Financial crisis and corporate cash holdings: Evidence from East Asian firms

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Abstract

We investigate the long-term effect of the Asian financial crisis on corporate cash holdings in eight East Asian countries. The mean (median) cash to assets ratio for the Asian firms increases to 16.6% (12.2%) in 2005 from 10.7% (6.6%) in 1996. The sudden increase of the firms' cash holdings after the crisis is pervasive regardless of firm size, dividend payout, and profitability. Asian firms show a higher propensity to save cash out of their cash flows (the higher cash flow sensitivity of cash) after the crisis regardless of financial distress. We find that the increase in cash holdings is related to the firms' increased sensitivities to cash flow risk or stock return volatility. The financial crisis has systematically changed the cash holding policies of the Asian firms over the long-term. These findings are partially consistent with the precautionary motive of cash holdings in that the firms increase cash holdings to better manage their risk after they experience exogenous shocks of the Asian financial crisis.

1. **Introduction**

The recent financial crisis has highlighted once again the importance of firms' demand on liquid assets. For many non-financial companies, external financing become too expensive and/or difficult to obtain due to the tight financial markets in a period of crisis. Therefore, the firms tend to make efforts to increase cash holdings to avoid raising external capital such as bank loans, bond offerings, and equity offerings. According to the Liquidity Management Poll conducted by the American Productivity & Quality Center in March 2009, nine of 10 finance executives report that their companies have taken proactive measures to increase their cash holdings and made their liquidity management a top corporate priority[1]. Although macroeconomic shocks affect the liquidity management policies of firms, there has been little research on the relation between financial crisis and changes in corporate cash holdings. To fill the void, we investigate the long-term effect of the Asian financial crisis on changes in the firms' cash-holding policies.

Previous literature has extensively studied the motives that firms hold cash far in excess of transaction needs using mostly U.S. data. They find that precautionary motive, agency motive, and tax motive have some explanatory power for variation in the firms' cash holdings. They find that small firms, firms with more growth opportunities, and those facing more volatile cash flows hold more cash, which is consistent with the precautionary motive. In addition to those factors, macroeconomic conditions could be an important determinant of firms' cash-holding behavior. However, only a few studies have examined the relation between macroeconomic uncertainty and the firms' cash holdings. Baum, Caglayan, Ozkan, and Talavera (2005) document that the cross-sectional dispersion of corporate cash holdings narrows as increased macroeconomic uncertainty hinders managers' ability to accurately evaluate firms-specific information. In this

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[1] eBankings & Payments News, May 7, 2009.

study, we focus on how different the cash holdings of East Asian firms are before and after the Asian financial crisis.

Most of the previous studies try to explain the cross-sectional variation of the firms' cash holdings. In contrast, Bates, Kahle, and Stulz (2009) focus on the time-series trend of U.S. firms' cash holdings. Similar to Bates et al. (2009), we are interested in time-series differences in cash holdings of East Asian firms, and specially focus on the differences before and after the Asian financial crisis. The Asian financial crisis over the period of 1997-1998 was one of the biggest events for the Asian firms in the modern era. The firms experienced unusual exogenous shocks like currency devaluation, high interest rates, and difficulty of raising capital, etc., and a substantial number of firms filed bankruptcy during the crisis. Almeida, Campello, and Weisbach's (2004) model suggests that firms tend to increase their propensity to save cash following negative macroeconomic shocks. Therefore, the Asian financial crisis provides us with a natural experiment to investigate the long-term impact of macroeconomic shocks on the change in firms' cash holding behavior. To our knowledge, the relation between changes in the firms' cash policies and macroeconomic shocks has not been formally tested.

Using a sample of 23,098 firm-years representing 4,374 East Asian firms over the period of 1991-2005, we investigate what factors explain the firms' increased cash holdings after the Asian financial crisis. The sample firms come from eight East Asian countries including Hong Kong, Indonesia, South Korea, Malaysia, the Philippines, Singapore, Taiwan, and Thailand, which were affected the most by the crisis during the period of 1997-1998. We find that East Asian firms increased the mean cash holdings from 10.7% in 1996 to 16.6% in 2005 and decreased the mean leverage from 30.9% in 1995 to 21% in 2005. The mean cash ratio slightly decreases in the early 1990s and gradually increases after 1998. The sudden increase in cash

holdings and decrease in leverage happened after the Asian financial crisis in 1997-1998. We find that the firms increase cash holdings after the crisis in seven countries except for Indonesia.

We then examine whether the increase of Asian firms' cash ratios after the crisis can be explained by existing theories of cash holdings. First, we examine changes in the firms' propensity to save cash out of cash flow after the crisis. Almeida et al. (2004) term a firm's propensity to save cash out of cash inflow as the cash flow sensitivity of cash. They find that financially constrained firms display significantly positive cash-cash flow sensitivities while unconstrained firms do not show the positive sensitivities, which is consistent with the precautionary motive. If the Asian firms become more conservative in the post-crisis period, they might show the increased cash-cash flow sensitivities. Their model also suggests that financially constrained firms increase sensitivities more than unconstrained firms.

Second, we test whether the negative experiences around the Asian financial crisis make the firm managers more sensitive to risk after the crisis. Using U.S. data, Opler, Pinkowitz, Stulz, and Williamson (1999) find that riskier firms or firms with better investment opportunities hold more cash. Asian firms might increase cash ratios in response to higher cash flow risk or higher stock return volatility after the crisis. However, although firms have the same level of risk after the crisis, firms can increase their cash holdings if their sensitivities to the risk factors increase after the Asian financial crisis. We examine whether the sudden increase in cash holdings after the crisis is related to the increased sensitivity to the cash flow risk or stock return volatility of the firms, or it is related to higher risk in the post-crisis period.

Next, there is a possibility that the increase of Asian firms' cash holdings after the crisis can be explained by changes in firm characteristics. Han and Qiu (2007) find that financially constrained firms increase their cash holdings in response to increases in cash flow volatility.

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Bates et al's (2009) find that the increase of U.S. firms' cash holdings in the 1990s and 2000s is related to increased risk, lower net working capital, and more R&D investments. Although Asian firms' sensitivities to risk measures remain the same after the crisis, they might increase cash holdings in a response to the changes in firm characteristics. We test whether the change in firm characteristics including cash flow risk affects the firms' cash holdings.

Our results show that the increase of Asian firms' cash holdings is pervasive regardless of firm size, dividend payment, and profitability. We also find that the Asian firms show a higher propensity to save cash out of their cash flow (the cash flow sensitivity of cash) after the crisis regardless of financial distress. We then investigate whether the firms' increased cash holdings are related to the changes in the firms' sensitivities to risk factors. We find that firms' increased sensitivities to cash flow risk or stock return volatility in the post-crisis period are the main factors to explain a steady increase in the firms' cash holdings after the crisis. Inconsistent with Bates et al. (2009), we document that changes in firm characteristics including a higher level of cash flow risk in the post-crisis period are not the main factors to explain the increase of the Asian firms' cash holdings. In general, our findings are partially consistent with the precautionary motive of cash holdings.

The rest of the paper proceeds as follows. Section 2 reviews previous literature and develops hypotheses we test in this paper. Section 3 explains the sample selection and the data, Section 4 describes the empirical findings, and Section 5 concludes the paper.

1. Literature review and hypothesis development

Previous literature has extensively examined the motives of firms' cash holdings, using mainly U.S. data. The literature develops models of optimal cash holdings based on various motives,

and explains the cross-sectional variation in the firms' cash holdings. Earlier literature develops models of optimal demands for cash based on transaction costs. From the perspective of the transactional motive, the main benefit of cash holdings is that a firm can save transaction costs by using cash to make payments without having to liquidate assets. A firm holds more cash when it incurs higher transaction costs to covert a non-cash asset into cash whereas it holds less cash when an opportunity cost of money is higher. For instance, Miller and Orr (1966) show that brokerage costs could induce firms to hold more liquid assts. There are economies of scale with transaction costs, so that large firms hold less cash. Mulligan (1997) finds that large firms hold less cash as a percentage of sales than small firms consistent with the transaction motive.

Another explanation is that a firm tends to hold cash to cope with future adverse shocks when access to capital markets is costly. The precautionary motive argues that a firm holds cash to hedge for the risk of future cash shortfalls. Kim, Mauer, and Sherman (1998) develop a model in which the optimal amount of cash holdings is determined by a tradeoff between the low return earned on liquid assets and the benefit of minimizing the need for costly external financing. Using the U.S. data, they find that firms that face higher costs of external financing, have more volatile earnings, and have lower returns on physical assets tend to have large cash holdings. Opler, Pinkowitz, Stulz, and Williamson (1999) also develop a model of optimal corporate cash holdings. The main benefit of cash holdings in their model is that the firm can reduce the underinvestment problem by maintaining sufficient cash levels while the cost of cash holdings is the lower return earned on the cash holdings compared to investing other opportunities. They find that riskier firms or firms with better investment opportunities hold more cash in their empirical tests, which is consistent with the precautionary motive. Baum, Caglayan, Ozkan, and Talavera (2005) also find that changes in macroeconomic volatility affect the cash management

policies of the firms supporting the motive. Specifically, they find that the presence of greater

macroeconomic uncertainty leads to a narrowing of the cross-sectional dispersion of firms' cash-

to-asset ratios. The precautionary motive indicates that firms tend to increase their cash holdings

after experiencing exogenous shocks. We conjecture that managers of the Asian firms might be

more sensitive to risks after they experienced the adverse external shocks during the Asian

financial crisis. The managers would manage their businesses more conservatively and hold

more cash after the crisis. We test whether the Asian firms' sensitivities to risk have changed

around the crisis and the increased sensitivities explain the increase in the firms' cash holdings.

