The Adjustment Speed of Corporate Cash Holdings

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Abstract

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The current literature provides some empirical evidences about whether firms have target ratios of cash holdings. In my thesis, I employ a partial-adjustment model with panel data of Compustat Industrial Annual tapes during 1974 to 2006. I find evidence supportive of target corporate cash ratios. A typical firm closes each year over 50% of the gap between the actual target cash ratios and its long-run target. My results also indicate that the adjustment speed of cash holdings increases if firm sizes are smaller, firms are more financially constrained or firms have more growth opportunities.

key words: Target cash holdings; Partial adjustment model; Adjustment speed

Contents

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Chapter 1

Introduction

As the most liquid asset, cash and cash equivalents are applied in a company to serve the operation and investment purposes. Generally, it is easier for a company to cover the liabilities, to grasp future investment opportunities or to prepare for possible contingency if it holds more cash. In other words, more cash holdings help reduce the idiosyncratic risks for a firm, which is one of the reasons why executives prefer to multiply their cash holdings. On the other hand, however, holding too much cash, which would reduce the rate of return of a firm, is not a favorable option for shareholders. Therefore, a reasonable guess is that an "optimal" cash holding ratio may exist. Currently, plenty of academics show interests in this area. Does corporate cash holdings matter? Do firms have a preference of keeping a certain ratio of cash holdings? What factors influence the cash ratio target? A large amount of literature tries to answer these questions and gives close attention to the existence or determinants of the target corporate cash ratios, but not many papers refer to the speed of cash ratio adjustment to the target up to now. If the target or "optimal" cash ratios do exist, what would firms do when actual cash ratios deviate from their targets? Will companies modulate the cash ratios toward the optimal ones they set

or will they just "let it be"? If management chooses to adjust cash holdings toward the target levels, how fast is the adjustment speed? This is what I attempt to find out in this article.

In order to examine the adjustment speed of cash holdings, first of all, there should be a target. The theoretical foundation of this article is trade off theory. Most literature supporting this theory considers that the target cash levels exist (e.g., Kim. et al., 1998; Opler et al., 1999; Ozkan and Ozkan, 2004). According to the prior works, several firm-specific characteristics are important for firms' cash reserves, such as firm size, growth opportunities, dividend policy and cash flow volatility. Based on the implicit assumption that firms have a target cash ratio, my thesis tries to find out the adjustment speed of this ratio. When corporate cash ratio is in a suboptimal level, companies trade off between two types of cost: the cost of adjusting the cash level to its target and the cost of being at the off-target level. If the latter outweighs the former, management chooses to adjust the cash holdings toward its target until the two costs are equal to each other. Otherwise is the former is larger than the latter, current cash holdings would be kept. To the extent that the adjustment is not necessarily complete, I employ a partial adjustment model to look into the adjustment speed of corporate cash holdings, which is the major contribution of this paper to the literature.

My study proceeds in two steps. First, I focus on the average adjustment speed of corporate cash holdings with the complete sample from Compustat Industrial Annual tapes during 1974 through 2006. After comparing various definitions of cash ratio, I find insignificant differences among results of different definitions. Thus I follow some previous papers and pick a traditional one as the primary measure for the whole study. Also I check several models and conclude the partial adjustment model with fixed effects should be preferred.

In the second step, since most prior papers only pay attention to the determinants of the levels of cash holdings, I in my thesis try to explore the determinants of the adjustment speed of cash ratio. I expect firm size, growth opportunity, and financial constraints would affect the adjusting speed. In order to verify this hypothesis, I implement several tests to capture the relationship between adjustment speed and these different firm characteristics. The results reveal that cash holdings adjustment speed increase with growth opportunity and financial constraints while decrease with firm size, which justify the hypothesis.

The whole thesis is organized as follows. Chapter 2 is literature review. Chapter 3 describes the Compustat data I use and supply the summary statistics for variables used in regressions. Chapter 4 introduces the partial adjustment model used here. Chapter 5 presents empirical results of the regressions and robustness checks of the model. Chapter 6 concludes. Appendix B defines the variables used in the thesis. Appendix C explains the meanings of relevant Compustat data.

Chapter 2

Literature Review

2.1 Reasons for firms to hold cash

In 2002, Standard and Poor's added liquidity analytics into its ratings process. After that, some firms' debts were downgraded mainly due to the concern of cash, which is the most reliable source of liquidity. Holding a certain amount of cash plays a vital important role in firms' operation and investment process. In the short-run, cash holdings indicate the liquidity and the ability of firms to make current payments for the matured liabilities or other operational expenditures. Also holding cash helps meet the financing needs for firms' investments and activities. It provides firms with a safe channel to make risk management and gain returns over investment. In his book *The General Theory of Employment, Interest and Money*, Keynes talks about the reasons for firms' preference to cash and liquidity. He gives 3 motives as explanation: transaction motive, precautionary motive and speculative motive. Transaction motive means that cash is needed either when disbursement has already happened while income has not been received (which is specified as income motive) or when business costs have to be paid but sale proceeds have not yet been acquired

(which is identified as business motive). It reflects that payments and receipts do not always happen simultaneously. Precautionary motive arises from the uncertain future demands of cash. For instance, when unpredictable expenditures or liabilities occur, immediate payments may be required. On some other occasions, when good investment opportunities come forth unexpectedly, if firms need to finance them due to lack of cash, time would be wasted and the financing costs would be high. From this perspective, if access to capital market is costly, firms would hold more cash. The speculative motive from Keynes specifies the choice between cash and bonds. Deriving from Keynes, this motive can explain the relationship between cash and other assets. Whether a firm holds cash or makes investment with its cash depends on the relation of cost and return. If holding cash is perceived to be less risky and the return of lending or investing money is not high, managers would rather keep money in their pockets.

Besides the above 3 motives, scholars after Keynes have explored other incentives for firms holding cash. Foley et al. (2007) discusses about the tax motive for holding cash. The authors of this paper find out that when firms have subsidiaries overseas, the repatriated earnings from these foreign subsidiaries need to be taxed, which reduces the company profits. To diminish this repatriation related tax burden, the multinational companies prefer to accumulate more cash in their foreign affiliates. They also prove that firms which are more financially constrained (with higher leverage and lower debt ratings) and technology oriented (with higher R&D ratios) tend to be highly responsive to the change of tax rate on repatriated income. On the other hand, however, Faulkender and Wang (2006) figure out that taxes costs would reduce the marginal value of cash holdings, because the corporate interest income tax rate is basically higher than the individual interest income rate.

Another explanation for firms holding cash in current literature is agency motive.

