NBER WORKING PAPER SERIES

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Working Paper 12534
http://www.nber.org/papers/w12534

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
September 2006

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NBER Working Paper No. 12534
September 2006
JEL No. G30,G32,G35

ABSTRACT

The average cash to assets ratio for U.S. industrial firms increases by 129% from 1980 to 2004. Because of this increase in the average cash ratio, American firms at the end of the sample period can pay back their debt obligations with their cash holdings, so that the average firm has no leverage when leverage is measured by net debt. This change in cash ratios and net debt is the result of a secular trend rather than the outcome of the recent buildup in cash holdings of some large firms. It is concentrated among firms that do not pay dividends. The average cash ratio increases over the sample period because the cash flow of American firms has become riskier, these firms hold fewer inventories and accounts receivable, and the typical firm spends more on R&D. The precautionary motive for cash holdings appears to explain the increase in the average cash ratio.

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Considerable media attention has been devoted to the increase in cash holdings of American firms. For instance, a recent article in the *Wall Street Journal* states that "The piles of cash and stockpile of repurchased shares at [big U.S. companies] have hit record levels".[1] In this paper, we investigate how cash holdings of American firms have evolved since 1980 and whether this evolution can be understood using existing models of cash holdings. We find that there is a secular increase in the cash holdings of the typical firm. In a regression of the average cash to assets ratio on a constant and time from 1980-2004, time has a significantly positive coefficient implying that the average cash to assets ratio (the cash ratio) has increased by 0.45% per year. Another way to see this evolution is that the average cash ratio more than doubles from 10.48% to 24.03% between 1980 and 2004.

This increase in cash holdings is paradoxical. We would expect improvements in financial technology to reduce cash holdings. After all, firms can hedge more effectively as more types of derivatives become available, so that the precautionary demand for cash should fall. We would also expect firms to become better able to forecast their cash needs and to better keep track of their liquid assets.

The increase in cash holdings that we document has dramatic implications for leverage if cash is netted out of debt when computing leverage. Much of the finance literature measures leverage by considering the ratio of debt to assets or debt to equity. Using these popular definitions of leverage, there is little evidence of a decrease in leverage for American firms. However, the net debt ratio (debt minus cash, divided by assets) exhibits a sharp secular decrease and most of this decrease in net debt is explained by the increase in cash holdings. The fall in net debt is so dramatic that average net debt for American firms is negative in 2004. In other words, on average, American firms could have paid off their debt with their cash holdings.

After documenting the increase in cash holdings and the decrease in net debt, we investigate why the increase in cash holdings has taken place. Much attention has been paid to the cash hoards in excess of

[1] "Capital Pains: Big Cash Hoards", by Ian McDonald, Wall Street Journal, July 21, 2006, p. C1.

$30 billion in mid-2006 of firms like Microsoft and Exxon.[2] We find that the increase in the average cash to assets ratio (the cash ratio) is not explained by the evolution of cash holdings for large firms or in recent years. The average cash ratio has a significant positive time trend for all firm size quintiles. Only the evidence for the largest firms is due to the recent cash buildup. Recently, Hartzell, Titman, and Twite (2006) argue that a reason for the cash buildup is that U.S. firms had profits trapped abroad that would have been taxed had they been repatriated. We find that firms that have no foreign taxable income, firms with presumably little or no foreign activities, experience a larger increase in cash holdings than firms that have foreign taxable income.

The increase in cash holdings is closely related to the disappearing dividends phenomenon documented by Fama and French (2001). There is a clear time trend in cash holdings and in net debt for firms that do not pay dividends. There is no time trend in these variables for firms that pay dividends. In other words, average cash holdings of established stable firms hardly increase over our sample period. Firms with more recent listings tend to be non-dividend payers. For non-payers, the mean ratio of cash to total assets more than doubles from 1980 to 2004 and the median ratio of cash to total assets more than triples from 1980 to 2004. Over the same period, the average net debt ratio for non-dividend payers falls from 19.32% to -4.51% and the median ratio from 21.44% to -6.18%.

