Essays on Corporate Cash holdings and Business groups

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Submitted in partial fulfillment of the

requirements for the degree

of Doctor of Philosophy

in the Graduate School of Arts and Sciences

COLUMBIA UNIVERSITY

2013

ABSTRACT

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This dissertation studies corporate cash holdings in Korea, with its own business groups ("*chaebol*s"), and the impact of Asian financial crisis in 1997-1998.

The first essay examines the effects of cash on performance from 1994 to 2006. It first shows that cash-rich firms are more likely to survive and the exit rate of *chaebol* firms with large cash holdings during the crisis is much smaller. Moreover, large cash holdings in non-*chaebol* firms increase profitability compared to industry rivals after the crisis when external capital becomes more costly. Efficiently allocated internal cash holdings in *chaebol*s, rather than affiliates' own cash, are related to better performance in pre-crisis period. My results suggest that business group affiliation is a key to explain the effect of cash on market performance, and that the precautionary motive plays a central role.

The second essay studies the determinants of cash in Korean listed firms from 1993 to 2006. I find that the amount of cash in business groups is significantly smaller than that in stand-alones. *Chaebol* firms with financial subsidiaries, which can provide alternative financial resources, can reduce cash holdings. I also find that diversification contributes to lower the level of cash in *chaebol*s. Both sources became more important after the crisis. The results also suggest that the smaller amount of cash in business groups is driven by a smaller need for precautionary cash.

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Acknowledgments

This dissertation would never have been completed without Professor Bernard Salanié. He has provided exceptional guidance, patience, support and time, all of which I needed to finish this work. He has made every single step of the program I took possible. I am deeply grateful to Professor Maria Guadalupe who shaped my thought and provided insightful comments. I owe special thanks to Professor Chris Conlon for his valuable suggestions and feedback. I wish to thank Professor Brenden O'flaherty and the Department for allowing me to have this great opportunity. I am grateful to Professor David Wolfenzon for being a member of dissertation committee and his generosity. I am indebted and grateful to Professor Kun-Young Yun, my advisor in undergraduate, for encouraging me to pursue a PhD in economics and to broaden my experience beyond campus.

I am blessed to be a part of my family. I thank my parents for their unconditional love and prayers. They are always there for me with supports to find my own passion, courage, and faith in God. I am grateful to my brother for his sincere prayers in the ups and downs of the graduate program. I also thank my friends in Seoul and New York for their love and support.

Most of all, thanks be to God.

To my parents

Chapter 1

Introduction

1.1   Introduction

The literature on corporate cash holdings explains firms' motives for cash reserves in the following three ways: (1) it can reduce transaction costs incurred when other assets are liquidated to make payments (Baumol, 1952; Miller and Orr, 1966); (2) it can function as a hedge against the future risks or adverse shocks on cash flows and investment opportunities (Keynes, 1937). Firms need to hold cash to avoid default or maintain investment opportunities as per the empirical evidence presented since Kim, Mauer, and Sherman (1998); (3) multinational firms can retain earnings in the form of cash outside the home country instead of incurring the tax effects of repatriating the earnings (Foley et al., 2007).

Recent financial crises have emphasized the importance of precautionary cash holdings in a volatile financial market where firms were seen to increase the amount of cash held. Bates, Kahle, and Stulz (2009) documents that the ratio of cash to total assets in U.S. firms doubled from 1980 through 2006. This tendency was not limited to the U.S. only, in that evidence for Economic and Monetary Union (EMU) countries (Ferreira and Vilela, 2004) and for Asia (Song and Lee, 2012) have also shown elevated cash holdings. Lins, Servaes, and Tufano (2010) and Campello, Graham, and Harvey (2010) also support the idea of the precautionary motive with their surveys on international and U.S. chief financial officers, respectively.

There is a growing body of literature on the precautionary motive in cash holdings (Bates, Kahle, and Stulz, 2009; Almeida, Campello, and Weisbach, 2004; Acharya, Almeida, and Campello, 2007). This dissertation attempts to shed light on the relationship between corporate cash holdings due to the precautionary motive, and business group affiliation. Firms' financial positions and market outcomes vary with their organizational form. Thus, the management of cash also depends on firm structure, so I expect cash policy and its effects to be different in business groups than in stand-alone firms. Moreover, I explore whether

the differences are related mainly to the precautionary motive. I investigate the precautionary motive's effect on firms' market performance and on their level of cash, respectively. I conduct a single-country analysis of Korea, which has significant business groups called "*chaebols*" that experienced challenges during the Asian Financial Crisis of 1997-1998.

The following second chapter examines the associations between a firm's cash holdings, its market performance, and its business group affiliation from 1994 to 2006. First, I provide evidence that cash is essential for firm survival, using a duration model to reflect time dependency. Irrespective of group affiliation, firms with large cash holdings are less likely to exit from the industry. In addition, I discern that during a crisis, cash-rich firms, especially *chaebol* firms have a much lower probability of exit when compared to other firms. The results confirm the benefits from precautionary cash in costly external capital market.

I take one more step to examine the effect of cash on operating performances, measured by the return on assets of a firm and that of its industry rivals. I apply the Dynamic Generalized Methods of Moments (GMM) that take first differences to remove the unobservable firm heterogeneity and employ lagged values of regressors as instruments to solve endogeneity problems. I show that non-*chaebol* firms with large cash holdings perform better than their rivals in the post-crisis period. Cash in *chaebol* firms facing fewer financial constraints and greater agency problems than non-*chaebol* firms is not value-increasing, but internal cash held by other members and financial affiliates was effective and efficient for the performance of affiliates only before the crisis. This means the management of cash, especially precautionary cash, in operation depends on the condition of external capital market and firms' organizational form.

The third chapter studies the determinants of cash holdings using a sample of listed firms on Korean Stock Exchange from 1993 to 2006. I find that *chaebol* affiliation leads to a lower level of cash. The study further reveals the difference in cash policy with two group characteristics: group-wide funds and group-wide diversity. My results show that group cash

and cash flow of other affiliates in the same business group do not have a significant effect, while *chaebol*s with financial affiliates can reduce the amount of cash holdings. Next, I test co-insurance effect from diversified business groups. Imperfectly correlated investment opportunities or cash flows reduce the marginal value of cash in terms of precautionary demand. I provide evidence for the negative effect of diversification on cash holdings with industry and affiliate-level measures: the number of industries, Q-correlation across industries, and CF-correlation across affiliates. Furthermore, I find that the extent of both group funds and the diversification effect are strong in the constrained post-crisis corporate environment.

Chapter 2

Business groups and the Effect of Cash on Performance: Evidence from Korea

2.1 Introduction

Does cash add value to firms? The literature finds that cash reserves serve the interests of either the shareholders or the managers. Firms choose to hold cash to reduce the costs of external financing; this substituting role played by cash increases firm value (Almeida, Campello, and Weisbach, 2004; Acharya, Almeida, and Campello, 2007; Faulkender and Wang, 2006). Cash is thus particularly beneficial during economic downturns, when external capital is more costly (Harford, Mikkelson, and Partch, 2003; Bates, Kahle, and Stulz, 2009; Campello, Graham, and Harvey, 2010). Firms can also hold cash to serve the managers' own interests at the expense of shareholders (Jensen, 1986): empirical studies have found that cash can be dissipated quickly in value-destroying projects (Dittmar and Mahrt-Smith, 2007; Harford, Mansi, and Maxwell, 2008) or diverted to serve managers' private benefits (Dittmar, Mahrt-Smith, and Servaes, 2003; Pinkowitz, Stulz, and Williamson, 2006; Kalcheva and Lins, 2007). This paper examines whether cash is beneficial to shareholders in terms of how its operates with the organizational form to modify the member firms financial constraints and agency problems in business groups.

Business groups, sets of firms with concentrated ownership led by a controlling shareholder or family, are prevalent in Central Europe and Asia. Legally independent firms form business groups with both formal and informal ties (La Porta et al., 2000; Khanna and Palepu, 2000; Morck, Wolfenzon, and Yeung, 2005; Khanna and Yafeh, 2005, 2007). Affiliates, as members of a business group, have greater access to both internal and external capital sources and hence, face fewer financial constraints. This leads a difference in cash policy and studies on business groups in Europe and Asia also find that group firms hold less cash than do stand-alones (Deloof, 2001; Pinkowitz and Williamson, 2001; Kim et al., 2004), but the implications of this cash policy differential for the market have received little attention.

I perform a single-country study using Korean data to examine the cash-performance relationship within organizational form. To consider Korea's important business groups, called "*chaebol*s," I obtain a list of affiliates to business groups from the Korean Fair Trade Commissions. Thus, I can derive a clear definition of business groups and government guidelines (Khanna, 2000). This single-country analysis also allows me to avoid endogeniety problems encountered in cross-country analysis since each country's business group structure is highly correlated with the country's own legal institutions and investor protection laws. (La Porta et al., 2000; Joh, 2003).

My analysis proceeds in two steps using data for Korean firms between 1992 and 2006 period. Before I examine the relationship between cash and firm performance, I begin by studying the effect of cash holdings on firm exits. I find that large-cash-holding firms are less likely to exit, and this holds for both organizational forms: *chaebol*s and non-*chaebol*s. The importance of cash holdings in firm operation is supported. This is consistent with precautionary cash holdings by Keynes (1937). During a crisis, when both external and internal capitals are constrained, the effect of cash on firm survival is much greater for *chaebol* firms.

I then examine the impact of relative cash on operating performance. The estimation method used in this study is carefully chosen to solve the econometric problems in fixed-effects model. Firm fixed-effects correct omitted variable biases but concerns on unobservable heterogeneity still remain. In addition, endogeneity problem in covariates leads estimates to be inconsistent. To remove time-invariant firm heterogeneity and provide valid instruments with lagged values, I employ the Generalized Method of Moments (GMM). This method is especially appropriate to this study, which has a sample panel with a relatively short time span in comparison to the number of firms and deals with a persistency of organizational form.

I find that cash had a negative effect on performance before the crisis, and that cash

did not add value to either *chaebol*s or non-*chaebol*. The Asian financial crisis in 1997–1998 caused noteworthy changes in the Korean economy. I examine whether there is a modification in the use of cash after this economy-wide shock. As financial constraints intensify, a firm's dependence on internal resources, especially cash, increases. The financial crisis tightens the external capital independent of firm structure, and cash becomes a more crucial asset than it was before the crisis. I demonstrate that cash-rich non-*chaebol* firms show better performance (i.e., a higher return on assets) than their rivals in the industry, but this value-enhancing effect of cash is limited to only stand-alone firms. For chaebol firms, cash holdings still show a negative impact on return on assets.

To explain the value-destroying use of cash in *chaebol* firms, I examine the effect of liquidity inside business groups on member firms' performance. Liquidity inside business groups can be perceived as a substitute for an affiliated firm's own cash. There is a positive relationship between group liquidity and profitability of affiliates but only before the crisis; the Asian financial crisis attenuates the effect of internal liquidity. This result is consistent with the findings in Lee, Park, and Shin (2009), which analyzes the operation of internal capital market inside *chaebol*s through reform and restructuring.

I extend the reach of prior studies in order to discover the differential effect in the benefits of group liquidity across affiliates with the allocation of internal capital market. I find that the effect of group liquidity on performance is greater in member firms with the highest total sales before the crisis, meaning that the controlling shareholder is able to allocate group resources to affiliates with good outcomes. This confirms the idea of an efficient internal capital market that transfers group resources to winning firms (Stein, 1997). However, after the crisis, member firms operating in industries with high growth potential rather than the highest sales show a stronger improvement in performance by group liquidity.

This paper contributes to the growing body of literature on cash holdings in organizational forms, especially in diversified firms. Firms with multiple segments hold significantly

less cash than do focused firms (Duchin, 2010; Subramaniam et al., 2011) because of the diversification of operations and the internal capital market. In addition, the value of cash for diversified firms is less than for stand-alones (Tong, 2011). This study also provides insight into the effect of cash holdings on the market. The persistent high cash firms perform better than firms matched by size and industry (Mikkelson and Partch, 2003) and Frésard (2010) shows that relatively large cash holdings produce a market share increase at the expense of rivals.

In addition, this study contributes to the literature on business groups. Business groups carry both costs and benefits. They are particularly beneficial in emerging and less-developed financial markets (Khanna and Palepu, 2000). Ferris, Kim, and Kitsabunnarat (2003) shows that Korean business groups do not add value: they tend to stabilize profits, invest in low-performing industries, and subsidize weaker group members. My finding supports this view, given my results on the relationship between cash and performance.

The remainder of this paper is organized as follows. Section 2 discusses the hypotheses. Section 3 describes the data. Sections 4 and 5 examine the effect of cash on firms exit and operating performance. Section 6 concludes the paper.

2.2   Hypotheses

A high level of cash holdings in financially constrained firms is a competitive advantage allowing the pursuit of valuable investments, leading to better market performance. The role and use of cash differs according to the organizational form, because business groups have few financial constraints and severe agency problems. First, business groups are less financially constrained than are stand-alone firms for various reasons. Their firm size and consequent debt capacity tends to be large. As Pinkowitz and Williamson (2001) and Kim et al. (2004) show, group firms enjoy a more favorable relationship with external capital

market through a group reputation and loan guarantees from other affiliates. Moreover, affiliated firms in the same business group share financial and non-financial resources by forming an internal capital market such as internal debt, intra-relations and other various types. An additional source of capital, internal capital can be used as a substitute for a firm's own or external capital (Stein, 1997; Shin and Park, 1999).

In addition, the agency problem affects the use of cash, as entrenched managers may divert cash to increase their own wealth. Dittmar and Mahrt-Smith (2007) finds that poor corporate governance is associated with lower firm value, as the dissipation of cash reduces operating performance. Business groups suffer from an agency problem when the controlling shareholder extracts from the minority shareholders. Korean *chaebol*s have been criticized for having a controlling shareholder who, despite holding a small share of the groups equity, rules all affiliates. I predict the agency problem inside *chaebol*s would dominate the cash management of member firms as well as firm operations. Thus, I expect the value-enhancing effect of cash on the market to apply mainly to non-*chaebol* firms.

(H1) The beneficial effect of large cash holdings on firm performance is limited to non-*chaebol* firms.

Korea experienced a massive macroeconomic shock, the Asian financial crisis, in 1997 and 1998, which increased external financing costs and set up a natural experiment to examine cash's effect on firm performance in the context of financial constraints. Almeida, Campello, and Weisbach (2004) finds that financially constrained firms hold significantly large cash and that the value of the cash is higher than that of unconstrained firms (Faulkender and Wang, 2006; Denis and Sibilkov, 2010). In order to continue investing, firms tend to depend on cash more than they did before the crisis. Moreover, Luo (2011) shows that financial constraints play a disciplinary role in the use of cash holdings in that the dissipation of cash by entrenched managers in financially constrained firms brings higher profitability.

After the crisis, both *chaebol* and non-*chaebol* firms faced greater financial constraints, such as banks tightened loan guidelines. The government initiated reforms and restructuring of firms, particularly for *chaebol* firms; debt ratios were limited to 200% and cross-loan guarantees in business groups were prohibited. I explore whether the use of cash became more favorable to performance of all firms in the post-crisis period, when firms are financially constrained than before.

(H2) After the Asian financial crisis, the effect of cash on firm performance became greater than it had been in the pre-crisis period.

As mentioned, the internal capital market is an additional source of financial strength for business groups. This internal capital market, such as liquid assets held by other members and financial affiliates, puts *chaebol* firms in a relatively cash-rich position. I expect that group liquidity substitutes for the role of a firm's own cash.

Furthermore, the effect of group liquidity on members' performance depends on the controlling shareholder's allocation decision, because resources inside business groups are not equally distributed across affiliates. If this reallocation is efficiently managed by well-informed but self-serving controlling shareholders, group resources are transferred from firms with poor prospects to those with good prospects, enhancing the value of the group (Stein, 1997). Scharfstein and Stein (2000) argues the opposite, finding that internal capital market operates to subsidize members with poor performance. Thus, if controlling shareholder efficiently transfers resources inside a group, I expect group liquidity to be beneficial to high-performing affiliates:

(H3) Liquidity in business group substitutes for affiliated firms' cash holdings, and the effect is greater for members with good prospects than others if internal capital market is efficient.

I combine the above hypotheses into the following table. This table summarizes the predictions of the hypotheses. A plus (minus) sign indicates a positive (negative) impact of cash holdings on firm performance. A question mark indicates no decisive relation.

Effect of firm's cash on performance		
	pre-crisis	post-crisis
non-*Chaebol*	?	(+)
Chaebol	(-)	?

2.3   Data

I use the annual financial data for all available firms whose total assets were more than seven billion Korean won at least once between 1992 and 2006 as recorded by the Korean Investors Service. In examining the impact of cash policy on *chaebol* and non-*chaebol* firms, the identification of business groups is based on the yearly report of the Korea Fair Trade Committee (KFTC). The Korean government concerns itself deeply with business groups and releases annual statements about *chaebol*s with detailed ownership information every April; changes in affiliates are also reported monthly.

The KFTC defines a *chaebol* as a set of firms controlled directly or indirectly by the controlling shareholder and meets two criteria: 1) it is a group of companies where more than 30% of the shares are owned by individuals or companies and, 2) there exists a cutoff for the total value of group affiliates. Only the thirty largest groups were included in *chaebol*s up to 2000. Since 2001, however, any group above the combined total assets cutoff is included. Hence, the number of *chaebol*s increased to 52 by 2006, the final year of the sample. I exclude financial and utility firms from the sample, following the literature. I also ignore firm-years for which data on total assets, cash holdings, and sales are not available and those

with an asset growth higher than 200%. In defining the industry, I eliminate all firm-year observations lacking an industry code based on the three-digit Korean Standard Industrial Classification (KSIC), the Korean form of the SIC.

For this dataset, I use the following data selection criteria. To study firm survival, I adjust the sample cutoff for total assets with the yearly GDP growth rate to balance the number of firms across the years. For the firm performance study, which uses industry-adjusted data, I include all firms and require that each industry comprise more than ten firms. In addition, I restrict the sample to firms have at least four consecutive years to run the dynamic GMM estimation; hence, the sample starts in 1994.

2.4   Firm Survival and cash holding

2.4.1   Model

I first examine the effect of a firm's cash on exit from the market in this section before examining the relationship between a relative cash and firm performance. Cash on hand can be quickly used for any purpose and is especially important for firms at the risk of default. I classify the firms that remain in the sample from the beginning of a year to the beginning of the next year as 'survivors' for that year; 'exiting firms' are those that leave the sample during the year by closing. The dependent variable is set to 1 if the firm exits and zero otherwise.

To measure firms' liquidity, I define cash as the ratio of the sum of cash, cash equivalents, and short-term financial instruments, to total assets. Cash can be physical currency in domestic and foreign notes, currency equivalents, and demand deposits that can be withdrawn at any time, such as checking accounts. Cash equivalents are instruments such as U.S. government Treasury bills and bank certificates of deposit that can be converted into cash

immediately. Also included in cash equivalents are financial instruments and marketable securities whose expiration dates are in less than three months. Short-term instruments are products and services of financial institutions used for short-term financial management that are due within one year. Examples are time deposits, certificates of deposit, commercial paper, and cash management accounts. Further, this measure separates the effect of cash from that of other short-term capital management such as lines of credit, inventory, or net working capital.