The principle-agent problem stems from the divergent objectives of principles and agents and information asymmetry. Managers do not always have the same goal with shareholders. They are more risk-averse and have incentives to hold more cash to prevent the future financial distress or to invest on projects in the interest of themselves rather than of shareholders (Shleifer and Vishny, 1997). A number of previous papers show evidence of this motive for holding cash. Ferreira and Vilela (2004) find out that firms in countries with weak shareholder protection, which means the agency problem is relative serious, hold more cash. Also for firms with lower ownership concentration which indicates higher agency problem, more cash is accumulated. Similarly, Kusnadi (2003) uses the data of Singapore to verify that firms with larger broad size and less outside blockholder ownership hold more cash. Agency motive brings about agency costs of "free cash flow" which result in management's extravagance or over-investment on valueless projects(Jensen, 1986), and the agency costs make the marginal value of excess cash less than $1 (Faulkender and Wang, 2006).

2.2 Do firms have target cash ratios?

If the capital markets were perfect, cash holdings would be a matter of indifference. Firms could raise funds immediately in the perfect capital market with no extra costs. Under this case, discussing about the target cash holdings would be meaningless. No matter what the cash ratio were, shareholders' value would not change. Nevertheless the world is far away from perfection, which makes the research on cash holdings possible. Recent scholars studying cash holdings pay much attention to the determinants of cash holdings, cash holding targets and adjustment to the target cash holdings. A main theory about these problems are tradeoff theory.

Under tradeoff theory, decision makers should decide the target cash holdings by

considering both the costs and benefits of holding cash so that the marginal costs are equal to marginal benefits. There are three main costs of holding cash. First, holding cash reduces the benefit from higher leverage, thus decreases the rate of return on liquid assets. Second, holding cash leads to higher tax burden, for corporate tax rates are higher relative to investor tax rates (Faulkender and Wang, 2006). Third, holding cash highlights agency problems between managers and shareholders. Management with cash is apt to invest on undesirable projects, which would jeopardize the shareholders' interests. The main advantages of keeping cash are consistent with the transaction motive and precautionary motive. Via cash holdings, firms can guarantee the corporate cash flow flexibility, lessen transaction costs, avoid expensive external financing costs, meet unexpected expenditure needs and finance potential investment project (Jani et al., 2004; DeAngelo and DeAngelo, 2007).

A large amount of current literature tests this tradeoff theory and show the existence evidence of target cash holdings. Opler et al. (1999) estimate a first order autoregressive model in order to find out whether firms have a target cash ratio. They conclude that cash holdings are mean-reverting, which proves the existence of target cash levels. The paper also studies the determinants of cash holdings and present support to static tradeoff theory. More recently, Bruinshoofd and Kool (2002) employ data in Netherland and contend that firms actively manage the liquidity and have a target ratio of cash holdings in the long run. Jani et al. (2004) gives support to Bruinshoofd and Kool (2002) with the data in Switzerland. Moreover, with an error correction model, their paper gets the same result with Opler et al. (1999) that cash holdings are mean-reverting and firms adjust to their target cash holdings.

With the implicit assumption or evidence that target cash ratios exist, scholars try to find out the determinants of the target. Under tradeoff theory, firms with higher cash flow volatility tend to keep more cash because he opportunity costs of

the lack of capital for these firms are more severe. For the same reason, firms with more investment/growth opportunities are likely to hold more cash. (Kim et al., 1998; Opler et al., 1999). The relationship between capital expenditure and cash holdings are positive because more capital expenditure means higher transaction costs and greater opportunity costs. In contrast, since smaller firms have fewer financing channels, cash holdings are prone to be larger for firms with smaller size. Similarly, for firms with lower debt rating, their financing channels are limited. Therefore increasing the cash holdings is their choice. In addition, given all else equivalent, more cash would be held for companies who pay dividends than for companies who do not. these dividend payers can cut the dividend payment if more capital is needed (Dittmar et al., 2003).

Chapter 3

Data Descriptions and Summary Statistics

The sample contains all firms in the Compustat North America Industrial Annual file from 1974 to 2006, both survivors and non-survivors. All financial firms (SIC code 6000-6999) and utilities (SIC code 4900-4999) are excluded because these companies may have to meet some regulatory or statutory requirements. Only firm-years with positive total assets(data6)and positive sales(data12) are included. Since lagged variables are used, all firm-years with less than two consecutive years cannot be included when running regressions. Most variables are winsorized at the 1st and 99th percentiles. Following Bates et al. (2006), leverage is winsorized to ensure that it is between 0 and 1. Nearly all variables are expressed in the form of ratios. For exceptions, I convert them to real values in 2004 dollars using the Consumer Price Index (CPI).

For the explanatory variables, I follow Bates et al. (2006) and consider the following firm or industry characteristics which may influence the target of cash holding ratio and the adjustment speed toward that target.

1) Cash flow to assets. Cash flow is calculated by operating income before depreciation (data13) minus interest expense (data15), total income taxes(data16) and common dividends (Data21). The denominator is total assets(data6).

2) Market-to-book ratio. The market value is measured as total book assets (data6) minus total book common equity (data60) then plus market value of common shares outstanding (data199*data25). The book value is measured as total book assets (data6).

3) Real size of firms. I deflate the logarithm of total assets (data6) into the real values in 2004 dollars.

4) Industry cash flow risk. According to the precautionary principle, if firms are in the industry which has more idiosyncratic risk, they are prone to hold more cash then those firms in the industry which has less idiosyncratic risk. In order to measure the cash flow risk, standard deviation of cash flow-to-assets are used. I calculate the cash flow risk of each firm-year via the standard deviation of cash flow-to-assets of the previous ten years. For every 10 years, at least 3 years of observations are required. Industry cash flow risk for each year is then calculated by averaging the firm level cash flow risk in each industry based on 2-digit SIC codes.

5) Net working capital to assets. Net working capital (NWC) is working capital (data179, which is current assets minus current liabilities) minus cash (data1). The dominator is total assets (data6).

6) Capital expenditures to assets. This variable is calculated by dividing capital expenditures (data128) by total assets (data6).

7) Leverage. Leverage in this thesis is defined as the debt-to-assets ratio, namely, the sum of long-term debt (data9) and debt in current liabilities (data34) divided by total assets (data6).

8) R&D to sales. R&D to sales is calculated as research and development expenses

(data46) divided by sales (data12). Since a great many of firms have no research and development expenses (data46) or don't report them, I set R&D expenses to 0 if they are missing to prevent the sample size from being dramatically reduced because of missing values.

9) Dividend dummy. If firms pay common dividends ($data21 > 0$), the dividend dummy is set to 1; Otherwise the dividend dummy is set to 0.

10) Acquisition activity. Acquisition activity is measured as acquisitions from the statement of cash flows (data129) divided by total assets (data6).

[Table 1 about here]

Table 1 provides the summary statistics for all the dependent and independent variables used in my thesis. The first four variables are commonly used cash holding measures in literature with mean values varying greatly from -2.850 to 1.292. As dependent variables in my model, definitions of these measures are described later in the empirical result chapter. Since firm size is the only variable not deflated by assets or sales, the value of size is much larger than other variables with a mean value of 18.590.

