the top third of each information asymmetry measure, and zero for firms in the bottom third. We use the dummy variable

[34] These models are based on the valuation model used in Fama and French (1998).
[35] When RD is missing, we set it equal to zero.

approach to provide a more intuitive interpretation of the coefficients and to mitigate the measurement problem associated with information asymmetry metrics. Panel A in Table VIII shows the fixed-effects regression results of regression model (10).[36]

As in Dittmar and Mahrt-Smith (2007), we find that firm value is positively associated with the amount of excess cash. The regression coefficients on Excess Cash range from 12.1288 to 14.5336 and are all statistically significant at the 1% level. The regression coefficients on HIA Dummy are negative and significant at the 1% level when we measure information asymmetry by price impact, adverse selection components of the spread (LSB, GH, and GKN), dispersion of analysts' earnings forecasts (DISP), and the composite information asymmetry score (SCORE). The regression coefficient on PIN is also negative, but not significant. These results are consistent with the expectation that firm value decreases with information asymmetry because investors require higher returns when information asymmetry is higher.

More important, the regression coefficients on the interaction term between Excess Cash and all seven information asymmetry variables are negative and significant at the 1% level, suggesting that excess cash adds less value to companies that operate in higher information asymmetry environments. The impact of information asymmetry on the market valuation of excess cash is economically significant. For example, the value of excess cash for firms in the top third of Price Impact is 12.9022 (= 14.5336 – 1.6314), which is 11% smaller than the corresponding figure (14.5336) for firms in the bottom third. For another example, the value of excess cash for firms in the top third of LSB is 7.5202 (= 13.1254 – 5.6052), which is 42%

[36] Following Dittmar and Mahrt-Smith (2007), we estimate the model using only those firms with positive excess cash. To accurately measure the effect of information asymmetry on firm value, we first regress Excess Cash on HIA Dummy and obtain residuals and then estimate regression model (10) using the residuals. Because HIA Dummy is orthogonal to the residual, the coefficient on HIA Dummy captures the effect of information asymmetry on firm value that is independent of the correlation between HIA and Excess Cash. Note that the regression coefficient (and its t-statistic) on excess cash itself is invariant to the orthogonalization.

smaller than the corresponding figure (13.1254) for firms in the bottom third. We find similar results using other measures of information asymmetry. To check the robustness of our results, we also estimate regression model (10) using the Fama-MacBeth method and find qualitatively similar results (see Panel B in Table VIII).[37] On the whole, these results are consistent with the conjecture that managers are more likely to waste corporate cash when it is harder for outsiders to monitor and interpret their actions. The relations between firm value and other explanatory variables are qualitatively similar to those reported in prior studies.

Dittmar and Mahrt-Smith (2007) show that excess cash is more valuable to firms with better governance structures. To determine whether the relation between firm value and information asymmetry remains significant after controlling for the effect of corporate governance on firm value, we include both LGIM (where LGIM equals one for firms that have below-median GIM governance indices and zero otherwise) and the interaction between LGIM and Excess Cash in the regression model. The number of observations (3,600+) in the regressions with these two additional explanatory variables is substantially smaller than the number of observations (6,300+) in the regressions without them because the IRRC database does not include many companies in the TAQ/CRSP/Compustat databases. Hence, the regression results with these governance variables shed additional light on whether our results regarding the effect of excess cash and information asymmetry on firm value are sensitive to study samples.

Panel A in Table IX shows the fixed-effects regression results when we include each of the seven high information asymmetry dummy variables, LGIM, and the interaction variables between these variables and Excess Cash in the regression model, where the dummy variable for

[37] For brevity we report only the results for key explanatory variables.

high information asymmetry, HIA Dummy$_{i,t}$, is the same as defined in regression model (10).[38] As in Table VIII, we find that the regression coefficients (8.9150, 8.9967, 10.3254, 7.5970, 7.0062, 9.4725, and 8.0927) on Excess Cash are all positive and significant, whereas the regression coefficients (−6.7826, −6.7618, −7.6060, −4.6326, −4.6555, −7.4667, −6.9615) on the seven interaction variables between HIA Dummy and Excess Cash are all negative and significant at the 1% level. Consistent with Dittmar and Mahrt-Smith (2007), we find that firm value is positively and significantly related to the interaction variable between LGIM and Excess Cash, indicating that cash is more valuable in companies with better corporate governance. We obtain similar results (see Panel B in Table IX) from the Fama-MacBeth regressions. Overall, these results indicate that how information asymmetry affects the relation between cash holdings and firm value does not materially depend on corporate governance structure.

VI. Summary and Concluding Remarks

Prior research shows that the level of a firm's cash holdings is determined by many factors, including the transaction cost and precautionary motives, taxes, regulatory and legal environments for investor protection, uncertainty in cash flows, ownership structure, and internal governance mechanisms. Other studies show that the market valuation of cash depends on factors such as corporate governance, financial leverage, regulatory and legal environments for investor protection, corporate diversification, and CEO risk-taking incentives. Despite the importance of information asymmetry in the finance and management behavior literature, there is very little empirical evidence on how it affects corporate cash holdings. The present study

[38] As in Table VIII, we use the orthogonalized excess cash variable in the regression.

sheds further light on this issue by analyzing the effects of information asymmetry on cash holdings and the market valuation of cash holdings.

We propose that information asymmetry exerts an impact on corporate cash holdings because it affects both managerial behavior and the ability of outsiders to understand managerial behavior. Using a battery of regression analyses and different measures of information asymmetry, we show that firms hold less cash when the level of information asymmetry is higher. We also show that cash adds less value to companies with higher levels of information asymmetry. We interpret these results as evidence that managers are more likely to waste corporate cash when it is difficult for outside shareholders to monitor and interpret their actions. Our study underscores the importance of the firm's information environment in corporate cash-holding decisions and provides evidence that supports the monitoring cost hypothesis of cash holdings.

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Table I
Descriptive Statistics

Cash/NCA is the ratio of cash and marketable securities to non-cash assets (NCA = total assets – cash and marketable securities), Cash/Total Assets is the ratio of cash and marketable securities to total assets, Price Impact is the mean price impact of trades, LSB/GH/GKN are the Lin, Sanger, and Booth (LSB), Glosten and Harris (GH), and George, Kaul and Nimalendran (GKN) adverse selection components of the spread, PIN is the probability of information-based trading, $DISP_{i,t}$ is the dispersion of analysts' earnings forecasts, SCORE is the composite information asymmetry score, Analyst Following is the number of financial analysts following the firm, Quoted Spread is the time weighted proportional quoted bid-ask spread, Institutional Ownership is the percentage of shares held by institutions, GIM-Index is the GIM governance index, Cash Flow Ratio is the ratio of earnings to NCA, Net Working Capital Ratio is the ratio of current assets net of cash minus current liabilities to NCA, Market-to-Book Ratio is the ratio of the book value of assets minus book value of equity plus the market value of equity to NCA, R&D Expenditure Ratio is the ratio of R&D expenditures to NCA, Debt Ratio is the ratio of total debt to NCA, Dividend Dummy equals one for firms that paid a common dividend and zero otherwise, Acquisition Expenditure Ratio is the ratio of acquisition expenditures to NCA, Capital Expenditure Ratio is the ratio of capital expenditure to NCA, and Industry Risk is the ratio of the industry average of the standard deviation of cash flow for the past ten years to NCA.

			Standard	Percentile		
Variable	N	Mean	Deviation	25th	50th	75th
Cash/NCA	48,216	0.6625	2.0763	0.0258	0.1134	0.4481
Cash/Total Assets	48,216	0.2029	0.2337	0.0252	0.1018	0.3094
Price Impact	48,216	0.0019	0.0022	0.0006	0.0012	0.0024
LSB	46,924	0.2700	0.1763	0.1288	0.2099	0.3916
GH	46,073	0.2515	0.1480	0.1564	0.2123	0.3054
GKN	46,043	0.3251	0.1351	0.2370	0.3359	0.4299
PIN	47,914	0.1853	0.0733	0.1313	0.1829	0.2365
DISP	35,971	0.0073	0.0312	0.0004	0.0012	0.0034
SCORE	35,971	5.3365	1.3566	4.3333	5.3333	6.3333
Analyst Following	48,216	7.9709	7.6613	3.0000	5.0000	11.0000
Quoted Spread	48,216	0.0169	0.0211	0.0032	0.0088	0.0227
Institutional Ownership	48,216	0.5135	0.2815	0.2752	0.5235	0.7481
GIM-Index	18,332	9.1022	2.6646	7.0000	9.0000	11.0000
NCA	48,216	1,915	5,741	60	248	1028
Cash Flow Ratio	48,216	-0.4110	1.3785	-0.0023	0.0841	0.1420
Net Working Capital Ratio	48,216	0.0283	0.3766	-0.0508	0.0779	0.2265
Market-to-Book Ratio	48,216	4.2534	7.8461	1.3013	1.9129	3.5288
R&D Expenditure Ratio	48,216	0.1662	0.4717	0.0000	0.0046	0.1127
Debt Ratio	48,216	0.2316	0.2196	0.0220	0.1942	0.3662
Dividend Dummy	48,216	0.2991	0.4579	0.0000	0.0000	1.0000
Acquisition Expenditure Ratio	48,216	0.0332	0.0810	0.0000	0.0000	0.0203
Capital Expenditure Ratio	48,216	0.0876	0.0940	0.0296	0.0571	0.1069
Industry Risk	48,216	2.2471	3.2057	0.4462	1.1264	2.3062

Table II
Time-Series and Industry Variations in Cash Holdings and Non-Cash Assets

Panel A shows time-series variations in cash holdings and non-cash assets and Panel B shows variations in cash holdings and non-cash assets across industries during the period from 1993 through 2009. As in Dittmar and Mahrt-Smith (2007), we use the Fama and French 48-industry classification.