Motivated by Clementi and Hopenhayn (2006), who develop a theory of borrowing constraints and study its implications for firm survival and similar to Spaliara and Tsoukas (2010)'s empirical model, I include size, profits, total leverage, and tangible assets in the model:

$$
\begin{aligned}
Pr(Exit_{i,t} = 1) = F(&\beta_1 Cash_{i,t-1} + \beta_2 Total\ Leverage_{i,t-1} + \beta_3 Profitability_{i,t-1} \\
&+ \beta_4 Collateral_{i,t-1} + \beta_5 Size_{i,t-1} + \beta_6 Age_{i,t-1} \\
&+ \beta_7 Exchange_{i,t-1} + \beta_8 MES_{j,t-1} + \epsilon_{i,t})
\end{aligned}
\tag{2.1}
$$

Large firms tend to face lower barriers in capital markets (Rajan and Zingales, 1995). Firm age is related to size, which is defined as a log of total assets; mature firms tend to survive longer than do start-up firms. Profitability is defined as the ratio of operating income before depreciation and amortization expenses to total assets. Collateral is tangible assets. Firms unable to generate internal funds and pledge collateral with tangible assets are more likely to fail. Total Leverage is measured as total debt divided by total assets and implies that highly indebted firms are also at risk of bankruptcy.

I also include the exchange rate to estimate firm survival, because it is central to international competitiveness and export strength. Baggs, Beaulieu, and Fung (2009) finds that currency appreciation lowers survival rates in Canada because foreign firms enjoy a cost ad-

vantage over the domestic currency. The evidence from East Asian countries shows that the real appreciation of the early 1990s weakened financial structures and triggered the subsequent financial crisis (Radelet and Sachs, 2000). I use minimum efficient scale (MES), the log of median total sales, for the industry to reflect industry conditions. Industries with a large MES tend to have high price-cost margins, which is positively associated with firm survival. However, start-ups in industries with large minimum efficient scales are less likely to survive (Audretsch, 1991; Mata and Portugal, 1994). Industry fixed effects are also included in the estimation.

Firm exit is a binary outcome; this type of data is estimated by Logit model in the literature. However, traditional Logit model does not take account of time dependency so the probability of survival at any point in time is always the same. In the presence of time dependency, the estimates are inefficient and the standard errors may be underestimated by 50% or more (Beck and Katz, 1997). Thus, I employ the discrete duration model introduced in Jenkins (1995).

Let T denote a discrete random variable indicating the time of an exit. Firm exits are observed at discretely defined points in time, t.

$$f(t) = Pr(T = t) \tag{2.2}$$

The hazard rate is the risk of an exit, equivalent to the ratio of the probability of failure to the probability of survival. This ratio can be expressed as the conditional probability of exit given survival up to that point in time.

$$h(t) = \frac{f(t)}{S(t)} = Pr(T = t_i | T \geq t_i) \tag{2.3}$$

Thus, the probability of exit at t_i is

$$
\begin{aligned}
f(t_i) &= Pr(T = t_i) \\
&= Pr(T = t_i | T \geq t_i) \times Pr(T > t_{i-1} | T \geq t_{i-1}) \times \cdots \times Pr(T > t_1 | T \geq t_1) \\
&= h(t_i) \times (1 - h(t_{i-1})) \times \cdots \times (1 - h(t_1)) \\
&= h(t_i) \prod_{t=1}^{t_i - 1} (1 - h(t))
\end{aligned}
\tag{2.4}
$$

The survival function can be written as

$$
\begin{aligned}
S(t) &= Pr(T > t_i) = (1 - h(t_i)) \times (1 - h(t_{i-1})) \times \cdots \times (1 - h(t_1)) \\
&= \prod_{t=1}^{t_i} (1 - h(t))
\end{aligned}
\tag{2.5}
$$

giving that the probability of surviving beyond t_i is equal to the conditional probability of surviving through each of the t previous periods.

The likelihood function for duration model is

$$
\begin{aligned}
L &= \prod_{i=1}^{n} [f(t)]^{d_{it}} [S(t)]^{1-d_{it}} \\
&= \prod_{i=1}^{n} \left[h(t_i) \prod_{t=1}^{t_i - 1} (1 - h(t)) \right]^{d_{it}} \left[\prod_{t=1}^{t_i} (1 - h(t)) \right]^{1-d_{it}}
\end{aligned}
\tag{2.6}
$$

In this paper, I replace the duration in the model with firm ages since durations can be calculated by the difference between firm age and the beginning of sample year (here, 1994).

2.4.2 Results

Table 2.1 presents the univariate test for the exit and non-exit firms, with the statistical differences in panel A. Exit firms tend to be significantly smaller, less mature, and financially

weaker in terms of leverage, profits, and tangibles than the remaining firms, as expected. The BG liquidity measure is also larger in surviving firms. Panel B shows the contrast between *chaebol* and non-*chaebol* firms. *Chaebol* firms are larger, more mature, and have higher profits. However, the small tangible assets and high total leverage ratio of *chaebol* firms indicate a favorable external market from the group reputation effect and cross-loan guarantees.

Table 2.2 reports the results of the baseline estimation. Column (1), without firm cash, shows that all the control signs are as predicted in the earlier section. I introduce the cash ratio in the estimation in columns (2) and (3). The coefficients of cash (-2.742 and -2.651) are negative and statistically significant at 1% in both regressions, implying that a cash-rich firm is more likely to survive in the market after controlling other variables. Predicted probability of exit at mean of all independent variables in the baseline model is 1.3%, close to the probability of exit in Table 2.1. The economic magnitude of cash ratio is interpreted with the averaged marginal effect in column (4) that means one percent increase in cash brings a reduction of 0.035 percentage point in the predicted probability of exit from the market. In addition, there is a time dependency on firm exit from the results regarding age duration dummy variables. Younger firms are more likely to exit compared to more matured firms.

Now, I include two main considerations of this paper in estimations, *chaebol* affiliation and the Asian Financial Crisis. First, Table 2.3 examines whether the impact of cash holdings on firm survival depends on the organizational form (business groups). I classify firms BG as *chaebol* affiliates if they are listed in the annual reports by the KFTC. The coefficient of both *chaebol* firms (-2.110, significant at 10%) in column (1) and non-*chaebol* firms (-2.520, significant at 1%) in column (2) are negative. In pooled regression (column (3)), the positive but not significant coefficient of the interaction term between Cash and BG confirms the results of the separate regressions. Firms with a high cash-to-asset ratio are more likely to

survive regardless of business group affiliation since the result does not provide evidence of the differential effect from firm structure.

I extend the regression by considering the Asian financial crisis. As Keynes (1937) explains concerning the precautionary motive of cash holdings, cash-rich firms are more likely to survive adverse shocks. I examine the relationship between firm exit probability and cash for all firms in column (1) of Table 2.4. I introduce an interaction term between firm cash and the crisis dummy (AFC) set to 1 in the period from 1997 to 1998 and zero otherwise. The coefficients of the crisis are undoubtedly positive, in that firms face a higher probability of exit during the crisis. Switching to a period of crisis after several tranquil years increases the likelihood of exit by 1.9 percentage point on average (column (2)). For example, at the mean of the other controls, the predicted probability of exit during the crisis is 2.85% compared to 1.12%. The interaction term (-1.654, significant at 10%) shows a significantly large reduction in the probability of an exit from the cash holdings. Cash is especially powerful during the crisis.

I repeat the tests for *chaebol* firms (in column (3)) and for non-*chaebol* firms (in column (4)). Cash-rich firms are able to sustain themselves during adverse market shocks regardless of their firm structure. In addition, the effect is much stronger for *chaebol* firms; those with large cash holdings are more likely to survive through the crisis (-10.29, significant at 5%). Each affiliate operates as an independent firm, whose managers first try to cope with a crisis within their own firm. The benefits of affiliation, such as internal supports and good relationships with banks, are not effective during crises. Hence, their dependence on their own cash increases and the effect of cash on firm exit is greater in the crisis period.

2.4.3 Robustness check

A firm's cash policy may be endogenously related to the business environment, especially to a financial crisis. An amplified positive relationship between cash holdings and firm survival during the financial crisis might have arisen from either a bankruptcy risk or lost investment opportunities. I address this endogeneity issue by examining previous levels of cash holdings before the crisis. I define Pre_Cash as an averaged cash ratio in the pre-crisis period (1994–1996) and examine the effect of cash holdings on firm survival during the crisis period (1997–1998) for the robustness on my findings. Table 2.5 reports the results. In column (1), I still find that highly levered, low-profit, small firms with fewer tangible assets were more likely to exit. Moreover, the coefficient of Pre_Cash (-3.477) is negative and statistically significant at the 1% level, which means firms with large cash holdings before the crisis were less likely to exit during the crisis. This again confirms the precautionary demand on cash holdings as shown in the results of Table 2.4. I consider the effect of group affiliation with the interaction term between Pre_Cash and the BG dummy in column (2). The greater positive effect of cash on firm survival probability in *chaebol* firms is also robust.

2.5 Firm Performance and cash holding

2.5.1 Model

This section examines whether holding more cash than industry rivals adds value to firm performance, the main interest of this paper. Following Campello (2003) and Frésard (2010), I specify the baseline model as follows:

$$Performance_{i,t} = \beta_0 Performance_{i,t-1} + \beta_1 Cash_{i,t-1} + \gamma' X_{i,t-1} + \omega_i + \nu_t + \epsilon_{i,t} \qquad (2.7)$$

where the dependent variable $Performance$ is ROA, the return on total assets minus the industry-year average. This variable measures a firm's performance compared to that of its rivals. $Cash_{i,t-1}$ is the sum of cash and cash equivalents and short-term financial instruments divided by total assets of firm i at time $t-1$ less the industry-mean. To consider each firm's initial performance level, the lagged ROA is in the equation. $X_{i,t-1}$ is the matrix of the control variables, which are lagged one year and adjusted by the mean of the industry. Firm size, leverage, investment, and cash flow as control variables to capture other sources of market performance are included. Size is the log of total assets. Leverage is defined as the sum of long term debt and current position of long term debt divided by total assets. Investment is measured with capital expenditure scaled by total assets. Cash flow is operating income plus depreciation scaled by total assets.

Finally, I include ω_i for the time-invariant firm effects, ν_t for aggregate shocks to all firms and $\epsilon_{i,t}$ for random disturbances. To examine the difference by the affiliation to business groups, I extend the baseline model with business group liquidity.

$$Performance_{i,t} = \beta_0 Performance_{i,t-1} + \beta_1 Cash_{i,t-1} + \gamma' X_{i,t-1} +$$
$$+ \delta BG\ Liquidity_{i,t-1} + BG_{i,t-1} + \omega_i + \nu_t + \epsilon_{i,t} \qquad (2.8)$$

For business group liquidity variables, I include two measures. First, BG Cash measures the cash holdings of the firms affiliates in the same business group. This direct measure is defined as the log of total cash in all affiliates except the firm under consideration. The other variable is the number of financial affiliates inside *chaebol*s (Fin_Affiliates).

There are two empirical challenges to obtaining more precise and consistent estimates for effects of cash holdings: unobservable firm heterogeneity and the possible endogeneity of the regressors.

The literature uses a fixed-effect model to correct for the omitted variables bias: unob-

servable heterogeneity might be correlated with regressors. This is why I include individual dummies, here ω_i. However, fixed effects models provide inconsistent estimates when time span is small (Nickell, 1981), and it may not completely control heterogeneity. Furthermore, the persistency of business group affiliation requires another form of regression (Zhou, 2001; Coles, Lemmon, and Felix Meschke, 2012) since firm fixed effects regressions cannot capture the time variations of exogenous factors nor include the cross-sectional differences across firms.

The Dynamic General Method of Moments developed by Arellano and Bond (1991) allows me to solve the heterogeneity and endogeneity issues. First, I take the first difference to remove the firm heterogeneity controlled by the firm-specific effect ω_i in the baseline model (2.7).

$$\Delta Performance_{i,t} = \alpha(\Delta Performance_{i,t-1}) + \beta(\Delta Cash_{i,t-1}) + \gamma^{'}(\Delta X_{i,t-1})$$
$$+ \Delta \nu_t + \Delta \epsilon_{i,t} \tag{2.9}$$

Then, to solve possible endogeneity between $\Delta Cash_{i,t-1}$ and $\Delta \epsilon_{i,t}$, I exploit orthogonality conditions between the lagged values of variables and the random disturbance. Instead of exogenous instruments, I use instruments for the cash ratio and business group affiliation variables lagged from t-2 to t-4 as instruments for the equations in differences and t-2 for the equations in levels following the assumption in Blundell and Bond (2000); Bond (2002).

$$E(\omega_i) = E(\epsilon_{it}) = E(\omega_i \epsilon_{it}) = 0$$
$$E(\epsilon_{is}\epsilon_{it}) = 0, \quad s \neq t$$
$$E(Cash_{i1}\epsilon_{it}) = 0, \quad t = 2, \ldots, T$$
$$E(\Delta Cash_{it-1}\epsilon_{it}) = 0, \quad t = 3, \ldots, T \tag{2.10}$$

These assumptions show that there is no correlation between instruments and the error term and consequently, the validity of instruments. To check the assumption of no second order serial correlation in the first difference residual, I show each model's AR(2) statistic from the Arellano and Bond test in the result tables. The system GMM is estimated using the xtdpdsys command in Stata.

2.5.2   Univariate tests: non-*Chaebol*s vs. *Chaebol*s

I first provide the descriptive statistics of the variables in Table 2.6. To investigate the differences between *chaebol* and non-*chaebol* firms in Korea, I test the differences in the means and medians of the variables. Table 2.7 presents the results of these univariate tests. I report the statistics separately for the periods before (Panel A), during (Panel B) and after (Panel C) the crisis.

As shown in the table, *chaebol* firms (with a mean of around 19) are significantly larger than non-*chaebol* firms are (with a mean of around 16) for all periods. In the pre-crisis period, the mean and median of the cash to asset ratio of *chaebol* firms are 5.8% and 3.9% of total assets, respectively, while the mean and median are 9.8% and 7.2%, respectively for non-*chaebol* firms. After the crisis period, both the mean (11.1% of total assets) and median (6.0% of total assets) cash ratio of *chaebol* firms continue to be smaller and are statistically different from the mean (12.4% of total assets) and median (7.7%) of non-*chaebol* firms. However, the cash ratio increase of the *chaebol*s is much larger between periods than that of non-*chaebol*s, and the difference between the two classes becomes smaller in later years.

Investment is defined as capital expenditure divided by total assets. In the pre- and crisis periods, investment is higher for *chaebol* firms (with means of 6% and 5%) than for non-*chaebol* firms (with means of 4.1% and 2.1%). The ratio of long-term debt to total assets is slightly higher for *chaebol* firms (with means of 15.1% and 15.6%) than for non-*chaebol* firms

(with means of 13.9% and 15.2%) in the pre- and crisis periods. After the crisis, however, we observe the opposite pattern for leverage and investment: the non-*chaebol* firms invest more (2.2%) and are indebted more (10.7%) in means than are *chaebol* firms (with means of -1.8% and 8.2%). This pattern is driven mainly by a post-crisis plunge of the ratios of *chaebol*s. This is consistent with banks charging higher loan rates to *chaebol* firms as well as non-*chaebol* firms during the crisis and post-crisis periods (Kim et al., 2004) and *chaebol* firms showing a reduced bank loan-to-debt ratio (Song and Lee, 2012).

A firm's cash flow is defined as its operating income plus depreciation divided by total assets. *Chaebol* firms' mean cash flow is smaller than that of the non-*chaebol* firms in the pre-crisis and crisis periods. In the post-crisis period, though, *chaebol* firms' cash flow (with a mean of 8.1%) is greater than that of the non-*chaebol* firms (with a mean of 7.3%), perhaps partly due to the somewhat depressed capital investment activities of *chaebol* firms during that period, as documented above.

Business group liquidity variables change across periods, as do firm-level variables. BG Cash increases over the periods as individual affiliates increase their own cash. Interestingly, the number of financial affiliates (Fin_Affiliates) increases (with a mean of 4), but many firms failed during and after the crisis, causing a situation similar to that of the pre-crisis period. I find no significant difference between the pre- and post-crisis periods (with means of 2.59 and 2.56 respectively).

2.5.3   Results

Baseline estimation

This subsection provides the results of the regressions testing the impact of cash holdings on firm performance. To measure firm performance, I use the return on assets (ROA) as EBITDA/Total Assets. Table 2.8 presents the basic estimation along with the specification

methods.

In columns (1) and (2), I show the results of the OLS and firm fixed effects regression, respectively. Both estimated coefficients on the lagged cash ratio (0.01 and 0.003) are positive. Firms with large cash holdings show a better operating performance than do other firms in the same industry. Of the other explanatory variables, leverage is significant while other variables (including size, cash flow, and investments) are insignificant. I also control for the historic values of firm performance, since firm performance depends on time trends, and these coefficients are large and significant in both estimations (0.626 and 0.313).

To avoid biased and inconsistent estimators, I use the system GMM estimation in columns (3) to (5) with different lags (lags 2, 3, and 7). The main coefficient of interest on the cash-to-asset ratio is positive. Cash-rich firms show a higher return on assets than their industry rivals do, but the coefficients are not significant. The previous level of ROA explains almost 50% of current ROA, and size is negatively correlated to firm performance, as expected. Investment, leverage, and cash flow increase the relative ROA. Leverage and investment are statistically significant. Assumptions on no second order correlation cannot be rejected for all specifications by their AR(2) statistics. The main challenge for system GMM is to choose the appropriate numbers of instruments. Adding more instruments with increasing lag lengths does not change the results, and hence, I use up to lag 3 as instruments for the subsequent estimations.

Business group (*Chaebol*) affiliation

Cash can be helpful to make profits directly as investments in production and indirectly as expenditures on selling related projects. *Chaebol* firms are different from non-*chaebol* firms in financing conditions, incentives of managers, and subsequent usage of cash. The results of the baseline estimation analyzing the effect of cash on firm performance vary according to organizational form. Cash in a business group is not dissipated in the same way as it

is in stand-alone firms. Because of characteristics of business groups as partly shown with the different effect of cash on firm survival from the previous section. *Chaebol*s have more ability to manage their capital because of easier access to the external capital markets, given their group reputation and cross-loan guarantees. They also can usually tap their internal capital market.

To take account of *chaebol* affiliation in the relationship between cash holdings and return on assets, I include the interaction term between cash ratio and the business group affiliation dummy (BG dummy), which equals one for *chaebol* firms and zero otherwise. I also separate subsamples with *chaebol* firms and non-*chaebol* firms.

