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Firm Investment, Liquidity, and Bank Health: A Panel Study of Asian Firms in the 2000s

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Kazuo Ogawa

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ABSTRACT

The purpose of this study is to investigate how firms responded to the deterioration of bank health during the financially turbulent periods in the 2000s in making investment decisions and in meeting demand for liquidity. A rise in uncertainty regarding the ability to obtain external funds may have induced firms to rely on internal funds to finance investment activities. Therefore, we shed light on the cash flow sensitivity of investment and cash holdings by estimating firm-level investment and cash holdings equations using panel data for Asian firms in the 2000s. Our sample firms are from countries at different stages of financial development. The sample enables us to analyze the different roles played by internal funds in the financial and investment policy of firms in a financial environment with different stages of development.

We find that the cash flow sensitivity of investment and cash holdings rises as bank health deteriorates. Moreover, the impact of non-performing loans on the cash flow sensitivity of investment and cash holdings is more prevalent across firms, irrespective of firm age, in countries with a higher level of financial intermediary development. Our findings suggest that as financial intermediaries develop, firms become more dependent on bank credit so that bank-dependent firms are more vulnerable to external shocks that hit the financial system. Therefore, when bank health is impaired, bank-dependent firms increase their reliance on internal funds and raise their propensity to save cash flow to materialize potentially profitable investment opportunities in the future.

Keywords: investment, financial constraint, cash flow sensitivity, cash holdings, bank health

JEL Classification: E21, E22, E44, G31, G32, O16

I. INTRODUCTION

The financial market plays an important role in allocating limited financial resources to the most efficient uses. Development of the financial market enhances the functions of financial intermediaries and mitigates the flow of asymmetrical information between lenders and borrowers. As asymmetric information drives a wedge between the cost of internal funds and that of external financing, alleviation of asymmetric information helps firms gain access to external financing at lower cost, which enables firms to attain higher levels of investment that is less constrained by the availability of internal funds. This positive relationship between financial development and economic activities has been confirmed in empirical studies.¹

However, financial institutions should be healthy enough to provide stable external funds to firms in order for financial development to enhance economic growth. How much would the economic growth of a country in the course of financial development be affected when a severe financial shock hits its economy? This is an interesting and important research question to be posed. In fact, a number of financial institutions across the globe suffered from massive non-performing loans during the global financial crisis in the 2000s. Deterioration of bank health had a serious impact on bank-dependent firms, which had difficulty raising stable external funds at a low cost and were forced to rely again on their limited internal funds.

The purpose of this study is to investigate how firms responded to the deterioration of bank health in the 2000s in making investment decisions and in meeting demand for liquidity. A rise in uncertainty related to the ability to obtain stable external funds may have induced firms to rely on internal funds to finance investment activities. We reexamine the role of internal funds in firm activities during the financially turbulent period, using panel data on Asian firms.

Specifically, we shed light on the cash flow sensitivity of investment and cash holdings. A debate has taken place for many years regarding the role of cash flow in firm investment behavior.² In this study, we estimate the cash flow sensitivity of investment and cash holdings of Asian firms in the 2000s. Our sample firms come from twelve countries at different stages of financial development: Bangladesh; Hong Kong, China; India; Indonesia; the Republic of Korea; Malaysia; the Philippines; Singapore; Sri Lanka; Taipei, China; Thailand; and Viet Nam. The data enable us to analyze the different role played by internal funds in the financial and investment policies of the firms operated in a financial environment at different stages of development.

We preview our main findings of this study. We find that the cash flow sensitivity of investment falls as a financial market develops, but the cash flow sensitivity of cash holdings rises as a financial market develops. We also find that the cash flow sensitivity of investment and cash holdings rises as bank health deteriorates. Moreover, the impact of non-performing loans on the cash flow sensitivity of investment and cash holdings is more prevalent across firms, irrespective of firm age, in countries with a higher level of financial intermediary development. In fact, as bank health deteriorates, the cash flow sensitivity of investment and cash holdings rises more sharply for firms in countries with greater financial intermediary development. This finding seems a bit contradictory to the conventional wisdom that financial development mitigates external financial constraints, and thus, investment and cash holdings become less sensitive to cash flow. However, our findings suggest that as financial

¹ For example, see King and Levine (1993), Demirgüç-Kunt and Maksimovic (1998), Rajan and Zingales (1998), Wurgler (2000), and Love (2003).

² A heated debate started from the seminal work of Fazzari, Hubbard, and Petersen (1988) and a challenge to the above work by Kaplan and Zingales (1997).

intermediaries develop, firms become more dependent on bank credit, and thus, bank-dependent firms are more vulnerable to the financial shocks that hit the banking system. Therefore, bank-dependent firms increase their reliance on internal funds and raise their propensity to save cash flow to materialize potentially profitable investment opportunities in the future.

This paper is organized as follows. In Section II, we provide an economic background for our analysis. Section III describes the empirical model. Section IV explains the data set and shows some descriptive statistics of firm characteristics. Section V presents the estimation results. Section VI concludes this study.

II. INVESTMENT, CASH HOLDINGS, AND CASH FLOW: ECONOMIC BACKGROUND

In this section, we explain the main features of our analysis in the course of over-viewing the extant literature on the role of cash flow in the investment and cash holding behavior of firms.

A. Investment and Cash Flow

There is a broad consensus among economists that cash flow is one of the important determinants of investment. However, an intense debate has taken place regarding the interpretation of the cash flow sensitivity of investment. One strand of research, pioneered by Fazzari, Hubbard, and Petersen (1988), interprets high cash flow sensitivity of investment as an indication of financial constraints. They find that firms that are a priori more likely to face financial constraints exhibit a greater cash flow sensitivity of investment. Hoshi, Kashyap, and Scharfstein (1991) is an interesting study in line with Fazzari, Hubbard, and Petersen that compares the cash flow sensitivity of investment to liquidity between independent firms and those with close financial ties to banks. They find that the investment of independent firms exhibits greater sensitivity to liquidity, reflecting costly external finance. A number of studies support FHP's main conclusion.³

Kaplan and Zingales (1997) seriously challenge Fazzari, Hubbard, and Petersen's findings. The Kaplan and Zingales study reports the opposite finding: firms classified as the least financially constrained exhibited the highest cash flow sensitivity. A debate on which of the two opposing views is correct followed and has not yet been settled (Cleary, 1999; Fazzari, Hubbard, and Petersen, 2000; Kaplan and Zingales, 2000; Gomes, 2001; Alt, 2003; and Allayannis and Mozumdar, 2004).

Guariglia (2008) suggests that the different conclusions reached by these two groups can be explained consistently by the different ways in which financial constraints are measured. Most studies giving support to Fazzari, Hubbard, and Petersen's findings define financial constraints as the extent to which firms are susceptible to informational asymmetries or the degree of external financial constraints on the firms. Firm size, firm age, and bond rating are typical examples of the sample separation criteria along this line of study.

On the other hand, studies in support of Kaplan and Zingales findings define financial constraints as the extent to which internal funds are available to the firm. They use variables related to the firm's liquidity, such as the current ratio and the coverage ratio. A firm's liquidity

³ See Sciantarelli (1996), Hubbard (1998), and Bond and Van Reenen (2007) for an excellent survey of the literature.

also works as a determinant of investment, since the firm can realize investment opportunities by unpiling liquid assets. In fact, Myers and Majluf (1984) argue that the amount of a firm's cash holdings, which the authors call "financial slack," has a direct effect on investment in the presence of asymmetric information.

It should be noted that these two measures of financial constraints are closely related.

When a firm has abundant internal funds, it can readily raise external funds at a low cost, as a cash-rich firm can be perceived as less risky by lenders. However, when a firm has difficulty obtaining external funds at a low interest rate, the firm might prepare internal funds for potentially profitable investment opportunities in the future by saving a part of cash flow as cash. Thus, a firm's cash holdings out of cash flow are affected by external financial constraints faced by the firm.

B. Cash Holdings and Cash Flow

Almeida, Campello, and Weisbach (2004) is a seminal work that links external financial constraints with corporate demand for cash. They construct a model of firms' cash demand where the firms anticipating external financial constraints in the future respond to those binding constraints by hoarding cash today. Holding cash can be costly, as cash savings force the firms to give up some current, valuable investments. Constrained firms thus choose the optimal cash holdings so that the benefit of future profitable investments might be equal to the cost of giving up present investments. They show that financially constrained firms exhibit positive cash flow sensitivity of cash holdings, while financially unconstrained firms do not display a systematic propensity to save cash.