Panel A: Time-Series Variations in Cash Holdings and Non-Cash Assets

	Cash/NCA		Cash/Total Assets		NCA ($ in millions)	
Year	Mean	Median	Mean	Median	Mean	Median
1993	0.4231	0.0837	0.1635	0.0773	1,214	140
1994	0.3610	0.0705	0.1506	0.0659	1,189	142
1995	0.4446	0.0674	0.1610	0.0632	1,190	147
1996	0.6447	0.0883	0.1932	0.0811	1,154	132
1997	0.6199	0.0922	0.1915	0.0844	1,200	143
1998	0.4910	0.0729	0.1762	0.0680	1,351	173
1999	0.6297	0.0753	0.1911	0.0700	1,565	211
2000	0.7340	0.0949	0.2121	0.0867	1,705	233
2001	0.7541	0.1404	0.2298	0.1231	1,933	268
2002	0.6771	0.1478	0.2237	0.1287	2,052	298
2003	0.6921	0.1590	0.2245	0.1372	2,258	363
2004	0.8524	0.1752	0.2390	0.1491	2,255	359
2005	0.8774	0.1796	0.2361	0.1522	2,223	378
2006	0.8443	0.1501	0.2269	0.1304	2,442	443
2007	0.9091	0.1454	0.2276	0.1270	2,630	441
2008	0.7127	0.1237	0.2065	0.1101	3,551	543
2009	0.6914	0.1655	0.2200	0.1420	3,495	545

Panel B: Variations in Cash Holdings and Non-Cash Assets across Industries

	Cash/NCA		Cash/Total Assets		NCA ($ in millions)	
	Mean	Median	Mean	Median	Mean	Median
Agriculture	0.1481	0.0759	0.1095	0.0706	1,828	607
Food Products	0.1224	0.0278	0.0719	0.0270	3,329	590
Candy and Soda	0.1528	0.0299	0.0888	0.0291	5,895	2,187
Alcoholic Beverages	0.1537	0.0639	0.0998	0.0601	8,098	933
Tobacco Products	0.1732	0.0797	0.1218	0.0738	15,130	2,742
Recreational Products	0.2125	0.0698	0.1307	0.0652	738	103
Entertainment	0.2381	0.0689	0.1231	0.0644	1,626	495
Printing and Publishing	0.2042	0.0186	0.0710	0.0183	2,268	1,089
Consumer Goods	0.1462	0.0514	0.0980	0.0489	1,978	337
Apparel	0.1988	0.0710	0.1287	0.0663	724	263
Healthcare	0.2329	0.0632	0.1222	0.0594	1,106	216
Medical Equipment	1.0332	0.3008	0.3021	0.2312	557	57
Pharmaceutical Products	3.8228	1.3035	0.5302	0.5659	1,434	27
Chemicals	0.2273	0.0401	0.1031	0.0385	2,934	1,070
Rubber and Plastic Product	0.0863	0.0390	0.0703	0.0375	631	280
Textiles	0.0489	0.0114	0.0389	0.0112	743	384
Construction Materials	0.1550	0.0521	0.0903	0.0495	1,581	385
Construction	0.1271	0.0612	0.0877	0.0577	1,472	587
Steel Works	0.0786	0.0331	0.0643	0.0321	2,131	647
Fabricated Products	0.0920	0.0161	0.0645	0.0159	359	205
Machinery	0.2554	0.0809	0.1477	0.0749	1,437	289
Electrical Equipment	0.3290	0.0828	0.1523	0.0765	1,182	189
Automobiles and Trucks	0.1153	0.0517	0.0873	0.0492	4,058	527
Aircraft	0.0753	0.0388	0.0581	0.0374	8,792	1,778
Shipbuilding, Railroad	0.1520	0.0692	0.1051	0.0647	939	469
Defense	0.2632	0.0942	0.1454	0.0861	4,755	763
Precious Metals	0.2106	0.1103	0.1422	0.0993	2,016	553
Nonmetallic Mining	0.3001	0.0555	0.1067	0.0526	4,223	788
Coal	0.0876	0.0406	0.0638	0.0390	2,276	1,292
Petroleum and Natural Gas	0.0951	0.0302	0.0658	0.0293	4,071	694
Telecommunications	0.2941	0.0567	0.1377	0.0536	6,379	851
Personal Services	0.3087	0.0865	0.1656	0.0796	717	211
Business Services	0.8928	0.3718	0.3162	0.2710	844	102
Computers	0.7176	0.4040	0.3146	0.2878	1,312	94
Electronic Equipment	0.6935	0.3501	0.2985	0.2593	1,159	133
Measuring and Control Equipment	0.5405	0.2912	0.2549	0.2255	584	99
Business Supplies	0.1062	0.0246	0.0540	0.0240	3,952	940
Shipping Containers	0.0508	0.0204	0.0373	0.0200	2,558	1,510
Transportation	0.1814	0.0541	0.1006	0.0513	3,095	607
Wholesale	0.0982	0.0291	0.0667	0.0282	1,293	422
Retail	0.1951	0.0562	0.1119	0.0532	2,263	430
Restaurants, Hotels, Motels	0.0967	0.0412	0.0745	0.0396	1,272	302
Miscellaneous	0.7832	0.1337	0.2141	0.1179	2,337	172

Table III
Regression Results on the Relation between Information Asymmetry and Cash Holdings

This table shows the results of Ordinary Least Squares (OLS) regressions with clustered standard errors at the firm level using the pooled data of cross-sectional and time-series observations. We estimate the following regression model:

$$\begin{aligned}\text{Log}(1+\text{Cash}_{i,t}/\text{NCA}_{i,t}) = \beta_0 + \beta_1\,(&\text{Price Impact}_{i,t}, \text{LSB}_{i,t}, \text{GH}_{i,t}, \text{GKN}_{i,t}, \text{PIN}_{i,t}, \text{DISP}_{i,t}, \text{or SCORE}_{i,t})\\ &+ \beta_2\,\text{Analyst Following}_{i,t} + \beta_3\,\text{Quoted Spread}_{i,t} + \beta_4\,\text{Institutional Ownership}_{i,t}\\ &+ \beta_5\text{Log(GIM-Index}_{i,t}) + \beta_6\,\text{Log(NCA}_{i,t}) + \beta_7\,\text{Cash Flow Ratio}_{i,t} + \beta_8\text{Net Working Capital Ratio}_{i,t}\\ &+ \beta_9\,\text{Market-to-Book Ratio}_{i,t} + \beta_{10}\,\text{R\&D Expenditure Ratio}_{i,t} + \beta_{11}\text{Debt Ratio}_{i,t} + \beta_{12}\text{Dividend Dummy}_{i,t}\\ &+ \beta_{13}\text{Acquisition Expenditure Ratio}_{i,t} + \beta_{13}\text{Capital Expenditure Ratio}_{i,t} + \beta_{14}\,\text{Industry Risk}_{i,t}\\ &+ \text{Year Dummy Variables} + \text{Industry Dummy Variables using Two-Digit SIC Industry Code} + \varepsilon_{i,t};\end{aligned}$$

where $\text{Cash}_{i,t}/\text{NCA}_{i,t}$ is the ratio of cash and marketable securities to non-cash assets (NCA) for firm i in year t; $\text{Price Impact}_{i,t}$ is the mean price impact of trades; $\text{LSB}_{i,t}/\text{GH}_{i,t}/\text{GKN}_{i,t}$ are the Lin, Sanger, and Booth (LSB), Glosten and Harris (GH), and George, Kaul and Nimalendran (GKN) adverse selection components of the spread; $\text{PIN}_{i,t}$ is the probability of information-based trading; $\text{DISP}_{i,t}$ is the dispersion of analysts' earnings forecasts; $\text{SCORE}_{i,t}$ is the composite information asymmetry score; $\text{Analyst Following}_{i,t}$ is the number of financial analysts following the firm; $\text{Quoted Spread}_{i,t}$ is the time weighted proportional quoted bid-ask spread; $\text{Institutional Ownership}_{i,t}$ is the percentage of shares held by institutions; $\text{GIM-Index}_{i,t}$ is the GIM governance index; $\text{Cash Flow Ratio}_{i,t}$ is the ratio of earnings to NCA; Net Working Capital $\text{Ratio}_{i,t}$ is the ratio of current assets net of cash minus current liabilities to NCA; $\text{Market-to-Book Ratio}_{i,t}$ is the ratio of the book value of assets minus book value of equity plus the market value of equity to NCA; R&D Expenditure $\text{Ratio}_{i,t}$ is the ratio of R&D expenditures to NCA; Debt $\text{Ratio}_{i,t}$ is the ratio of total debt to NCA; Dividend Dummy equals one for firms that paid a common dividend and zero otherwise; Acquisition Expenditure $\text{Ratio}_{i,t}$ is the ratio of acquisition expenditures to NCA; Capital Expenditure Ratio $_{i,t}$ is the ratio of capital expenditures to NCA; $\text{Industry Risk}_{i,t}$ is the ratio of the industry average of the standard deviation of cash flow for the past ten years to NCA; and $\varepsilon_{i,t}$ is the error term. Numbers in parenthesis are t-statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Results When Log(GIM-Index) is Not Included in the Model

	Dependent Variable: Log(1+ Cash/NCA)						
	1	2	3	4	5	6	7
Intercept	0.6380***	0.6013***	0.6065***	0.6016***	0.6581***	0.6157***	0.6949***
	(31.71)	(30.25)	(29.98)	(29.94)	(31.60)	(30.11)	(31.55)
Price Impact	-11.9562***						
	(-11.18)						
LSB		-0.0860***					
		(-7.86)					
GH			-0.0873***				
			(-7.27)				
GKN				-0.0604***			
				(-4.98)			
PIN					-0.2266***		
					(-8.65)		
DISP						-0.1712***	
						(-2.96)	
SCORE							-0.0122***
							(-9.37)
Analyst Following	0.0062***	0.0059***	0.0061***	0.0060***	0.0059***	0.0063***	0.0055***
	(19.74)	(18.58)	(18.92)	(19.19)	(18.63)	(19.80)	(17.52)
Quoted Spread	-1.1948***	-1.7194***	-1.7268***	-1.4538***	-1.4812***	-1.5068***	-1.5477***
	(-10.34)	(-14.13)	(-13.18)	(-11.75)	(-12.86)	(-8.76)	(-9.11)
Institutional	0.0252***	0.0437***	0.0460***	0.0453***	0.0367***	0.0006	0.0007
Ownership	(2.98)	(5.07)	(5.24)	(5.25)	(4.32)	(0.06)	(0.08)
Log(NCA)	-0.0763***	-0.0707***	-0.0723***	-0.0698***	-0.0759***	-0.0741***	-0.0757***
	(-34.40)	(-32.53)	(-32.79)	(-31.61)	(-34.25)	(-32.00)	(-32.57)
Cash Flow Ratio	-0.0136***	-0.0131***	-0.0131***	-0.0134***	-0.0130***	-0.0128***	-0.0125***
	(-7.55)	(-7.21)	(-7.14)	(-7.34)	(-7.18)	(-6.85)	(-6.67)
Net Working Capital	-0.1147***	-0.1113***	-0.1124***	-0.1080***	-0.1098***	-0.1084***	-0.1085***
Ratio	(-11.01)	(-10.68)	(-10.69)	(-10.53)	(-10.72)	(-9.21)	(-9.22)
Market-to-Book	0.0216***	0.0216***	0.0216***	0.0221***	0.0217***	0.0227***	0.0224***
Ratio	(40.72)	(36.47)	(36.23)	(35.98)	(40.30)	(33.35)	(32.96)
R&D Expenditure	0.3235***	0.3280***	0.3260***	0.3252***	0.3253***	0.3293***	0.3322***
Ratio	(28.64)	(28.01)	(27.58)	(27.65)	(28.61)	(25.02)	(25.21)
Debt Ratio	-0.1325***	-0.1380***	-0.1407***	-0.1457***	-0.1389***	-0.1094***	-0.1010***
	(-12.99)	(-13.35)	(-13.55)	(-14.20)	(-13.69)	(-10.15)	(-9.34)
Dividend Dummy	-0.0061	-0.0024	-0.0048	-0.0059	-0.0079*	-0.0086**	-0.0056
	(-1.45)	(-0.57)	(-1.13)	(-1.41)	(-1.88)	(-1.98)	(-1.29)
Acquisition	-0.1073***	-0.0995***	-0.0965***	-0.0972***	-0.0948***	-0.1290***	-0.1314***
Expenditure Ratio	(-7.78)	(-7.19)	(-6.85)	(-6.96)	(-6.86)	(-8.53)	(-8.73)
Capital	0.2041***	0.1991***	0.2073***	0.1978***	0.2169***	0.1552***	0.1430***
Expenditure Ratio	(8.65)	(8.29)	(8.56)	(8.18)	(9.17)	(6.09)	(5.61)
Industry Risk	0.0012**	0.0012**	0.0014**	0.0012**	0.0012**	0.0005	0.0006
	(2.11)	(2.18)	(2.41)	(2.08)	(2.07)	(1.04)	(1.15)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	48,216	46,924	46,073	46,043	47,914	35,971	35,971
R^2	0.78	0.78	0.78	0.78	0.78	0.79	0.79