Han and Qiu (2007) analyze the role of financial constraints on the precautionary

corporate cash holdings. They find that financially constrained firms increase their cash holdings

in response to increases in cash flow volatility while unconstrained firms show no systematic

relation between cash holdings and cash flow volatility. After the Asian financial crisis, Asian

firms might experience higher cash flow risk and higher stock return volatility due to more

severe competition with foreign competitors and macroeconomic uncertainty. Han and Qiu

(2007) indicate that Asian firms increase cash holdings due to the higher cash flow risk or higher

stock return volatility in the post-crisis period.

Almeida, Campello, and Weisbach (2004) develop a model in which financial constraints

are related to a firm's propensity to save cash out of cash inflows (cash flow sensitivity of cash).

They find that financially constrained firms display significantly positive cash-cash flow

sensitivities while unconstrained firms do not show the positive sensitivities. They also show

that financially constrained firms' cash flow sensitivity increases during recessions, while

unconstrained firms' cash flow sensitivity is unaffected by business cycles. Almeida et al.

(2004) indicate that the cash-cash flow sensitivity increases after macroeconomic shocks. We

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conjecture that the firms' cash-cash flow sensitivities increase after the Asian financial crisis, especially for financially constrained firms.

Previous literature also finds that agency problem is an important determinant of cash holdings. Jensen (1986) argues that agency conflicts between shareholders and managers are most severe when firms have large free cash flows. Managers can spend cash for their own interests at the expense of shareholders if they have free cash flows. Cross-country evidence is consistent with the agency costs of free cash flows in that greater shareholder rights are associated with lower cash holdings. Dittmar, Mahrt-Smith, and Servaes (2003) investigate 11,000 firms from 45 countries. They find that firms in countries with poor shareholder protection hold more cash. They also find that the determinants of cash holdings like investment opportunities and asymmetric information are less important when shareholder protection is poor, and firms hold more cash when access to funds is easier. Their evidence supports the agency theory. Ozkan and Ozkan (2004) find that cash holdings fall as managerial ownership increases up to 24%, rise as managerial ownership increase to 64%, and fall gain above 64% in U.K. firms. They also find that cash holdings of firms are positively related to cash flows and growth opportunities, and are associated with lower levels of bank debt and leverage. Using international data, Kalcheva and Lins (2007) find that outside shareholders apply a valuation discount to high cash balances carried by firms whose managers are also expected to be entrenched. Due to the data limitation, we do not test whether the agency problems have affected the increases in the Asian firms' cash holdings.

Harford (1999) and Harford, Mansi, and Maxwell (2007) study how agency problems affect the use of internal funds. Harford (1999) finds that cash-rich firms in U.S. are more likely to make diversifying acquisitions and those acquisitions by cash-rich firms are value decreasing,

as reflected in the negative stock price reaction to the announcement and subsequent poor

operating performance. He argues that the evidence supports the agency costs of free cash flow

explanation for acquisitions by cash-rich firms. Building on the research, Harford, Mansi, and

Maxwell (2007) find that firms with weaker corporate governance dissipate their cash reserves

more quickly and the firms spend the cash primarily on acquisitions. Dittmar and Mahrt-Smith

(2007) also find that firms with poor corporate governance dissipate cash quickly in ways that

significantly reduce operating performance. However, Mikkelson and Partch (2003) find that

operating performance of high cash firms in U.S. is comparable to or greater than the

performance of firms matched by size and industry and high cash firms grow faster, undertake

higher levels of investment, and have higher ratios of market-to-book value of assets. They also

find that governance characteristics do not explain the variation in performance among firms

with large cash holdings.

Foley, Hartzell, Titman, and Twite (2007) explain large cash holdings of U.S. firms based

on the tax motive. They find that multinational firms that face higher repatriation tax burdens

hold higher levels of cash and hold this cash abroad. They also find that financially

unconstrained firms and technology intensive firms exhibit a higher sensitivity of affiliate cash

holdings to repatriation tax burdens.

While most of previous literature focuses on cross-sectional differences in corporate cash

holdings, Bates et al. (2009) investigate the time-series variation in cash ratios and net debt of the

U.S. firms over the period of 1980-2004. They find that the average cash to assets ratio increases

from 10.48% in 1980 to 24.03% in 2004, which is the result of a secular trend rather than the

outcome of the recent buildup. They also document that the increase is concentrated among non-

dividend-paying firms and is explained by the precautionary motive. Bargeron, Lehn, and Zutter

(2007) also find that U.S. firms have significantly reduced their R&D and capital expenditures, but significantly increased their cash holdings since the Sarbanes-Oxley Act of 2002 compared with their U.K. counterparts. Similar to Bate et al. (2009), we investigate the change in cash holdings of East Asian firms after the Asian financial crisis of 1997-1998.

For the research on Asian firms' cash holdings, Rajan and Zingales (1995) present descriptive statistics showing that Japanese firms hold more cash out of G-7 countries. Pinkowitz and Williamson (2001) investigate why Japanese firms hold twice as much cash holdings as U.S. and German firms. They argue that the large cash holdings in Japan are explained by the strong bank power, and the cash holdings decrease as the bank power weakens.

2. Sample and data

We construct our sample of firms from Thomson Financial's Worldscope database for the period 1991-2005. We restrict our sample to firms that are incorporated in the eight East Asian countries including Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan, and Thailand, which were affected the most by the Asian financial crisis during the period of 1997-1998. We collect most of accounting data beginning in 1991 because the *Worldscope* includes the data of only a few firms in some countries for the 1980s. Because we calculate coefficients of variation of earnings before interest and taxes (EBIT) for each firm-year using the data for prior five years and stock return volatility using three-year data, the data goes back to 1987 for some firms. We obtain the stock return data from *Datastream*. We also require that the firms have the positive EBIT on average during the prior five years to be included in the given year to get the positive coefficient of variation of EBIT because a negative coefficient of variation might distort the regression results. We exclude financial firms classified by

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Worldscope because they may carry cash to meet the regulations of the industry or each country[2].

Our final sample consists of 23,098 firm-years representing 4,374 unique firms. Of the 4,374 firms, most of the firms (1,013 firms, 23.2%) are incorporated in Taiwan and the least (94 firms, 2.15%) are incorporated in the Philippines.

We use the variables used in the regression models in Opler et al. (1999) to examine the relation between various firm characteristics and the changes in cash ratios over time. We report descriptive statistics on each variable used in our tests in Table 1. The table reports the number of firm-years (N), mean, median, maximum, minimum, and standard deviation (Std) for each variable. Cash ratio is the ratio of cash and short-term investments to the book value of total assets. The mean (median) cash ratio is 14% (9.9%) with a standard deviation of 13.2%, which is lower than U.S. firms with cash ratios of higher than 20% in the 2000s. Leverage is the ratio of total debt to the book value of total assets while net leverage is calculated as the difference between total debt and cash and short-term investments, divided by the book value of total assets. The mean leverage is 25.5% and the mean net leverage is 11.5%. The mean noncash net working capital to assets ratio (NWC/assets), which is the ratio of net working capital minus cash and short-term investments to the book value of total assets, is 2.9% with a standard deviation of 18%. The mean ratio of capital expenditures to assets (CAPEX/assets) is 6.2% and the mean ratio of EBIT to assets (EBIT/assets) is 7.1%. Market-to-book ratio is calculated as the sum of total debt and the market value of equity, divided by the book value of total assets. The mean market to book ratio of assets is about one while standard deviation is 0.67. Firm size is measured as a natural log of the book value of total assets ($ in thousands), which is translated to U.S. dollar using year-ending exchange rates. The mean firm size is 11.96 ($152 million) with a

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[2] We use *Worldscope* Industrial Classification Level 6 to classify each company by industry. The Level 6 is the most detailed classification by *Worldscope*.

standard deviation of 1.56. Dividend ratio is the ratio of cash dividend paid to the book value of

total assets for only 16,451 dividend-paying firm-years (71.22% of 23,834 firm-years). The

mean (median) dividend payout is 2.7% (1.6%) with a standard deviation of 4.5%. We use stock

return volatility, coefficient of variation of EBIT (CV of EBIT), and industry average of CV of

EBIT (industry sigma) to measure the risk of each firm-year. Stock return volatility is measured

as a standard deviation of monthly returns of each stock over 36 months. The mean stock return

volatility is 16.5%. CV of EBIT is calculated using the ratios of EBIT to the book value of total

assets over five years. We then calculate the average risk of each industry, which is termed as

industry sigma. We classify the sample firms into 83 industries following Worldscope's

Industrial Classification Level 6^3. The industry sigma is the average coefficient of variation of

EBIT for each industry in the same country and year. The mean CV of EBIT is 0.895 and the

mean industry sigma is 0.893.