Riddick and Whited (2009) challenge the work of Almeida, Campello, and Weisbach. They argue that the cash flow coefficient of cash saving might take a negative value if a change in cash flow provides any indication of a productivity shock of the firm and the firm thus shifts some of its cash holdings into physical investments.

Ogawa (2012) obtains empirical evidence supporting Almeida, Campello, and Weisbach. Using panel data on Japanese firms in the 2000s, he estimates a cash holdings equation separately for two groups of firms: independent firms and bank-dependent firms. He finds that cash holdings are less sensitive to cash flow for bank-dependent firms.

C. Financial Development and the Cash Flow Sensitivity of Investment and Cash Holdings

As discussed by Rajan and Zingales (1998), financial development improves a firm's access to external financing at a low cost, thereby mitigating the effects of external financial constraints upon the firm. Given the discussions about the effects of external financial constraints on a firm's investment and cash holdings, financial development will lower a firm's cash flow sensitivity of investment and cash.

A number of studies have investigated the effects of financial development on the cash flow sensitivity of investment for financially constrained firms. Examining panel data on firms in thirteen developing countries in South America and East Asia, Laeven (2003) finds that financial liberalization reduces the cash flow sensitivity of investment of small-sized firms but not large ones. Love (2003) estimates a structural model of investment based on the Euler equation using firm-level data from 40 countries and finds a strong negative relationship between financial

market development and the sensitivity of investment on the stock of liquid assets, a proxy for the availability of internal funds.

Evidence for the effects of financial liberalization on the cash flow sensitivity of investment in developing countries has been provided by Harris, Schiantarelli, and Siregar (1994) for Indonesia; Gelos and Werner (2002) for Mexico; Forbes (2003) and Gallego and Loayza (2004) for Chile; Guncavdi, Bleaney, and McKay (1998) for Turkey; and Laeven (2002), Koo and Shin (2004) and Koo and Maeng (2005) for the Republic of Korea.⁴

In a similar vein, it is expected that the cash flow sensitivity of cash holdings will be mitigated by financial development. Khurana, Martin, and Pereira (2006) examine the impact of financial development on demand for liquidity by looking at how financial development affects the sensitivity of firms' cash holdings to cash flow. Using firm-level data for 35 countries for 1994–2002, they find that the sensitivity of cash holdings to cash flow decreases with financial development.

D. Bank Health and the Cash Flow Sensitivity of Investment and Cash Holdings

In general, non-performing loans accumulate during financial crises, which deteriorates bank health severely and leads to a substantial reduction of bank credit to the corporate sector. Deterioration of bank health has a tremendous impact on bank-dependent firms. The main purpose of this study is to evaluate quantitatively the effects of the deterioration of bank health on the cash flow sensitivity of investment and cash holdings.

In earlier discussions, we have argued that the cash flow sensitivity of investment and cash holdings decreases as a financial market develops. Thus, the firm switches from internal funds to external funds, which become available at a lower cost, as asymmetric information between lenders and borrowers decreases. However, a deterioration of bank health might have a larger impact on the behavior of firms facing a highly developed financial market since bank-dependent firms are more vulnerable to the external shocks that hit the banking system. Thus, as bank health deteriorates, the firms facing a highly developed financial market might have a greater propensity to save from their cash flows to create greater liquidity for financing future profitable investment opportunities. Thus, when banks health is impaired, the cash flow sensitivity of cash holdings might rise for firms in countries with highly developed financial markets.

In a similar vein, when banks' health deteriorates, investment might be financed more from internal funds by the firms facing highly developed financial markets or their investment may become more sensitive to cash flow. We incorporate the dependence of cash flow sensitivity of investment and cash holdings on bank health in specifying investment and cash holdings equations in Section 3.

⁴ There are, however, empirical studies that report little or no effect of financial liberalization on firms' investment. See Jaramillo, Schiantarelli, and Weiss (1996) for Ecuador; Hermes and Lensink (1998) for Chile; and Bhaduri (2005) for India.

III. EMPIRICAL SPECIFICATION

In this section, we model the investment and cash holding behavior of firms to evaluate empirically the cash flow sensitivity of investment and cash holdings of Asian firms in the 2000s, which cover two financial crises. Our baseline investment equation and cash holdings equation are specified below.

A. Baseline Specification

Investment equation

$$\begin{aligned} \frac{I_{it}}{K_{i,t-1}} = & \alpha_0 + \alpha_1 PROFIT_{it} + \alpha_2 \frac{CASHFLOW_{it}}{K_{i,t-1}} + \alpha_3 \left(\frac{CASH}{K} \right)_{i,t-1} + \alpha_4 \left(\frac{DEBT}{K} \right)_{i,t-1} \\ & + \alpha_5 TIMEDUM_t + \alpha_6 (COUNTRY)_i \times (TIMEDUM)_t + \mu_i + v_{it} \end{aligned} \quad (1)$$

Cash holdings equation

$$\begin{aligned} \left(\frac{\Delta CASH}{TW} \right)_{it} = & \beta_0 + \beta_1 PROFIT_{it} + \beta_2 \log(RTW)_{i,t} + \beta_3 \left(\frac{\Delta NWC}{TW} \right)_{i,t} + \beta_4 \left(\frac{CASHFLOW}{TW} \right)_{i,t} \\ & + \beta_5 \left(\frac{DEBT}{TW} \right)_{i,t-1} + \beta_6 \left(\frac{CASH}{TW} \right)_{i,t-1} + \beta_7 TIMEDUM_t \\ & + \beta_8 (COUNTRY)_i \times (TIMEDUM)_t + v_i + u_{it} \end{aligned} \quad (2)$$

where I_{it} : investment of the i-th firm in period t

$K_{i,t-1}$: capital stock of the i-th firm at the end of period t-1

$PROFIT_{it}$: profitability of the i-th firm in period t

$CASHFLOW_{it}$: cash flow of the i-th firm in period t

$CASH_{it}$: cash holdings of the i-th firm in period t

$DEBT_{i,t-1}$: debt of the i-th firm at the end of period t-1

TW_{it} : total assets of the i-th firm in period t

RTW_{it} : real total assets of the i-th firm in period t

NWC_{it} : net working capital of the i-th firm in period t

$TIMEDUM_t$: time dummies

$COUNTRY_i$: country dummies

μ_i, v_i : firm-specific effects

u_{it}, v_{it} : disturbance⁵

Our specification of an investment equation is standard with profitability of investment ($PROFIT$) and cash flow ($CASHFLOW$) as explanatory variables. Profitability is measured by two variables: the growth rate of real sales ($GSALES$) and Tobin's q ($TOBINQ$). Both profitability

⁵ The subscript i and t represent firm and year, respectively.

and cash flow will have non-negative effects on investment ($\alpha_1 \geq 0$ and $\alpha_2 \geq 0$). The investment equation is augmented by two additional explanatory variables. One variable is cash stock at the end of the previous year (*CASH*). As was discussed above, cash stock provides liquidity to firms and thus can be a measure of internal funds; thus, $\alpha_3 \geq 0$. The other variable is the ratio of debt to capital stock (*DEBT/K*). Higher debt/capital stock ratio implies a higher cost of external finance and decreases investment ($\alpha_4 < 0$). The dependent variable is the ratio of investment to capital stock or the investment rate, and accordingly, cash flow, cash and debt are also normalized by the capital stock. We add time dummies as well as the cross terms of country dummies with time dummies to account for country-specific shocks.

Regarding the firms' cash holdings equation, the dependent variable is a change in cash holdings ($\Delta CASH$) divided by total assets (*TW*). The explanatory variables basically correspond to the transaction motive and the precautionary motive of cash holdings.⁶ The total current profitable investment projects might be sustained by retaining more cash. Moreover, cash would be used to realize potentially profitable investments in the future for the financially constrained firms. Therefore, we expect the coefficient of profitability (β_1) to be positive. Evidence indicates that there are economies of scale to holding cash (see, for example, Mulligan [1997]). Therefore, the coefficient of the logarithm of real total assets (*RTW*), our measure of firm size, will be negative ($\beta_2 < 0$). A change in net working capital (*NWC*), defined as current assets–current liabilities, is a substitute for cash, and we expect β_3 to be negative.