Panel B: Results When Log(GIM-Index) is Included in the Model

	Dependent Variable: Log(1+ Cash/NCA)						
	1	2	3	4	5	6	7
Intercept	0.6146***	0.6106***	0.6165***	0.6217***	0.6350***	0.5257***	0.5770***
	(17.76)	(18.05)	(17.97)	(17.82)	(17.71)	(15.58)	(15.24)
Price Impact	-6.6799**						
	(-2.21)						
LSB		-0.0941***					
		(-6.43)					
GH			-0.0821***				
			(-4.48)				
GKN				-0.1332***			
				(-6.97)			
PIN					-0.1569***		
					(-4.17)		
DISP						-0.3268**	
						(-2.40)	
SCORE							-0.0082***
							(-4.34)
Analyst Following	0.0042***	0.0037***	0.0038***	0.0035***	0.0041***	0.0036***	0.0032***
	(10.33)	(9.18)	(9.38)	(8.64)	(9.91)	(8.92)	(8.24)
Quoted Spread	-1.3261***	-2.1573***	-2.2566***	-1.7722***	-1.5103***	-1.3709***	-1.5647***
	(-2.94)	(-5.10)	(-5.21)	(-4.12)	(-3.69)	(-3.09)	(-3.63)
Institutional	-0.0275**	-0.0221*	-0.0226*	-0.0174	-0.0263**	-0.0277**	-0.0232*
Ownership	(-2.03)	(-1.66)	(-1.68)	(-1.33)	(-1.97)	(-2.22)	(-1.84)
Log(GIM-Index)	-0.0218***	-0.0199***	-0.0211***	-0.0206***	-0.0227***	-0.0175***	-0.0168**
	(-3.02)	(-2.80)	(-2.95)	(-2.98)	(-3.19)	(-2.57)	(-2.48)
Log(NCA)	-0.0589***	-0.0571***	-0.0582***	-0.0539***	-0.0593***	-0.0513***	-0.0531***
	(-18.14)	(-18.15)	(-18.11)	(-16.94)	(-18.09)	(-16.00)	(-16.12)
Cash Flow Ratio	-0.0084***	-0.0079***	-0.0082***	-0.0073***	-0.0083***	-0.0085***	-0.0081***
	(-3.32)	(-3.18)	(-3.28)	(-2.99)	(-3.30)	(-3.53)	(-3.37)
Net Working Capital	-0.0928***	-0.0913***	-0.0924***	-0.0860***	-0.0919***	-0.0765***	-0.0757***
Ratio	(-6.41)	(-6.36)	(-6.43)	(-6.48)	(-6.37)	(-5.73)	(-5.63)
Market-to-Book	0.0290***	0.0290***	0.0293***	0.0305***	0.0289***	0.0328***	0.0321***
Ratio	(13.23)	(13.09)	(13.12)	(12.64)	(13.04)	(13.68)	(13.21)
R&D Expenditure	0.4007***	0.4053***	0.4103***	0.3994***	0.4079***	0.4476***	0.4422***
Ratio	(9.88)	(10.22)	(10.12)	(10.27)	(9.85)	(9.88)	(9.42)
Debt Ratio	-0.0543***	-0.0510***	-0.0539***	-0.0619***	-0.0534***	-0.0362**	-0.0336**
	(-3.51)	(-3.30)	(-3.49)	(-4.09)	(-3.49)	(-2.49)	(-2.30)
Dividend Dummy	-0.0246***	-0.0192***	-0.0216***	-0.0202***	-0.0247***	-0.0236***	-0.0208***
	(-4.57)	(-3.59)	(-4.09)	(-3.94)	(-4.62)	(-4.63)	(-4.11)
Acquisition	-0.1057***	-0.1049***	-0.1019***	-0.1051***	-0.1033***	-0.1180***	-0.1203***
Expenditure Ratio	(-4.75)	(-4.69)	(-4.50)	(-4.77)	(-4.66)	(-5.45)	(-5.64)
Capital	-0.1937***	-0.2005***	-0.1858***	-0.1977***	-0.1813***	-0.1624***	-0.1650***
Expenditure Ratio	(-4.47)	(-4.71)	(-4.45)	(-4.60)	(-4.30)	(-4.05)	(-4.13)
Industry Risk	0.0003	0.0004	0.0002	0.0003	0.0004	-0.0002	-0.0001
	(0.59)	(0.80)	(0.54)	(0.75)	(0.77)	(-0.49)	(-0.25)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	18,332	18,233	17,940	17,856	18,273	16,153	16,153
R^2	0.69	0.69	0.69	0.69	0.69	0.70	0.70

Table IV
Regression Results on the Relation between Information Asymmetry and Cash Holdings using Different Measures of Analyst Following and Cash Holdings

This table shows the results of Ordinary Least Squares (OLS) regressions with clustered standard errors at the firm level using the pooled data of cross-sectional and time-series observations. Panel A shows the results of the following regression model:

$$\begin{aligned}\text{Log}(1+\text{Cash}_{i,t}/\text{NCA}_{i,t}) = \beta_0 + \beta_1\,(&\text{Price Impact}_{i,t}, \text{LSB}_{i,t}, \text{GH}_{i,t}, \text{GKN}_{i,t}, \text{PIN}_{i,t}, \text{DISP}_{i,t}, \text{or SCORE}_{i,t})\\ &+ \beta_2\,\text{Analyst Following}_{i,t} + \beta_3\,\text{Quoted Spread}_{i,t} + \beta_4\,\text{Institutional Ownership}_{i,t}\\ &+ \beta_5\text{Log}(\text{GIM-Index}_{i,t}) + \beta_6\,\text{Log}(\text{NCA}_{i,t}) + \beta_7\,\text{Cash Flow Ratio}_{i,t} + \beta_8\text{Net Working Capital Ratio}_{i,t}\\ &+ \beta_9\,\text{Market-to-Book Ratio}_{i,t} + \beta_{10}\,\text{R\&D Expenditure Ratio}_{i,t} + \beta_{11}\text{Debt Ratio}_{i,t} + \beta_{12}\text{Dividend Dummy}_{i,t}\\ &+ \beta_{13}\text{Acquisition Expenditure Ratio}_{i,t} + \beta_{13}\text{Capital Expenditure Ratio}_{i,t} + \beta_{14}\,\text{Industry Risk}_{i,t}\\ &+ \text{Year Dummy Variables} + \text{Industry Dummy Variables using Two-Digit SIC Industry Code} + \varepsilon_{i,t},\end{aligned}$$

where $\text{Cash}_{i,t}/\text{NCA}_{i,t}$ is the ratio of cash and marketable securities to non-cash assets (NCA) for firm i in year t; $\text{Price Impact}_{i,t}$ is the mean price impact of trades; $\text{LSB}_{i,t}/\text{GH}_{i,t}/\text{GKN}_{i,t}$ are the Lin, Sanger, and Booth (LSB), Glosten and Harris (GH), and George, Kaul and Nimalendran (GKN) adverse selection components of the spread; $\text{PIN}_{i,t}$ is the probability of information-based trading; $\text{DISP}_{i,t}$ is the dispersion of analysts' earnings forecasts; $\text{SCORE}_{i,t}$ is the composite information asymmetry score; $\text{Analyst Following}_{i,t}$ is the number of financial analysts following the firm (we assume zero analyst following for firms not included in the I/B/E/S database); $\text{Quoted Spread}_{i,t}$ is the time weighted proportional quoted bid-ask spread; $\text{Institutional Ownership}_{i,t}$ is the percentage of shares held by institutions; $\text{GIM-Index}_{i,t}$ is the GIM governance index; $\text{Cash Flow Ratio}_{i,t}$ is the ratio of earnings to NCA; $\text{Net Working Capital Ratio}_{i,t}$ is the ratio of current assets net of cash minus current liabilities to NCA; $\text{Market-to-Book Ratio}_{i,t}$ is the ratio of the book value of assets minus book value of equity plus the market value of equity to NCA; $\text{R\&D Expenditure Ratio}_{i,t}$ is the ratio of R&D expenditures to NCA; $\text{Debt Ratio}_{i,t}$ is the ratio of total debt to NCA; Dividend Dummy equals one for firms that paid a common dividend and zero otherwise; $\text{Acquisition Expenditure Ratio}_{i,t}$ is the ratio of acquisition expenditures to NCA; $\text{Capital Expenditure Ratio}_{i,t}$ is the ratio of capital expenditures to NCA; $\text{Industry Risk}_{i,t}$ is the ratio of the industry average of the standard deviation of cash flow for the past ten years to NCA; and $\varepsilon_{i,t}$ is the error term. Panel B shows the results when variables are scaled by $\text{Total Assets}_{i,t}$ instead of NCA. We use Log(Cash/Total Assets) instead of Log(Cash/ NCA) as the dependent variable, Log(Total Assets) instead of Log(NCA), and all other relevant independent variables ($\text{Cash Flow Ratio}_{i,t}$, $\text{Net Working Capital Ratio}_{i,t}$, $\text{Market-to-Book Ratio}_{i,t}$, $\text{R\&D Expenditure Ratio}_{i,t}$, $\text{Debt Ratio}_{i,t}$, and $\text{Acquisition Expenditure Ratio}_{i,t}$) scaled by total assets. Numbers in parenthesis are t-statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Results When Firms not Included in the I/B/E/S Database are Assumed to Have No Analyst Following