To understand why cash holdings increased, we follow two separate approaches. Both approaches start from the equation estimated in Opler, Pinkowitz, Stulz, and Williamson (1999, OPSW) to explain cash holdings. With the first approach, we investigate whether allowing for changes in the intercept and slopes of the estimated regression for the 1990s and 2000s is helpful in explaining the cross-section of cash holdings. Though there is evidence of changes in slopes and intercepts, we find that the regression which does not allow for changes in slopes and intercepts explains roughly as much of the cross-section of cash holdings as a regression that allows for such changes. While OPSW do not take into account

[2] See Ian McDonald, "Cash Dilemma: How to Spend It," Wall Street Journal, May 24, 2006, p. C3. Jesse Eisenger, "Long & Short: The Tech Sector is Hogging the Green Blanket," Wall Street Journal April 5, 2006, p. C1. Simon London, "A Surplus of Cash Invariably Leads to a Shortage of Sense," Financial Times, November 30, 2005.

recent capital raising as a predictor of cash holdings, we do so and see that doing so increases the adjusted R-square of the regression by about 4%. With this approach, there is no evidence of an exogenous increase in the demand for cash by corporations.

With our second approach, we estimate the OPSW model for the 1980s and use it to predict cash holdings in the 1990s and the 2000s. Strikingly, there is no evidence for the sample as a whole that firms hold abnormal amounts of cash in 2001-2004. The model estimated over the 1980s helps explain why cash holdings are high in recent years, however. In the cases where cash holdings are significantly higher or lower than predicted by the model, the departures are mostly small. Over 2001-2004, the only sizeable average mistakes are that the model overstates cash holdings by dividend payers by about 3% of assets and understates holdings of firms within five years of their IPO by 8%.

Since the OPSW model tracks well the increase in average cash holdings for the whole sample, we use it to understand which changes in firm characteristics help explain the increase in cash holdings. Three variables are particularly important. First, firm cash flow risk increases substantially. Since cash holdings are positively related to firm risk, the increase in firm risk has a substantial impact on cash holdings. Second, firms hold less net working capital (net of cash), and in particular hold fewer inventories and accounts receivable. Since the non-cash components of working capital and cash are substitutes, the decrease in the non-cash components of working capital not surprisingly leads to an increase in cash holdings. Essentially, firms hold fewer inventories but substitute cash for inventories. Third, capital expenditures fall. In our estimate of the model, cash holdings are negatively related to capital expenditures.

The paper proceeds as follows. In the next section, we briefly review theories of cash holdings and the existing evidence. We then describe how our sample is constructed in Section 2 and show that there is a secular trend in cash holdings and net debt for our sample. In Section 3, we examine subsamples to understand which types of firms explain this secular trend. In Section 4, we estimate the OPSW model allowing for changes in slopes and intercepts for the 1990s and 2000s and taking into account fund-

raising activities. In Section 5, we use the OPSW model estimated for the 1980s to identify the changes in firm characteristics which explain the increase in cash holdings. We conclude in Section 6.

Section 1. Why firms hold cash

The economics and finance literature have identified four motives for firms to hold cash. We review the theory and evidence on these motives briefly:

a) *The transaction motive.* Classic models in finance (e.g., Baumol, 1952, Miller and Orr, 1966) derive optimal demands for cash when a firm incurs a transaction cost when converting a non-cash financial asset into cash and uses cash for payments. There are economies of scale with the transactions motive, so that large firms hold less cash. There is much evidence supporting the existence of these economies of scale (see, for instance, Mulligan, 1997).

b) *The precautionary motive.* Firms hold cash to be in a better position to cope with adverse shocks when access to capital markets is costly. OPSW find evidence supportive of this motive in their work. In particular, they find that riskier firms hold more cash. With the precautionary motive, we expect firms with better investment opportunities to hold more cash because adverse shocks that lead to financial distress are more costly for them. OPSW also find support for this prediction using market-to-book and R&D spending as proxies for investment opportunities. Almeida, Campello, and Weisbach (2004) model the precautionary demand for cash and find that financially-constrained firms invest in cash out of cash flow, while unconstrained firms do not. Further, Acharya, Almeida, and Campello (2006) develop a model showing that firms accumulate cash instead of reducing debt when the correlation between operating income and investment opportunities is low. In their model, firms that issue debt and hoard cash transfer income from future high cash flow states of the world to enable them to fund investment in all states of the world, including those with low cash flow.