I rank the *chaebol*s by total assets: 1) all *chaebol*s (BG dummy); 2) the thirty largest (BG30 dummy); 3) the five largest (BG5 dummy). The regression results for business groups are shown in Table 2.9. I first show the results of separate regressions by firm structure in columns (1) to (4). Columns (5) to (6) present the results of the pooled regression. The sign and significance of the interaction between Cash and BG dummy strongly support the view that cash has a negative impact on firm profitability and confirm the results of the separated regressions.

The cash ratio for non-*chaebol*s in column (4) is positive (0.023) and significant at the 10% level while that for all *chaebol*s is no longer positive and significant at the 5% level in columns (1) to (3). These results show that cash is value destroying for *chaebol* firms. As also seen in column (5) for pooled regression, the positive effect of cash (0.023) on return on assets for non-*chaebol* firms becomes negative for *chaebol* firms (-0.05). Assessing the economic significance of the result, I see a one-standard-deviation increase (decline) in industry-adjusted lagged cash in non-chaebol (chaebol) firms increases industry-adjusted ROA by 3.1% (6.2%) of the mean cash holdings. Column (6), comprising only the thirty largest business groups, presents a similar result.

Substantially lower effect of cash provides evidence of an agency problem between con-

trolling and minority shareholders in *chaebol*s. This is consistent with the idea of value-destroying operation of business groups Ferris, Kim, and Kitsabunnarat (2003); Morck, Wolfenzon, and Yeung (2005); Khanna and Yafeh (2007). Studies including Joh (2003); Kim, Lim, and Sung (2007) note that controlling shareholders in Korean *chaebol*s dominate affiliates with relatively very few shares and provide empirical evidence. Manager's interests are usually in line with those of the controlling shareholders in Korean *chaebol* because they appoint the managers, who are usually family or people who have built close relationships for years.

I extend the business group regression in column (1) by including a five-largest group dummy and its interaction with the cash ratio in column (2). Interestingly, I find a positive effect of cash on ROA (0.028) for these large *chaebol*s, although with a large cash decrease in other *chaebol* firms (-0.135). In these groups, such as Samsung, LG and Hyundai Motors, outside monitoring is more strict, and ownership is more dispersed than for other *chaebol*s. The other explanation with business group liquidity is tested in a later subsection.

The Asian Financial Crisis

As Figure 12.1 indicates, both *chaebol* and non-*chaebol* firms increase their cash holdings after a crisis. I examine whether this change is meaningful for firm performance or caused by a lack of investment opportunities during economic downturns. This model differs from the previous one in that I include an explanatory Asian Financial Crisis dummy (AFC), which takes a value of one for observations from 1997 to 1998 and zero otherwise. The post-crisis dummy (Post) is one from 1999 to 2006 and zero, otherwise. The results are shown in Panel A of Table 2.10.

For all firms in column (1), the results show that cash is significantly beneficial to firm performance after the crisis. In the pre-crisis period, large reserved cash holdings are negatively related to ROA, but the effect becomes considerably positive during the post-crisis

period (0.12).

To investigate whether two classes of firms have different effects, I show business group affiliates in columns (2) to (3) and stand-alones in column (4). Large cash holdings do not add value before the crisis for both classes, and the absolute value of the coefficient for *chaebols* is -0.15, more than three times that for non-*chaebol*s. During and after the crisis, cash is still negatively associated with the *chaebol* firms' performance although the degree becomes smaller. Firms in Korea are more financially constrained because banks do not increase credit lines and try to collect on loans in the crisis period. This increase is also caused by new regulation and restructuring following the crisis. The Korean government requires firms to reduce their debt to equity ratio by up to 200% and has banned cross-loan guarantees to regulate *chaebol*s' financial soundness. *Chaebol*s cannot depend on banks as much as they did before, confirming the decreased leverage ratio in the descriptive statistics after a crisis (Kim et al., 2004). However, to the extent that the use of cash for *chaebol* firms is still driven by the agency problem of the earlier section, it is value reducing for firms. In contrast, non-*chaebol* firms enjoy the benefits of high cash holdings in a financially constrained market after the crisis. For a one-standard-deviation increase in lagged cash, the standard deviation of ROA decreases by 0.4% in the pre-crisis period. On the other hand, the coefficient of lagged cash equals 0.2, such that one standard deviation increase in cash is associated with a 0.3% lower ROA, 3.1% of ROA in average non-*chaebol* firm.

For robustness, I re-estimate the relationship between cash holdings and the Asian financial crisis using different time frames. The crisis, resultant regulations, and restructuring persisted until 2000. Thus, 2000 may be the most appropriate cut-off by which to define the post-crisis period. I redefine the crisis as the period between 1997 and 2000 (AFC00) and the post-crisis period (Post00) as the years after 2001 in order to separate the differences across periods in Panel A. Panel B shows the results: the effect of cash again becomes greater after the crisis. This confirms the robustness of my findings.

Cash inside *Chaebol*s: Internal capital market

The evidence in the previous section shows that cash does not increase firm performance for business groups as it does for non-*chaebol* firms (Table 2.9). In this subsection, I examine how internal financing inside *chaebol*s, their internal capital market, may affect firm performance as a substitute for the firm's own liquidity. I introduce two measures: one is the log of other affiliates' cash (BG Cash), and the other is the number of financial affiliated firms (Fin_Affiliates). The estimated results are provided in Table 2.11, with Panel A representing all business groups and Panel B the thirty largest groups. The effect of BG Cash, directly measuring the group liquidity, is close to zero and insignificant for the performance in *chaebol* firms. In addition, I cannot find a significant increase in the return on assets from Fin_Affiliates. The benefits of the cash held by other affiliates or financial affiliates are thus not clear. I further test whether the Asian financial crisis triggered a change in the role of internal capital markets in firm performance, as it had changed the effect of firms' cash holdings.

I again identify periods with dummy variables: a pre-crisis dummy for the 1992 to 1996 period, and a post-crisis one for the 1999 to 2006 period. The results are presented in Table 2.12. In the pre-crisis period, the coefficients for both group liquidity measures are positive and statistically significant. The coefficient of BG Cash (0.001) in column (4) is economically significant before the crisis, meaning that a one standard deviation increase in cash in other affiliates leads to an increase in ROA by 0.4%. However, the effect becomes statistically insignificant and trivial in the post-crisis period. Column (8) regarding financial affiliates shows similar results. *Chaebol* firms take advantage of their internal capital markets for the sake of firm performance. However, the interaction variable between group liquidity and the post-crisis dummy shows a negative association, and the effect of liquidity after the crisis becomes close to zero. This indicates that group liquidity does not operate as much as it had

before the crisis. Thus, the data support the literature's assertions about Korea's internal capital market. Lee, Park, and Shin (2009) show that the positive investment sensitivity of affiliates cash flow before the crisis did not hold after the crisis, and they call this tendency the disappearance of the internal capital market.

Allocation in Internal Capital Market

I then extend my empirical demonstration that the business group liquidity contributes to an increased relative firm performance in the pre-crisis period by considering the reallocation of liquid assets inside the group. The internal capital market literature offers conflicting views on how business groups allocate internal resources across affiliates. Stein (1997) argues that well-informed headquarters, unlike outside banks suffering from information asymmetry, transfer inner resources in support of the better-performing divisions in diversified firms. In contrast, Scharfstein and Stein (2000) argue that the agency problem across division managers leads to the misallocation of resources in the form of subsidizing poorly performing divisions.

This subsection identifies whether affiliates enjoy the benefits of internal liquidity inside business groups. If the controlling shareholders allocate resources efficiently, the effect of internal liquid resources on firms with the highest sales will be greater than for other member firms. I define a dummy variable for Max_Sales to take the value of one if a firm has the highest total sales in its *chaebol* group and zero otherwise. Panel A of Table 2.13 presents the results. I separate the field into the periods before and after the 1997-1998 crisis, as previous results have shown how the internal capital market operates efficiently before the crisis.

First, as shown in column (1), the positive effect (0.004+0.002=0.006) of BG Cash, cash in other affiliates, is greater for affiliates with the highest total sales inside *chaebol*s than for other affiliates (0.004) during the pre-crisis period. This result also holds for Fin_Affiliates,

the number of financial affiliates inside the *chaebol*s. Column (2) shows that the coefficient of Fin.Affiliates for the better performing affiliate is 0.057 and 0.002 for other affiliates. The effects of both group liquidity variables are positive, but they are not significant during and after the crisis (columns (3) to (4)). The estimated coefficients thus point to the efficient allocation of group liquidity, but the crisis hinders the efficient operation of internal capital markets.

I also investigate the relationship between growth potential of industries and the allocation of group liquidity. Tobin's Q, a proxy for investment opportunity used in the literature, is defined as the market value of equity plus assets minus the book value of equity over assets. I thus construct a median Tobin's Q for each industry with non-*chaebol* listed firms to examine the industry's investment potential. I then define a dummy variable, Med_Qnon, which takes the value of one for the industry in the above median within its *chaebol* and zero otherwise. The regression results using Med_Qnon are reported in panel B of Table 2.13. The coefficient for the interaction of Med_Qnon with both *chaebol* cash variables changes its sign from negative to positive throughout the crisis, indicating that the effect of group liquidity on performance is strong for the firms operating in the industries with low growth potential before the crisis (columns (5) to (6)). On the other hand, in the period of 1997-2006, member firms in the high growth potential industries are more strongly supported by group liquidity. For example, the coefficients in column (5) suggest that if a *chaebol* firm operating in industries with relatively high growth potential experiences a one standard deviation increase in cash among its other member firms, it raises its ROA by 0.1 percent point (0.001*1.353) compared to 0.9 percent point (0.007*1.353) when operating in industries with low growth potential. However, members operating in industries with high growth potential receive more benefits during and after the crisis. The economic magnitude is significant. A one standard deviation increase in group cash for firms in industries of higher investment opportunities leads to an increase of 0.15 standard deviation of ROA whereas firms in lower

growth potential industries experience only a 0.04 standard deviation of ROA. This is in line with recent anecdotes about business group management strategy that *chaebol*s expand and over-invest in highly profitable markets without establishing their priority operations or considering the survivability of small enterprises.

2.5.4 Robustness check

This section presents additional evidence on the robustness of my findings. One concern with the estimation might be that the relative performance depends on firm survival. A firm at risk of failure would show continually poor returns on assets compared to its industry rivals, and the beneficial effect of cash would be underestimated. Although the dependent variable, ROA, is adjusted by the industry mean in the main results, I restrict the sample to firms that have existed for at least 15 years to avoids the biases from firm failures. This new sample of 18231 firm-years includes 110 *chaebol*s and 450 non-*chaebol*s. Table 2.14 presents the results; my findings remain the same. The results in Panel A confirm that the effect of cash holdings on firm performance depends on the organizational form and the crisis, as shown in Table 2.10 and 2.11. The group liquidity variables shown in Table 2.12 are also robust, as shown by the results in Panel B.

2.6 Conclusion

My answer whether cash is really effective in the Korean market is nuanced. The effect depends on the organizational form, and in particular whether the firm belongs to a business group; and it changed after the Asian financial crisis.

Cash is an important determinant in firm survival, supporting the precautionary motive. Firms with large cash holdings are less likely to exit from the industry and this effect is strong during the crisis for business groups. I then find cash policy is also associated with

firm performance. The Asian financial crisis increased the effect of cash on all firms market performance, and a positive association between cash and performance for non-*chaebol* firms can be observed after the crisis. However, cash does not play a significant role in *chaebol* firms because of their fewer financial constraints and agency problems.

Before the crisis, I observe that internal cash within the *chaebol*s was effective and efficient for the performance of affiliates since the internal capital market inside the business groups is an additional financial resource. However, the internal liquidity became less meaningful. The crisis changed not only the external environment but also the internal capital market. The less inefficient internal capital market in turn affected the dependence on the firms own cash holdings, with intensified financial constraints.

Additionally, the affiliate characteristics strongly influence the relationship between group liquidity and performance. In particular, my results indicate that group liquidity supported the affiliate with the highest total sales in the same group, consistent with the assumed efficiency of the internal capital market in the pre-crisis period. Regarding the industry growth potential, group liquidity is more highly focused on the affiliates operating in markets with a high Tobin's Q after the crisis.

Finally, the ownership structure inside a business group is worth examining in terms of relationship between cash and market performance. The Korean *chaebol*s have been criticized for their complicated cross-holding shares and pyramidal structures, allowing the controlling shareholder to influence all the affiliates with small shares. In particular, the disparity between cash flow rights and voting rights, tunneling (Bae, Kang, and Kim, 2002; Baek, Kang, and Lee, 2006) and propping (Bae, Cheon, and Kang, 2008), or the placement of firms in the pyramid (Almeida et al., 2011) can determine cash's impact on performance. Therefore, the interaction between cash holdings and ownership in *chaebol*s is an interesting topic for future research.

Table 2.1: Descriptive statistics: Firm Survival

Variables	All	Exit			BG		
		Exit=0	Exit=1	Difference	non-BG	BG	Difference
Exit	0.017	0.000	0.271	-0.271***	0.016	0.034	-0.018***
Cash	0.114	0.116	0.089	-0.027***	0.116	0.092	-0.024***
Size	17.292	17.299	17.186	0.113***	17.180	19.099	-1.918***
Age	17.094	17.274	14.407	2.867***	16.843	21.179	-4.336***
Leverage	0.291	0.287	0.355	-0.068***	0.295	0.231	0.064***
Profitability	0.096	0.097	0.084	0.013***	0.096	0.101	-0.004***
Collateral	0.319	0.320	0.306	0.014***	0.317	0.356	-0.039***
MES	17.057	17.061	17.007	0.054***	17.044	17.282	-0.238***
BG dummy	0.058	0.053	0.125	-0.072***	0.000	1.000	
N	81,821	76,668	5,153		77,078	4,743	

Notes: This table presents the mean values of characteristics for exit firms or not and *chaebol* (BG) firms or not during the sample period. The differences in the means (medians) between *chaebol* firms and non-*chaebol* firms are evaluated using Z-statistics (Wilcoxon rank-sum test). Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 2.2: Effect of Cash on Firm Exit: Baseline estimation

		Cash		
			Baseline	dy/dx
	(1)	(2)	(3)	(4)
Total Leverage	1.583***	1.219***	1.257***	0.021
	(11.40)	(8.44)	(8.59)	
Profitability	-2.298***	-2.177***	-2.168***	-0.037
	(-8.06)	(-7.55)	(-7.38)	
Collateral	-0.804***	-1.087***	-1.048***	-0.018
	(-5.16)	(-6.83)	(-6.56)	
Size	-0.0333	-0.127***	-0.0437	-0.001
	(-1.07)	(-6.33)	(-1.41)	
MES	-0.201***		-0.177***	-0.003
	(-3.28)		(-2.74)	
Exchange	-0.261*		-0.233	-0.004
	(-1.72)		(-1.53)	
Cash		-2.742***	-2.651***	-0.045
		(-6.63)	(-6.40)	
Age=2	0.384	0.176	0.407	0.007
	(1.53)	(0.76)	(1.62)	
Age=3	0.895***	0.668***	0.894***	0.015
	(4.14)	(3.42)	(4.12)	
Age=4	0.858***	0.623***	0.848***	0.014
	(4.03)	(3.23)	(3.96)	
Age=5	0.982***	0.765***	0.987***	0.017
	(4.73)	(4.13)	(4.73)	
Age≥6	0.665***	0.465***	0.674***	0.012
	(3.57)	(2.88)	(3.59)	
Age≥11	0.333*	0.136	0.338**	0.006
	(1.81)	(0.85)	(1.83)	
Age≥21	0.0439	-0.117	0.054	0.001
	(0.23)	(-0.68)	(0.28)	
Age≥31	-0.116	-0.238	-0.093	-0.002
	(-0.54)	(-1.20)	(-0.44)	
N	79,293	79,293	79,293	
Log likelihood	-6675	-6645	-6636	

Notes: This table presents results from Logit regressions that estimate the impact of cash holdings on firm exit. The regressions include industry effects at three digit KSIC and firm ages in duration. t-statistics are in parentheses. Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 2.3: Effect of Cash on Firm Exit with *Chaebol* affiliations

	BG (1)	non-BG (2)	All (3)	dy/dx (4)
Total Leverage	2.136***	1.234***	1.305***	0.022
	(4.27)	(7.94)	(8.93)	
Profitability	-0.988	-2.408***	-2.259***	-0.038
	(-1.05)	(-7.77)	(-7.66)	
Collateral	0.337	-1.204***	-1.052***	-0.018
	(0.66)	(-6.88)	(-6.54)	
Size	-0.235***	-0.186***	-0.194***	-0.003
	(-3.33)	(-4.64)	(-5.70)	
MES	-0.274	-0.0241	-0.053	-0.001
	(-1.03)	(-0.33)	(-0.72)	
Exchange	1.679***	-0.403**	-0.157	-0.003
	(3.68)	(-2.50)	(-1.03)	
Cash	-2.110*	-2.520***	-2.443***	-0.042
	(-1.73)	(-5.76)	(-5.67)	
Cash*BG			0.152	0.003
			(0.14)	
BG			1.824***	0.031
			(4.91)	
Age=2	-1.077	0.589**	0.625**	0.011
	(-1.63)	(1.98)	(2.11)	
Age=3	-0.256	1.050***	1.084***	0.018
	(-0.49)	(3.93)	(4.08)	
Age=4	0.133	0.959***	0.998***	0.017
	(0.27)	(3.62)	(3.79)	
Age=5	-0.003	1.133***	1.183***	0.020
	(-0.01)	(4.38)	(4.60)	
Age≥6	0.149	0.789***	0.844***	0.014
	(0.36)	(3.29)	(3.54)	
Age≥11*	-0.142	0.475**	0.526**	0.009
	(-0.37)	(2.00)	(2.22)	
Age≥21	-0.090	0.131	0.172	0.003
	(-0.25)	(0.54)	(0.70)	
Age≥31	-0.161	0.034	0.0670	0.001
	(-0.41)	(0.13)	(0.25)	
N	4,094	74,544	79,293	
Log likelihood	-601	-5889	-6570	

Notes: This table presents results from Logit regressions that estimate the impact of cash holdings on firm survival. The regressions include industry dummies and firm ages in duration. t-statistics are in parentheses. BG firms in column (1) and non BG firms in column (2). In column (3), I include the interaction term between BG and Cash. Averaged marginal effects from column (3) is in column (4). Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 2.4: Effect of Cash on Firm Exit with the Asian Financial Crisis

	All (1)	dy/dx (2)	BG (3)	non-BG (4)
Total Leverage	1.129***	0.019	1.847***	1.122***
	(7.66)		(3.67)	(7.17)
Profitability	-2.282***	-0.039	-1.136	-2.542***
	(-7.70)		(-1.24)	(-8.11)
Collateral	-1.032***	-0.018	0.430	-1.194***
	(-6.44)		(0.84)	(-6.82)
Size	-0.062**	-0.001	-0.243***	-0.204***
	(-2.00)		(-3.38)	(-5.05))
MES	-0.190***	-0.003	-0.287	-0.034
	(-3.56)		(-1.09)	(-0.55)
Exchange	0.614***	0.010	2.336***	0.463**
	(3.49)		(4.15)	(2.50)
Cash	-2.387***	-0.041	-1.515	-2.291***
	(-5.31)		(-1.27)	(-4.75)
Cash*AFC	-1.654*	-0.028	-10.29**	-1.301
	(-1.71)		(-2.19)	(-1.34)
AFC	1.134***	0.019	2.047***	0.714
	(3.01)		(3.52)	(1.27)
N	79,293	4,067	74,544	79,261
Log likelihood	-6561	-590	-5820	-6486