	Dependent Variable: Log(1+ Cash/NCA)						
	1	2	3	4	5	6	7
Intercept	0.6679***	0.6605***	0.6609***	0.6586***	0.6774***	0.5257***	0.5770***
	(16.24)	(16.14)	(16.08)	(16.21)	(15.91)	(15.58)	(15.24)
Price Impact	-9.2751***						
	(-4.60)						
LSB		-0.1011***					
		(-7.19)					
GH			-0.0754***				
			(-4.15)				
GKN				-0.1325***			
				(-6.83)			
PIN					-0.1302***		
					(-3.48)		
DISP						-0.3268**	
						(-2.40)	
SCORE							-0.0082***
							(-4.34)
Analyst Following	0.0040***	0.0034***	0.0037***	0.0034***	0.0039***	0.0036***	0.0032***
	(10.12)	(8.77)	(9.10)	(8.36)	(9.74)	(8.92)	(8.24)
Quoted Spread	-1.1915***	-2.2936***	-2.3783***	-1.8643***	-1.9268***	-1.3709***	-1.5647***
	(-3.09)	(-6.32)	(-6.30)	(-5.36)	(-5.41)	(-3.09)	(-3.63)
Institutional	-0.0279**	-0.0234*	-0.0235*	-0.0159	-0.0248*	-0.0277**	-0.0232*
Ownership	(-2.02)	(-1.70)	(-1.69)	(-1.19)	(-1.82)	(-2.22)	(-1.84)
Log(GIM-Index)	-0.0264***	-0.0250***	-0.0269***	-0.0253***	-0.0281***	-0.0175***	-0.0168**
	(-3.56)	(-3.41)	(-3.64)	(-3.53)	(-3.80)	(-2.57)	(-2.48)
Log(NCA) or	-0.0605***	-0.0584***	-0.0593***	-0.0549***	-0.0602***	-0.0513***	-0.0531***
Log(Total Assets)	(-17.25)	(-16.89)	(-16.91)	(-15.94)	(-16.90)	(-16.00)	(-16.12)
Cash Flow Ratio	-0.0082***	-0.0076***	-0.0077***	-0.0068***	-0.0077***	-0.0085***	-0.0081***
	(-3.13)	(-2.94)	(-2.99)	(-2.70)	(-2.95)	(-3.53)	(-3.37)
Net Working Capital	-0.0921***	-0.0899***	-0.0904***	-0.0851***	-0.0896***	-0.0765***	-0.0757***
Ratio	(-6.49)	(-6.37)	(-6.34)	(-6.42)	(-6.28)	(-5.73)	(-5.63)
Market-to-Book	0.0297***	0.0296***	0.0295***	0.0311***	0.0290***	0.0328***	0.0321***
Ratio	(15.29)	(14.48)	(14.02)	(13.65)	(14.06)	(13.68)	(13.21)
R&D Expenditure	0.3880***	0.3976***	0.4076***	0.3928***	0.4040***	0.4476***	0.4422***
Ratio	(9.89)	(10.10)	(10.04)	(10.09)	(9.98)	(9.88)	(9.42)
Debt Ratio	-0.0687***	-0.0662***	-0.0701***	-0.0776***	-0.0707***	-0.0362**	-0.0336**
	(-4.42)	(-4.22)	(-4.48)	(-5.06)	(-4.56)	(-2.49)	(-2.30)
Dividend Dummy	-0.0227***	-0.0163***	-0.0194***	-0.0179***	-0.0227***	-0.0236***	-0.0208***
	(-4.09)	(-2.92)	(-3.55)	(-3.35)	(-4.08)	(-4.63)	(-4.11)
Acquisition	-0.1022***	-0.1003***	-0.0977***	-0.0990***	-0.0987***	-0.1180***	-0.1203***
Expenditure Ratio	(-4.64)	(-4.51)	(-4.32)	(-4.49)	(-4.48)	(-5.45)	(-5.64)
Capital	-0.2147***	-0.2126***	-0.1974***	-0.2104***	-0.1986***	-0.1624***	-0.1650***
Expenditure Ratio	(-4.88)	(-4.90)	(-4.59)	(-4.78)	(-4.62)	(-4.05)	(-4.13)
Industry Risk	0.0012*	0.0012*	0.0010	0.0010	0.0011*	-0.0002	-0.0001
	(1.93)	(1.85)	(1.55)	(1.63)	(1.80)	(-0.49)	(-0.25)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	19,285	19,125	18,799	18,693	19,210	16,153	16,153
R^2	0.68	0.67	0.67	0.67	0.67	0.70	0.70

Panel B: Results When Variables are Scaled by Total Assets

	Dependent Variable: Log(1+ Cash/Total Assets)						
	1	2	3	4	5	6	7
Intercept	0.3845***	0.3938***	0.3992***	0.4062***	0.3872***	0.3619***	0.4111***
	(20.00)	(21.05)	(21.10)	(21.53)	(19.69)	(18.74)	(19.42)
Price Impact	-0.8025						
	(-0.51)						
LSB		-0.0753***					
		(-8.46)					
GH			-0.0582***				
			(-5.56)				
GKN				-0.1070***			
				(-9.62)			
PIN					-0.0204		
					(-1.04)		
DISP						-0.0654	
						(-1.22)	
SCORE							-0.0072***
							(-6.24)
Analyst Following	0.0021***	0.0017***	0.0019***	0.0016***	0.0021***	0.0019***	0.0017***
	(9.30)	(7.84)	(8.55)	(7.22)	(9.18)	(8.76)	(7.51)
Quoted Spread	-0.4800**	-0.8410***	-0.8693***	-0.5662**	-0.5084**	-0.5816**	-0.6247**
	(-1.97)	(-3.82)	(-3.84)	(-2.59)	(-2.36)	(-2.35)	(-2.52)
Institutional	-0.0169**	-0.0143*	-0.0139*	-0.0079	-0.0158**	-0.0112	-0.0101
Ownership	(-2.13)	(-1.83)	(-1.75)	(-1.03)	(-2.01)	(-1.42)	(-1.29)
Log(GIM-Index)	-0.0199***	-0.0183***	-0.0197***	-0.0187***	-0.0203***	-0.0190***	-0.0180***
	(-4.39)	(-4.09)	(-4.33)	(-4.30)	(-4.47)	(-4.17)	(-4.02)
Log(NCA) or	-0.0232***	-0.0230***	-0.0240***	-0.0214***	-0.0232***	-0.0226***	-0.0244***
Log(Total Assets)	(-14.14)	(-14.40)	(-14.73)	(-13.73)	(-14.23)	(-14.04)	(-14.79)
Cash Flow Ratio	-0.0037**	-0.0033**	-0.0035**	-0.0033**	-0.0037**	-0.0051***	-0.0047***
	(-2.34)	(-2.12)	(-2.27)	(-2.12)	(-2.35)	(-3.15)	(-2.92)
Net Working Capital	-0.0681***	-0.0659***	-0.0679***	-0.0644***	-0.0678***	-0.0598***	-0.0587***
Ratio	(-7.17)	(-6.97)	(-7.17)	(-7.01)	(-7.16)	(-6.55)	(-6.39)
Market-to-Book	0.0133***	0.0127***	0.0129***	0.0129***	0.0132***	0.0131***	0.0116***
Ratio	(9.29)	(9.00)	(9.03)	(9.86)	(9.27)	(9.57)	(8.69)
R&D Expenditure	0.4692***	0.4500***	0.4573***	0.4742***	0.4755***	0.5596***	0.5426***
Ratio	(12.21)	(11.81)	(11.92)	(12.89)	(12.80)	(15.16)	(14.58)
Debt Ratio	-0.1669***	-0.1612***	-0.1657***	-0.1652***	-0.1659***	-0.1463***	-0.1407***
	(-17.06)	(-16.39)	(-16.73)	(-17.33)	(-17.04)	(-15.46)	(-15.00)
Dividend Dummy	-0.0295***	-0.0257***	-0.0279***	-0.0243***	-0.0294***	-0.0260***	-0.0243***
	(-8.37)	(-7.31)	(-7.92)	(-7.29)	(-8.39)	(-7.65)	(-7.15)
Acquisition	-0.1878***	-0.1867***	-0.1883***	-0.1816***	-0.1873***	-0.1920***	-0.1952***
Expenditure Ratio	(-15.80)	(-15.73)	(-15.67)	(-15.57)	(-15.74)	(-15.54)	(-15.81)
Capital	-0.3999***	-0.4012***	-0.3993***	-0.3846***	-0.3982***	-0.3686***	-0.3710***
Expenditure Ratio	(-13.50)	(-13.62)	(-13.45)	(-13.50)	(-13.47)	(-12.84)	(-12.93)
Industry Risk	0.0001	0.0002	0.0001	0.0002	0.0001	-0.0000	0.0000
	(0.47)	(0.77)	(0.44)	(0.74)	(0.47)	(-0.13)	(0.13)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	18,332	18,233	17,940	17,856	18,273	16,153	16,153
R^2	0.55	0.56	0.56	0.55	0.55	0.70	0.70

Table V
Results of the Fixed-effects Regression and the Fama-MacBeth Regression

This table shows the results of the following regression model:

$$\begin{aligned}\text{Log}(1+\text{Cash}_{i,t}/\text{NCA}_{i,t}) = {} & \beta_0 + \beta_1\,(\text{Price Impact}_{i,t}, \text{LSB}_{i,t}, \text{GH}_{i,t}, \text{GKN}_{i,t}, \text{PIN}_{i,t}, \text{DISP}_{i,t}, \text{or SCORE}_{i,t}) \\ & + \beta_2\,\text{Analyst Following}_{i,t} + \beta_3\,\text{Quoted Spread}_{i,t} + \beta_4\,\text{Institutional Ownership}_{i,t} \\ & + \beta_5\text{Log}(\text{GIM-Index}_{i,t}) + \beta_6\,\text{Log}(\text{NCA}_{i,t}) + \beta_7\,\text{Cash Flow Ratio}_{i,t} + \beta_8\text{Net Working Capital Ratio}_{i,t} \\ & + \beta_9\,\text{Market-to-Book Ratio}_{i,t} + \beta_{10}\,\text{R\&D Expenditure Ratio}_{i,t} + \beta_{11}\text{Debt Ratio}_{i,t} + \beta_{12}\text{Dividend Dummy}_{i,t} \\ & + \beta_{13}\text{Acquisition Expenditure Ratio}_{i,t} + \beta_{13}\text{Capital Expenditure Ratio}_{i,t} + \beta_{14}\,\text{Industry Risk}_{i,t} \\ & + \text{Year Dummy Variables or Industry Dummy Variables using Two-Digit SIC Industry Code} + \varepsilon_{i,t,};\end{aligned}$$

where $\text{Cash}_{i,t}/\text{NCA}_{i,t}$ is the ratio of cash and marketable securities to non-cash assets (NCA) for firm i in year t; $\text{Price Impact}_{i,t}$ is the mean price impact of trades; $\text{LSB}_{i,t}/\text{GH}_{i,t}/\text{GKN}_{i,t}$ are the Lin, Sanger, and Booth (LSB), Glosten and Harris (GH), and George, Kaul and Nimalendran (GKN) adverse selection components of the spread; $\text{PIN}_{i,t}$ is the probability of information-based trading; $\text{DISP}_{i,t}$ is the dispersion of analysts' earnings forecasts; $\text{SCORE}_{i,t}$ is the composite information asymmetry score; $\text{Analyst Following}_{i,t}$ is the number of financial analysts following the firm; $\text{Quoted Spread}_{i,t}$ is the time weighted proportional quoted bid-ask spread; $\text{Institutional Ownership}_{i,t}$ is the percentage of shares held by institutions; $\text{GIM-Index}_{i,t}$ is the GIM governance index; $\text{Cash Flow Ratio}_{i,t}$ is the ratio of earnings to NCA; $\text{Net Working Capital Ratio}_{i,t}$ is the ratio of current assets net of cash minus current liabilities to NCA; $\text{Market-to-Book Ratio}_{i,t}$ is the ratio of the book value of assets minus book value of equity plus the market value of equity to NCA; $\text{R\&D Expenditure Ratio}_{i,t}$ is the ratio of R&D expenditures to NCA; $\text{Debt Ratio}_{i,t}$ is the ratio of total debt to NCA; Dividend Dummy equals one for firms that paid a common dividend and zero otherwise; $\text{Acquisition Expenditure Ratio}_{i,t}$ is the ratio of acquisition expenditures to NCA; $\text{Capital Expenditure Ratio}_{i,t}$ is the ratio of capital expenditures to NCA; $\text{Industry Risk}_{i,t}$ is the ratio of the industry average of the standard deviation of cash flow for the past ten years to NCA; and $\varepsilon_{i,t}$ is the error term. Numbers in parenthesis are t-statistics. Panel A shows the fixed-effects regression results and Panel B shows the Fama-MacBeth regression results. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Fixed-effects Regression Results