c) *The agency motive.* As argued by Jensen (1986), entrenched managers would rather hold on to cash when the firm has poor investment opportunities than increase payouts to shareholders. Dittmar, Mahrt-Smith, and Servaes (2003) find cross-country evidence suggesting that firms hold more cash in countries with greater agency problems. Dittmar and Mahrt-Smith (2006) and Pinkowitz, Stulz, and Williamson (2006) show that cash is worth less when agency problems between insiders and outside shareholders are greater. Dittmar and Mahrt-Smith (2006) and Harford, Mansi, and Maxwell (2006) provide evidence suggesting that entrenched management actually spends excess cash quickly.

d) *The tax motive.* Hartzell, Titman, and Twite (2006) point out that firms that generate income abroad have incentives to keep that income abroad in order to avoid taxes upon repatriation. Consequently, multinational firms may optimally accumulate cash abroad.

These four motives for holding cash have different implications for the causes and consequences of the secular increase in cash that we document. We would expect firms to become more efficient over time in handling transactions, so that the transactions motive would require lower cash holdings. The growth in derivatives markets and improvements in forecasting and control suggest that everything else equal, the precautionary motive would require lower cash holdings also. However, it is well-known that there has been a secular increase in idiosyncratic risk (Campbell, Lettau, Malkiel, and Xu, 2001). Irvine and Pontiff (2005) show that the increase in idiosyncratic risk mirrors an increase in cash flow volatility. Such an increase would be consistent with an increase in the volatility of unhedgeable risks and hence the precautionary motive would suggest greater cash holdings. Further, as shown in Fama and French (2004), the composition of firms has changed because of an influx of newly listed firms with weaker track records. Brown and Kapadia (2006) demonstrate that the newly listed firms have apparently permanently higher idiosyncratic risk, so that the increase in idiosyncratic risk is due to these firms. These firms would be more concerned about being financially constrained and hence would hold more cash. We would

therefore expect cash holdings to be affected by how close a firm is to its IPO. For the increase in the average cash ratio to be explained by Jensen's free cash flow theory, it would have to be that firms did well and that there was little pressure on management to pay out cash even as cash holdings grew. With this explanation, American management would be more entrenched.

Section 2. The increase in cash holdings and the decrease in net debt

We construct our sample of firms from the Compustat annual industrial files on the WRDS database for the period 1980-2004. These data include survivors and non-survivors that appeared on Compustat at any time in the sample period. We require that the firms have positive assets (data item #6) and positive sales (data item #12) to be included in a given year. We exclude financial firms (SIC codes between 6000 and 6999), because they may carry cash to meet capital requirements rather than for the economic reasons studied here. We also exclude utilities (SIC codes between 4900 and 4999) because their cash holdings can be subject to regulatory supervision in a number of states. Finally, we restrict our sample to firms that are incorporated in the U.S.

The second column of Table 1 reports the number of firms for each sample year. We see that the number of firms follows an inverted u shape and peaks in 1997. We measure liquid asset holdings as the ratio of cash and marketable securities (data item #1) to total assets (data item #6).[3] The third column of Table 1 reproduces the average cash ratio. This ratio is 10.48% in 1980. It falls in eight years and increases in sixteen years over the sample period. At the end of the sample period the average cash ratio is 24.03%. The same trend is conveyed by the median cash ratio, which is reproduced in column four. The median ratio is 5.48% in 1980. It increases during sixteen years over the sample period. It falls by more than 1% of assets during only three years. Strikingly, the median actually increases more than the mean. The median cash ratio in 2004 is 169% of the median cash ratio in 1980, while the mean is 129% of its value in 1980.

[3] While not reported in this paper, we also measure liquidity using the cash-to-sales ratio. This does not affect our main results in a material way.

In a typical year, the average cash ratio increases. To verify that there is a secular increase in the cash ratio, we estimate regressions of the cash ratio on a constant and time measured in years. The coefficient on the time trend for the average cash ratio is 0.45% with a p-value below 0.01. The R-square of the regression is 86%. For the median, the slope coefficient is lower, 0.23%, but it also has a p-value below 0.01. The R-square is 55%. This evidence is consistent with the existence of a positive time trend in cash holdings.