3. Empirical findings

4.1. How much has the firms' cash holdings increased after the Asian financial crisis?

We first examine changes in cash holdings of the East Asian firms after the Asian financial crisis.

Table 2 reports the number of firm-years and the mean and median cash, leverage, and net

leverage ratios by year. We make the table similar to Table 1 of Bates et al. (2009) to compare

with cash holdings of U.S. firms. They find that American firms increase cash holdings

gradually to 23.2% in 2004 from 10.5% in 1980. In comparison, we document in Table 2 that

the mean cash holdings of the Asian firms slightly decrease from 11.4% in 1991 to 10.7% in

1996, and start to increase after the Asian financial crisis of 1997-1998. The mean cash holdings

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[3] Worldscope's Industrial Classification Level 6 classifies firms into 121 industries. We do not include financial
firms in our sample. The sample firms are classified into 83 industries following the classification method.

are 16.1% in 2005. The changes in the median cash ratios for our sample firms are more

dramatic. The firms' cash holdings increases from 6.6% in 1996 to 12% in 2005 and almost

doubles over the 10-year period. The leverage ratios of the sample firms show opposite patterns.

The mean (median) leverage ratio increases from 28.2% (23.9%) in 1991 to 31.2% (30.5%) in

1996 and decreases to 21.4% (19.2%) in 2005. The decrease in net leverage ratio, which nets

cash from debt, is much sharper. The mean (median) net leverage ratio decreases from 20.5%

(21.5%) in 1996 to 5.3% (7.1%) in 2005, which means that Asian firms carry little debt in terms

of net leverage.

We then look at whether there are different patterns in changes of the firms' cash

holdings across countries. Table 3 reports the number of firm-years and the mean and median

cash ratios by country and year. The firms in seven countries except for Indonesia increase cash

holdings sharply after the crisis. For instance, Hong Kong firms increase mean cash holdings

from 12.2% in 1996 to 21.3% in 2005. The sample firms in Hong Kong, Korea, the Philippines,

and Thailand almost double the median cash holdings over the 10-year period, but Indonesian

firms slightly reduce the cash holdings from 12.8% to 10.5% over the same period. In general,

the firms in the region have increased cash holdings after the crisis regardless of the countries

they are incorporated.

Next, we divide the sample firms into two sub-samples based on firm size, dividend

payment, and profitability. Large firms are the firms of which assets belong to the top 30% of

the sample firm assets each year, and the remaining 70% are classified small firms. We also

divide the sample firms into non-dividend paying firms and dividend paying firms based on the

dividend payment each year. In another classification, when the ratio of EBIT to assets is higher

(lower) than the median each year, the sample firms are divided into profitable firms and

unprofitable firms. Table 4 reports the mean and median cash ratios for these sub-samples by year. Almeida et al. (2004) and Han and Qiu (2007) classify small firms and non-dividend paying firms as financially constrained firms. They argue that these firms should be more sensitive to cash flow risk. We also conjecture that unprofitable firms might hold more cash since they have a greater possibility to be short of cash. Therefore, we expect that small firms, non-dividend-paying firms, or unprofitable firms increase cash holdings more than other firms after the Asian financial crisis. The mean (median) cash holdings of small firms increases from 11.2% (6.8%) in 1996 to 16.8% (12.4%) in 2005 while the mean (median) cash holdings of large firms increases from 9.4% (6.4%) to 14.4% (11.4%) over the period. We do not find any difference in changes in cash holdings between small firms and large firms. We then examine whether there is any difference in changes in cash holdings between dividend paying firms and non-dividend paying firms. Interestingly, the mean cash holdings of non-dividend paying firms and dividend paying firms increase by almost the same amount (5.6% vs. 5.7%) over the 10-year period. Comparing unprofitable firms to profitable firms, we find that unprofitable firms increase the mean (median) cash holdings by 3.9% (4.2%) while profitable firms increase them by 7% (6.4%) from 1996 to 2005. In untabulated tests, we divide the sample into firms with negative vs. positive EBIT and find a similar result. The firms with negative EBIT represent about 8.87% of the sample. Firms with negative EBIT increase the mean cash holdings by 7.2% while firms with positive EBIT increase them by 5.8% over the 10-year period. In summary, the results in Table 4 show that the increase in cash holdings is very pervasive regardless of firm size, dividend payout, or profitability.

4.2. Has the cash flow sensitivity of cash changed after the crisis?

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In the previous sub-section, we find that the sample firms dramatically increase cash holding after the Asian financial crisis. The firms can easily increase cash holdings by saving more cash from cash flows. We examine whether the firms' increased cash holdings after the Asian financial crisis are related to changes in their propensity to save cash out of cash flow (cash flow sensitivity of cash). Almeida et al. (2004) suggests that the firms might save more cash from their internal cash flow after they experience external shocks during the crisis. The Asian financial crisis is one of the biggest external shocks to the firms in the modern era. We expect that the firms' cash flow sensitivity of cash naturally increase after the crisis. Almeida et al. (2004) also indicate that financially constrained firms should increase their cash flow sensitivity of cash more than unconstrained firms after the crisis. We modify Almeida et al.'s (2004) model because we cannot find some variables used in the paper from our data source, *Worldscope.* We use EBIT instead of cash flow, and omit acquisitions from Almedia et al.'s model. We estimate the following model using fixed effect regressions:

$$\Delta CashHolding_{i,t} = \beta_0 + \beta_1 EBIT_{i,t} + \beta_2 Market - To - Book_{i,t} + \beta_3 Size_{i,t} + \beta_4 Capex_{i,t} + \beta_5 \Delta NWC_{i,t} + \beta_6 \Delta ShortDebt_{i,t} + \varepsilon_{i,t}.$$

The annual change in cash holdings, EBIT, capital expenditure (Capex), the annual change in noncash net working capital (NWC), and the annual change in short-term debt (ST Debt) are scaled by the book value of total assets. Market-to-book ratio of assets and firm size (Size, a natural log of total assets) are also included as independent variables. We expect that the coefficient on market-to-book ratio is positive for constrained firms and unsigned for unconstrained firms, but it can be biased due to the usual positive relation between the measure of investment opportunities (market-to-book ratio) and cash flow (EBIT). We expect that the coefficient on firm size is negative because of standard arguments of economies of scale in cash management. We also expect that the coefficients on capital expenditure and change in NWC

are negative because the firms draw upon cash reserves in order to pay for the capital expenditure, and because NWC is a substitute for cash. We add changes in short-term debt because short-term debt can be a substitute for cash, or firms may use short-term debt to increase cash holdings. The coefficient on EBIT measures the cash flow sensitivity of cash.

We report the results from estimating the model in Table 5. We first estimate the model for the whole sample period, the pre-crisis period (1991-1998), and the post-crisis period (1999-2005) using the entire sample of firm-years. Even though the firms experienced the crisis in 1997-1998, we set the post-crisis period after 1998 because the firms cannot immediately change their managing policy on working capital[4]. The coefficient on market-to-book ratio for the whole sample period is significantly positive, which suggests that the firm with better growth opportunities saves more cash. The coefficient on firm size is insignificantly negative. The coefficient on capital expenditure is significantly negative as expected. The coefficients on non cash net working capital and short term debt are significantly negative, which suggests that net working capital and short term debt are substitutes for cash. The cash flow sensitivity of cash (the coefficient on EBIT) is significantly positive for the whole sample period. We then divide the sample period to the pre- and post-crisis periods. We mainly test whether firms save more cash from cash flows after the crisis. The cash flow sensitivity of cash increases from 0.134 in the pre-crisis period to 0.200 in the post-crisis period and the difference in the sensitivity is statistically significant. The result suggests that the sample firms save more cash out of their cash flow after the Asian financial crisis, which is consistent with Almeida et al.'s (2004) argument.

We then classify the sample firms into financially constrained firms and unconstrained firms and test the changes in the cash flow sensitivity of cash. Almeida et al. (2004) use five

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[4] When we set the post-crisis period after 1997, the results are not qualitatively different.

criteria including dividend payout ratio, firm size, bond ratings, commercial paper ratings, and

KZ index (Kaplan and Zingales, 1997) to classify the firms. We use firm size, dividend payment,

and KZ index to classify our sample firms due to the data limitation on bond ratings and

commercial paper ratings. A sample firm-year is classified as a large firm if its total assets

belong to the top 30% of total assets of sample firms each year. Small firms and non-dividend

paying firms are considered financially constrained firms. Following Almeida et al. (2004),

firms in the top three deciles of the KZ index ranking are also considered financially constrained.