	Dependent Variable: Log(1+ Cash/NCA)						
	1	2	3	4	5	6	7
Intercept							
Price Impact	-10.170***						
	(-6.91)						
LSB		-0.0192***					
		(-2.65)					
GH			-0.0162*				
			(-1.90)				
GKN				-0.0273***			
				(-3.16)			
PIN					-0.1224***		
					(-6.77)		
DISP						-0.1377**	
						(-2.53)	
SCORE							-0.0044***
							(-4.90)
Analyst Following	0.0025***	0.0025***	0.0026***	0.0023***	0.0025***	0.0022***	0.0021***
	(12.15)	(12.20)	(12.21)	(11.18)	(11.86)	(10.74)	(10.17)
Quoted Spread	-0.1765	-0.9101***	-0.9788***	-0.7036***	-0.7441***	-0.7464***	-0.8011***
	(-0.73)	(-4.11)	(-4.28)	(-3.26)	(-3.36)	(-2.86)	(-3.10)
Institutional	0.0289***	0.0322***	0.0316***	0.0279***	0.0308***	0.0083	0.0106
Ownership	(3.83)	(4.26)	(4.12)	(3.74)	(4.09)	(1.09)	(1.41)
Log(GIM-Index)	-0.0676***	-0.0692***	-0.0700***	-0.0622***	-0.0674***	-0.0531***	-0.0538***
	(-8.72)	(-8.86)	(-8.87)	(-8.05)	(-8.68)	(-6.81)	(-6.90)
Log(NCA)	-0.0919***	-0.0901***	-0.0899***	-0.0847***	-0.0914***	-0.0815***	-0.0827***
	(-39.55)	(-38.84)	(-38.49)	(-36.66)	(-39.42)	(-34.40)	(-34.70)
Cash Flow Ratio	-0.0064***	-0.0065***	-0.0071***	-0.0059***	-0.0062***	-0.0059***	-0.0058***
	(-5.94)	(-6.02)	(-6.54)	(-5.45)	(-5.68)	(-5.38)	(-5.33)
Net Working Capital	-0.1235***	-0.1249***	-0.1241***	-0.1154***	-0.1227***	-0.1168***	-0.1169***
Ratio	(-20.74)	(-20.81)	(-20.59)	(-19.76)	(-20.52)	(-19.29)	(-19.33)
Market-to-Book Ratio	0.0225***	0.0229***	0.0227***	0.0258***	0.0225***	0.0258***	0.0256***
	(53.58)	(52.92)	(52.34)	(54.20)	(53.44)	(52.91)	(52.37)
R&D Expenditure	0.3051***	0.3175***	0.3171***	0.2928***	0.3053***	0.3268***	0.3274***
Ratio	(27.24)	(27.72)	(27.59)	(25.40)	(27.26)	(25.48)	(25.54)
Debt Ratio	0.0655***	0.0641***	0.0631***	0.0544***	0.0641***	0.0665***	0.0673***
	(9.58)	(9.39)	(9.17)	(8.01)	(9.38)	(9.69)	(9.81)
Dividend Dummy	0.0140***	0.0150***	0.0150***	0.0139***	0.0144***	0.0113***	0.0116***
	(4.03)	(4.30)	(4.28)	(4.06)	(4.15)	(3.26)	(3.35)
Acquisition	-0.1175***	-0.1169***	-0.1182***	-0.1154***	-0.1178***	-0.1236***	-0.1240***
Expenditure Ratio	(-9.97)	(-9.91)	(-9.88)	(-9.89)	(-9.99)	(-10.60)	(-10.65)
Capital	-0.1107***	-0.1083***	-0.1056***	-0.1238***	-0.1142***	-0.1153***	-0.1179***
Expenditure Ratio	(-5.20)	(-5.08)	(-4.90)	(-5.84)	(-5.35)	(-5.42)	(-5.55)
Industry Risk	-0.0008**	-0.0008**	-0.0008**	-0.0007**	-0.0008**	-0.0008**	-0.0007**
	(-2.23)	(-2.22)	(-2.13)	(-2.18)	(-2.12)	(-2.22)	(-2.09)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	No	No	No	No	No	No	No
N	18,332	18,233	17,940	17,856	18,273	16,153	16,153
R^2	0.60	0. 60	0. 60	0.61	0. 60	0.61	0.61

Panel B: Fama-MacBeth Regression Results

	Dependent Variable: Log(1+ Cash/NCA)						
	1	2	3	4	5	6	7
Intercept	0.4812***	0.4793***	0.5024***	0.4708***	0.4914***	0.4080***	0.4472***
	(12.78)	(11.62)	(10.85)	(11.67)	(11.83)	(9.35)	(9.85)
Price Impact	-12.0295**						
	(-2.39)						
LSB		-0.0756***					
		(-4.98)					
GH			-0.1211***				
			(-3.81)				
GKN				-0.1207***			
				(-4.69)			
PIN					-0.1321***		
					(-4.81)		
DISP						-0.2110**	
						(-2.45)	
SCORE							-0.0065**
							(-2.71)
Analyst Following	0.0029***	0.0025***	0.0024***	0.0023***	0.0028***	0.0024***	0.0021***
	(5.42)	(4.87)	(4.79)	(4.67)	(5.56)	(4.46)	(3.83)
Quoted Spread	-2.2660*	-2.9448***	-3.7728***	-2.6387**	-2.6729***	-1.3709***	-4.2547**
	(-1.94)	(-3.47)	(-3.89)	(-3.47)	(-3.17)	(-3.09)	(-2.50)
Institutional	-0.0252**	-0.0185**	-0.0193**	-0.0146**	-0.0228**	-0.0218***	-0.0184**
Ownership	(-2.83)	(-2.47)	(-2.34)	(-2.22)	(-2.78)	(-3.41)	(-2.86)
Log(GIM-Index)	-0.0209***	-0.0195***	-0.0195***	-0.0190***	-0.0220***	-0.0177***	-0.0172***
	(-6.54)	(-6.35)	(-6.27)	(-5.77)	(-6.90)	(-6.37)	(-6.13)
Log(NCA)	-0.0490***	-0.0466***	-0.0480***	-0.0435***	-0.0489***	-0.0425***	-0.0431***
	(-10.72)	(-10.15)	(-9.74)	(-9.96)	(-10.02)	(-8.37)	(-8.49)
Cash Flow Ratio	0.0088	0.0056	0.0056	0.0040	0.0077	0.0054	0.0052
	(0.74)	(0.60)	(0.61)	(0.49)	(0.68)	(0.53)	(0.54)
Net Working Capital	-0.0784***	-0.0771***	-0.0778***	-0.0715***	-0.0776***	-0.0678***	-0.0669***
Ratio	(-7.70)	(-7.79)	(-7.69)	(-7.31)	(-7.58)	(-6.61)	(-6.59)
Market-to-Book	0.0351***	0.0357***	0.0356***	0.0354***	0.0350***	0.0369***	0.0364***
Ratio	(16.83)	(16.46)	(16.84)	(16.74)	(16.54)	(23.53)	(22.73)
R&D Expenditure	0.4147***	0.4094***	0.4092***	0.4145***	0.4197***	0.4994***	0.4856***
Ratio	(11.59)	(11.23)	(11.20)	(12.08)	(12.01)	(14.61)	(14.02)
Debt Ratio	-0.0533***	-0.0527***	-0.0546***	-0.0630***	-0.0550***	-0.0363***	-0.0341***
	(-7.41)	(-7.02)	(-7.24)	(-9.51)	(-7.00)	(-6.07)	(-5.45)
Dividend Dummy	-0.0271***	-0.0221***	-0.0218***	-0.0205***	-0.0266***	-0.0227***	-0.0201***
	(-10.43)	(-8.64)	(-8.45)	(-7.67)	(-10.76)	(-7.81)	(-7.07)
Acquisition	-0.1047***	-0.1003***	-0.1011***	-0.0958***	-0.1007***	-0.1105***	-0.1119***
Expenditure Ratio	(-5.84)	(-5.02)	(-5.10)	(-4.74)	(-5.50)	(-5.51)	(-5.75)
Capital	-0.1895***	-0.1785***	-0.1732***	-0.1709***	-0.1761***	-0.1485***	-0.1465***
Expenditure Ratio	(-6.04)	(-5.83)	(-6.01)	(-5.71)	(-6.01)	(-5.29)	(-5.30)
Industry Risk	0.0024	0.0018	0.0019	0.0017	0.0025	-0.0008	-0.0016*
	(0.90)	(0.70)	(0.72)	(0.70)	(0.88)	(-0.75)	(-1.94)
Year Dummies	No	No	No	No	No	No	No
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	18,332	18,233	17,940	17,856	18,273	16,153	16,153
R^2	0.70	0.70	0.70	0.69	0.70	0.69	0.69

Table VI
Regression Results using Changes in the Variables

This table shows the results of the following regression model:

$$\Delta \text{ Log}(1+ \text{Cash}_{i,t}/\text{NCA}_{i,t}) = \beta_0 + \beta_1 \Delta \text{ (Price Impact}_{i,t}, \text{LSB}_{i,t}, \text{GH}_{i,t}, \text{GKN}_{i,t}, \text{PIN}_{i,t}, \text{DISP}_{i,t}, \text{ or SCORE}_{i,t})$$
$$+ \beta_2 \Delta \text{ Analyst Following}_{i,t} + \beta_3 \Delta \text{ Quoted Spread}_{i,t} + \beta_4 \Delta \text{ Institutional Ownership}_{i,t}$$
$$+ \beta_5 \Delta \text{ Log(GIM-Index}_{i,t}) + \beta_6 \Delta \text{ Log(NCA}_{i,t}) + \beta_7 \Delta \text{ Cash Flow Ratio}_{i,t} + \beta_8 \Delta \text{ Net Working Capital Ratio}_{i,t}$$
$$+ \beta_9 \Delta \text{ Market-to-Book Ratio}_{i,t} + \beta_{10} \Delta \text{ R\&D Expenditure Ratio}_{i,t} + \beta_{11} \Delta \text{ Debt Ratio}_{i,t} + \beta_{12} \Delta \text{ Dividend Dummy}_{i,t}$$
$$+ \beta_{13} \Delta \text{ Acquisition Expenditure Ratio}_{i,t} + \beta_{14} \Delta \text{ Capital Expenditure Ratio}_{i,t} + \beta_{15} \Delta \text{ Industry Risk}_{i,t}$$
$$+ \text{Year Dummy Variables} + \text{Industry Dummy Variables using Two-Digit SIC Industry Code} + \varepsilon_{i,t};$$