Chapter 4

Partial Adjustment Model

Following Flannery and Rangan (2006) in their research about adjustment speed toward target capital structure, I employ a partial adjustment model in my study. A partial adjustment model comprises two parts. The first part is the static one which describes the target expectation in the form of

$$y^*_{i,t} = \alpha_0 + \alpha_1 X_{i,t-1} + \upsilon_{i,t}, \tag{1}$$

where $y^*_{i,t}$ is the target expectation or desired level of firm i in period t, and $X_{i,t-1}$ is a vector of characteristics of firm i in period $t-1$. The current target expectation is determined by relevant characteristics in the previous period.

The second part is the dynamic partial adjustment process in the form of

$$y_{i,t} - y_{i,t-1} = \lambda(y^*_{i,t} - y_{i,t-1}), \tag{2}$$

where the adjustment parameter λ measures the adjustment speed from the actual level to the desired one. λ is a number between 0 and 1. The closer λ is to 1, the faster is the adjustment speed.

The estimable model then is got by substituting (1) into (2) and rearranging

$$y_{i,t} = \alpha_0\lambda + (1-\lambda)y_{i,t-1} + \lambda\alpha_1 X_{i,t-1} + \lambda\upsilon_{i,t}. \tag{3}$$

As described in Eq. (1), the desired or target cash ratio is $\alpha_0 + \alpha_1 X_{t-1} + \upsilon_t$. In each period a certain firm i closes a proportion of λ of the gap between the actual and desired level of cash ratios until the actual cash ratio eventually converges to the target. When running regressions, the adjustment speed λ can be acquired by subtracting the estimated coefficient from 1, and the long-run impact of firm characteristics $X_{i,t-1}$ on the cash ratios can be acquired by dividing the corresponding estimated coefficients by λ. A problem here bout this model (3) is that as a smooth partial adjustment model it assumes firms converge to its target finally, whereas in the real world, small deviation from the target would be ignored because the cost of adjusting the small deviation is higher than the benefit. In Table 7 in the robustness test part, I find evidence to show that the speed estimated by model (3) is close to the true speed.

Chapter 5

Empirical Results

5.1 Alternative "cash holdings" definitions

Different measures of cash ratio are employed in previous research. This article demonstrates a comparison of 4 different measures of cash ratio, including: (1)cash (data1) to total assets (data6)(e.g., Guney et al., 2007; Ferreira and Vilela, 2004; Nguyen, 2010; Bates et al., 2009; PINKOWITZ, 2006), (2)cash (data1) to net assets which are calculated as total assets minus cash(data6-data1) (e.g., Opler et al., 1999; PINKOWITZ et al., 2003; Hill et al., 2010), (3)natural logarithm of the ratio of cash to assets, and (4)natural logarithm of the ratio of cash to net assets (e.g., Foley et al., 2007; Opler et al. 2001; Ferreira, 2005).

[Table 2 about here]

Table 2 summarizes the results in the regressions of alternative measures of cash holdings, where the impacts of the four measures on cash holdings adjustment speed are shown. Fixed effects of firms are taken into consideration in all the eight columns. Fixed effects method are applied to absorb the unobservable but stable over time

influence of firms on the target cash ratios. In Column (1), (3), (5) and (7), year dummies are not considered. In Column (2), (4), (6) and (8), a year dummy variable, though not reported, is generated for each year so that the time-varying effects on cash ratios are under control. In order to avoid the perfect multicollinearity problem or so called "dummy variable trap", I drop the year dummy variable in 1975. According to numbers in Table 2, the adjustment speed doesn't change much among different definitions of cash holdings. Within each definition, the models with or without year dummies get similar or even exactly the same parameters. One thing worth mentioning again is that the parameter in the table is $1 - \lambda$ in model (3) where λ is the adjustment speed. Therefore, for all the eight regressions, the adjustment speeds are between 0.53 and 0.59. For the same reason, the relative t statistics values in the parentheses only test the hypothesis $1 - \lambda = 0$. The absolute values of t statistics which examine the hypothsis $\lambda = 0$ are in the square brackets. Specifically, in order to keep consistent, I focus on the regressions with both fixed effects and unreported year dummies, namely Column (2), (4), (6) and (8). In these columns, the estimated adjustment speeds of cash holdings are from 53.1% to 59.0% per year, meaning that a typical firm closes each year more than half of the gap between actual and target cash ratios.

For firm characteristics which determine target cash holdings, the signs of the coefficients over different columns are basically the same although the magnitude varies. For the two explanatory variables CFtoAsset (cash flow to assets) in (5) and (6) and DivDum (dividend dummy) in (3) and (4), the results are insignificant although the signs are different. These signs are not inconsistent with the predictions tradeoff theory makes.

Since cash holding definition doesn't influence the results, I follow Bates et al. (2009) and pick the traditional measure cash-to-assets ratio as my primary dependent

variable in the following research.

5.2 The advantages of partial adjustment model with fixed effects

Flannery and Rangan (2006) test adjustment speed of capital ratios to their target. Their paper checks several capital structure models to find out which model to support. The authors finally employ the partial adjustment model with fixed effects. With this model, they claim a much faster adjustment speed than a lot of prior studies whose typical model is a simple cross-sectional one (e.g., Hovakamian et al., 2001; Fama and French, 2002) or whose model does not use fixed effects method. Similarly, in Table 3 I compare three models estimated over the same panel data set to make sure the partial adjustment specification with fixed effects should be preferred. All models use the same explained variable cash-to-assets ratio.

[Table 3 about here]

Model in Column (1) is what many predecessors use to infer the determinants of optimal cash level:

$$y_{i,t} = \beta_0 + \beta_1 X_{i,t-1} + \delta_{i,t}$$

This model doesn't consider the lagged cash ratio. In other words, the model assumes the coefficient of lagged cash ratio is 0. Therefore, the current level of cash ratio is the optimal cash ratio. The estimated coefficient signs are consistent with the other two columns. Particularly, target cash ratio rises with the increase of market-to-book ratio, cash flow to assets and R&D to sales, but declines as firm size, net working capital, capital expenditures, leverage or acquisition activity increases or if firms pay

dividend.

Based on model in Column (1), Column (2) adds lagged cash ratio:

$$y_{i,t} = \beta_0 + (1 - \lambda)y_{i,t-1} + \lambda\beta_1 X_{i,t-1} + \delta_{i,t}$$

The coefficient of this lagged dependent variable is 0.664. Comparing to Column (1), this number is high and significant, meaning the Column (1) hypothesis of lagged cash ratio coefficient being 0 is untenable. Besides, all the coefficients in Column (1) are of larger magnitude than in Column (2), which indicates Column (1) might ignore an notable variable and overstate the influence on the cash holdings of other variables. According to Column (2), a representative firm adjusts to its target cash level at a speed of 33.6% per year.