A firm will save part of the cash flow for precautionary purposes. Thus, the propensity to save (β_4) will be positive. Almeida, Campello, and Weisbach (2004) demonstrate theoretically and empirically that the propensity to save is higher for financially constrained firms.

When debt is sufficiently large relative to a firm's equity, the firm faces an increased risk of default and a higher cost of external finance. To avoid this situation, a debt-ridden firm will use cash to redeem debt, or the coefficient of the debt–asset ratio (β_5) is negative.⁷ Lastly, a lagged cash–asset ratio measures the adjustment speed of cash holdings toward an optimal target.⁸ Country-specific shocks are controlled by time dummies and the cross terms of the time dummies and country dummies.

B. Modification of Baseline Specification

We modify the baseline specification so that we may compare the cash flow sensitivity of investment and cash holdings between financially unconstrained firms and constrained ones. In our first modification, we estimate an investment equation and a cash holdings equation separately for two samples at different stages of financial development. Our data set is ideal for investigating the effects of financial development on the cash flow sensitivity of investment and cash holdings since our sample firms come from Asian countries at a variety of financial development stages. Specifically, we classify our sample countries into two groups based on

⁶ See Opler et al. (1999) and Bates, Kahle, and Stulz (2009) for a comprehensive survey of firms' demand for cash.

⁷ By contrast, Acharya, Almeida, and Campello (2007) demonstrate that constrained firms with high hedging needs should display a positive relation between cash flows and debt as well as a positive relation between cash flows and cash.

⁸ Capital expenditure is also a popular candidate for explaining demand for cash holdings. However, we do not include it as an explanatory variable since inclusion of capital expenditure renders the cash holdings equation almost an accounting identity.

the degree of financial development. We use four indices of financial development obtained from the World Bank database from 2002 to 2011. The indices used are (i) domestic credit provided by the banking sector over gross domestic product (GDP), (ii) domestic credit to private sector credit over GDP, (iii) the market capitalization of listed companies over GDP and (iv) total stock value traded over GDP. The sample averages of these four indices are shown in Table 1. Based on these sample averages, we categorize Hong Kong, China; the Republic of Korea; Malaysia; Singapore; Taipei, China; and Thailand as financially developed countries and Bangladesh, India, Indonesia, the Philippines, Sri Lanka, and Viet Nam as financially developing countries. Similarly, based on the sample averages associated with domestic credit in Table 1, we classify Hong Kong, China; the Republic of Korea; Malaysia; Taipei, China; and Thailand as countries with developed financial intermediaries and the rest as countries with developing financial intermediaries. The investment equation and the cash holdings equation are estimated separately for the two groups at different stages of financial development to compare the cash flow sensitivity of investment and cash holdings.

Table 1: Four Indices of Financial Development: 2002–2011

	Domestic Credit Provided by Banking Sector (% of GDP)	Domestic Credit to Private Sector (% of GDP)	Market Capitalization of Listed Companies (% of GDP)	Stocks Traded, Total Value (% of GDP)
Bangladesh	58.0	37.7	8.6	7.3
Hong Kong, China	154.0	156.7	435.5	408.8
India	63.7	42.3	71.4	61.4
Indonesia	42.8	26.2	33.2	15.6
Korea, Rep. of	96.7	96.2	78.4	149.3
Malaysia	128.2	112.5	141.5	44.0
Philippines	50.4	30.6	50.2	9.5
Singapore	77.8	100.1	186.3	123.2
Sri Lanka	43.1	29.8	21.9	4.0
Taipei, China	130.8	112.1	136.5	206.4
Thailand	129.7	109.2	66.7	54.6
Viet Nam	87.6	82.0	12.3	7.8

Data source: World Bank Database. <http://data.worldbank.org>

Our second modification is to allow for the dependence of the cash flow sensitivity on firm age. Firm age is a popular proxy for measuring the degree of external financial constraints. Old firms have a long history and are well known in the market, and thus, asymmetric information between lenders and borrowers is less severe for such firms, which lowers the cost of external finance. On the other hand, young firms are relatively unknown in the market, so they face higher cost of external finance. Therefore, we expect the cash flow sensitivity of investment and cash holdings to be higher for young firms. To account for the differential impact of cash flow on investment, we introduce a dummy variable for firm age. The dummy variable (*YOUNG*) takes unity when a firm is younger than the median age of the sampled firms and zero otherwise. Then, we add the cross term of the *YOUNG* dummy variable with cash flow. We also add the cross term of the *YOUNG* dummy variable with cash stock, another measure of liquidity.

Finally, we investigate the effects of bank health on the cash flow sensitivity of investment and cash holdings. When bank health deteriorates, the firms in countries with developed financial intermediaries might substitute cash for bank credit and thus raise cash flow sensitivity of investment and cash holdings. This assertion can be tested by including the cross

terms of the ratio of non-performing loans to total loans (*BADLOAN*) with cash flow or cash stock in the investment equation and the cash holdings equation. We can also investigate whether the substitution of cash for bank credit might also depend on firm age by including the triple cross terms of the non-performing loans ratio, firm age dummy and cash flow or cash stock. Table 2 shows the series of non-performing loans over the total loan for our sample countries during 2002–2011. We can see wide variations of the non-performing loans ratio across the countries and the periods. The non-performing ratios in Bangladesh, the Philippines, and Indonesia in the early 2000s exceed 20%, while those in Hong Kong, China and the Republic of Korea are below 5% throughout the sample period.

Table 2: Non-Performing Loans Ratio: 2002–2011

	Bangladesh	Hong Kong, China	India	Indonesia	Korea, Rep. of	Malaysia
2002	28.1	5.0	10.4	24.0	2.4	15.9
2003	22.1	3.9	8.8	6.8	2.6	13.9
2004	17.5	2.3	7.2	4.5	1.9	11.7
2005	13.6	1.4	5.2	7.4	1.2	9.6
2006	13.2	1.1	3.3	6.1	0.8	8.5
2007	13.2	0.8	2.5	4.1	0.7	6.5
2008	10.8	1.2	2.3	3.2	1.1	4.8
2009	9.2	1.6	2.3	3.3	1.2	3.6
2010	7.3	0.8	2.4	2.6	1.9	3.4
2011	7.1	0.7	2.3	2.9	1.4	2.9
Average	14.2	1.9	4.7	6.5	1.5	8.1

	Philippines	Singapore	Sri Lanka	Taipei,China	Thailand	Viet Nam
2002	26.5	7.7	15.3	8.9	15.7	7.2
2003	16.1	6.7	12.5	6.1	13.5	4.7
2004	14.4	5.0	9.0	3.8	11.9	4.6
2005	10.0	3.8	6.8	2.2	9.1	3.2
2006	7.5	2.8	5.5	2.1	8.1	2.6
2007	5.8	1.5	5.0	1.8	7.9	1.5
2008	4.5	1.7	6.0	1.5	5.7	2.1
2009	4.1	2.4	8.2	1.2	5.3	2.0
2010	3.8	1.8	5.1	0.6	3.9	2.2
2011	3.1	1.3	4.1	0.4	3.5	3.1
Average	9.6	3.5	7.8	2.9	8.5	3.3

Sources: World Bank database; Annual Report of Bangladesh Bank; Trend and Progress of Banking in India of Reserve Bank of India; Bangko Sentral Ng Pilipinas of the Philippines; Financial Services Commission Statistics of Korea; Financial Stability Review of Singapore; Financial System Stability Review of Central Bank of Sri Lanka; State Bank of Vietnam Statistics and Financial Statistics Monthly of Central Bank of the Republic of China (Taipei,China).