Notes: This table presents results from Logit regressions that estimate the impact of cash holdings on firm survival with the Asian Financial Crisis (1997-1998). The regressions include industry dummies, firm ages in duration and all interactions between the Asian Financial Crisis. All firms in column (1) with averaged marginal effects (2). BG firms in column (3) and non BG firms in column (4). t-statistics are in parentheses. Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 2.5: Robustness check: Effect of Average Cash in Pre-Crisis on Firm Exit during the Asian Financial Crisis

	(1)	(2)
Total Leverage	1.179***	1.208***
	(3.67)	(3.76)
Profitability	-3.593***	-3.790***
	(-4.34)	(-4.56)
Collateral	-1.006***	-1.041***
	(-2.82)	(-2.84)
Size	-0.137**	-0.314***
	(-2.06)	(-4.10)
MES	-2.073***	-2.019**
	(-2.62)	(-2.53)
Exchange	1.312	1.409*
	(1.58)	(1.68)
Pre_Cash	-3.477***	-2.680***
	(-3.31)	(-2.62)
Pre_Cash*BG		-10.98*
		(-1.86)
BG		3.333***
		(3.72)
Age=2	1.268*	2.327**
	(1.87)	(2.47)
Age=3	0.890*	1.780**
	(1.70)	(2.12)
Age=4	0.565	1.598*
	(1.10)	(1.91)
Age=5	1.020**	1.939**
	(2.16)	(2.38)
Age≥6	0.725*	1.630**
	(1.84)	(2.13)
Age≥11	0.364	1.290*
	(0.94)	(1.70)
Age≥21	0.163	1.003
	(0.41)	(1.32)
Age≥31	0.165	1.049
	(0.38)	(1.34)
N	8,128	8,108
Log likelihood	-1210	-1193

Notes: This table presents results from Logit regressions that estimate the impact of previous cash holdings on firm survival in the Asian Financial Crisis (1997-1998). Pre_Cash is calculated by the average cash holdings over three years (1994-1996) for each firm. The regressions include industry dummies and firm ages in duration. I include the interactions with BG dummies in column (2). t-statistics are in parentheses. Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 2.6: Descriptive statistics: Firm Performance

Variable	Mean	Median	Standard deviation	Min	Max	Number of Observations
Size	16.751	16.494	1.277	11.429	24.780	103,333
Return on Assets(ROA)	0.096	0.088	0.197	-54.594	1.184	103,333
Cash	0.116	0.074	0.125	-0.379	0.965	103,333
Leverage	0.118	0.072	0.137	0.000	0.907	103,333
Investment	0.025	0.003	0.281	-62.772	0.947	100,237
Cash Flow	0.065	0.058	0.206	-51.786	12.469	103,328
BG Cash	0.900	0.000	4.189	0.000	23.564	103,333
Fin_Affiliates	0.123	0.000	0.786	0.000	10.000	103,333

Notes: This table reports summary statistics for the sample, which consists of non-financial and non-utility firm-years from 1992 to 2006 with non-missing data on cash holdings and on the industry codes of each business segment. See the Appendix for variable definition.

Table 2.7: Univariate test: non-*Chaebols* vs. *Chaebols*

Variables	Mean			Median		
	non-BG	BG	Difference	non-BG	BG	Difference
Panel A: Pre-crisis (1992-1996)						
Size	19.093	16.727	2.366***	19.116	16.512	2.604***
ROA	0.083	0.086	-0.003	0.074	0.079	-0.005
Cash	0.058	0.098	-0.04***	0.039	0.072	-0.033***
Leverage	0.151	0.139	0.012***	0.134	0.114	0.021***
Investment	0.060	0.041	0.019***	0.030	0.015	0.015***
Cash Flow	0.035	0.045	-0.01***	0.026	0.035	-0.009***
BG Cash	19.944	0.000		19.960	0.000	
Fin_Affiliates	2.589	0.000		2.000	0.000	
Panel B: Asian Financial Crisis (1997-1998)						
Size	19.242	16.462	2.78***	19.223	16.309	2.914***
ROA	0.095	0.095	0.000	0.087	0.090	-0.003
Cash	0.070	0.109	-0.039***	0.047	0.075	-0.028***
Leverage	0.156	0.152	0.004	0.136	0.116	0.020***
Investment	0.050	0.021	0.029***	0.023	-0.001	0.024***
Cash Flow	0.037	0.050	-0.013***	0.036	0.043	-0.007***
BG Cash	20.616	0.000		20.511	0.000	
Fin_Affiliates	4.027	0.000		3.000	0.000	
Panel C: Post-crisis (1999-2006)						
Size	19.045	16.650	2.395***	18.955	16.451	2.504***
ROA	0.111	0.098	0.013***	0.102	0.091	0.011***
Cash	0.111	0.124	-0.013***	0.060	0.077	-0.016***
Leverage	0.082	0.107	-0.025****	0.036	0.052	-0.016***
Investment	-0.018	0.022	-0.04***	0.000	0.001	-0.001***
Cash Flow	0.081	0.073	0.008*	0.081	0.069	0.012***
BG Cash	20.353	0.000		20.222	0.000	
Fin_Affiliates	2.564	0.000		2.000	0.000	

Notes: This table presents the mean and median values of characteristics for *chaebol* firms and non-*chaebol* firms in the pre-crisis period (panel A), the crisis period (panel B) and in the post-crisis period (panel C). The differences in the means between *chaebol* firms and non-*chaebol* firms are evaluated using t-statistics and the differences in the medians are evaluated using Z-statistics (Wilcoxon rank-sum test). Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 2.8: Effect of Cash on Firm Performance: Baseline estimation

			Dynamic GMM		
	OLS (1)	**Fixed effects** (2)	**Lags2** (3)	**Lags3** (4)	**Lags7** (5)
ROA	0.626***	0.313***	0.490***	0.495***	0.494***
	(62.65)	(13.36)	(35.63)	(40.14)	(40.20)
Cash	0.010*	0.003	0.021	0.013	0.020*
	(1.73)	(0.29)	(1.48)	(0.98)	(1.73)
Leverage	0.032***	0.048***	0.016**	0.016**	0.018***
	(5.84)	(5.36)	(2.53)	(2.55)	(3.06)
Investment	0.003	0.000	0.002	0.002	0.003
	(0.83)	(0.08)	(0.75)	(0.79)	(1.03)
Size	0.000	-0.015***	-0.008***	-0.008***	-0.007***
	(-0.81)	(-3.17)	(-6.17)	(-6.79)	(-6.18)
Cash flow	-0.005	-0.014	0.008	0.007	0.007
	(-0.60)	(-1.46)	(0.87)	(0.95)	(0.91)
Constant	-0.003	0.000	0.007***	0.007***	0.007***
	(-0.72)	(0.28)	(4.65)	(5.67)	(5.43)
N	86,760	86,760	86,760	86,760	86,760
R-sq	0.034	0.052			
AR(2)			0.398	0.372	0.373

Notes: This table presents results from OLS, Fixed effects, and Dynamic GMM regressions that estimate the impact of firm cash holdings on a firms performance. All variables are adjusted by industry-mean. All estimations include year fixed effects and t-statistics are provided in parentheses. Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 2.9: Effect of Cash on Firm Performance with *Chaebol* affiliations

	BG	BG	BG30	non-BG	Pooled	
	(1)	(2)	(3)	(4)	(5)BG	(6)BG30
ROA	0.473***	0.489***	0.444***	0.497***	0.491***	0.495***
	(8.03)	(8.10)	(7.23)	(38.47)	(38.21)	(38.76)
Cash	-0.080**	-0.135***	-0.096**	0.023*	0.023*	0.024*
	(-1.97)	(-3.04)	(-2.23)	(1.71)	(1.69)	(1.78)
Cash*BG					-0.073*	
					(-1.75)	
Cash*BG 30						-0.134**
						(-2.11)
Cash*BG 5		0.193**				
		(2.34)				
Leverage	0.049**	0.041*	0.038	0.015**	0.016***	0.017***
	(2.03)	(1.86)	(1.52)	(2.43)	(2.59)	(2.68)
Investment	0.003	0.004	0.002	0.003	0.002	0.002
	(0.15)	(0.22)	(0.10)	(0.94)	(0.70)	(0.75)
Size	-0.012***	-0.010***	-0.013***	-0.010***	-0.008***	-0.008***
	(-2.69)	(-3.42)	(-4.13)	(-5.87)	(-5.50)	(-6.01)
Cash flow	-0.025	-0.028	-0.006	0.007	0.008	0.009
	(-0.49)	(-0.53)	(-0.13)	(0.91)	(0.96)	(1.06)
BG					0.004	
					(0.90)	
BG 30						-0.001
						(-0.07)
BG 5		0.016**				
		(2.30)				
Constant	0.025***	0.017**	0.026***	0.005***	0.006***	0.017***
	(2.90)	(2.49)	(3.10)	(4.16)	(3.84)	(5.54)
N	3,682	3,682	3,350	83,078	86,760	83,692
AR(2)	0.276	0.276	0.36	0.412	0.385	0.307

Notes: This table presents estimates from dynamic GMM regressions explaining firm performance for 1992 to 2006. The regressions are estimated separately for all chaebols(BG), top 30 chaebols (BG30), and non-*chaebol*s(non-BG). Also, the results from pooled regressions by including interaction terms with business group dummies are reported. All estimations include year fixed effects and t-statistics are in parentheses. Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 2.10: Effect of Cash on Firm Performance with the Asian Financial Crisis

	PanelA: Crisis period of 1997-1998				PanelB: Crisis period of 1997-2000			
	All (1)	BG (2)	BG30 (3)	non-BG (4)	All (5)	BG (6)	BG30 (7)	non-BG (8)
ROA	0.496***	0.470***	0.445***	0.492***	0.495***	0.470***	0.444***	0.498***
	(39.90)	(7.69)	(7.00)	(35.30)	(39.14)	(8.11)	(7.11)	(37.38)
Cash	-0.040***	-0.192	-0.210**	-0.028*	-0.044***	-0.201**	-0.229***	-0.036**
	(-2.66)	(-1.41)	(-2.35))	(-1.77)	(-3.03)	(-2.43)	(-2.80)	(-2.44)
Cash*AFC	0.015	0.162	0.167**	0.008				
	(0.91)	(1.53)	(2.02)	(0.49)				
Cash*Post	0.052**	0.127*	0.128	0.053***				
	(3.18)	(1.44)	(3.00)					
Cash*AFC00					0.014	0.139*	0.144**	0.014
					(0.92)	(1.86)	(1.97)	(0.89)
Cash*Post00					0.055***	0.123	0.129	0.054***
					(3.46)	(1.42)	(1.50)	(3.30)
Leverage	0.015**	0.046*	0.036	0.014**	0.014**	0.044**	0.033	0.013**
	(2.42)	(1.81)	(1.40)	(2.25)	(2.30)	(1.97)	(1.36)	(2.18)
Investment	0.002	0.003	0.003	0.002	0.002	0.003	0.003	0.002
	(0.77)	(0.19)	(0.15)	(0.87)	(0.73)	(0.19)	(0.15)	(0.88)
Size	-0.008***	-0.012**	-0.013***	-0.008***	-0.008***	-0.011***	-0.012***	-0.008***
	(-6.76)	(-2.51)	(-4.00)	(-6.12)	(-6.90)	(-3.49)	(-3.62)	(-5.95)
Cash flow	0.007	-0.025	-0.006	0.009	0.008	-0.023	-0.004	0.009
	(0.96)	(-0.47)	(-0.12)	(0.91)	(0.98)	(-0.44)	(-0.07)	(0.94)
Constant	0.007***	0.025***	0.027***	0.006***	0.007***	0.024***	0.024***	0.006***
N	86,760	3,682	3,350	83,078	86,760	3,682	3,350	83,078
AR(2)	0.36	0.285	0.373	0.423	0.354	0.301	0.405	0.39

Notes: This table presents estimates from dynamic GMM regressions explaining firm performance for 1992 to 2006. The regressions are estimated separately for all firms, all chaebols, top 30 chaebols, and non-*chaebol*s with the crisis dummy. Panel A defines the crisis (AFC) effect holds during 1997-1998. In panel B, I define the crisis period (AFC00) is 1997- 2000. Also, the results from pooled regressions with business group dummy are reported. All estimations include year fixed effects and t-statistics are in parentheses.Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 2.11: Effect of Internal Liquidity in *Chaebol*s on Firm Performance

	PanelA: BG firms		PanelB: BG30 firms	
	(1)	(2)	(3)	(4)
ROA	0.470***	0.469***	0.440***	0.440***
	(7.85)	(7.94)	(7.00)	(7.12)
Leverage	0.051**	0.049**	0.040	0.039
	(2.07)	(2.06)	(1.47)	(1.43)
Investment	0.004	0.002	0.003	0.001
	(0.21)	(0.13)	(0.16)	(0.08)
Size	-0.012**	-0.012***	-0.014***	-0.014***
	(-2.56)	(-2.80)	(-3.45)	(-3.52)
Cash flow	-0.024	-0.023	-0.003	-0.004
	(-0.46)	(-0.44)	(-0.07)	(-0.08)
Cash	-0.082**	-0.076**	-0.104**	-0.096**
	(-1.99)	(-1.85)	(-2.42)	(-2.23)
BG Cash	0.000		0.000	
	(0.81)		(1.53)	
Fin_Affiliates		0.002		0.001
		(1.30)		(1.19)
Constant	0.0190*	0.022**	0.021**	0.026***
	(1.69)	(2.43)	(2.22)	(2.82)
N	3,682	3,682	3,350	3,350
AR(2)	0.260	0.282	0.351	0.376

Notes: This table presents estimates from dynamic GMM regressions explaining firm performance for 1992 to 2006. The regressions are estimated separately with two group liquidity, (i)log of all other affiliates' cash (BG Cash) and (ii) the number of financial affiliates (Fin_Affiliates). Panel A is for all chaebols and Panel B is for only top thirty chaebols. All estimations include year fixed effects and t-statistics are in parentheses. Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 2.12: Effect of Internal Liquidity in *Chaebol*s on Firm Performance with the Asian Financial Crisis

	PanelA: BG Cash				PanelB: Financial Affiliates			
	BG		BG30		BG		BG30	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ROA	0.469***	0.468***	0.440***	0.439***	0.465***	0.465***	0.434***	0.434***
	(7.79)	(7.88)	(6.88)	(6.83)	(7.93)	(7.92)	(7.05)	(7.07)
Leverage	0.050*	0.050**	0.040	0.040	0.048**	0.048**	0.037	0.038
	(1.95)	(2.04)	(1.34)	(1.32)	(2.01)	(1.99)	(1.50)	(1.51)
Investment	0.004	0.004	0.003	0.002	0.002	0.002	0.001	0.001
	(0.22)	(0.20)	(0.15)	(0.12)	(0.09)	(0.09)	(0.05)	(0.03)
Size	-0.012**	-0.012***	-0.013**	-0.013**	-0.012***	-0.012***	-0.013***	-0.013***
	(-2.22)	(-2.87)	(-2.47)	(-2.47)	(-2.62)	(-2.67)	(-4.19)	(-4.17)
Cash flow	-0.025	-0.025	-0.004	-0.004	-0.022	-0.021	-0.001	-0.001
	(-0.45)	(-0.45)	(-0.07)	(-0.08)	(-0.42)	(-0.40)	(-0.03)	(-0.03)
Cash	-0.073*	-0.075*	-0.094**	-0.094**	-0.076*	-0.076*	-0.097**	-0.097**
	(-1.71)	(-1.79)	(-1.98)	(-1.97)	(-1.82)	(-1.82)	(-2.25)	(-2.23)
BG cash	0.001**	0.001*	0.001**	0.001*				
	(2.08)	(1.95)	(2.29)	(1.72)				
BG cash*Pre	-0.001		-0.001					
	(-0.67)		(-0.73)					
BG cash*Post	-0.002*	-0.001*	-0.001*	-0.001				
	(-1.91)	(-1.77)	(-1.83)	(-1.32)				
Fin_Affiliates					0.003*	0.003	0.003**	0.003**
					(1.65)	(1.53)	(2.02)	(2.00)
Fin_Affiliates*Pre					0.000		-0.001	
					(-0.16)		(-0.65)	
Fin_Affiliates*Post					-0.002	-0.002	-0.003*	-0.003*
					(-1.12)	(-1.04)	(-1.72)	(-1.69)
Constant	-0.009	-0.003	-0.008	-0.002	0.010	0.011	0.012	0.012
	(-0.37)	(-0.16)	(-0.33)	(-0.06)	(0.60)	(0.59)	(1.07)	(1.13)
N	3,682	3,682	3,350	3,350	3,682	3,682	3,350	3,350
AR(2)	0.255	0.263	0.34	0.351	0.290	0.288	0.397	0.389

Notes: This table presents estimates from dynamic GMM regressions explaining firm performance for 1992 to 2006. The regressions are estimated separately with two group liquidity, (i) log of all other affiliates' cash (BG Cash) in Panel A and (ii) the number of financial affiliates (Fin_ Affiliates) in Panel B. All estimations include year fixed effects and t-statistics are in parentheses. Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 2.13: Effect of Internal Liquidity in *Chaebol*s on Firm Performance with Allocation of Internal capital market