Column (3) is actually the model in Table 2, which include firm fixed effects μ_i:

$$y_{i,t} = \beta_0 + (1 - \lambda)y_{i,t-1} + \lambda\beta_1 X_{i,t-1} + \mu_i + \delta_{i,t}$$

The result in Column (3) suggests that Column (2) omits some important firm characteristics which are unobservable but constant over time. The adjustment speed shown in Column (3) is 53.1% each year. Among the three models, the last one with fixed effects considers the most comprehensive factors which may influence the cash holdings adjustment speed and therefore should be picked.

5.3 Firm size and cash holdings

Bates et al. (2009) notice that during 1980 to 2006 cash holdings are increasing for every firm size quintile, but the increase for smaller firms is faster. One reason for this is that financing resources for small firms are limited. Most small-sized firms have low

or no credit ratings and are easy to go bankrupt (Titman and Wessels, 1988). They usually finance through private bank loans because it is hard for them to access public capital market. On the other hand, small firms, unlike large firms which have large numbers of non-core assets to sell or have several subsidiaries to transfer free capital, have few inside channels of financing. Therefore, small firm have more incentives to accumulate money in order to avoid the cash insufficiency. Also, as indicated in transaction motive theory, economies of scale exist. Thus for firms with large asset size, less cash are held than for small firms (Dittmar et al., 2003). Besides, small firms have greater information asymmetry and principal-agent problem. Management in small firms are prone to maintain a high level of cash ratios. Finally, firm size is a proxy of takeover deterrent. Small firms are more easier to be taken over, so it is more important for their management to hold more cash to prevent against being taken over.

[Table 4 about here]

To test the differences in cash holdings adjustment speed over different firm sizes, I run size-based regressions under the partial adjustment speed. Table 4 presents the results. For each fiscal year I construct quartiles of firm size measured by log of total assets in 2004 dollars. As we can see, the adjustment speed of cash holdings decrease monotonically with the increasing firm size. The largest firms have the slowest adjustment speed of 49.0%, while the smallest firms adjust toward targets at a speed of 61.6% per year. The reasons are easy to understand. As mentioned above, large firms usually have more channels to get capital. They finance more in the public capital market, which is more complicated, expensive and time-consuming than private bank financing, which means the adjustment cost is higher for large firms than for small firms. As explained by Flannery and Rangan (2006), small firms financing

through private debt may have to accept some relatively strict covenants. Therefore a typical small firm adjusts its cash holdings faster than a typical large firm. I test the statistical difference of the parameters of the lagged dependent variables between the first quartile and the fourth one to make sure the difference is meaningful. The result is significant with a t statistic value of -10.93.

5.4 Growth opportunities and cash holdings

Besides firms with small size, Opler et al. (2001) argue that firms with great growth opportunities have the tendency to hold more cash balances as well. Market-to-book ratio is used by them as the proxy of growth opportunity. Similar statements and measurement are also made by Opler et al. (1999), Foley et al. (2007) and Harford et al. (2008). Indeed, firms with higher market-to-book ratios are expected to have more profitable investment chances and more growth chances. For these firms, the opportunity costs of insufficient capital, namely, being financially constrained, is more severe. John (1993) employs market-to-book ratio and tangible assets ratio as the proxy for financial constraints cost and argues that firms with higher market-to-book ratio and lower tangible assets ratio hold more cash. If these firms become financially constrained, the costs are higher than other companies whose market-to-book ratio is low and tangible assets ratio is high. Custio et al. (2005) use R&D-to-sales ratio to measure the financial constraints cost and got the same conclusion.

[Table 5 about here]

In Table 5, I test the cash holdings adjustment based on the quartiles of market-to-book ratio. The pace of adjustment improves monotonically with the MB ratio. For firms with the highest quartile of MB ratio, the adjustment speed is as fast as

62.7%, while companies with the lowest MB ratio close 47.6% of the gap between the actual level and their target. The statistical difference between these two parameters is significant at 0.01 level with a t statistic of 12.54. The rapid speed of high MB ratio firms is consistent with what previous studies conclude. Firms with high growth chances have more cost of financial constraints, so they are inclined to adjust to their target more rapidly in case they are trapped in financial distress.

5.5 Financial constraints and cash holdings

Previous studies contend that cash are more valued in financially constrained firms than in unconstrained firms (Myers and Majluf, 1984; Faulkender and Wang, 2006; Denis and Sibilkov, 2009). With my sample from 1984 to 2006, I find that the adjustment speed is higher for companies with fewer financial constraints. Table 6 examines the influence of financial constraints to cash holdings adjustment speed. I use payout ratio, long-term bond rating and commercial paper rating to differentiate between constrained firms and unconstrained ones. Following Faulkender and Wang (2006), a firm is considered financially constrained if (1) the firm has a payout ratio (total dividends to earnings, which is the sum of total dividends (data21) and repurchases (data115) divided by the sum of income before extraordinary items (data18), interest expense (data15), deferred taxes (data50) and investment tax credit (data51)) above (below) or equal to 70th (30th) percentile of the annual payout ratio distribution, (2) the firm reports positive debt (long-term debt (data9) plus debt in current liabilities (data34)) and has a long-term bonding rate (data280), or (3) the firm reports positive debt and has a commercial paper rating (data283).

[Table 6 about here]

The results in Table 6 show that financially constrained firms with low payout ratios or commercial paper ratings adjust their cash ratio more rapidly than unconstrained firms. To be specific, if payout ratio is used as the classification basis, financially unconstrained firms adjust their cash holdings to target with a speed of 41.3% a year and constrained firms adjust at a rate of 58.8% per year, 17.5% faster than unconstrained firms. With commercial paper rating as the classification basis, financially unconstrained firms close 49.6% of the gap each year while constrained firms close 61.7% a year, 12.1% more than firms with financial constraints. The statistical differences are both significant at 0.01 level with t statistics of 18.72 and 4.11 respectively. When long-term bond rating is used to partition the sample, however, the speed doesn't vary much between the two groups of companies. The adjustment speed for financially unconstrained firms is 62.4% and for constrained firms it is only 0.3% higher. Nevertheless, the t statistic of statistical differences between theses two coefficients is 5.29, showing this difference is significant at 0.01 level. Why financially constrained firms adjust toward their target cash ratio level faster? Constrained firms have more restrictions. Without bond ratings, it is more expensive for companies to raise funds when money is needed to invest new projects. Because of lack of money, profitable investment opportunities may be missed. Therefore, financially constrained firms have more motivation to keep cash at the target level. Besides, firms with bond ratings can raise money in the public market more easily, so they have less motivation to adjust cash ratio to some certain level. For firms whose payout ratios are low, cash holdings should be needed more urgently to pay debt holders or make investment, consequently these firms are more likely to raise cash quickly toward their target level.