The results for the financially constrained and unconstrained firms are also reported in Table 5.

The cash flow sensitivity of cash for small firms is 0.166 with a p-value of less than 0.01 while

that for large firms is 0.136 for the full sample period, which suggests that small firms save more

cash from their cash flows. The sensitivity increases from 0.157 in the pre-crisis period to 0.196

in the post-crisis period while that for large firms changes from 0.030 to 0.173. The sensitivity

of large firms has significantly increased after the crisis. The cash flow sensitivity of cash for

non-dividend paying firms is 0.154 while that for dividend paying firms is 0.178. The sensitivity

increases from 0.069 to 0.202 while that for dividend paying firms increases from 0.147 to 0.198.

The cash flow sensitivity of cash for KZ-constrained firms is even smaller than that for KZ-

unconstrained firms, and it increases more for KZ-unconstrained firms. We cannot tell from the

results that the increases in cash flow sensitivity of cash are different for financially constrained

and unconstrained firms. The results are not consistent with Almeida et al's (2004) suggestion

that financially constrained firms should increase their cash flow sensitivity of cash more than

unconstrained firms. However, we find that the firms increase the propensity to save cash out of

their cash flow after the crisis regardless of financial distress. Overall, the results in Table 5 are

partially consistent with the precautionary motive of cash holdings.

4.3. Are the firms' sensitivities to risk after the crisis related to the increased cash holdings?
We examine whether the firm characteristics included in Opler et al.'s (1999) regression are associated with the firms' increased cash holdings. We mainly test whether the coefficients on risk measures like cash flow risk or stock return volatility change after the Asian financial crisis. Opler et al. (1999) find that market-to-book ratio, firm size, cash flow to assets, net working capital to assets, capital expenditures to assets, leverage, industry sigma, R&D to sales, dividend dummy, and regulation dummy are related to cash holdings. We use the ratio of EBIT to assets instead of cash flow to assets due to limited data on depreciation and amortization expenses from *Worldscope*. We do not include regulation dummy because regulated industry might be different across countries and the data on the regulated industry is not available from the database.

We first run pooled ordinary least square (OLS) regression to include all the observations and to test whether there is a regime change in the regression. We report the results in Table 6. The dependent variable is cash ratios across all the specifications. In Model 1, we include all the variables used in Opler et al. (1999) as independent variables except for risk measures. We expect that noncash net working capital to assets ratio (NWC/assets) and cash ratio has a negative relation because noncash net working capital can be a substitute for cash. The coefficient on NWC/assets is -0.156 with a p-value of less than 0.01 as expected. The significantly negative relation remains regardless of model specifications. We expect that capital expenditures and cash ratios have a negative relation since capital expenditures consume cash. The coefficient on Capex/assets is significantly negative at 1% significance level. We use EBIT as a measure of cash flow while Opler et al. use EBIT plus depreciation. We expect that firms with higher cash flow hoard more cash. We find that EBIT/assets and cash ratios have a significantly positive relation as expected. These results are consistent with Opler et al.'s (1999)

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findings. We use market-to-book ratio of assets as a proxy for growth opportunities. The precautionary motive of cash holdings suggests that firms with higher growth opportunities have higher cash holdings since it is costlier for these firms to obtain external financing. The coefficient on market-to-book ratio is 0.036 with a p-value of less than 0.01, which is consistent with the results in Kim et al. (1998) and Opler et al. (1999). We expect a negative relation between firm size and cash ratio since there are economies of scale to holding cash. We also expect a negative relation between leverage and cash ratio because firms use cash to make interest payments or repay the principal on a debt. The coefficients on firm size and leverage are significantly negative as expected, which is also consistent with the results in Kim et al. (1998) and Opler et al. (1999). Finally, we expect a negative relation between dividend payment and cash ratio since cash dividends consume cash. The coefficient on a dividend dummy variable in Model 1 is insignificantly positive, but it depends on model specifications.

To investigate whether there is a regime change after the Asian financial crisis for the demand for cash, we include a post-crisis dummy variable in Model 2. The dummy variable takes a value of one if a firm-year is in the period of 1999-2005 and zero otherwise. We expect that the dummy variable has a positive and significant coefficient if the cash ratio increases after the crisis for exogenous reasons unrelated to firm characteristics. The coefficient on the dummy variable is 0.031 with a p-value of less than 0.01, which indicates that the cash ratio is about 3% higher in the post crisis period after controlling for other determinants. We also do a Chow test to examine whether there is a structural change in the regression after 1998. We specifically test the null hypothesis that some of or all coefficients in the regression are the same before or after the end of 1998. We find that the F-test rejects the null hypothesis with a p-value of less than

0.01. The results indicate that the intercept term and some of or all the coefficients change after 1998.

Next, we add our risk measures, CV of EBIT, industry sigma, and stock return volatility, in Model 3, 4, and 5. Because these risk measures are strongly correlated, we include only one risk measure in each model. We expect a positive relation between cash ratio and these risk measures since firms with greater cash flow risk or stock return volatility hold more precautionary cash. The coefficients on the risk measures are significantly positive with p-values of less than 0.01 as reported in Model 3, 4, and 5. Then, we test whether each coefficient on these risk measures changes after 1998 using Chow tests. We find that the changes in the coefficients are significantly positive, and the coefficients are not statistically different from zero for the period of 1991-1998 but they are significantly positive after 1998. These results suggest that the firms become sensitive to cash flow risk or stock return volatility after the Asian financial crisis. In short, our results suggest that the firms' increased sensitivities to the cash flow risk or stock return volatility are related to the higher level of the firms' cash holdings after the Asian financial crisis.

Then, we run fixed effects regressions since our sample is a cross-sectional and time series data and we report the results in Table 7. We remove firms with one or two observations for these regressions. The results are mostly similar to the results of pooled OLS regressions. The coefficients on market-to-book ratio are not significantly from zero in Models 1 to 5, which is not consistent with Kim et al. (1998) and Opler et al. (1999). The coefficient in Model 6 is positive with a p-value of 0.08. The coefficients on the dividend dummy are significantly positive, which is opposite to our expectation. However, Opler et al. (1999) also report that the coefficient on the dividend dummy is significantly positive in the fixed effects regression. In

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these tests, we focus on whether the coefficients on our risk measures, CV of EBIT, industry sigma, and stock return volatility change in the post-crisis period of 1999-2005. We add the interaction terms between the risk measures and the post-crisis dummy in Models 2, 4, and 6. The coefficients on the interaction terms are significantly positive with p-values of less than 0.01, which indicates that the coefficients on the risk measures are much higher after the Asian financial crisis. The results suggest that the effect of cash flow risk or stock return volatility on cash holdings increases after the crisis.

4.4. Do changes in firm characteristics explain the increase of cash holdings?

There is a possibility that firms increase cash holdings after the crisis because their characteristics have changed. We test whether the firm characteristics are different pre- vs. post-crisis period (1991-1996 vs. 1999-2005). We compare the mean and median firm characteristics of the two periods and report the results in Table 7. All the variables except for EBIT/assets significantly change after the crisis. The mean (median) leverage significantly decreases from 28.9% (28%) to 22.9% (20.8%). The mean noncash NWC/assets increases from -0.2% to 4.1% while the mean Capex/assets decreases from 8.8% to 5.7%. The mean growth opportunities, market-to-book ratio, decrease from 1.051 to 1.028. The firm size gets smaller after the crisis and the portion of dividend paying firms significantly decreases from 88.2% to 66.37%. Stock return volatility and cash flow risk (CV of EBIT and industry sigma) significantly increase after the crisis. Previous literature indicates that decreases in leverage and market-to-book ratio, and an increase in net working capital have negative effects on cash holdings while decreases in capital expenditure, firm size, and proportion of dividend paying firms, and an increase in risk

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have positive effects on cash holdings. Therefore, the changes in firm characteristics after the

crisis might have offsetting effects on the level of cash holdings

To further investigate whether changes in firm characteristics explain the increase of cash

holdings in the post-crisis period, we estimate the modified Opler et al.'s (1999) model for the

pre-crisis period using Fama-MacBeth's (1973) regression. Then, we compute how actual cash

holdings differ from cash holdings predicted by that model in the post-crisis period. This method

is used in Bates et al.'s (2009) paper.

The Fama-McBeth estimates of the modified Opler et al.'s model for the pre-crisis period

are as follows:

Cash ratio = 0.1043 – 0.0089 Industry Sigma + 0.0121 Market-to-book ratio + 0.0022 Firm size + 0.2814 EBIT/asset – 0.1750 NWC/assets – 0.2129 Capex/assets - 0.1551 Leverage + 0.2188 Dividend + 0.1971 Proceeds from stock sales + 0.1062 Increase in total debt

The coefficient on industry sigma is not significantly from zero, which again suggests

that the cash flow risk is not correlated to cash holdings in the pre-crisis period. The coefficient

on firm size is positive, which is not consistent with previous literature. All other coefficients

have the same signs as those in Bates et al. (2009).