	Total sales					Investment opportunity			
	Pre-crisis(1992-1996)		AFC-Post(1997-2006)			Pre-crisis(1992-1996)		AFC-Post(1997-2006)	
	(1)	(2)	(3)	(4)		(5)	(6)	(7)	(8)
ROA	0.728***	0.711***	0.435***	0.434***	ROA	0.739***	0.705***	0.444***	0.439***
	(6.33)	(6.16)	(6.19)	(6.14)		(6.38)	(5.98)	(6.24)	(6.34)
Leverage	0.076***	0.078***	0.043	0.037	Leverage	0.082***	0.076***	0.054	0.037
	(2.80)	(2.89)	(1.12)	(0.98)		(2.89)	(2.82)	(1.42)	(1.02)
Investment	0.021	0.017	-0.001	-0.001	Investment	0.013	0.011	0.004	0.003
	(0.75)	(0.59)	(-0.04)	(-0.05)		(0.48)	(0.38)	(0.24)	(0.14)
Size	-0.012**	-0.012**	-0.012***	-0.011***	Size	-0.011**	-0.011**	-0.011**	-0.010***
	(-2.17)	(-2.24)	(-2.91)	(-2.77)		(-2.30)	(-2.32)	(-2.56)	(-2.58)
Cash flow	-0.189	-0.178	-0.013	-0.012	Cash flow	-0.200*	-0.176	-0.011	-0.010
	(-1.62)	(-1.53)	(-0.24)	(-0.22)		(-1.67)	(-1.45)	(-0.20)	(-0.19)
Cash	-0.066	-0.071	-0.049	-0.048	Cash	-0.057	-0.078	-0.037	-0.037
	(-0.62)	(-0.66)	(-1.02)	(-1.00)		(-0.61)	(-0.79)	(-0.76)	(-0.76)
BG Cash	0.004		0.003		BG Cash	0.007*		0.003**	
	(1.08)		(1.52)			(1.88)		(2.18)	
BG Cash* Max_Sales	0.002***		0.000		BG Cash* Med_Qnon	-0.006*		0.008***	
	(7.69)		(-0.05)			(-1.81)		(3.25)	
Fin. Affiliates		0.002		0.000	Fin_ Affiliates		0.004*		-0.001
		(1.05)		(0.17)			(1.78)		(-0.53)
Fin_Affiliates* Max_Sales		0.037***		0.014	Fin_Affiliates* Med_Qnon		-0.003		0.003**
		(6.35)		(0.98)			(-1.25)		(2.02)
Max_Sales			-0.009	-0.041	Med_Qnon	0.122*	-0.001	-0.174***	-0.016**
			(-0.05)	(-1.06)		(1.69)	(-0.12)	(-3.31)	(-2.19)
Constant	-0.060	0.003	-0.040	0.023**	Constant	-0.118	0.001	-0.044	0.028**
	(-0.73)	(0.19)	(-0.95)	(2.08)		(-1.50)	(0.06)	(-1.42)	(2.40)
N	1,309	1,309	2,373	2,373	N	1,309	1,309	2,373	2,373
AR(2)	0.380	0.378	0.320	0.327	AR(2)	0.344	0.374	0.311	0.303

Notes: This table presents the dynamic GMM regression results of group liquidity allocations. Max_Sales is a dummy variable with a value of one for affiliates with the highest total sales within *chaebol* and zero otherwise; Med_Qnon is a dummy variable with a value of one for *chaebol*s' industries showing above median Tobin's Q, calculated from non-*chaebol* firms, and zero otherwise. All estimations include year fixed effects and t-statistics are in parentheses. Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 2.14: Robustness check: Effect of Liquidity in *Chaebol*s on Firm Performance

	Panel A: Cash				Panel B: BG cash			
	All	BG	BG30	non-BG	All	BG	BG30	non-BG
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ROA	0.529***	0.386***	0.340***	0.543***	0.363***	0.363***	0.347***	0.336***
	(24.86)	(5.17)	(4.11)	(23.55)	(5.07)	(7.14)	(4.01)	(4.48)
Leverage	0.025**	0.118***	0.115***	0.018	0.130***	0.132***	0.122**	0.127**
	(2.29)	(3.32)	(3.23)	(1.50)	(3.47)	(2.87)	(2.32)	(2.47)
Investment	0.002	0.035**	0.035**	0.001	0.034**	0.035**	0.034**	0.034*
	(0.30)	(2.09)	(2.25)	(0.12)	(1.98)	(2.02)	(2.34)	(1.65)
Size	0.000	-0.016***	-0.016***	0.005*	-0.017***	-0.016***	-0.016***	-0.017***
	(0.08)	(-5.36)	(-3.96)	(1.71)	(-5.05)	(-4.38)	(-3.59)	(-4.23)
Cash flow	0.008	0.008	0.043	0.006	0.033	0.040	0.044	0.049
	(0.55)	(0.10)	(0.50)	(0.38)	(0.49)	(0.79)	(0.48)	(0.79)
Cash	-0.030**	-0.221	-0.231	-0.030**	0.033	0.033	-0.006	0.005
	(-2.10)	(-1.33)	(-0.69)	(-2.02)	(0.44)	(0.23)	(-0.03)	(0.02)
Cash*AFC	0.020	0.271**	0.273	0.023				
	(1.06)	(2.18)	(1.29)	(1.24)				
Cash*Post	0.041***	0.280	0.215	0.050***				
	(2.81)	(1.63)	(0.51)	(3.19)				
BG cash					0.003*	0.002**	0.003**	0.002
					(1.95)	(2.34)	(2.15)	(0.79)
BG cash*Pre					-0.003		-0.002	
					(-0.60)		(-0.74)	
BG cash*Post					-0.002	-0.001*	-0.003	-0.002
					(-1.63)	(-1.79)	(-1.48)	(-0.58)
Constant	-0.001	0.035***	0.032	-0.001	-0.034	-0.007	-0.033	0.032
	(-0.37)	(4.04)	(1.59)	(-0.65)	(-1.18)	(-0.39)	(-1.15)	(0.78)
N	16,070	1,279	1,151	14,791	1,279	1,279	1,151	1,151
AR(2)	0.645	0.241	0.307	0.947	0.202	0.203	0.210	0.249

Notes: This table presents robustness checks for the dynamic GMM regressions of firm's own cash (Panel A) and business group liquidity (Panel B) on firm performance with only firms which are available in a whole sample period(1992-2006). All estimations include year fixed effects and t-statistics are in parentheses. Significant at 1%(***), 5%(**) and 10%(*) levels.

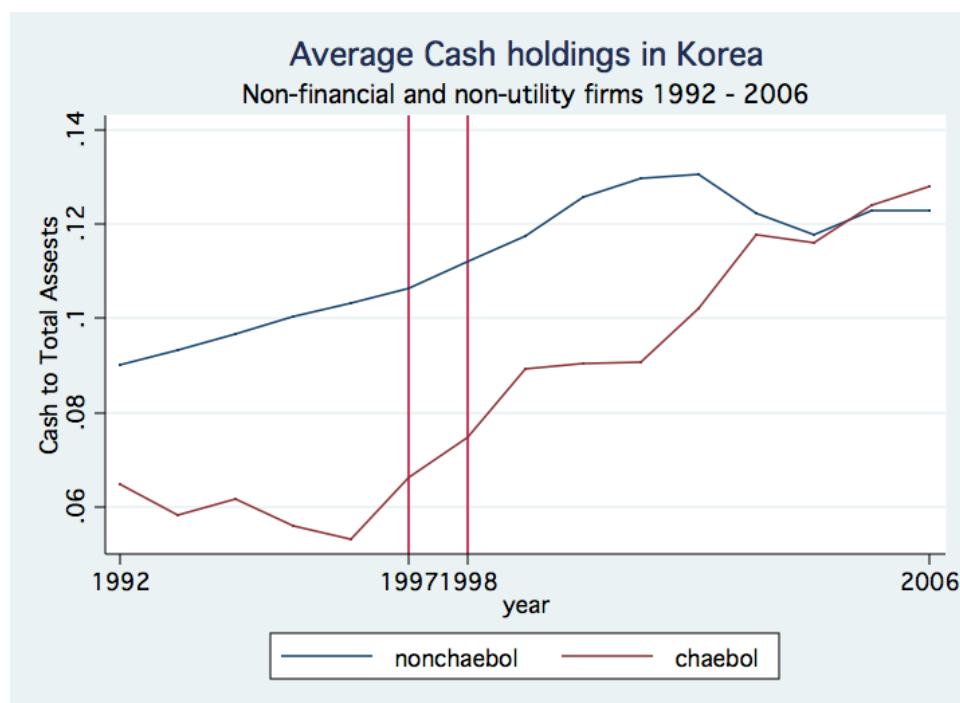Figure 2.1: Average annual cash to total assets ratios for non-*chaebol* and *chaebol* firms

Notes: This figure displays the average ratio of cash to total assets of non-*chaebol* and *chaebol* firm in the sample from 1992 to 2006. I exclude firms operating in financial and utility industries. Cash to assets is cash and short-term financial instruments divided by total assets. *Chaebol* is Korean business groups. I follow Korean Fair Trade Committee (KFTC) guidelines to classify *chaebol*, a set of firms controlled directly or indirectly by the controlling shareholder.

Chapter 3

The Determinants of Cash holdings: Evidence from Korean Business groups

3.1   Introduction

The management of cash is irrelevant to firms' financing and value in a perfect market but cash has long been studied in the real world in the context of frictions, such as transaction costs, agency problems, and information asymmetry. The trade-off model introduced by Miller and Orr (1966) and Kim, Mauer, and Sherman (1998) reveals that the optimal level of cash is determined when the costs of additional cash are offset by its benefits. Cash holding is beneficial because firms do not need to liquidate other assets to finance a new project, yet the valuable forgone investments incur costs.

Contrary to this, the financing hierarchy model (Myers and Majluf, 1984) asserts the order of preferred financing choice based on the assumption that there is no optimal level of cash, given that cash is available when the firm's generated internal funds exceed its investment. Moreover, the empirical literature after Opler et al. (1999) has examined cash policies under different settings for corporate governance (Pinkowitz, Stulz, and Williamson, 2006; Dittmar and Mahrt-Smith, 2007; Harford, Mansi, and Maxwell, 2008), information asymmetry (Drobetz, Grninger, and Hirschvogl, 2010), and financial constraints (Almeida, Campello, and Weisbach, 2004; Acharya, Almeida, and Campello, 2007; Denis and Sibilkov, 2010). This paper examines how business group affiliation affects the level of cash holdings while providing a partial answer to a more fundamental question: whether the nature of a cash policy depends on the organizational form.

Business groups consist of independent firms that operate in many industries and are linked through equity holdings or family relationships (Morck, Wolfenzon, and Yeung, 2005; Khanna and Yafeh, 2005, 2007). These firms, prevalent in Europe and Asia, are characterized by concentrated ownership through a pyramidal structure or cross-shareholdings rather than by the dispersed ownership structure, which is common in the U.S. and the U.K. (La Porta et al., 2000).

Korea is an appropriate environment for the study of business groups, and many aspects of its business groups have already been studied, such as tunneling and propping (Bae, Kang, and Kim, 2002; Baek, Kang, and Lee, 2006; Bae, Cheon, and Kang, 2008), the investment sensitivity of cash flows (Shin and Park, 1999; Song and Lee, 2012) and their structure (Almeida et al., 2011). Khanna and Yafeh (2007) presents a good summary of English-language articles on Korean business groups during the 1988 to 2005 period. Korea has significant business groups, called "*chaebol*s," which dominate the economy. The ten biggest *chaebol*s have attained over half of the total market capitalization on the Korean Stock Exchange, with total sales of around 70% of GDP since 2010. A single-country analysis allows me a clear definition of business groups and guidelines as set by a single government, by which I may avoid the endogeneity problem from the correlation between country-level legal protection and business group strucuture latent in cross-country studies (Khanna, 2000; Joh, 2003).

Studies on business groups show that group membership lowers cash holdings. Deloof (2001) shows that intra-group claims, which are flexible to a firms liquidity needs, reduce the cash balances of Belgian firms. Pinkowitz and Williamson (2001) reveal that "*keiretsu*" affiliation is negatively related to cash holdings in Japan. To the best of my knowledge, little attention has been paid to group-specific characteristics, with internal funds and diversity being determinants of the cash held by firms belong to business groups.

First, I examine whether group funds serve as an additional substitute for costly external capital and member firms' own cash in the same *chaebol*. As a result of several substituting determinants such as net working capital, bonds, and debt ratio found in the literature, firms do not need to bear costs of holding cash when other sources of capital are available. If a firm belongs to a business group with abundant capital, the level of cash holdings of that firm is smaller than that of the non-group firms. This is related to the literature on internal capital markets in business groups, which affiliates share resources and enjoy lower financial

constraints.

Diversity in groups also plays an important role in the cash policy of the affiliates. Binding with other firms also reflects the various operations. Thus, business groups consisting of affiliates having imperfectly correlated growth potential and/or cash flow do not need to reserve cash for future projects or precautionary cash against future adverse shock as much as stand-alone firms. The more diversified (co-insured) the group, the less the cash holdings. I measure diversification of *chaebol*s with the number of industries, correlation in investment opportunities calculated at the industry/ firm level, and correlation in cash flows at firm level.

Using Korean data for listed firms in the 1993 to 2006 period, this paper finds that *chaebol* firms hold significantly less cash than non-*chaebol* firms after controlling for other determinants of cash cited in previous literature, such as size, leverage, investment opportunity, net working capital, risks, payout, and dividends. I find that *chaebol* firms affiliated to financial firms have a lower level of cash holdings but cash or cash flow in other affiliates are not meaningful to those firms' cash policy. Diversification and cash holdings inside *chaebol* have a negative relationship, but only the industry-level measures are significant. However, these first results do not take into account the effects of the Asian financial crisis.

The Asian financial crisis is one of the most important aspects in the context of financial constraints. Regardless of organizational form, costs of external financing increases and in particular, *chaebol* firms are not able to guarantee other affiliates' loans in banks. This worsened external capital market would change the relationship between *chaebol* affiliation and cash policy. I re-estimate previous regressions by restricting the sample and including only the post-crisis years as a financially constrained period. I show that both effects of group funds and diversification have increased, with significant impact on the level of cash holdings. Firms belonging to *chaebol*s with large cash, financial affiliates, and more diversified operations can reserve less cash than non-*chaebol* firms after the crisis. This is consistent

with the fact that the value of cash depends on the financial constraints.

This paper contributes to the literature on cash holding by examining business groups with diversification. My results provide evidence that the affiliation of business groups has changed firms cash policy empirically. This paper also adds to the business group literature how business group firms survive and prosper by showing the advantage in reduced costs of holding cash.

This paper is organized as follows. I briefly discuss the hypotheses in Section 2. Section 3 describes the empirical method. Section 4 describes data and provides the descriptive statistics. Section 5 analyzes the determinants of cash holdings in *chaebol* and non-*chaebol* firms, and Section 6 concludes the paper.

3.2   Hypotheses

Business group firms share resources in both formal and informal ways. Prior research finds that member firms are less financially constrained through group reputation, internal debt and intra-group relations (Deloof, 2001; Pinkowitz and Williamson, 2001; Ferris, Kim, and Kitsabunnarat, 2003; Gopalan, Nanda, and Seru, 2007), and emphasizes the importance of the internal capital market. Funds inside a business group can be perceived as another substitute for cash holdings of member firms. Firms can lower the amount of cash holdings if they have other sources of capital. Empirical studies on cash holdings since Kim, Mauer, and Sherman (1998); Opler et al. (1999) have shown various forms of substitutes for cash holdings. Firms that have an easier access to the debt market, issue bonds, or have large net working capital can hold a lower amount of cash.

As a direct measure of group funds, I expect that member firms with large cash holdings in other affiliates under the same controlling shareholder can lower their own cash holdings compared with non-group firms. In addition, the existence of financial affiliates inside a

group has a negative impact on cash holdings of member firms. Financial affiliates inside Korean *chaebol*s do not have a dominant power over groups but they operate to supplement external and internal funds of other affiliates.

(H1) Firms that belong to business groups with i) large cash (cash flow) in other affiliates or ii) financial affiliates can lower their cash holdings.

Business groups have affiliates operating in related and unrelated industries. For example, "few people know that Samsung Group makes summery dresses and blouses. Even fewer are likely to remember that the South Korean conglomerate famous for its microchips and mobile phones rose to prominence in the 1950s as a woolen mill."("Evolution is crucial to *chaebol* survival," *Financial Times*, June 2011.)

The diversification in business groups also leads to an imperfect correlation between investment opportunities and generated cash flows. This group-level smoothening can lower the risk of default and financing constraints. Thus, I expect that the diversification in groups also affects the members firm-level cash holdings. As the trade-off model argues, firms try to maintain consistent financing for their future investments by using reserve cash as a fraction of assets while giving up investments today, which is the cost of holding cash.

Diversification is also related to precautionary demand for cash by Keynes (1937), which means that firms hold cash against future adverse shocks. In more diversified business groups, the higher the hedge against adverse shocks, the lower the amount of cash.

This paper closely follows a recent line of enquiry on the relationship between cash policy and firm diversification in the U.S. Duchin (2010) and Subramaniam et al. (2011) argue that diversified firms with complementary growth opportunities across segments hold significantly less cash within an active internal capital market. In addition, the value of cash in diversified firms is lower than that in focused firms, as shown in Tong (2011).

(H2) Business groups with diversified investment opportunities or cash flows

can hold less cash than non-group firms.

3.3 Empirical model

Following Opler et al. (1999), I introduce variables to control for the determinants of cash holdings: size, leverage, growth opportunity, cash flow, net working capital, R&D costs, payout, bonds, and risks:

$$
\begin{aligned}
Cash_{i,t} = {} & \alpha + \beta_1 Size_{i,t} + \beta_2 Leverage_{i,t} + \beta_3 Investment\ opportunities_{i,t} \\
& + \beta_4 Cash\ flow_{i,t} + \beta_5 Net\ working\ capital_{i,t} + \beta_6 Investment_{i,t} \\
& + \beta_7 R\&D\ Costs_{i,t} + \beta_8 Payout_{i,t} + \beta_9 Bond_{i,t} \\
& + \beta_{10} Industry\ sigma_{i,t} + \beta_{11} Firm\ sigma_{i,t} \\
& + \beta_{12} BG\ Characteristics_{i,t} + \eta_i + \nu_t + \epsilon_{i,t}
\end{aligned}
\tag{3.1}
$$

Cash is defined as the sum of cash and marketable securities over total assets following the literature. Size is defined as a natural logarithm of total assets. Cash is more valuable for smaller firms because large firms enjoy economies of scale in terms of fixed costs for external financing and are able to sell redundant assets to finance capital. Leverage is calculated as total debt divided by total assets. Growth opportunity is measured as the market-to-book ratio (Tobin's Q). Firms with a higher Q are expected to have valuable growth options in the future. Firms with high-growth opportunities are likely to hold a lot of cash for investment. Cash flow is earnings before depreciation and amortization divided by total assets. Net working capital, defined as working capital minus cash scaled by total assets, is considered a substitute for cash because it can be easily converted to cash. R&D is calculated as the research and development expenses divided by total sales. The payout dummy is equal to 1 if firms pay dividends to shareholders and is zero otherwise. I also include a Bonds dummy,

set to 1 when firms issue bonds in that year and zero otherwise.

Riskier firms tend to maintain a higher level of cash holdings. A companys risk is twofold and measured by the firm and industry sigma. Firm sigma is proxied by the cash flow volatility of a firm within a three-year window. The median of firm sigma in each industry, based on the two-digit Korean Standard Industrial Classification (KSIC), the Korean form of the SIC, measures the industry sigma.

I now outline the liquidity and diversification of *chaebol*s, the main interest of this paper. First, I introduce four measures for group funds. The first variable is a direct measure of the cash of the other affiliates in the same business group. I calculate the sum of the cash for each *chaebol* and subtract the firm's own cash. Then, I take its logarithm and name it "BG Cash". "BG Cash flow" is measured the same way with cash flows. The third measure is "Fin.AFF No", the number of *chaebol*s' financial intermediaries. Lastly, I include a dummy variable "Fin.AFF D", set to 1 if financial affiliates exist inside *chaebol*s. I expect these proxied variables that imply an alternative financial resource to be negatively related to the level of cash holdings.

For the complementary growth of *chaebol*s, which affects cash holding levels, I employ the diversification measures in the estimation. For robustness, I use four diversity measures. First, I include the number of operating industries as a two-digit KSIC for each group (INDN), a traditional but vague measure, as the growth potentials of highly correlated industries may move together.