5.6 Robustness

5.6.1 The adjustment speeds of different forecast horizons

The independent variables in my previous regressions are one-year lagged variables. Actually in partial adjustment model, the lagging interval can be any number. In Table 7 I check the partial adjustment model with fixed effects and year dummies when the lagging interval k is 2, 3, 4 and 5 years respectively. From the model with fixed effects in Table 2, a typical firm closes 53.1% of the gap. With this estimated speed, a firm would close $(1-(1-0.531)^k) * 100\%$ of the gap after the year k. Therefore, the estimated speed would be 78.0%, 89.7%, 95.2% and 97.7% for k=2, 3, 4 and 5 respectively. In Column (1) of Table 7 the adjustment speed for these 4 intervals is 76.7%, 88.1%, 94.5% and 99.3% respectively. The predicted and actual adjustment speeds are of the similar magnitude in all the four time intervals. In this respective, the partial adjustment model is robust. When k=5, the company nearly closes all the gap and gets to its target.

[Table 7 about here]

5.6.2 The adjustment speed stability over time

My whole sample include data of 33 years during 1974 to 2006. I regroup the data by time period into three parts: from 1974 to 1984, from 1985 to 1995, and from 1996 to 2006. By running regression with each sub-sample of 3 periods under Model (3), I get Table 8. The adjustment speed over the 3 time periods are quite stable, from 64.3% to 67.6%, while the speed for whole sample adjustment is less than 60%. For variables describing firm characteristics, all the coefficients of them are the same over 3 periods except the cash flow-to-assets ratio. In the first period its coefficient

is positive, and in the later periods the coefficient is negative.

[Table 8 about here]

Chapter 6

Conclusions

This paper investigate the modulation of corporate cash holdings with the data from Compustat Industrial Annual tapes (financial firms and utilities excluded) during 1974 to 2006. When actual cash ratio departs from the target, management takes measures to close the gap between the current cash ratio and its target. A partial adjustment model with fixed effects and a set of control variables in place is constructed to uncover how fast companies bridge the existing cash holdings gaps. The result proves to be considerable: A typical firm close as high as more than 50% of the gap each year.

Besides adjustment speed itself, I am also interested in the determinants of the speed. The paper puts emphasis on the association of several firm characteristics and adjustment speed of cash holdings, with a set of control variables in place. The results suggest that the adjustment speed is related negatively to firm size(as measured by natural log of assets in 2004 values) but positively to financial constraints (as measured by payout ratio, long-term bond rating and commercial paper rating) and growth/investment opportunities (as measured by market-to-book ratio). The results are robust over time and forecast horizons. Since previous works do not use

a partial adjustment model to study the adjustment speed of cash holdings and the determinants of the speed, the paper make some contribution to the literature.

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Appendix A

Table 1 Summary Statistics for the 1974-2006 Sample

This table provides summary statistics for the key variables in my sample of firm-years in the COMPUSTAT Industrial Annual tapes from 1974 to 2006. All financial firms (SIC code 6000-6999) and utilities (SIC code 4900-4999) are excluded. Total: 14,671 firms; 143,289 firm-years. All variables are winsorized at the 1st and 99th percentiles to avoid the influence of extreme observations. Detailed variable definitions are provided in Appendix 1.

Variables	Obs. No	Mean	Median	Std.Dev	Min	Max
CashRatio	143171	0.137	0.063	0.178	0.000	0.927
NCashRatio	143130	1.292	1.068	0.823	1.000	13.341
LnCash	141643	-2.850	-2.738	1.513	-8.020	-0.075
LnNCash	141601	-2.666	-2.672	1.736	-8.020	2.513
IndSigma	143285	0.162	0.089	0.311	0.015	13.654
MB	127346	1.949	1.283	2.568	0.425	46.327
Size	143289	18.592	18.567	2.256	12.125	24.429
CFtoAsset	135988	-0.018	0.059	0.379	-6.611	0.341
NWC	138873	0.066	0.108	0.445	-8.364	0.606
CapExp	141334	0.067	0.046	0.069	0.000	0.456
Lev	143289	0.275	0.235	0.243	0.000	1.000
RDtoSales	143289	0.124	0.000	0.927	0.000	27.680
DivDum	143289	0.361	0.000	0.480	0.000	1.000
AcqAct	137150	0.015	0.000	0.050	-0.020	0.435

Table 2 Regression Results for Alternative Measures of Cash Holdings

This table presents the results of regressing the alternative definitions of cash holdings on the lagged firm characteristics. "L_" in the explanatory variables stands for time lag of 1 year, e.g. "L_X_t" means X_{t-1}. Detailed variable definitions are provided in Appendix 1. Absolute values of t statistics are in parentheses. Besides, absolute values of t statistics which examine the hypothesis $\lambda = 0$ are in square brackets. * significant at 5%; ** significant at 1%. For all the fixed effects regressions, the within R^2 is reported.

Table 2 Regression Results for Alternative Measures of Cash Holdings(Continued)

	CashRatio		NCashRatio		LnCash		LnNCash	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L_CashRatio	0.470	0.469						
	(150.03)**	(149.72)**						
	[169.20]**	[169.38]**						
L_NCashRatio			0.410	0.410				
			(122.81)**	(122.95)**				
			[176.81]**	[176.79]**				
L_LnCash					0.432	0.424		
					(135.78)**	(132.75)**		
					[205.23]**	[207.22]**		
L_LnNCash							0.440	0.433
							(138.44)**	(135.84)**
							[176.09]**	[177.57]**
L_IndSigma	0.021	0.004	0.104	0.018	0.138	0.088	0.173	0.093
	(6.49)**	(1.07)	(6.56)**	(0.90)	(4.25)**	(2.22)*	(4.87)**	(2.12)*
L_MB	0.002	0.003	0.012	0.013	0.009	0.014	0.014	0.019
	(10.75)**	(11.93)**	(11.69)**	(11.91)**	(4.01)**	(6.43)**	(5.68)**	(8.01)**
L_Size	-0.010	-0.011	-0.035	-0.042	-0.088	-0.080	-0.103	-0.098
	(18.89)**	(20.14)**	(13.38)**	(14.96)**	(16.78)**	(14.36)**	(17.94)**	(16.04)**
L_CFtoAsset	-0.004	-0.003	-0.087	-0.084	0.007	0.019	-0.016	-0.001
	(2.44)*	(1.55)	(10.08)**	(9.65)**	(0.37)	(1.05)	(0.78)	(0.04)
L_NWC	-0.013	-0.011	-0.072	-0.062	-0.094	-0.095	-0.113	-0.110
	(9.00)**	(7.33)**	(9.71)**	(8.38)**	(6.10)**	(6.15)**	(6.70)**	(6.47)**

Table 2 Regression Results for Alternative Measures of Cash Holdings(Continued)