Table 8 reports the mean predicted cash ratios and the mean differences between actual

cash ratios and predicted cash ratios in the post-crisis period for the whole sample, small and

large firms, and non-dividend and dividend paying firms. When we measure the predicted cash

ratios using Fama-MacBeth's regression, we assume that the coefficients on all the variables

remain the same even after the Asian financial crisis. If changes in firm characteristics explain

the increase of the firms' cash holdings after the crisis, we expect that the mean differences

between actual cash ratios and predicted cash ratios are zero. The predicted cash ratios for the

whole sample range from 10.4% to 10.9% and they are close to the mean actual cash ratio

(10.7%) of 1996. The mean differences between the actual cash ratios and the predicted cash ratios are significantly positive with p-values of less than 0.01 and the difference gets bigger as time goes on. The mean difference is 2.1% in 1999 and it increases to 5.7% in 2005. The result suggests that the Fama-MacBeth's regression underestimates the cash ratio and the increase of the firms' cash holdings in the post-crisis period is not explained by changes in firm characteristics. We do the same tests for small and large firms. The results show that the actual minus predicted cash ratios for small firms are significantly higher than those for large firms over the period. For instance, the regression underestimates small firms' cash holdings by 7.1% and large firms' cash holdings by 3.9% in 2005. The actual minus predicted cash ratios are similar for non-dividend paying firms and dividend paying firms. These findings are sharply different from Bates et al's (2009) results. They find that the increase of U.S. firms' cash holdings in the 1990s and 2000s is related to changes in risk, net working capital, and R&D investments. However, our results suggest that the increase of the Asian firms' cash holdings after the crisis is not explained by the changes in firm characteristics.

4.5. Robustness tests

We find in the previous sub-sections that firm size gets smaller and the proportion of dividend paying firms decreases after the Asian financial crisis. Fama and French (2004) find that the composition of firms has recently changed due to an influx of newly listed firms. These new firms tend to be small and have higher cash flow risk or stock return volatility. It can be argued that the increase of the sample firms' cash holdings after the crisis might be related to the different composition of firms. We test this possibility using sub-sample firms which went public before 1999. We find that the mean (median) cash ratio increase from 10.6% (6.6%) in

1996 to 14.4% (10.8%) in 2005 for the reduced sample. We run fixed effects regressions which are the same as those in Table 6 using the reduced sample and report the results in Table 10. The results are qualitatively the same as those reported in Table 6. The interaction terms between the post-crisis dummy and the risk measures, CV of EBIT, industry sigma, and stock return volatility, in Models 2, 4, and 6 are all significantly positive with p-values of less than 0.01. These indicate that the effects of cash flow risk or stock return volatility on cash ratios are bigger in the post-crisis period. The results also suggest that the firms increase cash holdings to better manage the risk. Therefore, the different composition of firms after the crisis does not drive our results.

We then test the effects of outliers on the regression results. The data from *Worldscope* have some unreasonable numbers for some variables. We cut 1% of the observations at the highest and lowest level of each variable and run the fixed effects regression using the reduced sample. The unreported results are qualitatively the same as those reported in Table 6. This suggests that the outlier problem does not drive our results.

5. **Conclusion**

We investigate how macroeconomic shocks like the Asian financial crisis affect firms' cash policies over the long-term. Using the sample firms from eight East Asian countries over the period of 1991-2005, we find that the mean cash ratio slightly decreases in the early 1990s and gradually increases after the crisis of 1997-1998. Specifically, the East Asian firms increase the mean cash holdings from 10.7% in 1996 to 16.6% in 2005. The Asian firms show a higher propensity to save cash out of their cash flow (the cash flow sensitivity of cash) after the crisis regardless of financial distress. We then find that the firms' increased sensitivities to cash flow risk or stock return volatility in the post-crisis period mainly explain the increase of their cash

holdings. The results show that the financial crisis has systematically changed the cash holding policies of the firms and has a long-term effect.

The precautionary motive of cash holdings indicate that financially constrained firms should be more sensitive to cash flow risk. Our results show that there is no difference in the changes in cash holding after the crisis for financially constrained vs. unconstrained firms. The results are partially consistent with the findings in the previous literature like Kim et al. (1998), Opler et al. (1999), and Almeida et al. (2004).

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Table 1: Descriptive statistics

The panel data on 23,098 firm-years representing 4,374 sample firms in eight East Asian countries are collected from Thomson Financial's Datastream. The table reports the number of firm-years (N), mean, median, maximum, minimum, and standard deviation (Std) for each variable. Cash ratio is the ratio of cash and short-term investments to the book value of total assets. Leverage is the ratio of total debt to the book value of total assets. Net leverage is calculated as the difference between total debt and cash and short-term investments, divided by the book value of total assets. NWC/assets is the ratio of net working capital minus cash and short-term investments to the book value of total assets. Capex/assets is the ratio of capital expenditures to the book value of total assets. EBIT/assets is the ratio of earnings before interests and taxes (EBIT) to the book value of total assets. Market-to-book ratio is calculated as the sum of total debt and the market value of equity, divided by the book value of total assets. Firm size is a natural log of the book value of total assets ($ in thousands), which is translated to U.S. dollar using year-ending currency rates. Dividend ratio is the ratio of cash dividend paid to the book value of total assets for only 16,683 dividend-paying firm-years. Stock return volatility is the standard deviation of monthly returns of each stock over 36 months. Coefficient of variation of EBIT (CV of EBIT) is calculated using the ratios of EBIT to the book value of total assets over five years. Industry sigma is the average coefficient of variation of EBIT of each industry, which is classified by Datastream's Industrial Classification Level 6.

	N	Mean	Median	Maximum	Minimum	Std
Cash ratio	23098	0.140	0.099	0.999	0.000	0.132
Leverage	23098	0.255	0.235	3.132	0.000	0.202
Net leverage	23098	0.115	0.128	2.853	-0.999	0.282
NWC/assets	23098	0.029	0.023	0.842	-0.999	0.180
Capex/assets	23098	0.062	0.040	0.888	0.000	0.067
EBIT/assets	23074	0.071	0.059	1.976	-0.551	0.072
Market-to-book ratio	23098	0.999	0.796	4.691	0.180	0.672
Firm size	23098	11.962	11.790	20.461	6.902	1.562
Dividend ratio	16451	0.027	0.016	3.064	0.000	0.045
Stock return volatility	18189	0.165	0.142	6.511	0.000	0.149
CV of EBIT	23098	0.895	0.464	15.460	0.000	1.490
Industry sigma	23098	0.893	0.761	14.710	0.002	0.695

Table 2: Mean and median cash and leverage ratios over time

The table reports the number of firm-years (N), the mean and median cash, leverage, and net leverage ratios by year. The panel data on the 4,374 sample firms in eight East Asian countries are collected from Worldscope of Thomson Financial. The cash ratio is measured as the ratio of cash and short-term investments to the book value of total assets. Leverage is the ratio of total debt to the book value of total assets while net leverage is computed as the difference between total debt and cash and short-term investments, divided by the book value of total assets.

Year	N	Cash ratio		Leverage		Net leverage	
		Mean	Median	Mean	Median	Mean	Median
1991	207	0.114	0.074	0.282	0.239	0.169	0.163
1992	388	0.111	0.073	0.265	0.250	0.154	0.169
1993	437	0.104	0.064	0.268	0.266	0.164	0.168
1994	556	0.111	0.065	0.285	0.279	0.174	0.201
1995	701	0.104	0.065	0.304	0.299	0.200	0.212
1996	979	0.107	0.066	0.312	0.305	0.205	0.215
1997	1123	0.106	0.073	0.349	0.332	0.243	0.248
1998	1223	0.112	0.073	0.334	0.317	0.222	0.230
1999	1253	0.121	0.082	0.299	0.284	0.177	0.178
2000	1610	0.130	0.089	0.281	0.264	0.152	0.166
2001	2053	0.137	0.096	0.258	0.235	0.121	0.134
2002	2663	0.151	0.111	0.226	0.204	0.076	0.092
2003	2954	0.158	0.118	0.221	0.202	0.063	0.081
2004	3330	0.160	0.121	0.221	0.205	0.061	0.086
2005	3621	0.161	0.120	0.214	0.192	0.053	0.071
Whole sample	23098	0.140	0.099	0.255	0.235	0.115	0.128

Table 3: Mean and median cash ratios by country

The table reports the number of firm-years (N), the mean and median cash ratios by country. The cash ratio is measured as the ratio of cash and short-term investments to the book value of total assets.