We modify the investment equation and the cash holdings equation by incorporating the discussions above as follows.

$$\begin{aligned}
\frac{I_{it}}{K_{i,t-1}} = & \alpha_0 + \alpha_1 PROFIT_{it} + \alpha_2 \frac{CASHFLOW_{it}}{K_{i,t-1}} + \alpha_3 \left(\frac{CASH}{K} \right)_{i,t-1} + \alpha_4 \left(\frac{DEBT}{K} \right)_{i,t-1} \\
& + \alpha_5 \left(\frac{CASHFLOW_{it}}{K_{i,t-1}} \right) \times (YOUNG)_{it} + \alpha_6 \left(\frac{CASH}{K} \right)_{i,t-1} \times (YOUNG)_{it} \\
& + \alpha_7 \left(\frac{CASHFLOW_{it}}{K_{i,t-1}} \right) \times (BADLOAN)_{it} + \alpha_8 \left(\frac{CASH}{K} \right)_{i,t-1} \times (BADLOAN)_{it} \\
& + \alpha_9 \left(\frac{CASHFLOW_{it}}{K_{i,t-1}} \right) \times (YOUNG)_{it} \times (BADLOAN)_{it} \\
& + \alpha_{10} \left(\frac{CASH}{K} \right)_{i,t-1} \times (YOUNG)_{it} \times (BADLOAN)_{it} \\
& + \alpha_{11} TIMEDUM_t + \alpha_{12} (COUNTRY)_i \times (TIMEDUM)_t + \mu_i + v_{it}
\end{aligned} \tag{3}$$

$$\begin{aligned}
\left(\frac{\Delta CASH}{TW} \right)_{it} = & \beta_0 + \beta_1 PROFIT_{it} + \beta_2 \log(RTW)_{i,t} + \beta_3 \left(\frac{\Delta NWC}{TW} \right)_{i,t} + \beta_4 \left(\frac{CASHFLOW}{TW} \right)_{i,t} \\
& + \beta_5 \left(\frac{DEBT}{TW} \right)_{i,t-1} + \beta_6 \left(\frac{CASH}{TW} \right)_{i,t-1} + \beta_7 \left(\frac{CASHFLOW}{TW} \right)_{i,t} \times (YOUNG)_{it} \\
& + \beta_8 \left(\frac{CASHFLOW}{TW} \right)_{i,t} \times (BADLOAN)_{it} + \beta_9 \left(\frac{CASHFLOW}{TW} \right)_{i,t} \times (YOUNG)_{it} \times (BADLOAN)_{it} \\
& + \beta_{10} TIMEDUM_t + \beta_{11} (COUNTRY)_i \times (TIMEDUM)_t + v_i + u_{it}
\end{aligned} \tag{4}$$

IV. DATA DESCRIPTION AND CHARACTERISTICS OF SAMPLE FIRMS

A. Data Set Characteristics

Our panel data set is constructed from Oriana, a comprehensive database that contains financial information on public and private companies in over 30 countries in the Asia and the Pacific region and the Middle East. We choose sample firms from 12 Asian countries: Bangladesh; Hong Kong, China; India; Indonesia; the Republic of Korea; Malaysia; the Philippines; Singapore; Sri Lanka; Taipei, China; Thailand; and Viet Nam. Our sample firms are taken from countries at various stages of financial development and with varying degrees of bank health, which enables us to shed light on the effect of financial development and bank health on the cash flow sensitivity of investment and on the cash holding behavior of firms.

The sample period covers 10 years, 2002–2011. Our unbalanced panel data set has 73,595 firm-year observations in total.

B. Descriptive Statistics of Firm Characteristics

Table 3 shows the median value of the major firm characteristics of the sample firms by country. The median firm size, measured by real total assets, is relatively large in Hong Kong, China; the Republic of Korea; and Taipei, China; and small in India; Sri Lanka; and Viet Nam. The median

firm size in Hong Kong, China is 20 times as large as that in Viet Nam. Regarding their investment rates, Hong Kong, China; Singapore; and Thailand have higher investment rates, ranging from 0.1973 to 0.2238. By contrast, investment rates are low in Bangladesh; the Republic of Korea; and Taipei, China. Compared across countries, a higher investment rate does not necessarily correspond to a higher sales growth or Tobin's q. In fact, the sales growth rate is high in Bangladesh (10.74%) and Sri Lanka (9.28%), but the investment rate is relatively low in these countries (0.1066 for Bangladesh and 0.1208 for Sri Lanka). The same is true for the relationship between the investment rate and Tobin's q. For example, Bangladesh has the highest Tobin's q (1.0419) but has the second lowest investment rate. Rather, investment is more related to the cash/asset ratio. Both Hong Kong, China and Singapore are classified as the country group with a relatively high investment rate and cash/asset ratio, while Bangladesh and Sri Lanka are characterized by a relatively low investment rate and a relatively low cash/asset ratio.

Table 3: Descriptive Statistics of Major Firm Characteristics by Country

	Investment Rate	Cash/Asset Ratio	Total Assets (\$ thousand)	Growth Rate of Real Sales (%)
Bangladesh	0.1066	0.0277	17823.8	10.74
Hong Kong, China	0.2188	0.1402	181543.0	12.86
India	0.1587	0.0207	10180.2	8.01
Indonesia	0.1373	0.0659	48307.4	-0.60
Korea, Rep. of	0.1192	0.0606	65129.7	6.00
Malaysia	0.1470	0.0865	47074.6	3.14
Philippines	0.1736	0.0757	35986.6	4.07
Singapore	0.2238	0.1469	55705.9	6.08
Sri Lanka	0.1208	0.0263	11765.6	9.28
Taipei, China	0.0290	0.1403	82640.0	7.30
Thailand	0.1973	0.0556	41256.9	3.50
Viet Nam	0.1828	0.0801	8900.7	3.84
Financially developing	0.1588	0.0282	12370.3	6.30
Financially developed	0.1487	0.1000	71555.9	6.44
Old	0.1286	0.0497	46938.6	4.73
Young	0.1938	0.0838	32607.7	9.00

	Tobin's q	Cash Flow/Asset Ratio	Debt/Asset Ratio	Number of Observations
Bangladesh	1.0419	0.0484	0.5065	397
Hong Kong, China	0.8102	0.0675	0.3869	8430
India	0.7524	0.0524	0.5883	23386
Indonesia	0.9596	0.0587	0.5542	2494
Korea, Rep. of	0.8379	0.0403	0.4835	10710
Malaysia	0.7577	0.0620	0.4087	6525
Philippines	0.8798	0.0466	0.4320	1717
Singapore	0.8641	0.0790	0.4782	4653
Sri Lanka	0.7892	0.0715	0.4007	491
Taipei, China	0.7202	0.0882	0.5074	7161
Thailand	0.8389	0.0896	0.4802	3914
Viet Nam	0.7320	0.0840	0.5655	3709
Financially developing	0.7715	0.0564	0.5706	32202
Financially developed	0.8077	0.0635	0.4576	41401
Old	0.8079	0.0586	0.5312	38924
Young	0.7672	0.0623	0.4664	34671

Source: Oriana Database, Bureau van Dijk

The 13th and 14th rows of Table 3 show the median values of firm characteristics separately for two country groups classified by their degree of financial development. The median firm size of the financially developed country group is about 5.8 times as large as that of the financially developing country group. The cash/asset ratio of the financially developed country group (0.1000) is much higher than that of the financially developing country group (0.0282). This result is observed because a variety of short-term financial products are available in the highly developed financial market, which helps firms accumulate liquid assets. There are no noticeable differences in the sales growth rate, Tobin's q , the cash flow/asset ratio or the investment rate between the two country groups.

The 15th and 16th rows of Table 3 show the median values of firm characteristics separately for two groups classified by firm age. As was discussed above, young firms are more likely to face financial constraints. Young firms are smaller than old ones. The median total assets of young firms are about 70% of those of old firms. However, young firms have higher growth potentials. The growth rate of sales and the investment rate are 9% and 0.1938, respectively, for young firms and 4.73% and 0.1286, respectively, for old firms. The cash/asset ratio of young firms (0.0838) is much higher than that of old firms (0.0497), reflecting the higher need for liquidity for young firms, possibly due to financial constraints.⁹

Figure 1 depicts the median value of the investment rate and the cash/asset ratio for the period from 2003 to 2011. The investment rate exhibits an increasing trend in the early 2000s, reaching its peak in 2007 (0.2094). This trend decreases sharply during the global financial crisis of 2008 (0.0372) but recovers quickly in 2009 and 2010. The investment rate again falls during the European debt crisis of 2011 (0.1244). The cash/asset ratio exhibits a gradually increasing trend in the 2000s and rises sharply in the year of the European debt crisis of 2011 (0.1003). Figure 2 shows the median value of the growth rate of sales and Tobin's q , two proxies of growth opportunities, for the period from 2003 to 2011. The growth rate of sales moves in tandem with the investment rate. The growth rate of sales fell sharply in 2008 and 2011, corresponding to the years of two financial crises. Tobin's q exhibits an increasing trend in the early 2000s and then fell in 2008 and 2011, although its drop is modest.