	CashRatio		NCashRatio		LnCash		LnNCash	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L_CapExp	-0.096	-0.090	-0.293	-0.268	-0.950	-0.987	-1.096	-1.114
	(15.71)**	(14.62)**	(9.67)**	(8.71)**	(15.53)**	(15.78)**	(16.15)**	(16.20)**
L_Lev	-0.029	-0.028	-0.100	-0.094	-0.369	-0.385	-0.405	-0.418
	(12.76)**	(12.28)**	(8.99)**	(8.40)**	(15.79)**	(16.41)**	(15.74)**	(16.19)**
L_RDtoSales	0.000	0.000	0.035	0.036	0.004	0.002	0.008	0.005
	(0.05)	(0.08)	(11.36)**	(11.58)**	(0.71)	(0.33)	(1.08)	(0.78)
L_DivDum	-0.001	-0.001	0.004	0.008	-0.010	-0.033	-0.012	-0.032
	(0.99)	(0.47)	(0.74)	(1.34)	(0.85)	(2.68)**	(0.87)	(2.40)*
L_AcqAct	-0.059	-0.054	-0.128	-0.127	-0.964	-0.846	-1.036	-0.915
	(9.39)**	(8.59)**	(4.07)**	(4.00)**	(15.02)**	(13.18)**	(14.71)**	(12.99)**
Constant	0.261	0.290	1.422	1.542	0.177	0.292	0.591	0.762
	(27.92)**	(29.14)**	(30.36)**	(30.88)**	(1.86)	(2.88)**	(5.65)**	(6.86)**
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	No	Yes	No	Yes	No	Yes	No	Yes
Observations	99906	99906	99888	99888	98660	98660	98641	98641
R^2	0.25	0.26	0.18	0.18	0.22	0.23	0.23	0.24

Table 3 Regression Models Comparison

This table compares 3 different regression models. The dependent variables here are cash-to-assets ratio in year t, which is $CashRatio_t$. Column (1) is a simple cross-sectional regression without lagged dependent variable or fixed effects. Column (2) is a partial adjustment model with lagged dependent variable but without fixed effects. Column (3) is a partial adjustment model with both lagged dependent and fixed effects. All 3 models included unreported year dummies for each year except 1975 in order to avoid the dummy variable trap. "L_" in the explanatory variables stands for time lag of 1 year, e.g. "L_X_t" means X_{t-1}. Detailed variable definitions are provided in Appendix 1. Absolute values of t statistics are in parentheses. Besides, absolute values of t statistics which examine the hypothesis $\lambda = 0$ are in square brackets. * significant at 5%; ** significant at 1%. For all the fixed effects regressions, the within R^2 is reported.

Models	CashRatio	CashRatio	CashRatio
	(1)	(2)	(3)
L_CashRatio		0.664	-0.469
		(266.60)**	(149.72)**
		[134.69]**	[169.38]**
L_IndSigma	0.059	0.048	0.004
	(14.26)**	(14.68)**	(1.07)
L_MB	0.006	0.002	0.003
	(24.29)**	(11.97)**	(11.93)**
L_Size	-0.010	-0.004	-0.011
	(21.61)**	(14.35)**	(20.29)**
L_CFtoAsset	0.011	-0.003	-0.003
	(6.00)**	(1.90)	(1.55)
L_NWC	-0.040	-0.010	-0.011
	(25.07)**	(7.67)**	(7.33)**
L_CapExp	-0.205	-0.069	-0.090
	(30.87)**	(12.98)**	(14.62)**
L_Lev	-0.156	-0.039	-0.028
	(66.24)**	(20.67)**	(12.28)**
L_RDtoSales	0.017	0.009	0.000
	(27.33)**	(19.65)**	(0.08)
L_DivDum	-0.009	-0.007	-0.001
	(6.66)**	(7.01)**	(0.47)
L_AcqAct	-0.128	-0.052	-0.054
	(18.07)**	(8.47)**	(8.59)**
Constant	0.372	0.133	0.290
	(43.71)**	(26.03)**	(29.14)**
Fixed Effects	No	No	Yes
Year Dummies	Yes	Yes	Yes
Observations	99906	99906	99906

Table 4 Regression Results with Different Firm Sizes

This table presents the results of regressing the cash holdings on the lagged firm characteristics based on real size of firms. The dependent variables here are cash-to-assets ratio in year t, which is $CashRatio_t$. All columns include fixed effects and unreported year dummies for each year except 1975 in order to avoid the dummy variable trap. "L_" in the explanatory variables stands for time lag of 1 year, e.g. "L_X_t" means X_{t-1}. Detailed variable definitions are provided in Appendix 1. Absolute values of t statistics are in parentheses. Besides, absolute values of t statistics which examine the hypothesis $\lambda = 0$ are in square brackets. * significant at 5%; ** significant at 1%. For all the fixed effects regressions, the within R^2 is reported. T statistic for the statistical differences between L_CashRatio's coefficients of smallest firms and of largest firms is -10.93, significant at the 0.01 level.

	Smallest	Small	Large	Largest
L_CashRatio	0.378	0.422	0.438	0.508
	(48.99)**	(62.79)**	(69.64)**	(84.82)**
	[80.47]**	[86.07]**	[89.27]**	[82.29]**
L_IndSigma	-0.006	0.025	-0.001	-0.015
	(0.51)	(2.89)**	(0.15)	(3.09)**
L_MB	0.003	0.005	0.005	0.002
	(6.21)**	(8.75)**	(8.58)**	(4.45)**
L_CFtoAsset	-0.003	-0.022	-0.019	-0.039
	(0.92)	(3.92)**	(2.60)**	(5.03)**
L_NWC	-0.014	0.004	-0.012	-0.003
	(5.09)**	(0.78)	(2.41)*	(0.60)
L_CapExp	-0.111	-0.086	-0.092	-0.083
	(6.33)**	(7.05)**	(8.36)**	(8.70)**
L_Lev	-0.024	-0.028	-0.037	-0.028
	(3.86)**	(5.34)**	(8.73)**	(7.92)**
L_RDtoSales	0.001	0.001	-0.004	-0.019
	(0.44)	(0.64)	(1.98)*	(6.10)**
L_DivDum	0.006	0.000	-0.007	-0.010
	(1.07)	(0.06)	(3.77)**	(6.35)**
L_AcqAct	-0.139	-0.038	-0.053	-0.029
	(4.63)**	(2.71)**	(5.45)**	(4.24)**
Constant	0.108	0.101	0.090	0.079
	(11.12)**	(17.00)**	(20.39)**	(23.61)**
Observations	21111	26324	26923	25548
R^2	0.17	0.21	0.24	0.31

Table 5 Regression Results based on Market-to-Book Ratios

This table presents the results of regressing the cash holdings on the lagged firm characteristics based on market-to-book ratio, which is a proxy for profitable growth opportunities of firms. The dependent variables here are cash-to-assets ratio in year t, which is $CashRatio_t$. All columns include fixed effects and unreported year dummies for each year except 1975 in order to avoid the dummy variable trap. "L_" in the explanatory variables stands for time lag of 1 year, e.g. "L_X_t" means X_{t-1}. Detailed variable definitions are provided in Appendix 1. Absolute values of t statistics are in parentheses. Besides, absolute values of t statistics which examine the hypothesis $\lambda = 0$ are in square brackets. * significant at 5%; ** significant at 1%. For all the fixed effects regressions, the within R^2 is reported.T statistic for the statistical differences between L_CashRatio's coefficients of lowest-mb firms and of highest-mb firms is 12.56, significant at the 0.01 level.