Year	Hong Kong			Indonesia			Korea			Malaysia		
	N	Mean	Median	N	Mean	Median	N	Mean	Median	N	Mean	Median
1991	35	0.169	0.112	7	0.129	0.133	63	0.080	0.068	45	0.105	0.059
1992	45	0.137	0.107	56	0.138	0.097	62	0.077	0.069	85	0.103	0.044
1993	54	0.139	0.097	60	0.137	0.093	60	0.069	0.057	87	0.076	0.043
1994	61	0.145	0.102	67	0.132	0.095	102	0.078	0.062	104	0.093	0.045
1995	80	0.124	0.081	71	0.121	0.078	131	0.085	0.065	122	0.089	0.046
1996	147	0.122	0.088	102	0.128	0.092	148	0.080	0.057	175	0.099	0.055
1997	201	0.116	0.094	103	0.121	0.097	179	0.093	0.068	207	0.108	0.063
1998	220	0.133	0.097	98	0.140	0.084	216	0.105	0.073	224	0.107	0.061
1999	217	0.154	0.115	101	0.148	0.121	254	0.110	0.077	223	0.121	0.066
2000	222	0.180	0.131	123	0.142	0.110	437	0.125	0.087	241	0.109	0.062
2001	287	0.191	0.153	155	0.123	0.085	460	0.130	0.086	370	0.119	0.075
2002	377	0.212	0.172	167	0.112	0.071	498	0.143	0.098	429	0.125	0.083
2003	435	0.213	0.181	166	0.119	0.078	565	0.134	0.094	448	0.127	0.076
2004	499	0.213	0.178	171	0.122	0.087	579	0.135	0.088	530	0.127	0.088
2005	536	0.213	0.165	172	0.105	0.072	620	0.149	0.107	599	0.130	0.086
Whole sample	3416	0.184	0.146	1619	0.125	0.087	4374	0.124	0.084	3889	0.117	0.072

Table 3 continued

Year	the Philippines			Singapore			Taiwan			Thailand		
	N	Mean	Median	N	Mean	Median	N	Mean	Median	N	Mean	Median
1991	5	0.068	0.021	30	0.177	0.159	3	0.164	0.176	19	0.042	0.019
1992	19	0.110	0.074	44	0.153	0.115	17	0.158	0.186	60	0.071	0.032
1993	23	0.086	0.073	48	0.156	0.104	18	0.140	0.117	87	0.082	0.030
1994	26	0.124	0.078	49	0.162	0.099	31	0.147	0.128	116	0.093	0.046
1995	27	0.116	0.087	63	0.146	0.113	75	0.118	0.078	132	0.087	0.036
1996	41	0.099	0.057	100	0.128	0.092	133	0.124	0.090	133	0.081	0.035
1997	45	0.091	0.048	107	0.125	0.104	143	0.123	0.093	138	0.065	0.038
1998	44	0.071	0.047	115	0.140	0.106	158	0.107	0.088	148	0.071	0.039
1999	45	0.098	0.051	118	0.138	0.105	149	0.104	0.071	146	0.086	0.053
2000	47	0.098	0.061	147	0.149	0.104	247	0.127	0.092	146	0.090	0.051
2001	59	0.100	0.058	228	0.159	0.117	308	0.141	0.105	186	0.091	0.055
2002	57	0.105	0.071	265	0.169	0.126	668	0.161	0.123	202	0.096	0.055
2003	55	0.107	0.070	308	0.185	0.142	763	0.177	0.137	214	0.110	0.069
2004	61	0.111	0.081	368	0.201	0.157	856	0.178	0.145	266	0.108	0.064
2005	63	0.125	0.099	428	0.187	0.146	891	0.180	0.140	312	0.104	0.060
Whole sample	617	0.103	0.064	2418	0.169	0.130	4460	0.160	0.124	2305	0.092	0.050

Table 4: Mean and median cash ratios conditional on firm size, dividend, and EBIT

The table reports the number of firm-years (N), and the mean and median cash ratios conditional on firm size, dividend payment, and profitability (EBIT/assets). Large firms are the firms of which assets belong to the top 30% of the sample firm assets each year, and the remaining 70% are classified small firms. When the ratio of EBIT to assets is higher (lower) than the median each year, it is classified as profitable (unprofitable) firms.

Year	Small Firms			Large Firms			Non-dividend paying firms			Dividend paying Firms			Unprofitable firms			Profitable firms		
	N	Mean	Median	N	Mean	Median	N	Mean	Median	N	Mean	Median	N	Mean	Median	N	Mean	Median
1991	145	0.120	0.079	62	0.098	0.074	12	0.063	0.043	195	0.117	0.079	104	0.095	0.066	103	0.132	0.091
1992	271	0.114	0.070	117	0.104	0.075	36	0.091	0.044	352	0.113	0.074	195	0.095	0.067	193	0.127	0.080
1993	306	0.109	0.058	131	0.094	0.067	31	0.080	0.040	406	0.106	0.064	219	0.087	0.052	218	0.121	0.083
1994	389	0.117	0.062	167	0.099	0.071	66	0.089	0.054	490	0.114	0.067	279	0.106	0.064	277	0.117	0.066
1995	490	0.107	0.062	211	0.097	0.068	88	0.087	0.054	613	0.107	0.066	352	0.098	0.059	349	0.110	0.071
1996	685	0.112	0.068	294	0.094	0.064	136	0.091	0.054	843	0.109	0.068	490	0.093	0.054	489	0.120	0.084
1997	786	0.106	0.075	337	0.104	0.068	220	0.099	0.054	903	0.108	0.077	563	0.094	0.066	560	0.118	0.085
1998	856	0.118	0.076	367	0.097	0.066	435	0.084	0.057	788	0.127	0.087	612	0.093	0.060	611	0.130	0.095
1999	877	0.130	0.087	376	0.100	0.077	487	0.088	0.058	766	0.142	0.104	628	0.100	0.064	625	0.142	0.106
2000	1127	0.139	0.097	483	0.108	0.081	579	0.111	0.071	1031	0.141	0.103	805	0.110	0.072	805	0.150	0.115
2001	1437	0.145	0.101	616	0.118	0.087	652	0.111	0.067	1401	0.149	0.110	1027	0.115	0.077	1026	0.158	0.123
2002	1864	0.160	0.119	799	0.128	0.094	932	0.128	0.086	1731	0.162	0.124	1333	0.121	0.083	1330	0.180	0.143
2003	2068	0.167	0.125	886	0.137	0.104	938	0.140	0.094	2016	0.166	0.130	1478	0.123	0.086	1476	0.192	0.154
2004	2331	0.169	0.126	999	0.141	0.111	1030	0.145	0.098	2300	0.167	0.132	1666	0.129	0.095	1664	0.192	0.153
2005	2534	0.168	0.124	1087	0.144	0.114	1005	0.147	0.098	2616	0.166	0.128	1817	0.132	0.096	1804	0.190	0.148
Total	16166	0.147	0.104	6932	0.123	0.091	6647	0.123	0.079	16451	0.147	0.108	11568	0.115	0.079	11530	0.164	0.124

Table 5: The cash flow sensitivity of cash

The dependent variable is the annual change in cash plus short-term investments divided by the book value of total assets. EBIT/assets is the ratio of earnings before interests and taxes (EBIT) to the book value of total assets. Market-to-book ratio is calculated as the sum of total debt and the market value of equity, divided by the book value of total assets. Firm size is a natural log of the book value of total assets ($ in thousands), which is translated to U.S. dollar using year-ending currency rates. Capex/assets is the ratio of capital expenditures to the book value of total assets. The annual change in noncash NWC/assets is the change in net working capital minus cash and short-term investments divided by the book value of total assets. The annual change in short-term debt/assets is the change in short-term debt divided by the book value of total assets. The sample firms are classified into financially constrained and unconstrained firms based on firm size (the median value of total assets each year), dividend payment, and KZ index (Kaplan and Zingales, 1997). The numbers in parentheses are p-values.

	Whole firms			Small firms			Large firms		
	1991 ~2005	1991 ~1998	1999 ~2005	1991 ~2005	1991 ~1998	1999 ~2005	1991 ~2005	1991 ~1998	1999 ~2005
Intercept	0.006 (0.88)	-0.150 (0.03)	0.023 (0.64)	0.052 (0.46)	-0.194 (0.03)	0.111 (0.18)	-0.103 (0.03)	-0.069 (0.51)	-0.118 (0.07)
EBIT/assets	0.163 (<0.01)	0.134 (<0.01)	0.200 (<0.01)	0.166 (<0.01)	0.157 (<0.01)	0.196 (<0.01)	0.136 (<0.01)	0.030 (0.62)	0.173 (<0.01)
Market-to-book ratio	0.005 (<0.01)	0.006 (<0.01)	0.009 (<0.01)	0.006 (<0.01)	0.003 (0.34)	0.010 (<0.01)	0.007 (0.01)	0.022 (<0.01)	0.008 (0.03)
Firm size	-0.003 (0.10)	0.010 (0.02)	-0.005 (0.08)	-0.004 (0.14)	0.014 (0.02)	-0.010 (0.03)	0.004 (0.12)	0.005 (0.50)	0.005 (0.25)
Capex/assets	-0.321 (<0.01)	-0.315 (<0.01)	-0.397 (<0.01)	-0.354 (<0.01)	-0.351 (<0.01)	-0.423 (<0.01)	-0.248 (<0.01)	-0.250 (<0.01)	-0.332 (<0.01)
Δ(NWC/assets)	-0.116 (<0.01)	-0.304 (<0.01)	-0.142 (<0.01)	-0.117 (<0.01)	-0.355 (<0.01)	-0.149 (<0.01)	-0.211 (<0.01)	-0.188 (<0.01)	-0.222 (<0.01)
Δ(STdebt/assets)	-0.005 (<0.01)	-0.261 (<0.01)	-0.003 (<0.01)	-0.004 (<0.01)	-0.322 (<0.01)	-0.003 (<0.01)	-0.152 (<0.01)	-0.121 (<0.01)	-0.156 (<0.01)
R^2	0.194	0.265	0.236	0.222	0.297	0.266	0.209	0.258	0.244
N	21971	5299	16450	15095	3592	11235	6618	1591	4961