⁹ It is frequently argued that firm size is a good proxy for financial constraints. If that is the case, then we can expect that the cash/asset ratio is higher for small firms. However, we find that the small firm group with total assets below the median has a smaller cash/asset ratio (0.0441) than the large firm group (0.0808).

Figure 1: Median Path of Investment Rate and Cash/Asset Ratio

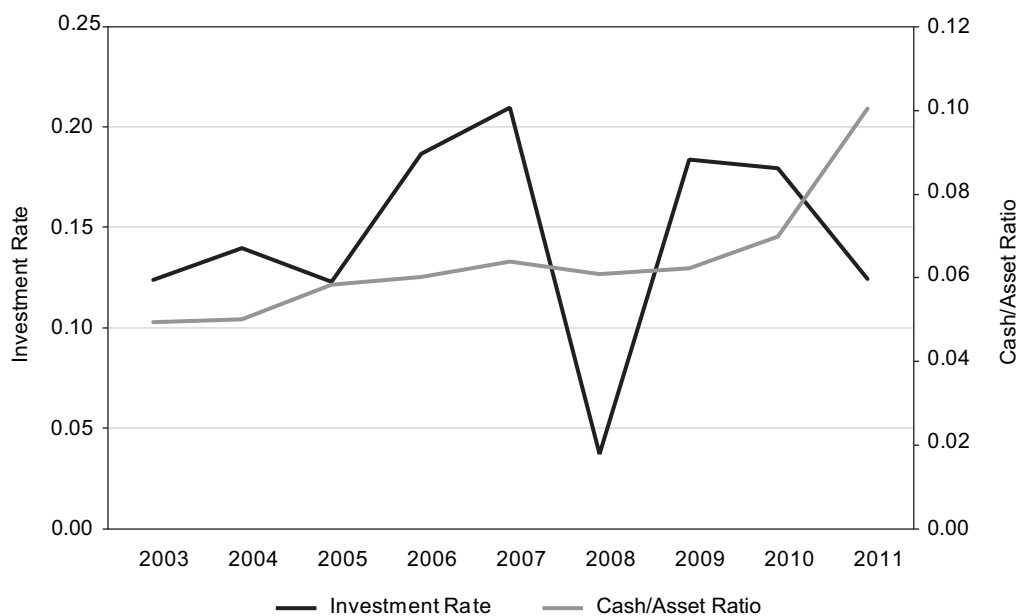
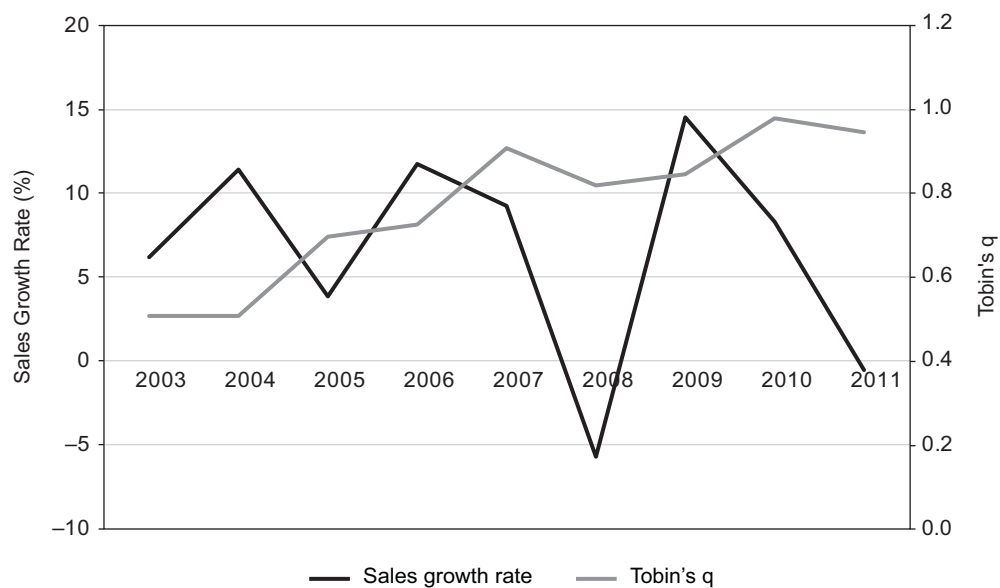


Figure 2: Median Path of Sales Growth Rate and Tobin's q



V. CASH FLOW SENSITIVITY OF INVESTMENT AND CASH HOLDINGS: EMPIRICAL EVIDENCE

First, we show the estimation results of the basic investment equation and the cash holdings equation given by eqs. (1) and (2) in Table 4. In the estimation, the top and bottom tails of the dependent and explanatory variables are trimmed at the 1% level. As for an estimation method, the fixed-effect model is adopted by use of the Hausman specification test. When investment opportunities are represented by the growth rate of sales (*GSALES*), all the explanatory variables of the investment equation and the cash holdings equation have coefficient estimates consistent with the theory, and they are statistically significant at the 1% level. Cash flow and cash stock have positive effects on investment. The marginal effects of cash flow and cash stock on investment are 0.0505 and 0.0479, respectively. Cash flow also has significantly positive effects on cash holdings. The marginal effect of cash flow on cash holdings is 0.1350.

**Table 4: Estimation Results of Investment Equation and Cash Holdings Equation:
Basic Case**

	Investment Equation	
<i>GSALES</i>	0.1587*** (21.57)	
<i>TOBINQ</i>	0.0021 (0.28)	
<i>CASHFLOW</i>	0.0505*** (24.57)	0.0599*** (26.22)
<i>CASHSTOCK₋₁</i>	0.0479*** (33.33)	0.0492*** (30.64)
<i>DEBT₋₁</i>	-0.2537*** (-11.15)	-0.2946*** (-12.08)
<i>CONSTANT</i>	0.3693*** (15.33)	0.4173*** (14.41)
adjusted R-squared	0.0784	0.0378
number of observations	56060	50362
estimation method	fixed-effect model	fixed-effect model

Table 4 (continued).

Cash Holdings Equation		
GSALES	0.0112*** (21.57)	
TOBINQ	0.0077*** (12.14)	
Log(RTW)	0.0018** (2.12)	0.0040*** (4.55)
ΔNWC	-0.0688*** (-19.34)	-0.0560*** (-16.04)
CASHFLOW	0.1350*** (34.28)	0.1337*** (34.14)
DEBT ₋₁	-0.0090*** (-4.20)	-0.0111*** (-5.53)
CASHSTOCK ₋₁	-0.4471*** (-95.25)	-0.4585*** (-92.81)
CONSTANT	0.0348*** (3.66)	0.0065 (0.00)
adjusted R-squared	0.0318	0.0335
number of observations	55216	51159
estimation method	fixed-effect model	fixed-effect model

ΔNWC = change in net working capital/asset ratio, CASHFLOW = cash flow/tangible asset for investment equation and cash flow/asset ratio for cash holdings equation, CASHSTOCK₋₁ = lagged cash/tangible asset for investment equation and lagged cash/asset ratio for cash holdings equation, CONSTANT = constant, DEBT₋₁ = lagged debt/tangible asset for investment equation and lagged debt/asset ratio for cash holdings equation, GSALES = growth rate of real sales, Log(RTW) = logarithm of real total assets, TOBINQ = Tobin's q.

Notes: The coefficient estimates of time dummies and cross terms of time dummies with country dummies are suppressed. Values in parentheses are t-ratios. *, **, *** significant at the 10%, 5% and 1% level, respectively

When Tobin's q (*TOBINQ*) is used as a proxy for investment opportunities, the coefficient estimate of Tobin's q is statistically insignificant in the investment equation. In the cash holdings equation, all the explanatory variables, including Tobin's q, have coefficient estimates that are statistically significant at the 1% level. Our findings that Tobin's q is insignificant in the investment equation but significant in the cash holdings equation might be interpreted as follows. In some Asian countries, the stock market is not well developed, so Tobin's q might capture the firm's current performance well, but it might be a poor indicator of the future growth potential of firms. The magnitude of the cash flow coefficient in the investment equation and the cash holdings equation remains unchanged even if we replace the sales growth rate with Tobin's q.