We now turn to the implications of this increase in the cash ratio for the measurement of leverage. Column five of Table 1 shows average leverage. We measure leverage as debt (long-term debt plus debt in current liabilities) divided by total assets. We see that leverage falls over the period 2001 to 2004. However, leverage in 2004 is almost the same as leverage ten years earlier, so there is no evidence of a time-trend. Examining median leverage, reported in column six, we see that leverage is low in the first half of the 1990s, but then increases before falling over the period from 1998 to 2004. However, when we consider instead the average net debt ratio, which nets cash from debt, shown in column seven, we reach a dramatically different conclusion. The net debt ratio is 16.45% in 1980. It falls during fifteen years and reaches -1.48% in 2004. In a regression of the average net debt ratio on a constant and time, the coefficient on time is -0.56% with a p-value of less than 0.01. The last column of the table shows the median net debt ratio. This ratio falls from 17.84% to -0.30% over the sample period.

Section 3. How pervasive is the increase in cash holdings?

Section 2 shows that there is a secular increase in the average cash ratio and a secular decrease in net debt. It is also clear from the data that the decrease in net debt occurs because firms hold more cash rather than because they have less debt. We show in the introduction that there has been much focus in the financial press recently on the hoards of cash held by the largest firms. It could therefore be that our finding of a secular increase in cash is due to the increase in cash of large firms in recent years. To

examine this possibility, we divide the sample firms each year into quintiles according to the book value of their assets at the end of the prior year. The results are similar if we use the market value of equity.

Figure 1 reports the average cash ratios for the firm size quintiles over our sample period. We see immediately that the average cash ratio increases across all firm size quintiles, but the increase is much sharper for the smaller firms. It is also clear from the figure that the increase in the average cash ratio for the largest firms is especially strong in the later years of our sample. Table 2a reports the average cash ratios for the five quintiles throughout our sample period. We see that average cash holdings more than double for the second and third quintiles and almost double for all other quintiles. Our earlier finding of a time trend for the average cash ratio holds for each size quintile.

Each average cash ratio is computed across at least 700 firms so that outliers cannot have much of an impact on the average cash ratio. In general, though, the median cash ratio is lower than the average cash ratio. It follows that the distribution of cash ratios appears skewed to the right. Though not reproduced in Table 2a, the medians increase through time across all size quintiles. However, the time trend is not significant for the medians for the two largest size quintiles. The evidence for a secular increase in cash ratios is therefore stronger for the three lowest quintiles.

The medians of the two largest quintiles exhibit an extremely sharp increase after 1998. For instance, for the largest quintile, the median in 1998 is 2.90%. By 2004, the median is 7.76%. This doubling of the median in six years is not matched by a doubling of the average over the same period of time. The average increases steadily over the whole sample period and does not show much acceleration towards the end of the sample period. Not surprisingly, therefore, our evidence of a time-trend for the average holds if we eliminate the last four years of our sample. Consequently, the secular increase in cash holdings cannot be explained by the recent increases focused on by the financial press.

The increase in cash holdings that the financial press has focused on is most visible when we compare the S&P 500 firms to the other firms in the sample (not reported). From this perspective, the increase in cash holdings of the S&P 500 firms since 1998 is dramatic since their average cash ratio doubles from

1998 to 2004. The change in the median cash ratio for these firms is even more dramatic. In 1998, the median cash ratio of S&P 500 firms is 2.79%. This ratio increases to 9.93% in 2004, so that it more than triples from 1998 to 2004. During that period, the median net debt ratio falls from 20.73% to 8.90%.

The 1990s witnessed numerous IPOs. Recent IPO firms could be expected to have more cash because of the IPO and because they often issue equity in a secondary offering within years of the IPO. In columns 2 and 3 of Table 2b, we report average cash ratios for firms that, respectively, did and did not have an IPO within five years. We see that the average cash ratio more than doubles for non-IPO firms during our sample period and nearly doubles for the IPO firms. Though we do not reproduce the medians, the median cash ratio for IPO firms triples over our sample period. Nevertheless, when we estimate the time trend, it is significant for the average and the median for both groups of firms. The increase in cash holdings is therefore not driven by IPO firms.