	Lowest MB	Low MB	High MB	Highest MB
L_CashRatio	0.524	0.487	0.449	0.373
	(78.75)**	(73.43)**	(64.57)**	(50.06)**
	[71.56]**	[77.23]**	[79.40]**	[84.19]**
L_IndSigma	0.012	0.014	0.018	-0.020
	(1.60)	(2.12)*	(2.18)*	(1.62)
L_Size	-0.008	-0.005	-0.008	-0.014
	(6.44)**	(5.46)**	(6.62)**	(8.95)**
L_CFtoAsset	0.005	-0.010	0.005	-0.007
	(0.71)	(1.59)	(0.85)	(2.49)*
L_NWC	0.012	0.002	-0.009	-0.013
	(2.55)*	(0.50)	(2.06)*	(4.82)**
L_CapExp	-0.086	-0.063	-0.103	-0.079
	(7.34)**	(5.88)**	(8.08)**	(4.59)**
L_Lev	-0.012	-0.027	-0.026	-0.039
	(2.15)*	(5.97)**	(5.29)**	(6.79)**
L_RDtoSales	-0.004	-0.011	-0.005	0.001
	(0.95)	(3.85)**	(2.09)*	(0.91)
L_DivDum	-0.002	-0.006	-0.004	-0.001
	(0.86)	(3.14)**	(1.45)	(0.15)
L_AcqAct	-0.029	-0.035	-0.039	-0.098
	(2.43)*	(3.72)**	(3.33)**	(4.18)**
Constant	0.207	0.171	0.225	0.402
	(9.18)**	(9.16)**	(10.53)**	(14.48)**
Fixed Effects	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
Observations	26091	25833	25263	23359
R^2	0.29	0.28	0.25	0.17

Table 6 Regressions for Constrained and Unconstrained Groups

This table presents the results of regressing the cash holdings on the lagged firm characteristics based on whether the firm is financially constrained or unconstrained. Letter (C) is for constrained firms and (U) is for unconstrained firms. Definitions for constrained/unconstrained are in the previous thesis. The dependent variables here are cash-to-assets ratio in year t, which is $CashRatio_t$. All columns include fixed effects and unreported year dummies for each year except 1975 in order to avoid the dummy variable trap. "L_" in the explanatory variables stands for time lag of 1 year, e.g. "L_X_t" means X_{t-1}. Detailed variable definitions are provided in Appendix 1. Absolute values of t statistics are in parentheses. Besides, absolute values of t statistics which examine the hypothesis $\lambda = 0$ are in square brackets. * significant at 5%; ** significant at 1%. For all the fixed effects regressions, the within R^2 is reported. T statistics for the statistical differences between L_CashRatio's coefficients of unconstrained and constrained firms are 18.72, 5.31 and 4.11 respectively under the three different measures of constrained/unconstrained firms, all significant at the 0.01 level.

Table 6 Regressions for Constrained and Unconstrained Groups (Continued)

Models	Payout Ratio		Bond Rating		Comm.PaperRating	
	(U)	(C)	(U)	(C)	(U)	(C)
L_CashRatio	0.587	0.412	0.376	0.373	0.504	0.383
	(98.51)**	(80.30)**	(43.04)**	(74.10)**	(34.53)**	(85.37)**
	[69.42]**	[114.47]**	[71.46]**	[124.57]**	[34.00]**	[137.51]**
L_IndSigma	-0.006	0.003	-0.013	0.005	-0.005	0.000
	(0.96)	(0.45)	(2.22)*	(0.83)	(0.66)	(0.00)
L_MB	0.002	0.003	0.004	0.003	0.003	0.003
	(3.53)**	(10.49)**	(5.03)**	(8.33)**	(2.67)**	(9.59)**
L_Size	-0.006	-0.011	-0.014	-0.011	-0.005	-0.010
	(5.93)**	(11.67)**	(10.78)**	(11.60)**	(2.04)*	(13.65)**
L_CFtoAsset	0.017	0.000	-0.015	-0.002	-0.032	-0.003
	(2.01)*	(0.13)	(1.74)	(0.87)	(1.71)	(1.13)
L_NWC	0.041	-0.012	-0.002	-0.006	0.026	-0.007
	(6.84)**	(5.58)**	(0.34)	(2.63)**	(2.30)*	(3.35)**
L_CapExp	-0.099	-0.082	-0.089	-0.074	-0.068	-0.075
	(8.83)**	(8.06)**	(6.12)**	(7.91)**	(2.73)**	(9.04)**
L_Lev	-0.017	-0.025	-0.025	-0.013	-0.008	-0.018
	(3.57)**	(6.95)**	(5.15)**	(3.67)**	(0.86)	(5.93)**
L_RDtoSales	0.011	0.002	-0.001	-0.002	0.185	-0.002
	(0.68)	(1.72)	(0.17)	(1.74)	(3.55)**	(1.79)
L_AcqAct	-0.035	-0.063	-0.032	-0.044	-0.033	-0.042
	(3.79)**	(5.37)**	(3.87)**	(4.94)**	(2.65)**	(5.90)**

Table 6 Regressions for Constrained and Unconstrained Groups (Continued)

Models	Payout Ratio		Bond Rating		Comm.PaperRating	
	(U)	(C)	(U)	(C)	(U)	(C)
L_DivDum			-0.004	-0.001	-0.010	-0.001
			(1.76)	(0.56)	(2.14)*	(0.83)
Constant	0.186	0.271	0.377	0.278	0.153	0.274
	(8.72)**	(16.18)**	(13.31)**	(16.08)**	(2.96)**	(19.70)**
FE	Yes	Yes	Yes	Yes	Yes	Yes
YearDummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	28001	43903	13174	41891	4501	50564
R^2	0.39	0.21	0.22	0.18	0.34	0.19

Table 7 Regressions over Differing Forecast Intervals

This table presents the results of regressing the cash holdings on the lagged firm characteristics based on different forecast horizons k equal to 2, 3, 4 and 5 years. The dependent variables here are cash-to-assets ratio in year t, which is $CashRatio_t$. All columns include fixed effects and unreported year dummies for each year except 1975 in order to avoid the dummy variable trap. "L_" in the explanatory variables stands for time lag of 1 year, e.g. "L_X_t" means X_{t-1}. Detailed variable definitions are provided in Appendix 1. Absolute values of t statistics are in parentheses. Besides, absolute values of t statistics which examine the hypothesis $\lambda = 0$ are in square brackets. * significant at 5%; ** significant at 1%. For all the fixed effects regressions, the within R^2 is reported.