Another industry-level diversification is Q-correlation across industries (INDQcorr). I calculate the yearly industry Q-correlation for each group as Subramaniam et al. (2011) and Hann, Ogneva, and Ozbas (2011). I first obtain the median of Tobin's Q in each industry at

two-digit and then calculate an asset-weighted portfolio correlation in *chaebol* as

$$\text{INDQcorr}_{t,k} = \sum_{m=1}^{N} \sum_{n=1}^{N} w_{m,k} w_{n,k} Corr(m,n) \tag{3.2}$$

where $Corr(m,n)$ is the correlation between investment opportunity of industries m and n and $w_{m,k}, w_{n,k}$ is the weight of industries m and n in the *chaebol* k, the ratio of assets in such industry to the total assets of group.

Thus, a higher INDQcorr value, implying a higher correlation, indicates less diversified *chaebol*s. The value of non-*chaebol*s and *chaebol*s operate in one industry is equal to 1.

In addition, I adopt correlation measures across affiliates, the Q-correlation (AFFQcorr) and the CF-correlation (AFFCFcorr), similar to correlation measures of diversified firms in Duchin (2010). Explicit financial data for each listed affiliate are used to calculate the correlation for *chaebol*s. In contrast to the segment data (Campa and Kedia, 2002; Villalonga, 2004), each affiliate in the sample has accurate data, eliminating the need to proxy the growth opportunity with the industry median.

First, I calculate the volatility of the affiliates as the standard deviation of Tobin's Q and the cash flow volatility for a three-year window. I then calculate the volatility of each *chaebol*'s Tobin's Q and cash flow as:

$$\sigma(Q)_{t,k} = \sqrt{\sum_{i=1}^{N} \sum_{j=1}^{N} w_i w_j \rho(Q)_{i,j} \sigma(Q)_{t,k}^i \sigma(Q)_{t,k}^j}$$

$$\sigma(CF)_{t,k} = \sqrt{\sum_{i=1}^{N} \sum_{j=1}^{N} w_i w_j \rho(CF)_{i,j} \sigma(CF)_{t,k}^i \sigma(CF)_{t,k}^j} \tag{3.3}$$

where $\rho_{i,j}$ is the correlation between investment opportunity or cash flow streams of affiliates i and j and w_i, w_j is the weight of affiliates i and j in the business group k, the ratio of the affiliate's assets to the total assets.

When there is no diversification ($\rho_{i,j} = 1$), volatilities of business group become

$$\overline{\sigma(Q)}_{t,k} = \sqrt{\sum_{i=1}^{N} \sum_{j=1}^{N} w_i w_j \sigma(Q)_{t,k}^i \sigma(Q)_{t,k}^j}$$

$$\overline{\sigma(CF)}_{t,k} = \sqrt{\sum_{i=1}^{N} \sum_{j=1}^{N} w_i w_j \sigma(CF)_{t,k}^i \sigma(CF)_{t,k}^j} \tag{3.4}$$

Finally, the Q-correlation and CF-correlation across affiliates are defined as:

$$\text{AFFQcorr}_{t,k} = \sigma(Q)_{t,k} - \overline{\sigma(Q)}_{t,k}$$

$$\text{AFFCFcorr}_{t,k} = \sigma(CF)_{t,k} - \overline{\sigma(CF)}_{t,k} \tag{3.5}$$

Since ρ is zero for all non-*chaebol* firms, the Q- and CF-correlation are also zero. A higher correlation in Tobin's Q and cash flow means less-diversified business groups. Thus, both AFFQcorr and AFFCFcorr are predicted to be positively associated with cash holdings.

3.4   Data

The data is from the Korea Information Service, which provides comprehensive financial information on listed firms on the Korea Stock Exchange (KSE). I supplement stock price data with TS-2000 database of Korean Listed Firms Association. The sample covers the 1990 to 2006 period. I exclude firms operating in the financial and utility industries and those lacking an industry code at the two-digit KSIC level. I also exclude firm-years with missing financial information or asset or sales growth exceeding 100%, following Almeida, Campello, and Weisbach (2004) and Acharya, Almeida, and Campello (2007).

To examine the determinants of cash holdings in *chaebol* and non-*chaebol* firms, I classify *chaebol* firms according to the guidelines of the Korea Fair Trade Commission (KFTC). The

KFTC defines a *chaebol* as a set of firms controlled directly or indirectly by the controlling shareholder following two criteria: 1) it is a group of companies in which more than 30% of the shares are owned by some individuals or companies and 2) there exists a cutoff for the total value of group affiliates. Initially, only the thirty largest groups were included in this category; as of 2001, however, any group above the combined total assets cutoff is included.

I include only those firms with a volatility measure on a past moving window of three years; the sample period begins in 1993 and runs to 2006; it consists of 7,180 firm-year observations on 701 firms. I select 5,662 firm-years for non-*chaebol*s and 1,518 firm-years for *chaebol*s.

Figure 1 shows the evolution of the average cash measured as a percentage of assets along the sample years for *chaebol* and non-*chaebol* firms. As with public U.S. firms (Bates, Kahle, and Stulz, 2009), the figure indicates an upward trend in cash holdings for Korean listed firms during the sample period. The figure also shows that non-*chaebol* firms hold a higher level of cash than the *chaebol* affiliates even though the gap between the two groups slightly narrows in the later years of the sample period.

Table 3.1 provides the descriptive statistics for the whole sample. I contrast those characteristics for *chaebol* and non-*chaebol* firms and report the statistical differences in Table 3.2. First, *chaebol* firms are significantly large in size for all periods. For the cash to total asset ratio, the main variable of interest, *chaebol* firms hold a significantly lower level of cash (5.8%) than do non-*chaebol* firms (9.8%), as expected. The literature presents the level of cash holdings across countries. The mean of the cash to total assets ratio is between 8 and 10.5% for U.S. firms (Kim, Mauer, and Sherman, 1998; Opler et al., 1999; Bates, Kahle, and Stulz, 2009), between 9.9% and 12.4% for U.K. firms (Ozkan and Ozkan, 2004; Brav, 2009), 14% for eight East Asian firms (Lee and Suh, 2011), and 13.7% for Japanese firms (Kato, Li, and Skinner, 2011).

I also observe that *chaebol* firms are highly indebted and make more investments with

larger generated funds than do non-*chaebol*s. The companies affiliated with *chaebol*s issue bonds and pay dividends significantly more often than non-*chaebol*s. I also find that the growth opportunity of *chaebol* firms, proxied by Tobin's Q, is higher. The risk a firm faces is measured by the industry sigma and firm sigma. Non-*chaebol* firms operate in riskier industries and have a higher level of firm risk. Finally, I represent *chaebol* characteristics in business group funds (Panel B) and the level of diversification (Panel C).

3.5   Results

3.5.1   Baseline estimation

I employ firm fixed effects regression with robust clustered errors at the firm level, and I include year dummies for macroeconomic uncertainty. Table 3.3 presents the results from the baseline estimation of the determinants of cash holdings. In column (1), I first present the result of the regression without considering organizational forms. Small firms are likely to hold more cash, but the coefficient is not significant. Size does not appear to be relevant to the determinants of cash holdings in Korea. I observe that the Tobin's Q has a significantly positive association with the amount of cash, meaning that firms increase cash if they have a higher growth potential. Firms with a higher debt ratio and larger net working capital hold significantly lower amounts of cash. This result confirms the theory that these variables are substitutes for cash. I also find that firms operating in risky industries tend to have a larger amount of cash from the positive signs of firm and industry sigmas. Payouts to shareholders are negatively associated with cash holdings in the U.S. (Opler et al., 1999), but the sign is positive in Korea. In addition, firms issuing bonds show significantly lower cash holdings, and R&D cost has no significant relationship with cash in Korea. Overall, these findings are consistent with the transaction costs and precautionary demands for cash.

In columns (2) to (4), I consider the *chaebol* affiliation in the baseline estimation. The results from a pooled regression are shown in column (2) with the BG dummy. The sign and significance of the BG dummy variable (-0.014) strongly supports the negative relationship between *chaebol* affiliations and the amount of cash. *Chaebol* firms hold significantly less cash than non-*chaebol* firms. Columns (3) to (4) report the results from the *chaebol* and non-*chaebol* firms, respectively.

To compare the effect of each variable between *chaebol* and non-*chaebol* firms, I perform a statistical test using "z-score" in column (5). z-score for each variable is calculated by the difference between unstandardized coefficients from columns (3) and (4) divided by the square root of the sum of two coefficients' variances. Interestingly, I find that there is no statistical difference of coefficients between two forms of organizations except Cash flow. Cash flow has a significantly greater effect in non-*chaebol* firms. The coefficient of cash flow for non-chaebol firms is economically significant, such that a one standard deviation increase in cash flow of non-chaebol firms is associated with an increase in cash of about 0.6 percent point. Given that most traditional determinants of cash holdings are independent of firm structure, I try to answer how *chaebol* firms can hold lower levels of cash than non-*chaebol* firms in the following sections

3.5.2 Funds in *Chaebol*

I first examine the sources of lower cash holdings in *chaebol* firms with group funds. *Chaebol* affiliates have another source of financing in the internal capital market by sharing resources inside the group. Thus, I expect that member firms can lower their cash holdings with group-wide capital. To address group funds as a substitute for the firm's own liquidity, I introduce two direct measures–the log of other affiliates' cash (BG Cash) and that of other affiliates' cash flow (BG Cash Flow). In addition, I also test the effect of financial affiliates

in the group. One is the number of financial affiliates (Fin.AFF No) and the other is the dummy variable, which takes 1 if the business group has a listed firm (Fin.AFF D).

The results are shown in Table 3.4. In columns (1) and (2), I find no effect of BG Cash and BG Cash Flow, as both insignificant coefficients are very small and close to zero. The amount of cash holdings or cash flows in other members does not directly affect the level of cash in affiliates.

However, the coefficient of Fin.AFF No is negative (-0.05) and statistically significant at the 10% level in column (3) but that of Fin.AFF D is negative but insignificant. As *chaebol*s hold many financial affiliates, the member firms can have less cash holdings than other firms. The estimate indicates that a one standard deviation increase in the number of financial affiliates decreases cash by 3.3% of cash in the average firm. Financial firms in *chaebol*s are different from the main banks placed at the top of the *keiretsu* business group in Japan. The biggest difference in the group structure is that Korean *chaebol*s cannot establish a bank inside the group. Pinkowitz and Williamson (2001) argue that large banks lower information asymmetry so that member firms can lower their cash reserves. However, abundant capital rather than the ability of reducing agency problem from financial firms in Korean *chaebol*s works as a substitute for affiliates cash.

3.5.3 Diversification in *Chaebol*

Now, I turn to the other group characteristic, the diversification. The existence of other affiliates in the same business group also indicates smoothened group profits and risks. Thus, the diversification inside the business group affects the cash policy of member firms similar to stand-alone firms with multiple segments holding lower cash in U.S. studies (Duchin, 2010; Subramaniam et al., 2011). The marginal value of cash decreases in *chaebol* firms with an imperfect correlation with cash flows or growth potential.

To test the effect of diversity inside *chaebol*s, I include the four diversity measures that were introduced in Section 3; the results are shown in Table 3.5. Column (1) presents the results for INDN, which is the number of different operating industries at the two-digit KSIC level in the sample. Similar to Opler et al. (1999)'s findings in diversified firms, the coefficient is negative and significant at the 10% level. The larger the number of different operating industries in the *chaebol*, the lower the affiliates cash holdings. A one standard deviation increase in the number of operating industry increases the cash ratio by 0.5 percent point. In addition, the magnitude of correlation in industry-level investment opportunities is associated with an increase of 6.7% in the mean cash holdings

Next, I include Q-correlation across operating industries in *chaebol*s in column (2). IN-DQcorr (0.026) has a positive coefficient and is significant at the 5% level, as expected. If growth opportunities across operating industries are highly correlated in *chaebol*s, firms increase their cash reserves.

Industry-level measures are economically significant. However, columns (3), (4), and (5), regarding firm-level diversification measures in Q and Cash flow, show insignificant coefficients. The effect of AFFQcorr, the correlation in Tobin's Q across affiliates, is not definite at the cash holding level. I run the same regressions with AFFCFcorr in column (3). There is a positive relationship (0.138) between the correlation of cash flow and cash holdings but it is not significant. I run the same regressions with AFFCFcorr in columns (4) and (5). The association between CF-correlation in *chaebol*s and cash holdings in member firms has the expected positive sign, but this is not significant.

3.5.4   The Asian Financial Crisis

The Asian financial crisis in 1997-1998 would lead to a change in the relationship between group characteristics and cash policy. The crisis is mainly related to the financial constraints

faced by firms and business groups. The cost of external financing is an important subject in the literature on cash holdings. Almeida, Campello, and Weisbach (2004) shows that cash flows and cash are correlated only in firms with high external financing costs, supporting Modigliani and Miller (1958)'s notion of the zero value of cash in a frictionless market. After the governments reforms, such as a ban on cross-loan guarantees, *chaebol* firms' access to external capital became more difficult than that in the pre-crisis period. In addition, Kim et al. (2004) shows that the relationship with the main bank, which is not affiliated to *chaebol*s, is attenuated as the interest-differential rises, and member firms increase their cash holdings after the crisis. Thus, I expect the relationship observed in the previous section to be significantly impacted after the crisis.

I repeat the regressions for the 1999 to 2006 period, after the Asian financial crisis in 1997 and 1998 and the results on group funds and diversity are shown in Table 3.6 and Table 3.7, respectively.

Group capital has a negative impact on cash holdings during the post-crisis period, as seen in Table 3.6. Although previous regressions from Table 3.4 show an insignificant effect of the two variables in group funds, I observe *chaebol* firms tend to have less cash if their business groups reserve large cash and generate cash flows within other affiliates. Both coefficients of BG Cash and BG Cash Flow are -0.001 and significant at the 5% level. In columns (3) and (4), the effect of the number of financial affiliates (FinAFF No) is intensified (-0.017, significant at the 1% level) over its effect in all periods after the crisis (see column (3) of Table 3.4). Business groups recognize the funds inside *chaebol*s as a reliable financing method of lowering their own liquidity when external financing is costly. The magnitude of estimates in one standard deviation increase of measures on group funds are associated with an increase of 0.6 to 0.8%, such that 6.2% to 8.2% in cash of the average firm after the crisis.

I again examine the effect of diversity on firms' cash after the crisis refer to Table 3.7. As with group capital, diversity measures show the expected signs and greater effects than

in the regressions described in Section 5.4. Columns (1) and (2) show that cash holdings are significantly negatively related to different industries (INDN, -0.006) and to the Q correlation across industries (INDQcorr, 0.057), consistent with the negative effect of complementary investment opportunities on the dependence on cash. The economic magnitude of industry-level diversification measures are significant. For example, a decrease (increase) of one standard deviation in the number of operating industries (the correlation across the industry's investment opportunity) leads to an increase of about 10% of the mean cash holdings after the crisis.

Moreover, both Tobin's Q and Cash Flow correlations across affiliates have positive coefficients in columns (3)-(5). In particular, diversity in cash flows has a larger and significant effect (0.9 and 0.832) on firms cash level than that in Q correlation (growth opportunity), indicating that smooth cash flows are more important to lower the cash policy. Using the estimate of the affiliate-level cash flow correlation in column (4), a one-standard-deviation increase in correlation to cash flows corresponds to an increase of 4.1% in cash holdings of the average firm during the post-crisis period.

3.6 Conclusion

Most of the literature on cash holdings has discussed firm structure in the context of diversified firms with multiple segments. This paper contributes to the literature by examining the sources of the negative relationship between affiliation to business groups and firms' cash policy using a sample of Korean listed firms from 1993 to 2006.

Affiliations to business groups have many advantages: group firms deter the entry of rivals and a shared reputation brings a favorable relationship with suppliers and consumers. In addition, affiliates share risks of default as well as resources. I extend the literature by investigating the facts behind lower cash holdings for affiliates: the precautionary motive.

To explain this difference in cash policy, I examine the determinants of cash using two business group characteristics: group-wide funds and group-wide diversity. First, I find that capital in other affiliates with direct measures of cash and cash flow held by other affiliates in the same business group does not lead to lower cash holdings before the crisis. However, affiliation to *chaebol*s having financial affiliates leads to hold less cash throughout the sample period. After the crisis, the negative impact of group capital becomes greater.

Co-insurance in diversified business groups is an important determinant of cash holdings. *Chaebol* firms with imperfectly correlated investment opportunities or cash flows have reduced marginal value of cash, which in turn decreases the level of cash based on the trade-off model of cash holdings. The evidence drawn through different measures demonstrates that business groups hold lower levels of cash holdings, especially the evidence from the number of different industries, Q-correlation across industries, and CF-correlation across affiliates. Moreover, the extent of the diversification effect is strong, especially in the constrained post-crisis corporate environment.

Table 3.1: Descriptive statistics

Variables	Mean	Median	Std. dev	Min	Max	Observations
Cash	0.090	0.062	0.087	0.000	0.726	7180
Size	19.115	18.942	1.400	13.809	24.780	7180
Leverage	0.293	0.256	0.298	0.000	8.320	7180
Tobin's Q	0.987	0.895	0.720	0.207	26.778	7180
Cash flow	0.069	0.075	0.112	-3.131	0.685	7180
Net Wcapital	-0.013	0.005	0.285	-7.327	0.729	7180
Investment	0.005	0.002	0.180	-7.841	0.626	7180
Dividend	0.652	1.000	0.476	0.000	1.000	7180
RD costs	0.001	0.000	0.006	0.000	0.259	7180
Bonds	0.316	0.000	0.465	0.000	1.000	7180
Firm sigma	0.029	0.019	0.048	0.000	1.359	7180
Industry sigma	0.020	0.018	0.009	0.000	0.220	7180
BG Liquidity						
BG cash	3.777	0.000	7.672	0.000	22.971	7180
BG cash flow	3.835	0.000	7.893	0.000	23.654	7180
Fin.AFF No	0.203	0.000	0.629	0.000	4.000	7180
Fin.AFF D	0.115	0.000	0.319	0.000	1.000	7180
BG Diversification						
INDN	1.603	1.000	1.577	1.000	9.000	7180
INDQcorr	0.943	1.000	0.138	0.352	1.000	7180
AFFQcorr	-0.003	0.000	0.012	-0.178	0.000	7180
AFFCFcorr	-0.001	0.000	0.003	-0.027	0.000	7180

Notes: This table reports summary statistics for the sample, which consists of non-financial and non-utility firm-years from 1993 to 2006 with non-missing data on cash holdings and on the industry codes of each business segment. See the Appendix for variable definition.