Another possible explanation for the increase in the cash ratio is that economic growth was high in the 1990s, so that firms were less likely to be economically distressed and hence were less likely to have to use up their cash reserves. Firms with negative net income are much more likely to be financially constrained than firms with positive net income. Using negative net income as an index of the probability that a firm is financially constrained, we split the sample between firms with negative net income and other firms and report average cash ratios for these subsamples in columns 4 and 5 of Table 2b. The firms with negative net income have a dramatic increase in cash holdings. The average cash ratio of these firms almost triples while the median cash ratio (not reported) almost quadruples. The firms with positive net income also exhibit an increase in cash holdings, but the time trend is markedly lower and only significant for the average cash holdings.

We turn next to the role of dividends. Fama and French (2001) show that firms have become less likely to pay dividends. Consider a firm that in 1980 would have paid dividends and an identical firm in 2000 that does not. Everything else equal, the firm in 2000 would have more cash. In the last two columns of Table 2b we reproduce the time series of the average cash ratio for regular dividend payers

and non-dividend payers. The average cash ratio of dividend payers in year t is the average cash ratio of firms that pay a dividend that year. The results are striking. There is a dramatic increase in the cash ratio among the non-dividend payers, but no evidence of a time trend for the dividend payers. For instance, the average cash ratio of dividend payers is about the same in 2000 as in 1980. In contrast, the average cash ratio of non-dividend payers is roughly 111.91% higher in 2004 than in 1980. Even more striking is the increase in the median cash ratio (not reported). In 1980, the median cash ratio is 5.98%. In 2004, it is 19.39%. Consequently, over our sample the median cash ratio increases by 224.25%. The evidence that non-dividend payers increase their cash ratio so much is consistent with the evidence in Brown and Kapadia (2006) that newly listed firms have higher idiosyncratic risk.

Finally, Hartzell et al. (2006) point out that over our sample period multinationals benefited from leaving abroad the cash they earned abroad as long as that the income repatriated from abroad would have been taxed in the U.S. at a higher rate than it was taxed abroad. After the end of our sample period, firms were allowed to repatriate cash held in foreign countries at a lower tax rate. We use firms with positive foreign pre-tax income to identify firms for which avoidance of taxation on foreign income might lead to higher cash holdings. There is no evidence that cash holdings increase more for firms with foreign taxable income.

Section 4. Did the demand function for cash holdings change?

In this section, we investigate whether the increase in the average cash ratio can be explained by firm characteristics and whether the relation between various firm characteristics and the cash ratio changes over time. For this examination, we start from the regression in OPSW that relates the cash ratio to firm characteristics. The data required to estimate the OPSW regression limits the size of the sample. To see this, note that the unrestricted sample has 3,693 observations in 2004. In contrast, the sample that has the data to estimate the OPSW regressions has 3,218 observations. However, the sample that meets the data requirements of the OPSW regression model has an average increase in the cash ratio of 120.72% over

the sample period. This increase is close to the increase of 129.29% for the unrestricted sample. Not surprisingly, there is a significant time trend in the average and median cash ratios for the restricted sample.

The firm characteristics included in the OPSW regression are motivated by the various theories of corporate cash holdings discussed in Section 1. We modify the OPSW model to add the ratio of a firm's acquisition expense to assets as an additional variable since acquisitions and capital expenditures would seem to be substitutes.

The variables used in the OPSW regression are as follows:

a) *Market-to-book ratio.* Firms with better investment opportunities value cash more since it is more costly for these firms to be financially constrained. We use the book value of assets minus the book value of equity plus the market value of equity as the numerator of the ratio and the book value of the assets as the denominator.

b) *Firm size.* There are economies of scale to holding cash. We use as our size measure the logarithm of total assets in 2004 dollars.

c) *Cash-flow-to-assets.* We measure cash flow as earnings after interest, dividends and taxes but before depreciation divided by book assets. Firms with higher cash flow accumulate more cash, everything else equal. Such firms might have better investment opportunities, but we control for these through other variables.

d) *Net working capital to assets.* Net working capital is composed of assets that can substitute for cash. We would therefore expect a negative relation between net working capital and cash holdings. We subtract cash (data item #1) from net working capital (data item #179), so that our net working capital measure is net of cash.

e) *Capital expenditures to assets.* We measure capital expenditures as the ratio of capital expenditures (data item #128) to assets (data item #6). Capital expenditures consume cash, so that we would expect capital expenditures to reduce cash. At the same time, however,

capital expenditures could proxy for costs of financial distress and/or investment opportunities, in which case they would be positively related to cash.