Table 5 continued

	Non-dividend paying firms			Dividend paying firms			KZ-constrained firms			KZ-unconstrained firms		
	1991 ~2005	1991 ~1998	1999 ~2005	1991 ~2005	1991 ~1998	1999 ~2005	1991 ~2005	1991 ~1998	1999 ~2005	1991 ~2005	1991 ~1998	1999 ~2005
Intercept	0.046 (0.52)	-0.081 (0.59)	0.111 (0.23)	-0.047 (0.36)	-0.209 (0.01)	-0.075 (0.24)	-0.046 (0.29)	0.040 (0.56)	-0.088 (0.13)	0.026 (0.72)	-0.093 (0.54)	0.032 (0.76)
EBIT/assets	0.154 (<0.01)	0.069 (0.35)	0.202 (<0.01)	0.178 (<0.01)	0.147 (<0.01)	0.198 (<0.01)	0.044 (0.01)	0.022 (0.62)	0.064 (<0.01)	0.250 (<0.01)	0.133 (0.04)	0.303 (<0.01)
Market-to-book ratio	0.006 (0.10)	0.008 (0.27)	0.005 (0.26)	0.003 (0.08)	0.008 (<0.01)	0.007 (0.01)	0.008 (<0.01)	0.002 (0.65)	0.017 (<0.01)	0.005 (0.06)	0.005 (0.35)	0.010 (0.01)
Firm size	-0.005 (0.22)	0.007 (0.55)	-0.011 (0.09)	0.001 (0.56)	0.014 (<0.01)	0.003 (0.42)	0.005 (0.01)	-0.003 (0.55)	0.009 (0.02)	-0.005 (0.27)	0.007 (0.53)	-0.007 (0.35)
Capex/assets	-0.297 (<0.01)	-0.314 (<0.01)	-0.327 (<0.01)	-0.370 (<0.01)	-0.339 (<0.01)	-0.474 (<0.01)	-0.163 (<0.01)	-0.137 (<0.01)	-0.213 (<0.01)	-0.697 (<0.01)	-0.644 (<0.01)	-0.839 (<0.01)
Δ(NWC/assets)	-0.039 (<0.01)	-0.262 (<0.01)	-0.048 (<0.01)	-0.290 (<0.01)	-0.325 (<0.01)	-0.323 (<0.01)	-0.065 (<0.01)	-0.080 (<0.01)	-0.070 (<0.01)	-0.451 (<0.01)	-0.488 (<0.01)	-0.469 (<0.01)
Δ(STdebt/assets)	0.0002 (0.88)	-0.194 (<0.01)	0.0004 (0.72)	-0.128 (<0.01)	-0.276 (<0.01)	-0.096 (<0.01)	-0.062 (<0.01)	-0.077 (<0.01)	-0.060 (<0.01)	-0.250 (<0.01)	-0.301 (<0.01)	-0.240 (<0.01)
R^2	0.254	0.332	0.270	0.258	0.286	0.314	0.247	0.283	0.282	0.397	0.435	0.431
N	5487	716	4479	15355	4256	10874	6128	1418	4474	5906	1421	4289

The table reports the results of pooled OLS regressions on cash ratios. Cash ratio is the ratio of cash and short-term investments to the book value of total assets. NWC/assets is the ratio of net working capital minus cash and short-term investments to the book value of total assets. Capex/assets is the ratio of capital expenditures to the book value of total assets. EBIT/assets is the ratio of earnings before interests and taxes (EBIT) to the book value of total assets. Market-to-book ratio is calculated as the sum of total debt and the market value of equity, divided by the book value of total assets. Firm size is a natural log of the book value of total assets ($ in thousands), which is translated to U.S. dollars using year-ending currency rates. Leverage is the ratio of total debt to the book value of total assets. Dividend dummy takes a value of 1 if a firm distributes cash dividend in a given year, and otherwise 0. Coefficient of variation of EBIT (CV of EBIT) is calculated using the ratios of EBIT to the book value of total assets over five years. Industry sigma is the average coefficient of variation of EBIT of each industry, which is classified by Worldscope's Industrial Classification Level 6. Stock return volatility is the standard deviation of monthly returns of each stock over 36 months. Post-crisis dummy takes a value of 1 if a firm-year is in the period of 1999-2005 (after the Asian financial crisis), and otherwise 0.

	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	0.245 (<0.01)	0.202 (<0.01)	0.241 (<0.01)	0.235 (<0.01)	0.175 (<0.01)
NWC/assets	-0.156 (<0.01)	-0.158 (<0.01)	-0.155 (<0.01)	-0.156 (<0.01)	-0.129 (<0.01)
Capex/assets	-0.265 (<0.01)	-0.242 (<0.01)	-0.264 (<0.01)	-0.262 (<0.01)	-0.245 (<0.01)
EBIT/assets	0.231 (<0.01)	0.219 (<0.01)	0.240 (<0.01)	0.240 (<0.01)	0.144 (<0.01)
Market-to-book ratio	0.036 (<0.01)	0.039 (<0.01)	0.036 (<0.01)	0.036 (<0.01)	0.032 (<0.01)
Firm size	-0.006 (<0.01)	-0.005 (<0.01)	-0.006 (<0.01)	-0.006 (<0.01)	-0.002 (<0.01)
Leverage	-0.265 (<0.01)	-0.255 (<0.01)	-0.265 (<0.01)	-0.265 (<0.01)	-0.229 (<0.01)
Dividend dummy	0.002 (0.39)	0.006 (<0.01)	0.002 (0.18)	0.003 (0.10)	0.014 (<0.01)
CV of EBIT			0.001 (0.01)		
Industry sigma				0.006 (<0.01)	
Stock return volatility					0.021 (<0.01)
Post-crisis dummy		0.031 (<0.01)			
Adjusted R^2	0.2561	0.265	0.2563	0.2571	0.211
N	23074	23074	23074	23074	18178

Table 7: Fixed effects regressions on cash ratios

The table reports the results of fixed effects regressions on cash ratios. Cash ratio is the ratio of cash and short-term investments to the book value of total assets. NWC/assets is the ratio of net working capital minus cash and short-term investments to the book value of total assets. Capex/assets is the ratio of capital expenditures to the book value of total assets. EBIT/assets is the ratio of earnings before interests and taxes (EBIT) to the book value of total assets. Market-to-book ratio is calculated as the sum of total debt and the market value of equity, divided by the book value of total assets. Firm size is a natural log of the book value of total assets ($ in thousands), which is translated to U.S. dollars using year-ending currency rates. Leverage is the ratio of total debt to the book value of total assets. Dividend dummy takes a value of 1 if a firm distributes cash dividend in a given year, and otherwise 0. Coefficient of variation of EBIT (CV of EBIT) is calculated using the ratios of EBIT to the book value of total assets over five years. Industry sigma is the average coefficient of variation of EBIT of each industry, which is classified by Worldscope's Industrial Classification Level 6. Stock return volatility is the standard deviation of monthly returns of each stock over 36 months. Post-crisis dummy takes a value of 1 if a firm-year is in the period of 1999-2005 (after the Asian financial crisis), and otherwise 0.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
NWC/assets	-0.137 (<0.01)	-0.138 (<0.01)	-0.137 (<0.01)	-0.137 (<0.01)	-0.123 (<0.01)	-0.124 (<0.01)
Capex/assets	-0.152 (<0.01)	-0.149 (<0.01)	-0.152 (<0.01)	-0.147 (<0.01)	-0.155 (<0.01)	-0.145 (<0.01)
EBIT/assets	0.092 (<0.01)	0.090 (<0.01)	0.090 (<0.01)	0.091 (<0.01)	0.081 (<0.01)	0.085 (<0.01)
Market-to-book ratio	0.010 (<0.01)	0.011 (<0.01)	0.010 (<0.01)	0.011 (<0.01)	0.011 (<0.01)	0.012 (<0.01)
Firm size	-0.004 (<0.01)	-0.005 (<0.01)	-0.004 (<0.01)	-0.005 (<0.01)	-0.004 (<0.01)	-0.006 (<0.01)
Leverage	-0.136 (<0.01)	-0.134 (<0.01)	-0.136 (<0.01)	-0.134 (<0.01)	-0.130 (<0.01)	-0.125 (<0.01)
Dividend dummy	0.011 (<0.01)	0.012 (<0.01)	0.011 (<0.01)	0.012 (<0.01)	0.012 (<0.01)	0.013 (<0.01)
CV of EBIT	0.0004 (0.36)	-0.004 (<0.01)				
CV of EBIT * post-crisis dummy		0.005 (<0.01)				
Industry sigma			-0.00003 (0.98)	-0.005 (<0.01)		
Industry sigma * post-crisis dummy				0.006 (<0.01)		
Stock return volatility					0.015 (<0.01)	-0.033 (<0.01)
Stock return Vol. * post-crisis dummy						0.048 (<0.01)
R^2	0.72	0.72	0.72	0.72	0.73	0.73
N	19599	19599	19599	19599	17723	17723