Table 3.2: Univariate test: non-*Chaebols* vs. *Chaebols*

Variables	Mean			Median		
	non-BG	BG	Difference	non-BG	BG	Difference
Cash	0.099	0.060	0.039***	0.071	0.038	0.033***
Size	18.689	20.707	-2.018***	18.654	20.771	-2.117***
Leverage	0.292	0.298	-0.006	0.250	0.285	-0.034***
Tobin's Q	0.980	1.010	-0.030	0.878	0.941	-0.063***
Cash flow	0.064	0.086	-0.022***	0.073	0.081	-0.008***
Net Wcapital	0.005	-0.078	0.083***	0.024	-0.074	0.098***
Investment	0.003	0.013	-0.010*	0.000	0.008	-0.008***
Dividend	0.643	0.687	-0.044***	1.000	1.000	0.000
RD costs	0.001	0.001	0.000	0.000	0.000	0.000
Bonds	0.271	0.482	-0.211***	0.000	0.000	0.000
Firm sigma	0.031	0.021	0.010***	0.020	0.015	0.005***
Industry sigma	0.021	0.019	0.002***	0.019	0.017	0.002***
BG Liquidity						
BG cash	0.000	17.865		0.000	18.932	
BG cash flow	0.000	18.141		0.000	19.428	
Fin.AFF No	0.000	0.960		0.000	1.000	
Fin.AFF D	0.000	0.543		0.000	1.000	
BG Diversification						
INDN	1.000	3.854		1.000	3.000	
INDQcorr	1.000	0.729		1.000	0.695	
AFFQcorr	0.000	-0.014		0.000	-0.006	
AFFCFcorr	0.000	-0.004		0.000	-0.002	

Notes: This table presents the mean and median values of characteristics for *chaebol* firms and non-*chaebol* firms during the sample period. The differences in the means between *chaebol* firms and non-*chaebol* firms are evaluated using t-statistics and the differences in the medians are evaluated using Z-statistics (Wilcoxon rank-sum test). Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 3.3: Baseline estimation

	All (1)	Pooled (2)	BG (3)	NonBG (4)	z-score (5)
Size	-0.001	0.000	0.009	0.000	0.855
	(-0.28)	(-0.00)	(1.12)	(0.04)	
Leverage	-0.062***	-0.061***	-0.078***	-0.060***	-0.735
	(-4.69)	(-4.67)	(-4.11)	(-3.92)	
Tobin's Q	0.008**	0.008**	0.002	0.008**	-0.763
	(2.05)	(1.99)	(0.25)	(2.05)	
Cash flow	0.049**	0.048**	-0.035	0.053**	-1.956
	(2.07)	(2.04)	(-0.93)	(2.12)	
Net Wcapital	-0.040***	-0.040***	-0.062***	-0.039***	-0.819
	(-3.15)	(-3.18)	(-2.60)	(-2.70)	
Firm sigma	0.087*	0.088*	0.180	0.080*	0.794
	(1.87)	(1.88)	(1.56)	(1.66)	
Industry sigma	0.353	0.351	0.424	0.361	0.136
	(1.42)	(1.42)	(1.16)	(1.23)	
Investment	-0.030***	-0.031***	-0.044***	-0.037**	-0.380
	(-3.01)	(-3.10)	(-4.09)	(-2.39)	
Dividends	0.006*	0.006*	0.004	0.009**	-0.814
	(1.92)	(1.89)	(0.73)	(2.17)	
RD costs	-0.031	-0.018	-0.344	0.172	-1.244
	(-0.12)	(-0.07)	(-1.22)	(0.56)	
Bonds	-0.006***	-0.006***	-0.005*	-0.007***	0.805
	(-3.48)	(-3.43)	(-1.86)	(-3.36)	
BG dummy		-0.014***			
		(-2.76)			
Constant	0.108	0.087	-0.098	0.083	
	(1.22)	(0.97)	(-0.63)	(0.74)	
N	7180	7180	1518	5662	
Adj. R2	0.502	0.503	0.514	0.494	

Notes: Effects of business group affiliation on cash holdings, 1993-2006. This table reports various regression results with firms' cash holdings as the dependent variable. Business group affiliation is represented using a dummy variable, BG, which is 1 if the firm is affiliated to *chaebol*s. All estimations include year fixed effects and t-statistics are in parentheses. Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 3.4: Funds in *Chaebol*

	Panel A: BG Liquidity		Panel B: Financial Affiliates	
	(1)	(2)	(3)	(4)
Size	0.000	0.000	-0.001	0.000
	(0.01)	(0.00)	(-0.12)	(-0.09)
Leverage	-0.061***	-0.061***	-0.061***	-0.061***
	(-4.66)	(-4.67)	(-4.61)	(-4.65)
Tobin's Q	0.008**	0.008**	0.008*	0.008*
	(2.01)	(2.00)	(1.91)	(1.92)
Cash flow	0.048**	0.048**	0.047**	0.047**
	(2.04)	(2.04)	(2.02)	(2.02)
Net Wcapital	-0.040***	-0.040***	-0.040***	-0.040***
	(-3.18)	(-3.18)	(-3.18)	(-3.19)
Firm sigma	0.088*	0.087*	0.086*	0.087*
	(1.88)	(1.88)	(1.86)	(1.87)
Industry sigma	0.350	0.350	0.361	0.356
	(1.42)	(1.42)	(1.45)	(1.44)
Investment	-0.031***	-0.031***	-0.030***	-0.030***
	(-3.11)	(-3.10)	(-3.01)	(-3.01)
Dividends	0.006*	0.006*	0.006*	0.006*
	(1.88)	(1.88)	(1.89)	(1.83)
RD costs	-0.019	-0.011	-0.008	-0.009
	(-0.07)	(-0.07)	(-0.03)	(-0.03)
Bonds	-0.006***	-0.006***	-0.006***	-0.006***
	(-3.44)	(-3.43)	(-3.43)	(-3.45)
BG dummy	-0.021*	-0.016*	-0.011**	-0.010*
	(-1.90)	(-1.88)	(-1.99)	(-1.79)
BG Cash	0.000			
	(0.67)			
BG Cash flow		0.000		
		(0.26)		
Fin.AFF No			-0.005*	
			(-1.65)	
Fin.AFF D				-0.011
				(-1.47)
Constant	0.086	0.087	0.099	0.096
	(0.95)	(0.96)	(1.09)	(1.06)
N	7180	7180	7180	7180
Adj. R-sq	0.503	0.503	0.503	0.503

Notes: Effects of business group liquidity on cash holdings, 1993-2006. This table reports various regression results with firms' cash holdings as the dependent variable. Business group liquidity is represented using four variables: BG Cash, BG Cash flow, Fin.AFF No, and Fin.AFF D. All estimations include year fixed effects and t-statistics are in parentheses. Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 3.5: Diversification in *Chaebol*

	Panel A: Industry-level		Panel B: Affiliate-level		
	(1)	(2)	(3)	(4)	(5)
Size	0.000	0.000	0.000	0.000	0.000
	(-0.05)	(-0.04)	(-0.01)	(0.00)	(-0.01)
Leverage	-0.061***	-0.061***	-0.061***	-0.061***	-0.061***
	(-4.66)	(-4.65)	(-4.66)	(-4.67)	(-4.66)
Tobin's Q	0.008*	0.008*	0.008**	0.008**	0.008**
	(1.96)	(1.93)	(1.98)	(2.00)	(1.98)
Cash flow	0.047**	0.048**	0.048**	0.048**	0.048**
	(2.02)	(2.03)	(2.04)	(2.04)	(2.04)
Net Wcapital	-0.040***	-0.040***	-0.040***	-0.040***	-0.040***
	(-3.18)	(-3.19)	(-3.18)	(-3.18)	(-3.18)
Firm sigma	0.086*	0.087*	0.088*	0.088*	0.088*
	(1.86)	(1.88)	(1.88)	(1.88)	(1.89)
Industry sigma	0.361	0.354	0.353	0.350	0.354
	(1.45)	(1.43)	(1.42)	(1.42)	(1.43)
Investment	-0.031***	-0.031***	-0.031***	-0.031***	-0.031***
	(-3.05)	(-3.14)	(-3.10)	(-3.11)	(-3.12)
Dividends	0.006*	0.006*	0.006*	0.006*	0.006*
	(1.89)	(1.89)	(1.90)	(1.89)	(1.90)
RD costs	-0.016	-0.022	-0.015	-0.020	-0.014
	(-0.06)	(-0.09)	(-0.06)	(-0.08)	(-0.06)
Bonds	-0.006***	-0.006***	-0.006***	-0.006***	-0.006***
	(-3.49)	(-3.45)	(-3.42)	(-3.46)	(-3.45)
BG dummy	-0.008	-0.005	-0.015***	-0.014**	-0.014***
	(-1.33)	(-0.80)	(-2.85)	(-2.58)	(-2.64)
INDN	-0.003*				
	(-1.82)				
INDQcorr		0.042**			
		(2.02)			
AFFQcorr			-0.038		-0.088
			(-0.35)		(-0.78)
AFFCFcorr				0.138	0.352
				(0.38)	(1.03)
Constant	0.094	0.063	0.088	0.087	0.088
	(1.05)	(0.70)	(0.98)	(0.97)	(0.98)
N	7180	7180	7180	7180	7180
Adj. R-sq	0.503	0.503	0.503	0.503	0.503

Notes: Effects of group-wide diversification on cash holdings, 1993-2006. This table reports various regression results with firms' cash holdings as the dependent variable. Diversification is represented using four measures: INDN, INDQ-corr, AFFQ-corr and AFFCF-corr. All estimations include year fixed effects and t-statistics are in parentheses. Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 3.6: After the Asian financial crisis I: Funds

	Panel A: BG Liquidity		Panel B: Financial Affiliates	
	(1)	(2)	(3)	(4)
Size	0.007	0.007	0.006	0.006
	(0.84)	(0.80)	(0.76)	(0.77)
Leverage	-0.066***	-0.065***	-0.065***	-0.065***
	(-3.77)	(-3.74)	(-3.71)	(-3.74)
Tobin's Q	0.005	0.005	0.005	0.005
	(0.91)	(0.91)	(0.81)	(0.84)
Cash flow	0.070***	0.071***	0.069**	0.070***
	(2.61)	(2.63)	(2.58)	(2.59)
Net Wcapital	-0.051***	-0.051***	-0.051***	-0.051***
	(-3.14)	(-3.12)	(-3.14)	(-3.15)
Firm sigma	0.043	0.044	0.042	0.042
	(0.58)	(0.59)	(0.56)	(0.57)
Industry sigma	-0.055	-0.048	-0.050	-0.056
	(-0.20)	(-0.17)	(-0.18)	(-0.20)
Investment	-0.037***	-0.037***	-0.036***	-0.036***
	(-2.95)	(-3.01)	(-2.85)	(-2.85)
Dividends	0.004	0.004	0.003	0.003
	(0.82)	(0.87)	(0.74)	(0.68)
R&D costs	0.104	0.093	0.152	0.135
	(0.35)	(0.31)	(0.52)	(0.46)
Bonds	-0.011***	-0.011***	-0.011***	-0.011***
	(-4.36)	(-4.40)	(-4.67)	(-4.54)
BG dummy	0.004	0.000	-0.011	-0.011
	(0.41)	(0.02)	(-1.63)	(-1.61)
BG Cash	-0.001**			
	(-2.42)			
BG Cash flow		-0.001**		
		(-2.45)		
Fin.AFF No			-0.017***	
			(-3.03)	
Fin.AFF D				-0.020**
				(-2.27)
Constant	-0.029	-0.024	-0.015	-0.017
	(-0.19)	(-0.16)	(-0.09)	(-0.11)
N	4182	4182	4182	4182
Adj. R-sq	0.596	0.596	0.597	0.597

Notes: Effects of business group liquidity on cash holdings, 1999-2006. This table reports various regression results with firms' cash holdings as the dependent variable. Business group liquidity is represented using four variables: BG Cash, BG Cash flow, Fin.AFF No, and Fin.AFF D. All estimations include year fixed effects and t-statistics are in parentheses. Significant at 1%(***), 5%(**) and 10%(*) levels.

Table 3.7: After the Asian financial crisis II: Diversification

	Panel A: Industry-level		Panel B: Affiliate-level		
	(1)	(2)	(3)	(4)	(5)
Size	0.007	0.006	0.007	0.006	0.007
	(0.82)	(0.77)	(0.83)	(0.81)	(0.82)
Leverage	-0.066***	-0.066***	-0.066***	-0.065***	-0.065***
	(-3.76)	(-3.70)	(-3.78)	(-3.75)	(-3.75)
Tobin's Q	0.005	0.005	0.005	0.005	0.005
	(0.86)	(0.86)	(0.94)	(0.91)	(0.92)
Cash flow	0.069**	0.070***	0.070***	0.070***	0.070***
	(2.58)	(2.63)	(2.61)	(2.59)	(2.59)
Net Wcapital	-0.051***	-0.050***	-0.051***	-0.051***	-0.051***
	(-3.15)	(-3.11)	(-3.12)	(-3.11)	(-3.11)
Firm sigma	0.042	0.042	0.043	0.045	0.045
	(0.56)	(0.57)	(0.58)	(0.60)	(0.60)
Industry sigma	-0.053	-0.041	-0.063	-0.051	-0.053
	(-0.19)	(-0.15)	(-0.23)	(-0.19)	(-0.19)
Investment	-0.036***	-0.038***	-0.036***	-0.037***	-0.037***
	(-2.87)	(-3.08)	(-2.94)	(-2.96)	(-2.96)
Dividends	0.003	0.004	0.004	0.004	0.004
	(0.71)	(0.76)	(0.77)	(0.79)	(0.78)
RD costs	0.128	0.117	0.095	0.092	0.091
	(0.44)	(0.40)	(0.32)	(0.31)	(0.30)
Bonds	-0.011***	-0.011***	-0.011***	-0.011***	-0.011***
	(-4.54)	(-4.51)	(-4.49)	(-4.61)	(-4.62)
BG dummy	-0.005	-0.003	-0.016**	-0.013*	-0.013*
	(-0.77)	(-0.38)	(-2.37)	(-1.92)	(-1.86)
INDN	-0.006***				
	(-3.03)				
INDQcorr		0.085***			
		(3.57)			
AFFQcorr			0.138		0.037
			(1.10)		(0.32)
AFFCFcorr				0.900**	0.832**
				(2.03)	(2.09)
Constant	-0.017	-0.076	-0.028	-0.025	-0.026
	(-0.11)	(-0.49)	(-0.18)	(-0.16)	(-0.16)
N	4182	4182	4182	4182	4182
Adj. R-sq	0.597	0.598	0.596	0.596	0.596

Notes: Effects of group-wide diversification on cash holdings, 1999-2006. This table reports various regression results with firms' cash holdings as the dependent variable. Diversification is represented using four measures: INDN,INDQ-corr, AFFQ-corr and AFFCF-corr. All estimations include year fixed effects and t-statistics are in parentheses. Significant at 1%(***), 5%(**) and 10%(*) levels.

Figure 3.1: Average annual cash to total assets ratio of Korean listed firms
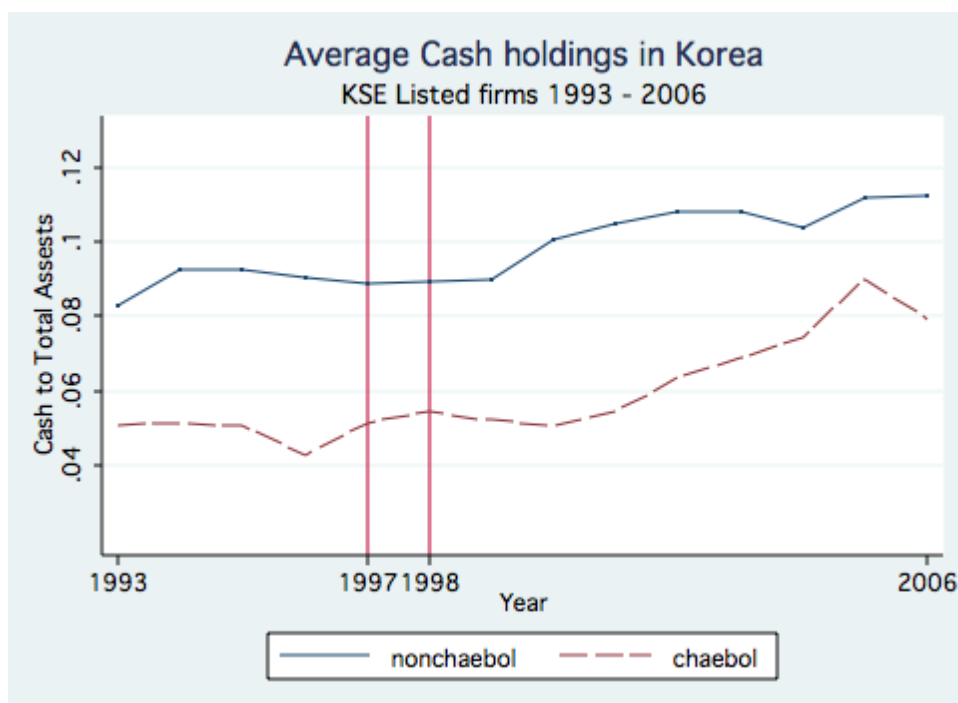
Notes: This figure displays the average ratio of cash to total assets of non-*chaebol* and *chaebol* listed firm on Korean Stock Exchange (KSE) in the sample from 1993 to 2006. I exclude firms operating in financial and utility industries. Cash to assets is cash and marketable securities divided by total assets. *Chaebol* is Korean business groups. I follow Korean Fair Trade Committee (KFTC) guidelines to classify *chaebol*, a set of firms controlled directly or indirectly by the controlling shareholder.

Bibliography

Acharya, Viral V., Heitor Almeida, and Murillo Campello. 2007. "Is cash negative debt? A hedging perspective on corporate financial policies." *Journal of Financial Intermediation* 16 (4):515–554.

Almeida, Heitor, Murillo Campello, and Michael S. Weisbach. 2004. "The cash flow sensitivity of cash." *Journal of Finance* 59 (4):1777–1804.

Almeida, Heitor, Sang Yong Park, Marti G. Subrahmanyam, and David Wolfenzon. 2011. "The structure and formation of business groups: Evidence from Korean chaebols." *Journal of Financial Economics* 99 (2):447–475.

Arellano, Manuel and Stephen Bond. 1991. "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations." *Review of Economic Studies* 58 (2):277–297.

Audretsch, David B. 1991. "New-firm survival and the technological regime." *Review of Economics and Statistics* 73 (3):441–450.

Bae, Gil S., Youngsoon S. Cheon, and Jun-Koo Kang. 2008. "Intragroup propping: evidence from the stock-price effects of earnings announcements by Korean business groups." *Review of Financial Studies* 21 (5):2015–2060.

Bae, Kee-Hong, Jun-Koo Kang, and Jin-Mo Kim. 2002. "Tunneling or value added? Evidence from mergers by Korean business groups." *Journal of Finance* 57 (6):2695–2740.

Baek, Jae-Seung, Jun-Koo Kang, and Inmoo Lee. 2006. "Business groups and tunneling: Evidence from private securities offerings by Korean chaebols." *Journal of Finance* 61 (5):2415–2449.

Baggs, Jen, Eugene Beaulieu, and Loretta Fung. 2009. "Firm survival, performance, and the exchange rate." *Canadian Journal of Economics/Revue canadienne d'conomique* 42 (2):393–421.