f) *Leverage.* We measure leverage using the debt/assets ratio, defined as (long-term debt plus debt in current liabilities) / book value of assets. To the extent that debt is sufficiently constraining, we would expect firms to use cash to reduce leverage, so that there would be a negative relation between cash holdings and leverage. However, the hedging argument of Acharya, Almeida, and Campello (2006) would be consistent with a positive relation between leverage and cash holdings.

g) *Industry Cash flow risk.* We expect firms with greater cash flow risk to hold more precautionary cash. We measure cash flow risk as the standard deviation of industry cash flow computed as follows. For each firm, we compute cash flow standard deviation for the previous ten years. We require at least three observations for the standard deviation to be calculated. We then take the average across the 2-digit SIC code of the firm cash flow standard deviations.

h) *Dividend payout dummy.* We define a dummy variable set equal to one in years where a firm pays a dividend. Otherwise the dummy equals zero. Dividends consume cash. Further, firms that pay dividends are likely to be less risky and have greater access to capital markets, so that the precautionary motive for cash holdings is weaker for them.

i) *R&D to sales*. This variable also measures growth opportunities. Firms with greater R&D to sales are assumed to have greater costs of financial distress. Though R&D expenditures consume cash and hence would appear to decrease cash, R&D's role as a proxy for growth opportunities and financial distress could lead to a positive relation between the cash ratio and R&D spending.

j) *Acquisitions to assets*. Acquisition activity is defined as acquisitions (data item #129) / book assets. Acquisitions consume cash.

It is important to note that activities that consume cash, such as capital expenditures and acquisitions, would have no impact on a firm's cash holdings if the firm could replenish its cash holdings immediately to stay at the optimum amount of cash holdings. One would not expect firms to be in a position to always be at the long-run optimum, so that activities that consume cash will, everything else equal, have an adverse effect on cash holdings.

Model 1 of Table 3 shows the estimates for the regression using all sample years. Given our data restrictions, the panel consists of 94,699 firm-year observations for 12,441 unique firms. We account for serial correlation in the residuals of individual firms. We do not use dummy variables for years or for industry in this regression. In OPSW, market-to-book and cash flow risk have consistently positive coefficients across specifications. They have positive coefficients in our regression as well. In OPSW, size, net working capital, leverage and the dividend dummy have consistently negative coefficients across specifications. They have negative coefficients here too. R&D to sales has a significant positive coefficient, which it has also in OPSW for most regressions. We also find that capital and acquisition expenditures are associated with negative and significant coefficients.

In unreported results, we estimate the regression using a different dependent variable, namely cash over assets minus cash. This measure is the one that OPSW use. The problem with this measure over our sample period is that it generates extreme outliers for firms with almost no assets but cash. Hartzell et al. (2006) use the logarithm of this measure which reduces but does not eliminate the influence of outliers in the dependent variable for a number of firms. If we use this measure, the regression coefficients are qualitatively the same but the coefficients are much larger.[4] We also estimate the regression to allow for macroeconomic conditions to affect the demand for cash. First, we include yearly dummies. Second, we include a short-term interest rate. The short-term interest rate is never significant. The yearly dummies

[4] Hartzell et al. also add foreign pre-tax income and domestic pre-tax income variables to the regression as well as a tax burden variable. Using these variables would force us to shorten our sample period, so we do not include regressions with these variables. The sample of Hartzell et al. includes only firms with assets in excess of $100 million. We do not impose this restriction in our analysis.

have no impact on the regression coefficients we focus on. We do not report the regression with yearly dummies because we allow for changes in intercept in the regressions we discuss next. Finally, we used an alternative measure of cash flow risk, estimating cash flow volatility over five years of data instead of ten. The results do not change with that alternate measure.

To investigate whether there is a regime change in the 1990s or the 2000s for the demand for cash, we estimate the OPSW regression in Model 2 of Table 3, allowing for changes in the intercept for the 1990s or the 2000s. We add two indicator variables to the regression: the first indicator variable takes value one for years 1990 and after; the second indicator variable takes value one for years 2000 and after. Consequently, the indicator variable for the 2000s tells us how the intercept for these years differs from the intercept for the 1990s. If the cash ratio increased for exogenous reasons unrelated to firm characteristics, we would expect these indicator variables to have positive and significant coefficients. We find that the estimates of the indicator variables are significantly negative. Consequently, firm characteristics must explain the increase in the cash ratio in the 2000s.