where Δ is change in the variable, $\text{Cash}_{i,t}/\text{NCA}_{i,t}$ is the ratio of cash and marketable securities to non-cash assets (NCA) for firm i in year t; $\text{Price Impact}_{i,t}$ is the mean price impact of trades; $\text{LSB}_{i,t}/\text{GH}_{i,t}/\text{GKN}_{i,t}$ are the Lin, Sanger, and Booth (LSB), Glosten and Harris (GH), and George, Kaul and Nimalendran (GKN) adverse selection components of the spread; $\text{PIN}_{i,t}$ is the probability of information-based trading; $\text{DISP}_{i,t}$ is the dispersion of analysts' earnings forecasts; $\text{SCORE}_{i,t}$ is the composite information asymmetry score; $\text{Analyst Following}_{i,t}$ is the number of financial analysts following the firm; $\text{Quoted Spread}_{i,t}$ is the time weighted proportional quoted bid-ask spread; $\text{Institutional Ownership}_{i,t}$ is the percentage of shares held by institutions; $\text{GIM-Index}_{i,t}$ is the GIM governance index; $\text{Cash Flow Ratio}_{i,t}$ is the ratio of earnings to NCA; $\text{Net Working Capital Ratio}_{i,t}$ is the ratio of current assets net of cash minus current liabilities to NCA; $\text{Market-to-Book Ratio}_{i,t}$ is the ratio of the book value of assets minus book value of equity plus the market value of equity to NCA; $\text{R\&D Expenditure Ratio}_{i,t}$ is the ratio of R&D expenditures to NCA; $\text{Debt Ratio}_{i,t}$ is the ratio of total debt to NCA; Dividend Dummy equals one for firms that paid a common dividend and zero otherwise; $\text{Acquisition Expenditure Ratio}_{i,t}$ is the ratio of acquisition expenditures to NCA; $\text{Capital Expenditure Ratio}_{i,t}$ is the ratio of capital expenditures to NCA; $\text{Industry Risk}_{i,t}$ is the ratio of the industry average of the standard deviation of cash flow for the past ten years to NCA; and $\varepsilon_{i,t}$ is the error term. Numbers in parenthesis are t-statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable: ΔLog(1+ Cash/NCA)							
	Δ Price Impact	Δ LSB	Δ GH	Δ GKN	Δ PIN	Δ DISP	ΔSCORE
	1	2	3	4	5	6	7
Intercept	0.0068	0.0051	0.0050	0.0065	0.0087*	0.0077*	0.0076*
	(1.44)	(1.09)	(1.04)	(1.37)	(1.87)	(1.72)	(1.69)
Δ Information Asymmetry	-8.7343***	-0.0150***	-0.0141*	-0.0219**	-0.0431***	-0.2426**	-0.0031***
	(-3.57)	(-2.78)	(-1.77)	(-2.40)	(-2.63)	(-2.41)	(-3.51)
Δ Analyst Following	0.0014***	0.0015***	0.0016***	0.0013***	0.0014***	0.0011***	0.0010***
	(5.09)	(5.42)	(5.58)	(4.71)	(5.18)	(3.72)	(3.66)
Δ Quoted Spread	-1.6344***	-2.4322***	-2.5523***	-2.0998***	-2.3887***	-2.3846***	-2.4392***
	(-3.86)	(-6.11)	(-6.21)	(-5.39)	(-6.00)	(-4.75)	(-4.92)
Δ Institutional Ownership	0.0312***	0.0313***	0.0287***	0.0253***	0.0320***	0.0117	0.0128
	(3.68)	(3.71)	(3.37)	(3.00)	(3.75)	(1.42)	(1.55)
Δ Log(GIM-Index)	0.0118	0.0138	0.0166	0.0013	0.0117	0.0075	0.0069
	(0.87)	(0.98)	(1.20)	(0.10)	(0.85)	(0.57)	(0.52)

Δ Log(NCA)	-0.1736***	-0.1709***	-0.1726***	-0.1635***	-0.1727***	-0.1534***	-0.1541***
	(-21.31)	(-21.26)	(-21.17)	(-19.48)	(-21.19)	(-18.06)	(-18.03)
Δ Cash Flow Ratio	0.0002	-0.0001	-0.0004	-0.0003	0.0003	0.0010	0.0009
	(0.12)	(-0.03)	(-0.23)	(-0.20)	(0.20)	(0.56)	(0.55)
Δ Net Working Capital	-0.1181***	-0.1179***	-0.1163***	-0.1092***	-0.1169***	-0.0856***	-0.0858***
Ratio	(-4.32)	(-4.22)	(-4.18)	(-4.11)	(-4.29)	(-3.22)	(-3.23)
Δ Market-to-Book Ratio	0.0183***	0.0185***	0.0188***	0.0221***	0.0182***	0.0244***	0.0244***
	(10.51)	(9.88)	(10.36)	(11.14)	(10.31)	(13.16)	(13.16)
Δ R&D Expenditure Ratio	0.2304***	0.2496***	0.2459***	0.2340***	0.2324***	0.2337***	0.2320***
	(5.32)	(5.65)	(5.61)	(5.32)	(5.35)	(3.97)	(3.95)
Δ Debt Ratio	0.0646	0.0650	0.0639	0.0590	0.0645	0.0576	0.0576
	(1.54)	(1.55)	(1.52)	(1.40)	(1.55)	(1.39)	(1.39)
Dividend Dummy	0.0047	0.0046	0.0048	0.0032	0.0042	0.0027	0.0028
	(1.09)	(1.08)	(1.08)	(0.79)	(0.98)	(0.63)	(0.65)
Δ Acquisition Expenditure	-0.0983***	-0.0995***	-0.1037***	-0.0900***	-0.0998***	-0.1002***	-0.1001***
Ratio	(-5.86)	(-5.88)	(-6.03)	(-5.42)	(-5.95)	(-6.00)	(-6.00)
Δ Capital	-0.0497*	-0.0532*	-0.0540*	-0.0581**	-0.0516*	-0.0489*	-0.0491*
Expenditure Ratio	(-1.77)	(-1.91)	(-1.90)	(-2.12)	(-1.83)	(-1.91)	(-1.92)
Δ Industry Risk	-0.0003	-0.0003	-0.0005	-0.0004	-0.0002	-0.0000	-0.0000
	(-0.78)	(-0.77)	(-1.00)	(-0.90)	(-0.46)	(-0.10)	(-0.03)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	15,290	15,198	14,717	14,685	15,204	12,798	12,798
R^2	0.46	0.45	0.45	0.45	0.46	0.45	0.45

Table VII
Testing Whether Information Asymmetry Affects Corporate Decisions to Payout Cash

To examine how information asymmetry affects the firm's dividend payout and share repurchase decisions, we estimate the following regression model:

$$\text{Dividend Increase}_{i,t} \text{ or Repurchase Change}_{i,t} = \beta_0 + \beta_1 \text{ Residual Cash}_{i,t-1} + \beta_2 (\text{Price Impact}_{i,t}, \text{LSB}_{i,t}, \text{GH}_{i,t}, \text{GKN}_{i,t}, \text{PIN}_{i,t}, \text{DISP}_{i,t}, \text{or SCORE}_{i,t}) + \beta_3 \text{ Residual Cash}_{i,t-1} * (\text{Price Impact}_{i,t}, \text{LSB}_{i,t}, \text{GH}_{i,t}, \text{GKN}_{i,t}, \text{or PIN}_{i,t}) + \beta_4 \text{ Institutional Ownership}_{i,t} + \beta_5 \text{ Idiosyncratic Risk}_{i,t} + \beta_6 \text{ Firm Age}_{i,t} + \beta_7 \text{Sales Growth}_{i,t} + \beta_8 \text{ Market-to-Book Ratio}_{i,t} + \beta_9 \text{Price-Earning Ratio}_{i,t} + \beta_{10} \text{ Annual Return}_{i,t-1} + \beta_{11} \text{ Log(MVE}_{i,t-1}) + \text{Industry Dummy Variables using Two-Digit SIC Industry Code} + \varepsilon_{i,t};$$

where Dividend Increase$_{i,t}$ is the percentage increase in the annual cash dividend; Repurchase Change$_{i,t}$ is the change in the annual repurchase amount from year t-1 to year t scaled by the market value of equity at the beginning of year t; Residual Cash$_{i,t-1}$ is the residual from a modified version of regression model (8); Idiosyncratic Risk is $\log[(1- R^2)/ R^2]$, where R^2 is the coefficient of determination estimated from an expanded market model; Firm Age is the number of years since the firm first appeared in the CRSP database; Sales Growth is the percentage change in annual sales; Price-Earnings Ratio is the ratio of stock price to net income per share; Annual Return is the logarithm of the continuously compounded annual stock return; MVE is the market value of equity; and all other variables are the same as defined in regression model (8). Panel A shows the Tobit-regression results for Dividend Increase and Panel B shows the OLS results for Repurchase Change. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Tobit Regression Results for Dividend Increase

	Dependent Variable: Dividend Increase							
		Price Impact	LSB	GH	GKN	PIN	DISP	SCORE
	1	2	3	4	5	6	7	8
Intercept	-0.3156***	-0.3575***	-0.3568***	-0.3741***	-0.3438***	-0.3773***	-0.3470***	-0.2794**
	(-2.78)	(-3.07)	(-3.20)	(-3.32)	(-3.11)	(-3.15)	(-3.06)	(-2.27)
Residual Cash $_{t-1}$	0.3218***	0.1587**	0.0807	0.1673*	0.0263	-0.2222*	0.2366***	-0.3721**
	(5.95)	(2.10)	(0.81)	(1.76)	(0.19)	(-1.73)	(4.18)	(-2.01)
Information Asymmetry $_{t-1}$		9.2579	-0.0701*	0.0139	0.0044	0.2154	-10.5656***	-0.0133**
		(0.93)	(-1.85)	(0.30)	(0.07)	(1.63)	(-5.39)	(-2.29)
Residual Cash $_{t-1}$		164.4145***	0.7074***	0.5051*	0.9432**	3.5293***	31.0919***	0.1282***
* Information Asymmetry $_{t-1}$		(3.11)	(2.70)	(1.77)	(2.51)	(4.70)	(4.52)	(3.61)
Institutional Ownership $_{t}$	-0.1865***	-0.1736***	-0.1554***	-0.1607***	-0.1810***	-0.1791***	-0.1344***	-0.1354***
	(-5.53)	(-5.09)	(-4.83)	(-4.92)	(-5.76)	(-5.22)	(-3.89)	(-3.92)
Idiosyncratic	0.0103	0.0108	0.0062	0.0049	0.0050	0.0095	0.0058	0.0046
Risk $_{t}$	(1.27)	(1.34)	(0.80)	(0.63)	(0.67)	(1.18)	(0.73)	(0.59)
Firm Age $_{t}$	-0.0037***	-0.0037***	-0.0031***	-0.0032***	-0.0030***	-0.0036***	-0.0032***	-0.0032***
	(-10.28)	(-10.44)	(-9.22)	(-9.33)	(-9.12)	(-9.89)	(-8.99)	(-9.16)
Sale Growth $_{t}$	0.0272	0.0291	0.0306	0.0315	0.0366	0.0267	0.0254	0.0298
	(0.89)	(0.96)	(1.05)	(1.07)	(1.29)	(0.88)	(0.84)	(0.99)
Market-to-Book Ratio $_{t}$	0.0211***	0.0212***	0.0218***	0.0227***	0.0208***	0.0207***	0.0184***	0.0196***
	(3.38)	(3.43)	(3.70)	(3.83)	(3.56)	(3.34)	(3.02)	(3.21)

Price-Earnings Ratio $_t$	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0003	0.0003
	(0.51)	(0.59)	(0.60)	(0.59)	(0.57)	(0.31)	(0.86)	(0.87)
Annual Return $_{t-1}$	0.1484***	0.1388***	0.1447***	0.1485***	0.1356***	0.1468***	0.1218***	0.1360**
	(6.93)	(6.51)	(7.14)	(7.22)	(6.85)	(6.81)	(5.63)	(6.30)
Log(MVE $_{t-1}$)	0.0466***	0.0505***	0.0439***	0.0433***	0.0427***	0.0507***	0.0404***	0.0393***
	(8.72)	(8.49)	(8.68)	(8.36)	(8.65)	(8.63)	(7.41)	(6.62)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	10,874	10,874	10,781	10,543	10,525	10,852	9,558	9,558
Pseudo R^2	0.06	0.06	0.06	0.06	0.06	0. 06	0. 07	0. 07