	k=2 years	k=3 years	k=4 years	k=5 years
L_CashRatio	0.233	0.119	0.054	0.006
	(63.10)**	(29.47)**	(12.59)**	(-1.40)
	[61.62]**	[28.19]**	[14.89]**	[10.02]**
L_IndSigma	0.016	0.045	0.069	0.09
	(3.09)**	(7.03)**	(9.00)**	(10.98)**
L_MB	0.001	0.000	0.001	0.001
	(3.97)**	(-1.03)	(-1.76)	(-1.91)
L_Size	-0.013	-0.011	-0.007	-0.006
	(20.10)**	(15.25)**	(10.02)**	(7.15)**
L_CFtoAsset	-0.005	-0.007	-0.004	0.002
	(2.24)*	(2.84)**	-1.47	-0.49
L_NWC	-0.011	-0.012	-0.009	-0.011
	(5.79)**	(5.32)**	(3.58)**	(3.87)**
L_CapExp	-0.087	-0.072	-0.061	-0.053
	(12.08)**	(9.38)**	(7.59)**	(6.25)**
L_Lev	-0.025	-0.026	-0.021	-0.016
	(9.15)**	(8.61)**	(6.58)**	(4.69)**
L_RDtoSales	0.000	-0.004	-0.003	0.001
	(-0.46)	(3.83)**	(-1.88)	(-0.80)
L_DivDum	-0.003	-0.005	-0.006	-0.005
	(-1.89)	(3.29)**	(3.60)**	(3.20)**
L_AcqAct	-0.054	-0.060	-0.048	-0.055
	(7.30)**	(7.53)**	(5.66)**	(6.19)**
Constant	0.368	0.323	0.262	0.246
	(29.30)**	(25.35)**	(19.23)**	(15.90)**
Fixed Effects	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
Observations	89649	80402	72152	64768
R^2	0.08	0.04	0.02	0.02

Table 8 Regression Results over Time

This table presents the results of regressing the cash holdings on the lagged firm characteristics over different time periods with 9 years each. The dependent variables here are cash-to-assets ratio in year t, which is $CashRatio_t$. All columns include fixed effects and unreported year dummies for each year except 1975 in order to avoid the dummy variable trap. "L_" in the explanatory variables stands for time lag of 1 year, e.g. "L_X_t" means X_{t-1}. Detailed variable definitions are provided in Appendix 1. Absolute values of t statistics are in parentheses. Besides, absolute values of t statistics which examine the hypothesis $\lambda = 0$ are in square brackets. * significant at 5%; ** significant at 1%. For all the fixed effects regressions, the within R^2 is reported.

	1974-1984	1985-1995	1996-2006
L_CashRatio	0.347	0.357	0.324
	(48.51)**	(59.83)**	(58.54)**
	[91.31]**	[107.83]**	[122.28]**
L_IndSigma	-0.108	-0.009	-0.006
	(2.02)*	(0.62)	(1.10)
L_MB	0.007	0.007	0.003
	(7.39)**	(10.71)**	(10.69)**
L_CFtoAsset	0.018	-0.013	-0.006
	(2.25)*	(2.88)**	(2.63)**
L_NWC	-0.002	-0.005	-0.016
	(0.46)	(1.38)	(7.33)**
L_CapExp	-0.088	-0.119	-0.109
	(9.77)**	(11.20)**	(8.32)**
L_Lev	-0.019	-0.021	-0.027
	(4.01)**	(4.68)**	(6.26)**
L_RDtoSales	-0.061	0.000	-0.001
	(1.47)	(0.12)	(0.71)
L_DivDum	-0.004	-0.009	-0.005
	(2.36)*	(3.95)**	(1.76)
L_AcqAct	-0.099	-0.061	-0.079
	(5.79)**	(5.75)**	(8.09)**
Constant	0.077	0.096	0.135
	(21.29)**	(29.47)**	(37.44)**
Fixed Effects	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
Observations	27391	33147	39368
R^2	0.15	0.16	0.14

Appendix B

Variable Definitions

VRRIABLE	DEFINITION
CashRatio	Cash to total assets. $CashRatio = \frac{data1}{data6}$.
NCashRatio	Net cash ratio, which is cash to net assets. $NCashRatio = \frac{data1}{data6-data1}$.
LnCash	Natural log of cash ratio. $LnCash = \ln \frac{data1}{data6}$.
LnNCash	Natural log of net cash ratio. $LnNCash = \ln \frac{data1}{data6-data1}$.
IndSigma	Industry cash flow risk. Mean value of cash flow-to-assets ratio for firms in the same industry (2-digit SIC code).
MB	Market-to-book ratio. $MB = \frac{data6-data60+data199*data25}{data6}$.
Size	Natural log of total assets in 2004 values. $\ln \frac{data6*10^8}{CPI}$.
CFtoAsset	Cash flow to total assets. $CFtoAsset = \frac{daa13-data15-data16-daa21}{data6}$.
NWC	Net working capital to assets. $NWC = \frac{data179-data1}{data6}$.
CapExp	Capital expenditures to total assets. $CapExp = \frac{data128}{data6}$.

Variable Definitions (Continued)

VRRIABLE	DEFINITION
Lev	Leverage, which is debt-to-total assets ratio. $Lev = \frac{data9+data34}{data6}$.
RDtoSales	R&D to sales. $RDtoSales = \frac{data46}{data12}$.
DivDum	Dividend dummy. If the company pays dividend (data21>0) then DivDum=1; Else DivDum=0.
AcqAct	Acquisition activity. $AcqAct = \frac{data129}{data6}$.

Appendix C

Compustat Industrial Annual Variables Used

VRRIABLE	VARIABLE LABEL
data1	Cash and Short-Term Investments (MM$)
data6	Assets - Total (MM$)
data9	Long-Term Debt - Total (MM$)
data12	Sales (Net) (MM$)
data13	Operating Income Before Deprec. (MM$)
data15	Interest Expense (MM$)
data16	Income Taxes - Total (MM$)
data18	Income Before Extraordinary Items (MM$)
data21	Dividends - Common (MM$)
data25	Common Shares Outstanding (MM)
data34	Debt in Current Liabilities (MM$)

Compustat Industrial Annual Variables Used (Continued)

VRRIABLE	VARIABLE LABEL
data46	Research and Development Expense (MM$)
data50	Deferred Taxes (Income Account) (MM$)
data51	Investment Tax Credit (Income Acct)(MM$)
data60	Common Equity - Total (MM$)
data115	Purchase of Common and Pref. Stock (MM$)
data128	Capital Expenditures (SCF) (MM$)
data129	Acquisitions (Statement of CF) (MM$)
data179	Working Capital (Balance Sheet) (MM$)
data199	Price – Fiscal Year – Close ($&c)
data280	S&P LT Domestic Issuer Credit Rating
data283	S&P ST Dom. Issuer Credit Rating- Hist