Table 8: Comparison of firm characteristics in the period of pre- vs. post-Asian financial crisis

The table compares the means and medians of firm characteristics in the pre- vs. post-Asian financial crisis period and the results (p-values) of mean difference tests and nonparametric median difference tests. The p-value for portion of dividend paying firms is the result of difference in proportion test. Leverage is the ratio of total debt to the book value of total assets. NWC/assets is the ratio of net working capital minus cash and short-term investments to the book value of total assets. Capex/assets is the ratio of capital expenditures to the book value of total assets. EBIT/assets is the ratio of earnings before interests and taxes (EBIT) to the book value of total assets. Market-to-book ratio is calculated as the sum of total debt and the market value of equity, divided by the book value of total assets. Firm size is a natural log of the book value of total assets ($ in thousands), which is translated to U.S. dollars using year-ending currency rates. Stock return volatility is the standard deviation of monthly returns of each stock over 36 months. Coefficient of variation of EBIT (CV of EBIT) is calculated using the ratios of EBIT to the book value of total assets over five years. Industry sigma is the average coefficient of variation of EBIT of each industry, which is classified by Worldscope's Industrial Classification Level 6.

| | Mean | | | Median | | |
	Pre-crisis (1991~1996)	Post-crisis (1999~2005)	p-value	Pre-crisis (1991~1996)	Post-crisis (1999~2005)	p-value
Leverage	0.313	0.236	<0.01	0.301	0.214	<0.01
NWC/assets	-0.013	0.042	<0.01	-0.016	0.038	<0.01
Capex/assets	0.081	0.055	<0.01	0.056	0.036	<0.01
EBIT/assets	0.070	0.071	0.18	0.059	0.060	0.74
Market-to-book ratio	1.159	0.948	<0.01	0.897	0.771	<0.01
Firm size	12.419	11.816	<0.01	12.337	11.620	<0.01
Proportion of dividend paying firms	81.76%	67.84%	0.02	NA	NA	NA
Stock return volatility	0.144	0.173	<0.01	0.126	0.149	<0.01
CV of EBIT	0.643	0.975	<0.01	0.370	0.501	<0.01
Industry sigma	0.656	0.969	<0.01	0.475	0.836	<0.01

Table 9: Predicted cash ratios and their deviations from actual cash ratios in the post-Asian financial crisis period

The table summarizes the predicted cash ratios of sample firms from 1999 to 2005, and deviations of the actual cash ratios from those predicted by Fama-MacBeth's (1973) regression of the modified Opler et al.'s model (1999). The coefficients of Fama-MacBeth's regression are the average coefficients from annual cross-sectional regressions estimated over the period 1991-1996. The cash ratio is measured as the ratio of cash and short-term investments to the book value of total assets. Estimates from the regression are as follows: Cash ratio = 0.0912- 0.0011 Industry Sigma + 0.0100 Market-to-book ratio + 0.0025 Firm size + 0.3004 EBIT/asset − 0.1727 NWC/assets − 0.2232 Capex/assets - 0.1453 Leverage + 0.3463 Dividend + 0.1834 Proceeds from stock sales + 0.1135 Increase in total debt. The table reports the mean predicted cash ratios and difference between actual cash ratios and predicted cash ratios by year for whole sample, small and large firms, and non-dividend and dividend paying firms. The numbers in parentheses are p-values from t-tests to test whether the actual minus predicted cash ratios are different from zero.

| Year | Whole sample | | Small firms | | Large firms | | Non-dividend paying firms | | Dividend paying firms | |
	Predicted	Actual-Predicted	Predicted	Actual-Predicted	Predicted	Actual-Predicted	Predicted	Actual-Predicted	Predicted	Actual-Predicted
1999	0.104	0.017 (<0.01)	0.104	0.027 (<0.01)	0.105	-0.005 (0.26)	0.087	0.001 (<0.01)	0.115	0.027 (<0.01)
2000	0.105	0.025 (<0.01)	0.104	0.035 (<0.01)	0.109	0.000 (0.79)	0.089	0.022 (<0.01)	0.114	0.027 (<0.01)
2001	0.104	0.033 (<0.01)	0.102	0.043 (<0.01)	0.107	0.011 (0.01)	0.086	0.025 (<0.01)	0.112	0.037 (<0.01)
2002	0.106	0.045 (<0.01)	0.104	0.056 (<0.01)	0.110	0.018 (<0.01)	0.088	0.041 (<0.01)	0.115	0.047 (<0.01)
2003	0.108	0.049 (<0.01)	0.106	0.061 (<0.01)	0.114	0.023 (<0.01)	0.090	0.050 (<0.01)	0.116	0.050 (<0.01)
2004	0.109	0.052 (<0.01)	0.106	0.063 (<0.01)	0.116	0.025 (<0.01)	0.092	0.053 (<0.01)	0.116	0.051 (<0.01)
2005	0.108	0.053 (<0.01)	0.106	0.062 (<0.01)	0.114	0.030 (<0.01)	0.090	0.056 (<0.01)	0.115	0.052 (<0.01)

Table 10: Fixed effects regressions on the sample firms that went public before 1999

The table reports the results of fixed effects regressions on cash ratios for only the sample firms going public before 1999. Cash ratio is the ratio of cash and short-term investments to the book value of total assets. NWC/assets is the ratio of net working capital minus cash and short-term investments to the book value of total assets. Capex/assets is the ratio of capital expenditures to the book value of total assets. EBIT/assets is the ratio of earnings before interests and taxes (EBIT) to the book value of total assets. Market-to-book ratio is calculated as the sum of total debt and the market value of equity, divided by the book value of total assets. Firm size is a natural log of the book value of total assets ($ in thousands), which is translated to U.S. dollars using year-ending currency rates. Leverage is the ratio of total debt to the book value of total assets. Dividend dummy takes a value of 1 if a firm distributes cash dividend in a given year, and otherwise 0. Coefficient of variation of EBIT (CV of EBIT) is calculated using the ratios of EBIT to the book value of total assets over five years. Industry sigma is the average coefficient of variation of EBIT of each industry, which is classified by Worldscope's Industrial Classification Level 6. Stock return volatility is the standard deviation of monthly returns of each stock over 36 months. Post-crisis dummy takes a value of 1 if a firm-year is in the period of 1999-2005 (after the Asian financial crisis), and otherwise 0.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
NWC/asset	-0.124 (<0.01)	-0.125 (<0.01)	-0.125 (<0.01)	-0.125 (<0.01)	-0.117 (<0.01)	-0.118 (<0.01)
Capex/asset	-0.139 (<0.01)	-0.134 (<0.01)	-0.140 (<0.01)	-0.132 (<0.01)	-0.145 (<0.01)	-0.134 (<0.01)
EBIT/asset	0.103 (<0.01)	0.100 (<0.01)	0.098 (<0.01)	0.099 (<0.01)	0.100 (<0.01)	0.105 (<0.01)
Market-to-book ratio	0.008 -0.070	0.009 (<0.01)	0.008 (<0.01)	0.009 (<0.01)	0.008 (<0.01)	0.010 (<0.01)
Firm size	-0.003 (0.09)	-0.003 (0.04)	-0.003 (0.05)	-0.004 (0.01)	-0.004 (0.02)	-0.006 (<0.01)
Leverage	-0.139 (<0.01)	-0.137 (<0.01)	-0.139 (<0.01)	-0.136 (<0.01)	-0.133 (<0.01)	-0.128 (<0.01)
Dividend dummy	0.013 (<0.01)	0.014 (<0.01)	0.012 (<0.01)	0.013 (<0.01)	0.013 (<0.01)	0.014 (<0.01)
CV of EBIT	0.002 (<0.01)	-0.003 (<0.01)				
CV of EBIT * post-crisis dummy		0.006 (<0.01)				
Industry sigma			0.002 (0.09)	-0.003 (0.05)		
Industry sigma * post-crisis dummy				0.006 (<0.01)		
Stock return volatility					0.021 (<0.01)	-0.025 (0.02)
Stock return vol. * post-crisis dummy						0.047 (<0.01)
R^2	0.64	0.64	0.64	0.64	0.65	0.65
N	12955	12955	12955	12955	12130	12130