A. Sample Separation by the Degree of Financial Development

Table 5 shows the estimation results of the investment equation and the cash holdings equation for the two country groups separated by the degree of financial development. When the growth rate of sales is used as a proxy for investment opportunities, the coefficient estimates of all the explanatory variables in the investment function are statistically significant at the 1% level for both country groups. The coefficient estimate of the sales growth rate is larger for the financially developed country group and the cash flow is larger for the financially developing country group. The coefficient estimate of cash flow for the financially developing country group is twice as

large as the coefficient estimate for the financially developed country group. Thus, firms in financially developing countries are more likely to face external financial constraints.

**Table 5: Estimation Results of Investment Equation and Cash Holdings Equation:
Sample Separation by the Degree of Financial Development**

	Investment Equation			
	Financially Developed	Financially Developing	Financially Developed	Financially Developing
GSALES	0.1845*** (18.30)	0.1197*** (11.37)		
TOBINQ			0.0009 (0.08)	0.0052 (0.49)
CASHFLOW	0.0414*** (17.13)	0.0822*** (20.04)	0.0433*** (15.36)	0.1017*** (25.14)
CASHSTOCK ₋₁	0.0470*** (27.83)	0.0510*** (17.63)	0.0483*** (24.99)	0.0517*** (16.84)
DEBT ₋₁	-0.2993*** (-8.63)	-0.2189*** (-7.55)	-0.3320*** (-7.91)	-0.2807*** (-9.69)
CONSTANT	0.3865*** (11.99)	0.3605*** (9.85)	0.4065*** (9.34)	0.4863*** (12.95)
adjusted R-squared	0.0886	0.0960	0.0707	0.1132
number of observations	33675	22390	26946	23420
estimation method	fixed-effect model	fixed-effect model	fixed-effect model	fixed-effect model

	Cash Holdings Equation			
	Financially Developed	Financially Developing	Financially Developed	Financially Developing
GSALES	0.0134*** (15.03)	0.0093*** (10.41)		
TOBINQ			0.0143*** (14.84)	0.0009 (1.09)
Log(RTW)	-0.0022* (-1.83)	0.0076*** (6.32)	0.0014 (1.06)	0.0066*** (5.80)
ΔNWC	-0.1149*** (-20.32)	-0.0324*** (-7.65)	-0.0929*** (-15.26)	-0.0341*** (-8.65)
CASHFLOW	0.1897*** (32.05)	0.0867*** (13.22)	0.1608*** (29.96)	0.0937*** (16.18)
DEBT ₋₁	-0.0046 (-1.41)	-0.0139*** (-5.27)	-0.0069* (-1.93)	-0.0118*** (-5.20)
CASHSTOCK ₋₁	-0.4261*** (-72.02)	-0.4953*** (-63.14)	-0.4463*** (-66.64)	-0.4801*** (-64.84)
CONSTANT	0.0856*** (6.15)	-0.0335*** (-2.75)	0.0385** (2.48)	-0.0232** (-1.99)
adjusted R-squared	0.0468	0.0390	0.0433	0.0365
number of observations	33175	22046	27007	24156
estimation method	fixed-effect model	fixed-effect model	fixed-effect model	fixed-effect model

Notes: See Table 4 for the notations of the table.

In the cash holdings equation, the coefficient estimate of cash flow is larger for the financially developed country group. This result is opposite to the result found in Khurana, Martin, and Pereira (2006). They find that the sensitivity of cash holdings to cash flows decreases with financial development. It should be noted that our study differs from the study of Khurana, Martin, and Pereira in several ways. First, we cover only Asian countries, while their study covers 36 countries all over the world, including highly developed countries such as France, Germany, Japan, the United Kingdom and the United States. The cash flow sensitivity of cash in their study might be significantly affected by these developed countries. Second, their sample period covers the period from 1994 to 2002, while our sample period is from 2002 to 2011, and our period includes two financial crises in 2008 and 2011. The inclusion of financially turbulent periods might affect the cash flow sensitivity of cash holdings, as will be seen below. We also find that the absolute value of net working capital is larger for firms in financially developed countries. Thus, cash is a closer substitute for net working capital for the firms in financially developed countries.

When Tobin's q is used instead of a sales growth rate, it does not alter our findings that the cash flow sensitivity of investment is larger for the financially developing country group and that the cash flow sensitivity of cash holdings is larger for the financially developed country group. However, the coefficient estimate of Tobin's q in the investment function is not significant for either the financially developed country group or the financially developing country group. Furthermore, Tobin's q is not a significant explanatory variable of the cash holdings equation for the financially developing country group. Therefore, Tobin's q is not a good indicator of a firms' current and future profitability in financially developing countries.

B. Cash Flow Sensitivity and Firm Age

Table 6 shows the estimation results of the investment equation and the cash holdings equation that allow for the effects of firm age on the sensitivity of investment and cash holdings on cash flow and cash stock. The cash stock sensitivity of investment is significantly larger for young firms, although there is no statistical difference in the cash flow sensitivity of investment between old firms and young firms. The coefficient of cash stock in the investment equation is 0.2434 for young firms, but it is only 0.0462 for old firms. The cash flow sensitivity of cash holdings is also significantly higher for young firms. This result lends empirical support to the assertion that young firms are more likely to be financially constrained.

**Table 6: Estimation Results of Investment Equation and Cash Holdings Equation:
The Case Where Firm Size Affects Cash Flow and Cash Stock Sensitivity**

		Investment Equation	
		Financially Developed	Financially Developing
GSALES	0.1589*** (21.60)	0.1847*** (18.32)	0.1178*** (11.21)
CASHFLOW	0.0485*** (13.20)	0.0441*** (8.86)	0.0554*** (10.32)
CASHFLOW × YOUNG	0.0032 (0.75)	-0.0032 (-0.57)	0.0625*** (7.99)
CASHSTOCK ₋₁	0.0462*** (30.24)	0.0460*** (25.45)	0.0472*** (15.79)
CASHSTOCK ₋₁ × YOUNG	0.1972*** (3.26)	0.1018 (1.48)	0.7350*** (5.12)
DEBT ₋₁	-0.2489*** (-10.91)	-0.2953*** (-8.48)	-0.2090*** (-7.22)
CONSTANT	0.3570*** (14.64)	0.3775*** (11.50)	0.3393*** (9.25)
adjusted R-squared	0.0799	0.0892	0.1027
number of observations	56060	33675	22390
estimation method	fixed-effect model	fixed-effect model	fixed-effect model

		Cash Holdings Equation	
		Financially Developed	Financially Developing
GSALES	0.0111*** (17.31)	0.0134*** (15.01)	0.0092*** (10.40)
Log(RTW)	0.0018** (2.01)	-0.0022* (-1.85)	0.0076*** (6.32)
ΔNWC	-0.0690*** (-19.39)	-0.1149*** (-20.33)	-0.0325*** (-7.66)
CASHFLOW	0.1207*** (20.49)	0.1539*** (18.37)	0.0854*** (10.86)
CASHFLOW × YOUNG	0.0250*** (3.26)	0.0086 (0.86)	0.0042 (0.30)
DEBT ₋₁	-0.0090*** (-4.21)	-0.0046 (-1.41)	-0.0139*** (-5.27)
CASHSTOCK ₋₁	-0.4472*** (-95.28)	-0.4261*** (-72.02)	-0.4953*** (63.14)
CONSTANT	0.0360*** (3.78)	0.0860*** (6.18)	-0.0335*** (-2.75)
adjusted R-squared	0.0323	0.0470	0.0390
number of observations	55216	33175	22046
estimation method	fixed-effect model	fixed-effect model	fixed-effect model

Notes: YOUNG: dummy variable that takes unity when a firm age is less than the median age of the sampled firms and zero otherwise. See Table 4 for the other notations.

When the estimation is conducted separately for the two country groups separated by the degree of financial development, we can obtain deeper insight into the relationship between financial development and financial constraints. First, there is no discernible difference in cash flow or cash stock sensitivity of investment between young firms and old ones in financially developed countries. This result indicates that firm age is not directly associated with external financial constraints in financially developed countries. In contrast, both the cash flow and cash stock sensitivity of investment are statistically greater for young firms in financially developing countries.

Turning to the estimation results of the cash holdings equation, our finding above that the cash flow sensitivity of cash holdings is higher for the firms in financially developed countries still holds. However, we find that the higher cash flow sensitivity of cash holdings for young firms no longer holds when we estimate the cash holdings equation separately for the two country groups at different stages of financial development.