Panel B: OLS Regression Results for Repurchase Change

	Dependent Variable: Repurchase Change							
		Price Impact	LSB	GH	GKN	PIN	DISP	SCORE
	1	2	3	4	5	6	7	8
Intercept	-0.0228***	-0.0224***	-0.0237***	-0.0211***	-0.0183**	-0.0228***	-0.0198**	-0.0219**
	(-3.21)	(3.16)	(-3.24)	(-2.62)	(-2.26)	(-3.21)	(-2.41)	(-2.42)
Residual Cash $_{t-1}$	0.0049***	0.0050***	-0.0006	-0.0019	-0.0044	-0.0020	0.0056***	-0.0279*
	(3.84)	(3.44)	(-0.21)	(-0.63)	(-0.64)	(-0.42)	(3.48)	(-1.94)
Information Asymmetry $_{t-1}$		-0.1422	0.0019	0.0025	-0.0034	0.0127*	0.0001***	0.0002
		(-0.11)	(0.91)	(0.63)	(-0.97)	(1.80)	(3.61)	(0.56)
Residual Cash $_{t-1}$		0.1874	0.0242***	0.0410***	0.0320*	0.0492**	0.0002***	0.0062**
* Information Asymmetry $_{t-1}$		(0.83)	(2.70)	(2.65)	(1.82)	(2.02)	(3.13)	(2.40)
Institutional Ownership $_{t}$	-0.0063***	-0.0065***	-0.0068***	-0.0069***	-0.0064***	-0.0055***	-0.0074***	-0.0072***
	(-5.89)	(-5.91)	(-6.07)	(-5.86)	(-5.44)	(-4.66)	(-5.22)	(-4.90)
Idiosyncratic	0.0006	0.0006	0.0007*	0.0008*	0.0007	0.0006	0.0006	0.0007
Risk $_{t}$	(1.54)	(1.56)	(1.71)	(1.83)	(1.61)	(1.55)	(1.31)	(1.38)
Firm Age $_{t}$	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***
	(-4.49)	(-4.44)	(-4.80)	(-3.91)	(-3.93)	(-3.70)	(-2.97)	(-2.83)
Sale Growth $_{t}$	-0.0000**	-0.0000**	-0.0000**	-0.0000**	-0.0000**	-0.0000*	-0.0000***	-0.0000***
	(-2.12)	(-2.08)	(-2.17)	(-1.97)	(-2.05)	(-1.90)	(-3.39)	(-3.53)
Market-to-Book Ratio $_{t}$	0.0002	0.0002	0.0003*	0.0003*	0.0002	0.0002	0.0002	0.0003
	(1.27)	(1.28)	(1.85)	(1.70)	(1.13)	(1.42)	(0.91)	(1.25)
Price-Earnings Ratio $_{t}$	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000
	(1.04)	(1.02)	(0.95)	(1.02)	(1.03)	(0.87)	(0.91)	(0.87)
Annual Return $_{t-1}$	0.0062***	0.0062***	0.0062***	0.0061***	0.0065***	0.0060***	0.0074***	0.0073***
	(7.79)	(7.74)	(7.72)	(7.56)	(7.89)	(7.09)	(7.40)	(7.22)
Log(MVE $_{t-1}$)	0.0007***	0.0007***	0.0008***	0.0008***	0.0007***	0.0010***	0.0005**	0.0007**
	(3.53)	(3.35)	(3.76)	(3.46)	(3.22)	(3.76)	(1.98)	(1.99)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	11,057	11,057	10,786	10,353	10,237	10,877	8,691	8,691
Pseudo R^2	0.07	0.07	0.07	0.08	0.08	0.07	0.08	0.08

Table VIII
Testing Whether the Effects of Cash Holdings on Firm Value Vary with Information Asymmetry

This table shows the results of the following regression model:

$$\frac{MV_{i,t}}{NCA_{i,t}} = \beta_0 + \beta_1 \frac{E_{i,t}}{NCA_{i,t}} + \beta_2 \frac{dE_{i,t+2}}{NCA_{i,t}} + \beta_3 \frac{dE_{i,t-2}}{NCA_{i,t}} + \beta_4 \frac{RD_{i,t}}{NCA_{i,t}} + \beta_5 \frac{dRD_{i,t+2}}{NCA_{i,t}} + \beta_6 \frac{dRD_{i,t-2}}{NCA_{i,t}} + \beta_7 \frac{D_{i,t}}{NCA_{i,t}} + \beta_8 \frac{dD_{i,t+2}}{NCA_{i,t}} + \beta_9 \frac{dD_{i,t-2}}{NCA_{i,t}}$$
$$+ \beta_{10} \frac{I_{i,t}}{NCA_{i,t}} + \beta_{11} \frac{dI_{i,t+2}}{NCA_{i,t}} + \beta_{12} \frac{dI_{i,t-2}}{NCA_{i,t}} + \beta_{13} \frac{dNCA_{i,t+2}}{NCA_{i,t}} + \beta_{14} \frac{dNCA_{i,t-2}}{NCA_{i,t}} + \beta_{15} \frac{dMV_{i,t+2}}{NCA_{i,t}}$$
$$+ \beta_{16} \text{Excess Cash}_{i,t} + \beta_{17} \text{HIA Dummy}_{i,t} + \beta_{18} (\text{Excess Cash}_{i,t} * \text{HIA Dummy}_{i,t}) + \varepsilon_{i,t};$$

where X_t is the value of variable X in year t; dX_{t+2} is the change in X from year t to year t + 2 (i.e., $X_{t+2} - X_t$); dX_{t-2} is the change in X from year t – 2 to year t (i.e., $X_t - X_{t-2}$); MV is the market value of the firm (i.e., the sum of the market value of equity, the book value of short-term debt, and the book value of long-term debt); NCA is "non-cash assets" (defined as total assets minus liquid assets); E is earnings before extraordinary items plus interest, deferred tax credits, and investment tax credits; RD is research and development spending; D is common dividends paid; and I is interest expense. We estimate Excess $Cash_{i,t}$ for each firm in each year using the 2SLS method of Dittmar and Mahrt-Smith (2007). The dummy variable for high information asymmetry, HIA $Dummy_{i,t}$, equals one for firms that belong to the top third of each information asymmetry measure, and zero for firms in the bottom third. Panel A shows the fixed-effects regression results and Panel B show the Fama-MacBeth regression results. Numbers in parenthesis are t-statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Fixed-Effects Regression Results

	Dependent Variable: $MV_{i,t}/NCA_{i,t}$						
	Price Impact	LSB	GH	GKN	PIN	DISP	SCORE
	1	2	3	4	5	6	7
$E_{i,t}/NCA_{i,t}$	-0.1787***	0.0963	0.1932***	0.3831***	-0.3312***	2.0501***	2.1760***
	(-2.86)	(1.38)	(2.63)	(5.02)	(-4.40)	(18.13)	(18.76)
$dE_{i,t+2}/NCA_{i,t}$	-0.0434***	-0.0387***	-0.2450***	-0.0860***	-0.0477***	-0.0129	-0.0070
	(-3.77)	(-3.23)	(-6.45)	(-4.79)	(-4.11)	(-1.20)	(-0.67)
$dE_{i,t-2}/NCA_{i,t}$	-0.0392***	0.0170	0.0435***	0.0025	-0.0301**	-0.0419***	0.0095
	(-3.34)	(1.45)	(3.51)	(0.20)	(-2.37)	(-2.93)	(0.59)
$RD_{i,t}/NCA_{i,t}$	3.3018***	4.7769***	4.2708***	4.1108***	4.7799***	6.3279***	6.2807***
	(31.96)	(46.08)	(36.28)	(36.28)	(39.10)	(41.20)	(39.86)
$dRD_{i,t+2}/NCA_{i,t}$	-0.0213	0.0725***	-0.0251	-0.0393	-0.0051	0.0691***	0.0691***
	(-0.96)	(3.46)	(-1.23)	(-0.85)	(-0.23)	(3.49)	(3.59)
$dRD_{i,t-2}/NCA_{i,t}$	-0.0469**	-0.0368	-0.0670**	-0.0861**	-0.0577**	-0.0610	-0.0569
	(-2.12)	(-1.55)	(-2.28)	(-2.17)	(-2.30)	(-1.58)	(-1.51)
$D_{i,t}/NCA_{i,t}$	-0.1584	-0.1911	-0.2179	-0.1613	-0.5860***	0.2277	1.2036
	(-0.64)	(-1.25)	(-0.97)	(-0.32)	(-2.97)	(0.24)	(1.07)

$dD_{i,t+2}/NCA_{i,t}$	0.0213	-0.0269	0.2606	-0.1577*	-0.0502	1.0854*	0.9182
	(0.10)	(-0.37)	(1.61)	(-1.91)	(-0.37)	(1.73)	(1.36)
$dD_{i,t-2}/NCA_{i,t}$	0.1319**	-0.0437	0.2279**	-0.2686**	0.4190***	0.3529**	0.0029
	(2.04)	(-0.53)	(2.16)	(-2.37)	(4.95)	(2.12)	(0.02)
$I_{i,t}/NCA_{i,t}$	4.4741***	5.1830***	4.9440***	-0.4618	-0.6899	-16.2002***	-17.0008***
	(5.29)	(8.04)	(8.08)	(-0.31)	(-0.62)	(-6.03)	(-6.22)
$dI_{i,t+2}/NCA_{i,t}$	-0.2137***	-0.0206	-0.2616***	-0.2950***	-0.0000	-0.1606	-0.2012
	(-3.29)	(-0.12)	(-3.93)	(-4.25)	(-0.00)	(-0.87)	(-1.11)
$dI_{i,t-2}/NCA_{i,t}$	-0.0186	-0.0255*	0.0812*	-0.0099	0.1174***	0.0399**	-0.0162
	(-0.56)	(-1.85)	(1.84)	(-0.66)	(5.91)	(2.43)	(-0.89)
$dNCA_{i,t+2}/NCA_{i,t}$	0.0080***	0.0013	0.0084***	0.0230***	0.0089***	0.0033**	0.0036**
	(4.90)	(0.74)	(4.91)	(2.83)	(3.18)	(2.06)	(2.33)
$dNCA_{i,t-2}/NCA_{i,t}$	0.0003	0.0001	-0.0146***	0.0005**	-0.0071***	0.0002	0.0003
	(1.31)	(0.65)	(-5.98)	(2.19)	(-4.41)	(0.69)	(1.27)
$dMV_{i,t+2}/NCA_{i,t}$	-0.0074***	-0.0345***	-0.0088**	-0.0285***	-0.0497***	-0.0087*	-0.0060
	(-3.18)	(-12.68)	(-2.01)	(-7.04)	(-13.44)	(-1.77)	(-1.17)
Excess $Cash_{i,t}$	14.5336***	13.1254***	14.0729***	13.8129***	12.1288***	13.7128***	12.9014***
	(31.32)	(46.55)	(46.88)	(43.38)	(30.57)	(32.27)	(33.70)
HIA $Dummy_{i,t}$	-0.3444***	-1.2007***	-0.6357***	-0.8907***	0.0211	-0.9690***	-0.6118***
	(-2.75)	(-10.30)	(-5.74)	(-7.40)	(0.19)	(-7.62)	(-5.11)
Excess $Cash_{i,t}$*	-1.6314***	-5.6052***	-5.4441***	-3.1125***	-2.2509***	-1.9587***	-1.5699***
HIA $Dummy_{i,t}$	(-2.97)	(-10.05)	(-10.72)	(-5.76)	(-4.64)	(-3.30)	(-2.70)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	9,759	9,468	9,218	9,158	9,665	6,423	6,395
R^2	0.46	0.50	0.49	0.49	0.47	0.53	0.53