Bates, Thomas W., Kathleen M. Kahle, and Ren M. Stulz. 2009. "Why do US firms hold so much more cash than they used to?" *Journal of Finance* 64 (5):1985–2021.

Baumol, William J. 1952. "The transactions demand for cash: An inventory theoretic approach." *Quarterly Journal of Economics* 66 (4):545–556.

Beck, Nathaniel and Jonathan N Katz. 1997. "The analysis of binary time-series-cross-section data and/or the democratic peace." Paper presented at the Annual Meeting of the Political Methodology Group, Ohio State University.

Blundell, Richard and Steve Bond. 2000. "GMM estimation with persistent panel data: an application to production functions." *Econometric Reviews* 19 (3):321–340.

Bond, Stephen R. 2002. "Dynamic panel data models: a guide to micro data methods and practice." *Portuguese Economic Journal* 1 (2):141–162.

Brav, Omer. 2009. "Access to capital, capital structure, and the funding of the firm." *Journal of Finance* 64 (1):263–308.

Campa, Jos M. and Simi Kedia. 2002. "Explaining the diversification discount." *Journal of Finance* 57 (4):1731–1762.

Campello, Murillo. 2003. "Capital structure and product markets interactions: Evidence from business cycles." *Journal of Financial Economics* 68 (3):353–378.

Campello, Murillo, John Graham, and Campbell R. Harvey. 2010. "The real effects of financial constraints: Evidence from a financial crisis." *Journal of Financial Economics* 97 (3):470–487.

Clementi, Gian Luca and Hugo A. Hopenhayn. 2006. "A theory of financing constraints and firm dynamics." *Quarterly Journal of Economics* 121 (1):229–265.

Coles, Jeffrey L., Michael L. Lemmon, and J. Felix Meschke. 2012. "Structural models and endogeneity in corporate finance: the link between managerial ownership and corporate performance." *Journal of Financial Economics* 103:149–168.

Deloof, Marc. 2001. "Belgian intragroup relations and the determinants of corporate liquid reserves." *European Financial Management* 7 (3):375–392.

Denis, David J. and Valeriy Sibilkov. 2010. "Financial constraints, investment, and the value of cash holdings." *Review of Financial Studies* 23 (1):247–269.

Dittmar, Amy and Jan Mahrt-Smith. 2007. "Corporate governance and the value of cash holdings." *Journal of Financial Economics* 83 (3):599–634.

Dittmar, Amy, Jan Mahrt-Smith, and Henri Servaes. 2003. "International corporate governance and corporate cash holdings." *Journal of Financial and Quantitative analysis* 38 (1):111–134.

Drobetz, Wolfgang, Matthias C. Grninger, and Simone Hirschvogl. 2010. "Information asymmetry and the value of cash." *Journal of Banking & Finance* 34 (9):2168–2184.

Duchin, Ran. 2010. "Cash holdings and corporate diversification." *Journal of Finance* 65 (3):955–992.

Faulkender, Michael and Rong Wang. 2006. "Corporate financial policy and the value of cash." *Journal of Finance* 61 (4):1957–1990.

Ferreira, Miguel A. and Antonio S. Vilela. 2004. "Why do firms hold cash? Evidence from EMU countries." *European Financial Management* 10 (2):295–319.

Ferris, Stephen P., Kenneth A. Kim, and Pattanaporn Kitsabunnarat. 2003. "The costs (and benefits?) of diversified business groups: The case of Korean chaebols." *Journal of Banking & Finance* 27 (2):251–273.

Foley, C. Fritz, Jay C. Hartzell, Sheridan Titman, and Garry Twite. 2007. "Why do firms hold so much cash? A tax-based explanation." *Journal of Financial Economics* 86 (3):579–607.

Frésard, Laurent. 2010. "Financial strength and product market behavior: The real effects of corporate cash holdings." *Journal of Finance* 65 (3):1097–1122.

Gopalan, Radhakrishnan, Vikram Nanda, and Amit Seru. 2007. "Affiliated firms and financial support: Evidence from Indian business groups." *Journal of Financial Economics* 86 (3):759–795.

Hann, Rebecca, Maria Ogneva, and Oguzhan Ozbas. 2011. "Corporate diversification and the cost of capital." Working Paper 58, Rock Center for Corporate Governance at Stanford University:32–09.

Harford, Jarrad, Sattar.A. Mansi, and Wiliam F. Maxwell. 2008. "Corporate governance and firm cash holdings in the US." *Journal of Financial Economics* 87 (3):535–555.

Harford, Jarrad, Wayne Mikkelson, and M. Megan Partch. 2003. "The effect of cash reserves on corporate investment and performance in industry downturns." Working paper, University of Washington.

Jenkins, Stephen P. 1995. "Easy estimation methods for discrete-time duration models." *Oxford bulletin of Economics and Statistics* 57 (1):129–136.

Jensen, M.C. 1986. "Agency costs of free cash flow, corporate finance, and takeovers." *American Economic Review* 76 (2):323–329.

Joh, Sung Wook. 2003. "Corporate governance and firm profitability: evidence from Korea before the economic crisis." *Journal of Financial Economics* 68 (2):287–322.

Kalcheva, Ivalina and Karl V. Lins. 2007. "International evidence on cash holdings and expected managerial agency problems." *Review of Financial Studies* 20 (4):1087–1112.

Kato, Kazuo, Meng Li, and Douglas J. Skinner. 2011. "Is Japan Really a Buy? The Corporate Governance, Cash Holdings, and Economic Performance of Japanese Companies." Chicago Booth Research Paper No.13-06, University of Chicago.

Keynes, John M. 1937. "The general theory of employment." *Quarterly Journal of Economics* 51 (2):209–223.

Khanna, Tice. 2000. "Business groups and social welfare in emerging markets: Existing evidence and unanswered questions." *European Economic Review* 44 (4):748–761.

Khanna, Tice and Krishna Palepu. 2000. "Is group affiliation profitable in emerging markets? An analysis of diversified Indian business groups." *Journal of Finance* 55 (2):867–891.

Khanna, Tice and Yishay Yafeh. 2005. "Business Groups and Risk Sharing around the World." *Journal of Business* 78 (1):301–340.

———. 2007. "Business groups in emerging markets: Paragons or parasites?" *Journal of Economic Literature* 45 (2):331–372.

Kim, Chang-Soo, David C. Mauer, and Ann E. Sherman. 1998. "The determinants of corporate liquidity: Theory and evidence." *Journal of Financial and Quantitative Analysis* 33 (3):335–359.

Kim, Woochan, Youngjae Lim, and Taeyoon Sung. 2007. "Group control motive as a determinant of ownership structure in business conglomerates: Evidence from Korea's chaebols." *Pacific-Basin Finance Journal* 15 (3):213–252.

Kim, Yitae, Kwangwoo Park, Ronald A. Ratti, and Hyun-Han Shin. 2004. "Do main banks extract rents from their client firms? Evidence from Korean chaebol." *Hitotsubashi Journal of Economics* 45 (1):15–46.

La Porta, Rafael, Florencio Lopez-de Silanes, Andrei Shleifer, and Robert Vishny. 2000. "Investor protection and corporate governance." *Journal of Financial Economics* 58 (1):3–27.

Lee, Bong Soo and Jungwon Suh. 2011. "Cash holdings and share repurchases: International evidence." *Journal of Corporate Finance* 17 (5):1306–1329.

Lee, Sangwoo, Kwangwoo Park, and Hyun-Han Shin. 2009. "Disappearing internal capital markets: Evidence from diversified business groups in Korea." *Journal of Banking & Finance* 33 (2):326–334.

Lins, K.V., H. Servaes, and P. Tufano. 2010. "What drives corporate liquidity? An international survey of cash holdings and lines of credit." *Journal of Financial Economics* 98 (1):160–176.

Luo, Mi. 2011. "A bright side of financial constraints in cash management." *Journal of Corporate Finance* 17 (5):1430–1444.

Mata, Jos and Pedro Portugal. 1994. "Life duration of new firms." *Journal of Industrial Economics* 42 (3):227–245.

Mikkelson, Wayne H. and M. Megan Partch. 2003. "Do persistent large cash reserves hinder performance?" *Journal of Financial and Quantitative Analysis* 38 (02):275–294.

Miller, Merton H. and Daniel Orr. 1966. "A Model of the Demand for Money by Firms." *Quarterly Journal of Economics* 80 (3):413–435.

Modigliani, Franco and Merton H. Miller. 1958. "The cost of capital, corporation finance and the theory of investment." *American Economic Review* 48 (3):261–297.

Morck, Randall, Daniel Wolfenzon, and Bernard Yeung. 2005. "Corporate governance, economic entrenchment and growth." *Journal of Economic Literature* 43(3) (3):655–720.

Myers, Stewart C. and Nicholas S. Majluf. 1984. "Corporate financing and investment decisions when firms have information that investors do not have." *Journal of Financial economics* 13 (2):187–221.

Nickell, Stephen. 1981. "Biases in dynamic models with fixed effects." *Econometrica* 49 (6):1417–1426.

Opler, Tim, Lee Pinkowitz, Ren M. Stulz, and Rohan Williamson. 1999. "The determinants and implications of corporate cash holdings." *Journal of Financial Economics* 52:3–46.

Ozkan, Aydin and Neslihan Ozkan. 2004. "Corporate cash holdings: An empirical investigation of UK companies." *Journal of Banking and Finance* 28 (9):2103–2134.

Pinkowitz, L., R. Stulz, and R. Williamson. 2006. "Does the Contribution of Corporate Cash Holdings and Dividends to Firm Value Depend on Governance? A Cross-country Analysis." *Journal of Finance* 61 (6):2725–2751.

Pinkowitz, Lee and Rohan Williamson. 2001. "Bank power and cash holdings: Evidence from Japan." *Review of Financial Studies* 14 (4):1059–1082.

Radelet, Steven and Jeffrey D. Sachs. 2000. "The Onset of the East Asian Financial Crisis." In *Currency Crises*, NBER Chapters. National Bureau of Economic Research, Inc, 105–162.

Rajan, Raghuram G. and Luigi Zingales. 1995. "What do we know about capital structure? Some evidence from international data." *Journal of Finance* 50 (5):1421–1460.

Scharfstein, David S. and Jeremy C. Stein. 2000. "The dark side of internal capital markets: Divisional rent-seeking and inefficient investment." *Journal of Finance* 55 (6):2537–2564.

Shin, Hyun-Han and Young S. Park. 1999. "Financing constraints and internal capital markets: Evidence from Korean chaebols." *Journal of Corporate Finance* 5 (2):169–191.

Song, Kyojik (Roy) and Youngjoo Lee. 2012. "Long-Term Effects of a Financial Crisis: Evidence from Cash Holdings of East Asian Firms." *Journal of Financial and Quantitative Analysis* 47 (03):617–641.

Spaliara, Marina-Eliza and Serafeim Tsoukas. 2010. "The role of bond finance in firms survival during the Asian crisis." Working Paper No. 32010, Hong Kong Institute for Monetary Research.

Stein, Jeremy C. 1997. "Internal capital markets and the competition for corporate resources." *Journal of Finance* 52 (1):111–133.

Subramaniam, Venkat, Tony T. Tang, Heng Yue, and Xin Zhou. 2011. "Firm structure and corporate cash holdings." *Journal of Corporate Finance* 17 (3):759–773.

Tong, Zhenxu. 2011. "Firm diversification and the value of corporate cash holdings." *Journal of Corporate Finance* 17 (3):741–758.

Villalonga, Beln. 2004. "Diversification discount or premium? New evidence from the business information tracking series." *Journal of Finance* 59 (2):479–506.

Zhou, Xianming. 2001. "Understanding the determinants of managerial ownership and the link between ownership and performance: comment." *Journal of Financial Economics* 62 (3):559–571.

Appendix A

Business groups in Korea 1993-2006

The Korea Fair Trade Commission (KFTC) has announced business groups (*chaebol*s) every April which are subject to regulations and restrictions of Korean government. This table represents the list of family-owned business groups from the annual reports of KFTC during 1993-2006. If a business group name is changed, I use the latest name in the sample period. Recent identification and detailed information on business groups can be found on the website (http://groupopni.ftc.go.kr).

Table A.1: *Chaebol*s in Korea

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
ANAM					▓	▓	▓	▓						
BOOYOUNG										▓	▓	▓	▓	▓
BYUKSAN	▓	▓	▓	▓										
CJ							▓	▓	▓	▓	▓	▓	▓	▓
DAERIM	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓
DAESANG	▓	▓	▓		▓	▓	▓			▓	▓			
DAESUNG										▓	▓	▓	▓	▓
DAEWOO	▓	▓	▓	▓	▓	▓	▓	▓						
DAEWOO E&C												▓	▓	▓
DAEWOO ELECTRONICS						▓	▓	▓	▓					
DAEWOO MOTORS											▓	▓	▓	
DSME											▓	▓	▓	▓
DONGA	▓	▓	▓	▓	▓	▓	▓	▓						
DONGBU	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
DONGKUK STEEL	■	■	■	■	■	■	■	■	■	■	■	■	■	■
DONGWON										■	■	■		
DOOSAN	■	■	■	■	■	■	■	■	■	■	■	■	■	■
ELAND													■	■
GEOPYUNG					■	■								
GM DAEWOO												■	■	■
GS													■	■
HAETAE	■	■	■	■	■	■	■							
HALLA	■	■	■	■	■	■	■							
HANARO									■	■	■	■	■	■
HANBO		■	■	■										
HANHWA	■	■	■	■	■	■	■	■	■	■	■	■	■	■
HANIL	■	■	■	■	■	■	■							
HANJIN	■	■	■	■	■	■	■	■	■	■	■	■	■	■
HANJIN HEAVY INDUSTRIES														■
HANKOOK TIRE										■	■	■	■	■
HANSOL				■	■	■	■	■	■	■	■	■	■	■
HANYANG	■													
HITE											■	■	■	■
HYNIX														■
HYOSUNG	■	■	■	■	■	■	■	■	■	■	■	■	■	■
HYUNDAI	■	■	■	■	■	■	■	■	■	■	■	■	■	■
HYUNDAI DEPARTMENT STORE										■	■	■	■	■
HYUNDAI DEVELOPMENT								■	■	■	■	■	■	■
HYUNDAI HEAVY INDUSTRIES										■	■	■	■	■
HYUNDAI MOTORS										■	■	■	■	■
HYUNDAI OILBANK								■	■	■			■	■
JINRO	■	■	■	■	■	■	■	■	■					
JOONGANG														■
KANGWON						■	■							
KCC										■	■	■	■	■
KIA	■	■	■	■	■									
KOHAP	■	■	■	■	■	■	■	■	■					
KOLON	■	■	■	■	■	■	■	■	■	■	■	■	■	■
KT										■	■	■	■	■
KT&G											■		■	■

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
KUKDONG	■	■	■	■										
KUMHO ASIANA	■	■	■	■	■	■	■	■	■	■	■	■	■	■
LG	■	■	■	■	■	■	■	■	■	■	■	■	■	■
LOTTE	■	■	■	■	■	■	■	■	■	■	■	■	■	■
LS												■	■	■
MUNHWA BROADCASTING												■	■	■
NEWCORE			■	■	■	■								
NONGSHIM												■	■	■
OCI									■	■	■	■	■	■
POSCO									■	■	■			■
SAEHAN						■	■							
SAMBO COMPUTER										■	■			
SAMMI	■	■	■	■										
SAMSUNG	■	■	■	■	■	■	■	■	■	■	■	■	■	■
SAMYANG							■					■	■	■
SEAH												■	■	■
SHINSEGAE									■	■	■	■	■	■
SINHO					■	■	■							
S-OIL							■							
SK	■	■	■	■	■	■	■	■	■	■	■	■	■	■
SSANG YONG	■	■	■	■	■	■	■	■	■					■
STX													■	■
TAE KWANG										■	■	■	■	■
TAEYOUNG														■
TAIHAN ELECTRIC WIRE												■	■	■
TONGYANG	■	■	■	■	■	■	■	■	■	■	■	■	■	■
WOOSUNG	■	■	■											
YOUNG POONG									■	■	■	■	■	■

Appendix B

Definitions of the main variables

Table B.1: Definition of the variables in Chapter 2

Total Assets	Total assets
Size	Logarithm of total assets
Age	Firm age
ROA (Profitability)	Ratio of operating income to total assets
Cash	Cash and short term financial instruments scaled by total assets
Cash Flow	Income before depreciation scaled by total assets
Total Leverage	Total debt scaled by total assets
Leverage	Long-term debt and current position of long term debt scaled by total assets
Collateral	Tangible assets scaled by total assets
Investment	Capital expenditure scaled by total assets
MES	The median of total sales in each industry at three-digit KSIC
Exchange	Exchage rate between Korean won and US dollar

BG(*Chaebol*) affiliation

BG	1 if a firm is affiliated to *chaebol*
BG 30	1 if a firm is affiliated to thirty largest *chaebol*s
BG 5	1 if a firm is affiliated to five largest *chaebol*s
BG cash	Logarithm of combined cash inside chaebols minus own cash
Fin. Affiliates	the number of financial intermediaries of each *chaebol*
Max_Sales	1 if an affiliate has the highest total sales inside *chaebol*
Med_Qnon	1 if Tobin's Q of operating industry is above the median inside *chaebol*

Asian financial crisis

Pre	1 if before the crisis (during 1992-1996)
AFC	1 if during the crisis (during 1997-1998)
Post	1 if after the crisis (during 1999-2006)

Table B.2: Definition of the variables in Chapter 3

Total Assets	Total assets
Size	Logarithm of total assets
Cash	Cash and marketable securities scaled by total assets
Leverage	Total debt scaled by total assets
Tobin's Q	Investment opportunity
	Market value of the firm (book value of asset less the book value of the equity plus the market value of the equity), divided by book value of the assets
Cash flow	Income before depreciation scaled by total assets
Net Wcapital	Working capital, less cash, divided by total assets
Investment	Capital expenditure scaled by total assets
R&D	Research and development spending over sales
Dividend	1 if the firms pay dividend in that year and 0 otherwise
Bonds	1 if the firms issue bonds in that year and 0 otherwise
Firm sigma	a volatility of firm-level cash flow over the past three years
Industry sigma	the median of Firm sigma in each industry at two-digit KSIC

BG(*Chaebol*) affiliation

BG	1 if a firm is affiliated to *chaebol*
BG Cash	Logarithm of combined Cash inside the chaebol minus firm own Cash
BG Cash flow	Logarithm of combined Cash Flow inside the chaebol minus firm own Cash Flow
Fin.AFF No	the number of financial intermediaries inside *chaebol*
Fin.AFF D	1 if a firm's chaebols have financial intermediaries and zero otherwise
INDN	the number of different two-digit operating industry inside *chaebol*
INDQcorr	Asset-weighted Tobin's Q correlations across industries in *chaebol*
AFFQcorr	Difference between asset-weighted Q volatility and the Q volatility obtained after accounting for the cross-affiliates Q correlations
AFFCFcorr	Difference between asset-weighted CF volatility and the CF volatility obtained after accounting for the cross-affiliates Q correlations