C. Cash Flow Sensitivity and Bank Health

We estimate the effects of bank health on the cash flow and cash stock sensitivity of investment and cash holdings by adding the cross terms of cash flow and cash stock with the non-performing loans ratio (*BADLOAN*) in the investment equation and the cash holdings equation. Table 7 shows the estimation results. We find that a rise in the non-performing loans ratio significantly increases the cash flow sensitivity of investment but not the cash stock sensitivity of investment for the whole sample. Regarding the impact of bank health on cash holdings, the non-performing loans ratio has no significant effect on the cash flow sensitivity for the whole sample. When the estimation is conducted separately for the two country groups classified by the development of financial intermediaries, we find that the effects of bank health on the cash flow sensitivity hinge on the degree of financial intermediary development. For the firms in countries with developed financial intermediaries, the cash flow sensitivity of investment rises as the bank health deteriorates, but we do not find any relationship between the cash flow sensitivity of investment and bank health for the firms in countries with developing financial intermediaries. The cash stock sensitivity of investment is not related to bank health, irrespective of intermediary development. The cash flow sensitivity of cash holdings also depends on the degree of financial intermediary development. In countries with developed financial intermediaries, the cash flow sensitivity of cash holdings rises as bank health deteriorates, while in countries with developing financial intermediaries, it falls as bank health deteriorates.

This financially defensive behavior of firms in countries with developed financial intermediaries might be explained as follows. In countries where financial intermediaries are developed, bank credit plays a vital role in financing firms' investment projects. However, excessive dependence on bank credit increases the risk that firms run short of the loans necessary to finance their investments when bank health is impaired. To avoid this situation, firms will depend more on cash flow in financing their investments and will save a larger part of cash flow in the form of liquid financial assets for precautionary purposes when the banking system is malfunctioning.

**Table 7: Estimation Results of Investment Equation and Cash Holdings Equation:
The Case Where Bank Health Affects Cash Flow and Cash Stock Sensitivity**

	Investment Equation		
		Financial Intermediary Developed	Financial Intermediary Developing
GSALES	0.1572*** (21.36)	0.1829*** (17.48)	0.1297*** (12.55)
CASHFLOW	0.0389*** (13.97)	0.0291*** (9.31)	0.0771*** (11.92)
CASHFLOW × BADLOAN	0.4262*** (6.00)	0.5053*** (6.21)	-0.2108 (-1.34)
CASHSTOCK ₋₁	0.0463*** (24.11)	0.0414*** (18.38)	0.0562*** (14.58)
CASHSTOCK ₋₁ × BADLOAN	0.0577 (1.12)	0.0930 (1.55)	-0.0689 (-0.66)
DEBT ₋₁	-0.2576*** (-11.32)	-0.3011*** (-8.17)	-0.2297*** (-7.97)
CONSTANT	0.3591*** (14.86)	0.3791*** (10.97)	0.3639 (0.00)
adjusted R-squared	0.0812	0.0923	0.0978
number of observations	56060	29538	26527
estimation method	fixed-effect model	fixed-effect model	fixed-effect model

	Cash Holdings Equation		
		Financial Intermediary Developed	Financial Intermediary Developing
GSALES	0.0112*** (17.34)	0.0138*** (14.63)	0.0091*** (10.43)
Log(RTW)	0.0020** (2.30)	-0.0016 (-1.24)	0.0056*** (4.75)
ΔNWC	-0.0689*** (-19.37)	-0.1148*** (-19.31)	-0.0406*** (-9.40)
CASHFLOW	0.1290*** (23.61)	0.1327*** (20.01)	0.1345*** (13.19)
CASHFLOW × BADLOAN	0.2000 (1.59)	0.6575*** (3.98)	-0.3643* (-1.76)
DEBT ₋₁	-0.0091*** (-4.25)	-0.0075** (-2.11)	-0.0105*** (-4.01)
CASHSTOCK ₋₁	-0.4470*** (-95.24)	-0.4394*** (-69.29)	-0.4552*** (-64.93)
CONSTANT	0.0324*** (3.36)	0.0777*** (5.17)	-0.0101 (-0.00)
adjusted R-squared	0.0318	0.0475	0.0301
number of observations	55216	29079	26142
estimation method	fixed-effect model	fixed-effect model	fixed-effect model

Notes: BADLOAN: ratio of non-performing loans to total loans. See Table 4 and 6 for the other notations.

The next question to be posed is whether a rise in the cash flow sensitivity of investment and cash holdings when bank health deteriorates might be more pronounced for young firms that are more likely to face financial constraints. To answer this question, we add the triple cross terms of the non-performing loans ratio, cash flow and firm age dummy to the list of explanatory variables, as was specified by equations (3) and (4). The estimation results are shown in Table 8. We find that for the firms in countries with developed financial intermediaries, the cash flow sensitivity of investment rises as bank health deteriorates, irrespective of firm age. However, for the firms in countries with developing financial intermediaries, the positive dependence of the cash flow sensitivity of investment on bank health is observed only for young firms. We do not detect any effects of bank health on the cash stock sensitivity to investment, irrespective of financial intermediary development and firm age.

**Table 8: Estimation Results of Investment and Cash Holdings Equations:
The Relation of Cash Flow and Cash Stock Sensitivity to Bank Health and Firm Age**

	Investment Equation		
		Financial Intermediary Developed	Financial Intermediary Developing
GSALES	0.1569*** (21.32)	0.1827*** (17.45)	0.1284*** (12.44)
CASHFLOW	0.0383*** (7.10)	0.0317*** (4.30)	0.0591*** (6.59)
CASHFLOW × YOUNG	−0.0021 (−0.34)	−0.0035 (−0.43)	0.0250** (2.06)
CASHFLOW × BADLOAN	0.2599*** (2.60)	0.4607*** (3.94)	−0.3745* (−1.88)
CASHFLOW × BADLOAN × YOUNG	0.4572*** (3.33)	0.0925 (0.59)	0.8028*** (2.67)
CASHSTOCK _{−1}	0.0456*** (22.17)	0.0405*** (16.68)	0.0551*** (13.76)
CASHSTOCK _{−1} × YOUNG	0.1712** (2.37)	0.1027 (1.27)	0.5749*** (3.41)
CASHSTOCK _{−1} × BADLOAN	0.0144 (0.26)	0.0682 (1.05)	−0.1229 (−1.13)
CASHSTOCK _{−1} × BADLOAN × YOUNG	1.0578 (0.62)	1.7522 (0.90)	−3.0454 (−0.81)
DEBT _{−1}	−0.2519*** (−11.04)	−0.2937*** (−7.94)	−0.2221*** (−7.70)
CONSTANT	0.3465*** (14.07)	0.3635*** (10.27)	0.3491 (0.00)
adjusted R-squared	0.0834	0.0928	0.1037
number of observations	56060	29538	26527
estimation method	fixed-effect model	fixed-effect model	fixed-effect model

Table 8 (continued).

		Cash Holdings Equation	
		Financial Intermediary Developed	Financial Intermediary Developing
GSALES	0.0110*** (17.10)	0.0136*** (14.48)	0.0090*** (10.29)
Log(RTW)	0.0022** (2.54)	-0.0015 (-1.13)	0.0060*** (5.05)
ΔNWC	-0.0699*** (-19.63)	-0.1159*** (-19.49)	-0.0413*** (-9.57)
CASHFLOW	0.1313*** (15.66)	0.1402*** (12.27)	0.1353*** (10.81)
CASHFLOW \times YOUNG	-0.0121 (-1.16)	-0.0170 (-1.27)	-0.0143 (-0.74)
CASHFLOW \times BADLOAN	-0.2869* (-1.77)	0.1636 (0.75)	-0.8325*** (-3.43)
CASHFLOW \times BADLOAN \times YOUNG	1.3472*** (5.83)	1.1585*** (3.84)	1.5833*** (4.03)
DEBT ₋₁	-0.0090*** (-4.19)	-0.0074** (-2.08)	-0.0104*** (-3.95)
CASHSTOCK ₋₁	-0.4478*** (-95.43)	-0.4400*** (-69.39)	-0.4561*** (-65.08)
CONSTANT	0.0305*** (3.16)	0.0762*** (5.06)	-0.0132 (-0.00)
adjusted R-squared	0.0324	0.0478	0.0310
number of observations	55216	29079	26142
estimation method	fixed-effect model	fixed-effect model	fixed-effect model

Notes: See Table 4, 6, and 7 for the notations.