Panel B: Fama-MacBeth Regression Results

	Dependent Variable: $MV_{i,t}/NCA_{i,t}$						
	Price Impact	LSB	GH	GKN	PIN	DISP	SCORE
	1	2	3	4	5	6	7
Excess $Cash_{i,t}$	11.7343***	10.4013***	9.9903***	9.9171***	9.9302***	10.7348***	9.5789***
	(9.74)	(14.97)	(11.76)	(13.60)	(6.69)	(13.16)	(11.74)
HIA $Dummy_{i,t}$	-0.6459**	-0.8144***	-0.3785*	-0.6672***	-0.3334*	-1.3169***	-0.6761***
	(-2.50)	(-3.86)	(-1.88)	(-3.47)	(-1.94)	(-7.67)	(-3.14)
Excess $Cash_{i,t}$*	-3.1955**	-5.3653***	-4.0255***	-2.6800**	-3.2475**	-2.5969**	-3.6038***
HIA $Dummy_{i,t}$	(-2.26)	(-5.34)	(-4.40)	(-2.13)	(-2.40)	(-2.36)	(-3.22)
N	9,759	9,468	9,218	9,158	9,665	6,423	6,395
R^2	0.68	0.70	0.72	0.73	0.67	0.78	0.79

Table IX
Testing Whether the Effect of Cash Holdings on Firm Value Vary with Information Asymmetry Regardless of Corporate Governance Structure

This table shows the results of the following regression model:

$$\frac{MV_{i,t}}{NCA_{i,t}} = \beta_0 + \beta_1 \frac{E_{i,t}}{NCA_{i,t}} + \beta_2 \frac{dE_{i,t+2}}{NCA_{i,t}} + \beta_3 \frac{dE_{i,t-2}}{NCA_{i,t}} + \beta_4 \frac{RD_{i,t}}{NCA_{i,t}} + \beta_5 \frac{dRD_{i,t+2}}{NCA_{i,t}} + \beta_6 \frac{dRD_{i,t-2}}{NCA_{i,t}} + \beta_7 \frac{D_{i,t}}{NCA_{i,t}} + \beta_8 \frac{dD_{i,t+2}}{NCA_{i,t}} + \beta_9 \frac{dD_{i,t-2}}{NCA_{i,t}}$$
$$+ \beta_{10} \frac{I_{i,t}}{NCA_{i,t}} + \beta_{11} \frac{dI_{i,t+2}}{NCA_{i,t}} + \beta_{12} \frac{dI_{i,t-2}}{NCA_{i,t}} + \beta_{13} \frac{dNCA_{i,t+2}}{NCA_{i,t}} + \beta_{14} \frac{dNCA_{i,t-2}}{NCA_{i,t}} + \beta_{15} \frac{dMV_{i,t+2}}{NCA_{i,t}}$$
$$+ \beta_{16} \text{Excess Cash}_{i,t} + \beta_{17} \text{HIA Dummy}_{i,t} + \beta_{18} (\text{Excess Cash}_{i,t} * \text{HIA Dummy}_{i,t})$$
$$+ \beta_{19} \text{LGIM}_{i,t} + \beta_{20} (\text{Excess Cash}_{i,t} * \text{LGIM}_{i,t}) + \varepsilon_{i,t};$$

where X_t is the value of variable X in year t; dX_{t+2} is the change in X from year t to year t + 2 (i.e., $X_{t+2} - X_t$); dX_{t-2} is the change in X from year t – 2 to year t (i.e., $X_t - X_{t-2}$); MV is the market value of the firm (i.e., the sum of the market value of equity, the book value of short-term debt, and the book value of long-term debt); NCA is "non-cash assets" (defined as total assets minus liquid assets); E is earnings before extraordinary items plus interest, deferred tax credits, and investment tax credits; RD is research and development spending; D is common dividends paid; and I is interest expense. We estimate Excess $Cash_{i,t}$ for each firm in each year using the 2SLS method of Dittmar and Mahrt-Smith (2007). The dummy variable for high information asymmetry, HIA $Dummy_{i,t}$, equals one for firms that belong to the top third of each information asymmetry measure, and zero for firms in the bottom third. LGIM equals one for firms that have below-median GIM governance indices and zero otherwise. Panel A shows the fixed-effects regression results and Panel B shows the Fama-MacBeth regression results. Numbers in parenthesis are t-statistics. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Fixed-Effects Regression Results

	Dependent Variable: $MV_{i,t}/NCA_{i,t}$						
	Price Impact	LSB	GH	GKN	PIN	DISP	SCORE
	1	2	3	4	5	6	7
$E_{i,t}/NCA_{i,t}$	3.8838***	4.7756***	3.6165***	3.9985***	3.6117***	3.5613***	3.8015***
	(16.27)	(21.29)	(15.77)	(18.53)	(15.79)	(12.45)	(13.74)
$dE_{i,t+2}/NCA_{i,t}$	1.4222***	1.5052***	1.4713***	0.2897**	1.5935***	0.3321**	0.2805*
	(7.50)	(8.35)	(8.33)	(1.97)	(8.90)	(2.09)	(1.73)
$dE_{i,t-2}/NCA_{i,t}$	0.1057*	0.0462	0.0167	0.1017*	0.0867	0.0121	-0.3349**
	(1.88)	(0.88)	(0.33)	(1.86)	(1.63)	(0.09)	(-2.36)
$RD_{i,t}/NCA_{i,t}$	11.2151***	9.4602***	9.6062***	9.3882***	12.8364***	10.0739***	10.8789***
	(25.92)	(24.15)	(27.52)	(27.97)	(29.92)	(28.35)	(27.49)
$dRD_{i,t+2}/NCA_{i,t}$	4.6342***	5.7449***	5.6474***	2.9804***	3.3744***	4.2455***	4.3042***

	(14.49)	(17.27)	(14.67)	(12.18)	(11.20)	(14.46)	(13.41)
$dRD_{i,t-2}/NCA_{i,t}$	-0.1244	1.4976***	0.7380*	5.6540***	2.9092***	-0.7724*	1.2217**
	(-0.25)	(3.49)	(1.77)	(8.40)	(5.14)	(-1.71)	(-2.55)
$D_{i,t}/NCA_{i,t}$	6.5904***	4.4318***	4.8461***	12.5978***	8.4519***	10.9093***	19.7467***
	(5.71)	(4.12)	(4.77)	(11.69)	(6.15)	(9.02)	(13.26)
$dD_{i,t+2}/NCA_{i,t}$	0.0467	-0.4388	-0.5373	9.3551***	0.6509***	5.0493***	5.1610***
	(0.07)	(-0.71)	(-0.99)	(9.24)	(0.84)	(6.52)	(5.76)
$dD_{i,t-2}/NCA_{i,t}$	-0.3996	-1.6211**	-1.4103**	-1.2738**	-6.3644***	-3.6245***	-0.8127
	(-0.51)	(-2.11)	(-2.01)	(-2.02)	(-4.24)	(-3.15)	(-0.53)
$I_{i,t}/NCA_{i,t}$	-16.9196	-18.5796***	-23.8584**	-9.8398***	-17.6011***	-13.1452***	-10.4985***
	(-7.68)	(-8.26)	(-10.86)	(-5.28)	(-8.01)	(-5.56)	(-4.43)
$dI_{i,t+2}/NCA_{i,t}$	-21.4150***	-12.0262***	-11.1988***	-12.7326***	-23.2229***	-9.6445***	-8.6642***
	(-11.51)	(-8.28)	(-7.75)	(-10.52)	(-11.97)	(-6.96)	(-6.30)
$dI_{i,t-2}/NCA_{i,t}$	-8.7046***	-9.4169***	-18.7537***	3.7015*	-10.0887***	-5.3022*	-13.5626***
	(-9.20)	(-10.55)	(-8.69)	(1.83)	(-10.65)	(-1.75)	(-4.50)
$dNCA_{i,t+2}/NCA_{i,t}$	0.7782***	0.4966***	0.4963***	0.5357***	0.7438***	0.4957***	0.6201***
	(17.41)	(12.24)	(12.18)	(15.50)	(17.37)	(13.16)	(16.01)
$dNCA_{i,t-2}/NCA_{i,t}$	0.1290***	0.1192***	0.4172***	-0.0284	0.1927***	0.2705***	0.5825***
	(3.41)	(3.38)	(6.72)	(-0.45)	(5.15)	(3.71)	(7.17)
$dMV_{i,t+2}/NCA_{i,t}$	-0.0958***	-0.0629***	-0.0822***	-0.0022	-0.0261***	0.0064	-0.0133*
	(-7.88)	(-7.23)	(-6.01)	(-0.29)	(-2.70)	(0.85)	(-1.71)
Excess $Cash_{i,t}$	8.9150***	8.9967***	10.3254***	7.5970***	7.0062***	9.4725***	8.0927***
	(28.07)	(28.77)	(29.85)	(25.97)	(24.01)	(28.12)	(26.95)
HIA $Dummy_{i,t}$	-0.5189***	-0.5160***	-0.4432***	-0.3334***	-0.3941***	-0.8725***	-0.5553***
	(-4.37)	(-5.69)	(-5.50)	(-4.49)	(-3.69)	(-10.07)	(-7.08)
Excess $Cash_{i,t}$*	-6.7826***	-6.7618***	-7.6060***	-4.6326***	-4.6555***	-7.4667***	-6.9615***
HIA $Dummy_{i,t}$	(-9.53)	(-14.41)	(-15.80)	(-11.19)	(-7.96)	(-14.30)	(-14.38)
$LGIM_{i,t}$	0.1850**	0.0437	0.1034	0.1072	0.1202	0.1512**	0.1846**
	(2.34)	(0.55)	(1.34)	(1.60)	(1.54)	(2.03)	(2.49)
Excess $Cash_{i,t}$*	3.5597***	1.6004***	1.4833***	1.1362***	2.9113***	1.8066***	2.5819***
$LGIM_{i,t}$	(6.69)	(3.33)	(3.03)	(2.74)	(6.08)	(3.63)	(5.53)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4,517	4,346	4,328	4,299	4,472	3,665	3,625
R^2	0.53	0.55	0.53	0.59	0.53	0.61	0.63

Panel B: Fama-MacBeth Regression Results

	Dependent Variable: $MV_{i,t}/NCA_{i,t}$						
	Price Impact	LSB	GH	GKN	PIN	DISP	SCORE
	1	2	3	4	5	6	7
Excess $Cash_{i,t}$	6.2847***	7.2728***	6.9730***	5.6909***	5.6775***	7.1798***	6.2859***
	(7.53)	(6.56)	(4.87)	(4.64)	(5.81)	(7.02)	(6.15)
HIA $Dummy_{i,t}$	0.0638	-0.3541***	-0.1568	-0.3069***	-0.1210	-0.5285***	-0.3905***
	(0.49)	(-4.34)	(-1.27)	(-4.47)	(-1.22)	(-5.29)	(-5.34)
Excess $Cash_{i,t}$*	-4.9147***	-4.9970***	-4.2066***	-2.8547**	-3.6259***	-4.4853***	-4.3008***
HIA $Dummy_{i,t}$	(-4.25)	(-3.68)	(-3.19)	(-2.34)	(-3.35)	(-5.15)	(-4.17)
$LGIM_{i,t}$	-0.0009	-0.0725	-0.0419	0.0445	0.0255	0.1360**	0.1181*
	(-0.02)	(-1.31)	(-0.66)	(0.81)	(0.35)	(2.01)	(1.88)
Excess $Cash_{i,t}$*	0.0463	-1.1667	-1.7697*	0.0788	1.0111	1.7568*	1.2917
$LGIM_{i,t}$	(0.05)	(-1.75)	(-1.76)	(0.19)	(1.04)	(1.80)	(1.33)
N	4,517	4,346	4,328	4,299	4,472	3,665	3,625
R^2	0.74	0.72	0.72	0.72	0.73	0.76	0.78