Regarding the cash flow sensitivity of cash holdings, we find that the cash flow sensitivity of cash holdings rises as bank health deteriorates only for young firms, regardless of financial intermediary development. This result implies that young firms, which are more likely to be financially constrained, tend to increase precautionary savings in the form of liquid financial assets as bank health is impaired.

D. Comparison of Cash Flow and Cash Stock Sensitivity of Investment and Cash Holdings

Now, we compare the cash flow and cash stock sensitivity of investment and cash holdings across the firms in each country. It is an interesting exercise to see the extent to which the importance of internal funds varies across financial development, the soundness of the banking sector and firm age. Table 9 reports the cash flow and cash stock sensitivity of investment and cash holdings of firms in twelve sample countries evaluated at the non-performing loans ratio in 2008. The cash flow sensitivity of investment for young firms is larger than that for old firms in countries with developing financial intermediaries, although there is little difference in the cash flow sensitivity of investment between young firms and old ones in countries with developed financial intermediaries. The cash flow sensitivity of investment for young firms in Bangladesh is the largest (0.1304). Note that Bangladesh has the highest non-performing loans ratio (10.8%) in 2008. On the other hand, the cash flow sensitivity of investment for the young firms is the smallest (0.0028) in the Republic of Korea, which has the lowest non-performing loans ratio

(1.10%) in 2008. We also find that the cash flow sensitivity of investment for young firms in countries with developing financial intermediaries is much larger than that for young firms in countries with developed financial intermediaries.

Table 9: Cash Flow and Cash Stock Sensitivity of Investment and Cash Holdings in 2008

	Cash Flow Sensitivity of Investment		Cash Stock Sensitivity of Investment		Cash Flow Sensitivity of Cash Holdings	
	Young	Old	Young	Old	Young	Old
Countries with Developing Financial Intermediaries						
Bangladesh	0.1304	0.0187	0.2878	0.0418	0.2021	0.0454
India	0.0940	0.0505	0.5571	0.0523	0.1383	0.1162
Indonesia	0.0978	0.0471	0.5286	0.0512	0.1450	0.1087
Philippines	0.1034	0.0422	0.4874	0.0496	0.1548	0.0978
Singapore	0.0914	0.0527	0.5761	0.0530	0.1338	0.1211
Sri Lanka	0.1098	0.0366	0.4399	0.0477	0.1660	0.0854
Viet Nam	0.0932	0.0511	0.5625	0.0525	0.1370	0.1176
Countries with Developed Financial Intermediaries						
Hong Kong, China	0.0033	0.0372	0.1650	0.0413	0.1391	0.1422
Korea, Rep. of	0.0028	0.0368	0.1632	0.0413	0.1377	0.1420
Malaysia	0.0233	0.0538	0.2306	0.0438	0.1867	0.1481
Taipei, China	0.0052	0.0388	0.1712	0.0416	0.1436	0.1427
Thailand	0.0282	0.0580	0.2470	0.0444	0.1986	0.1495

Note: Calculated from the estimation results of Table 8.

The cash stock sensitivity of investment is highest for young firms in countries with developing financial intermediaries, while it is lowest for old firms, irrespective of financial intermediary development. The cash stock sensitivity of investment for young firms in countries with developed financial intermediaries falls somewhere in between. The cash stock sensitivity is highest for young firms in Singapore (0.5761) and lowest for old firms in Hong Kong, China and the Republic of Korea (0.0413).

Finally, we compare the cash flow sensitivity of cash holdings. Higher values exist for young firms than for old ones in countries with developing financial intermediaries. The young firms in Bangladesh have the highest cash flow sensitivity of cash holdings (0.2021), while the old firms in Bangladesh have the lowest cash flow sensitivity of cash holdings (0.0454). There is no discernible difference between young firms in countries with developing financial intermediaries and those in countries with developed financial intermediaries. There is also little difference among old firms, regardless of financial intermediary development.

VI. CONCLUDING REMARKS

In this study, we investigated how firms responded to the deterioration of bank health during the financially turbulent periods in the 2000s in making investment decisions and in meeting demand for liquidity. In particular, we shed light on the cash flow sensitivity of investment and cash holdings by estimating firm-level investment and cash holdings equations using panel data for Asian firms in the 2000s. Our sample has two virtues in analyzing the cash flow sensitivity of investment and cash holdings. First, our sample firms were selected from twelve countries, each of which is at a different stage of financial development. Second, our sample period covers two financial crises: the global financial crisis in 2008 and the European debt crisis in 2011.

We find that the cash flow sensitivity of investment and cash holdings rises as bank health deteriorates. Moreover, the impact of non-performing loans on the cash flow sensitivity of investment and cash holdings is more prevalent across firms, irrespective of firm age, in countries with a higher level of financial intermediary development. Our findings suggest that as financial intermediaries develop, firms become more dependent on bank credit so that bank-dependent firms are more vulnerable to the external shocks that hit the financial system. Therefore, when bank health deteriorates, firms in markets with developed financial intermediaries increase their reliance on internal funds and have greater incentives to save liquid financial assets to materialize potentially profitable investment opportunities in the future. In this way, liquidity in firms' activities regains its importance during financially turbulent periods, especially in countries with developed financial intermediaries.

The policy implications derived from our study are quite straightforward. Banking policies such as a new capital-adequacy rule should be designed so that the devices to stabilize bank credit to firms might be built in the financial system to guarantee a stable supply of bank credit.

DATA APPENDIX

In this data appendix we explain the procedures to construct the variables used in regression analysis.

1. Gross investment (I): tangible fixed assets – tangible fixed asset at the end of previous period + depreciation
2. Capital stock (K): tangible fixed assets
3. Growth rate of real sales ($GSALES$): Real sales are obtained by dividing nominal sales by GDP deflator of each country
4. Tobin's q ($TOBINQ$): (market capitalization + debt)/(total assets)
5. Cash flow ($CASHFLOW$): profit for period + depreciation
6. Cash ($CASH$): cash and cash equivalents
7. Total debt ($DEBT$): current liabilities + non-current liabilities
8. Real total assets (RTW): total assets divided by GDP deflator
9. Net working capital (NWC): inventory assets + account receivables – account payable
10. Dummy for young firms ($YOUNG$): the dummy variable for young firms takes unity when the establishment date of a firm is newer than the median value
12. Ratio of non-performing loans to total loans ($BADLOAN$): The ratio of non-performing loans to total loans is taken from World Bank database; Annual Report of Bangladesh Bank; Trend and Progress of Banking in India of Reserve Bank of India; Bangko Sentral Ng Pilipinas of the Philippines; Financial Services Commission Statistics of Korea; Financial Stability Review of Singapore; Financial System Stability Review of Central Bank of Sri Lanka; State Bank of Vietnam Statistics and Financial Statistics Monthly of Central Bank of the Republic of China (Taipei,China).
13. Financially developed countries: Based on the mean of four indices of financial development over 2002 to 2011 obtained from the World Bank database (domestic credit provided by banking sector over the GDP, domestic credit to private sector over the GDP, market capitalization of listed companies over the GDP and total stock value traded over the GDP), we define the following countries: Hong Kong, China; the Republic of Korea; Malaysia; Singapore; Taipei,China; and Thailand as financially developed and the rest: Bangladesh, India, Indonesia, the Philippines, Sri Lanka, and Viet Nam as financially developing.
14. Countries with developed financial intermediaries: Based on the mean of two indices of financial intermediaries development over 2002 to 2011 obtained from the World Bank database (domestic credit provided by banking sector over the GDP and domestic credit to private sector over the GDP), we define the following countries: Hong Kong,China; the Republic of Korea; Malaysia; Taipei,China; and Thailand as countries with developed financial intermediaries and the rest: Bangladesh, India, Indonesia, the Philippines, Singapore, Sri Lanka and Viet Nam as countries with developing financial intermediaries.

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Firm Investment, Liquidity and Bank Health: A Panel Study of Asian Firms in the 2000s

This study examines the effects of a deterioration in bank health on the cash flow sensitivity of investment and cash holdings of firms. Using a panel data set of Asian firms in the 2000s, it finds that both cash flow sensitivity and cash holding of firms increase as bank health deteriorates, especially given bank-dependent financing of investment.

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