It is possible that the intercepts do not change over time but that the slopes do. This would be the case if the influence of firm characteristics on the cash ratio changes over time. We examine this possibility in Model 3 of Table 3, which allows for the slopes to differ by decade. The most striking result is perhaps that allowing the slopes and intercepts to differ by decade has no impact on the adjusted R-square. It is true that some of the interactions are significant. In particular, the coefficient on cash flow risk is much higher in the 1990s and 2000s. So is the coefficient on size. Strikingly, by the 2000s, the traditional negative relation between cash holdings and size does not seem to exist anymore. The coefficient on acquisitions is much lower in the 1990s and 2000s and so is the coefficient on dividends.

In the last regression, we modify the model to account for equity issues and debt issues as well as proximity to an IPO. We define net debt issuance as debt issuance (data item #111) minus debt retirement (data item #114), divided by book assets. Likewise, net equity issuance is calculated as equity sales (data item #108) minus equity purchases (data item #115), divided by book assets. Since Section 3 shows that

firms reporting a loss have more cash, we also add a dummy variable for firms reporting a loss. Finally, we add dummy variables for firms' two-digit industry SIC code. Adding these variables increases the adjusted R-square by roughly four percent. As expected, IPO firms hold more cash, but the cash ratio falls as the IPO gets more distant. We would expect firms that issue more equity or more debt to have more cash. This is true, but not in the 2000s. However, taking into account these additional variables has no meaningful impact on the intercepts.

There are several important lessons from these regressions. First, allowing for time variation in the coefficients adds little to the explanatory power of the regressions. Second, the negative relation between cash holdings and firm size breaks down in the 2000s. Third, had firm characteristics remained constant, firms would hold less cash. Apparently, the reason firms hold more cash is that their characteristics changed in a way that makes it optimal for them to hold more cash. This latter evidence is inconsistent with the view that there was a regime shift in cash holdings.

Section 5. Why did the cash ratio increase?

Section 4 shows that changes in firm characteristics are the major reason cash holdings increase. In this section, we attempt to attribute the increase in cash holdings to specific changes in firm characteristics. To do so, we proceed in three steps. First, we estimate the modified OPSW model for the 1980s using Fama-McBeth regressions. Second, we compute how actual cash holdings differ from cash holdings predicted by that model in the 1990s and 2000s. Finally, we attribute the increase in predicted cash holdings to changes in specific firm characteristics.

The Fama-McBeth estimates of the modified OPSW model for the 1980s are as follows:

Cash ratio = 0.3099 + 0.2334 Industry cash flow volatility + 0.0069 Market-to-book – 0.0092 Log size + 0.0579 Cash-flow/Assets – 0.2339 Net working capital/Assets – 0.3560 Capital

expenditures/Assets – 0.3693 Leverage + 0.0361 R&D/Sales – 0.0269 Dividends/Assets – 0.2046 Acquisitions/Assets + 0.1155 Net equity/Assets + 0.1743 Net debt/Assets

All Fama-McBeth t-statistics exceed 4.0 in absolute value. The regression coefficients do not differ much from the regression coefficients reported in Table 3.

Table 4 reports the predicted cash ratios for the whole sample in column 2. The difference between the actual and predicted cash ratios is in column 3 and the t-statistic for the difference is in column 4. The actual average cash ratio is not reproduced but is equal to the sum of columns 2 and 3. In 2004, the difference between the predicted and actual cash ratios is half a percent and is (barely) insignificant. Strikingly, all differences that are significant actually indicate that the model predicts a higher cash ratio than the actual cash ratio over the sample period. The regression model does a better job of predicting the cash ratios late in the post-estimation period than early. From the perspective of this cash ratio model, the surprise is not in the high cash ratios of the last few years but in the low cash ratios of the early 1990s. The early years include a recession, but so do the early 2000s when the model underpredicts the average cash ratio.

In the next three columns of Table 4, we focus on the S&P 500 firms in our sample. Remember that for a firm to be in our sample it has to be an industrial firm and have the data we need to estimate the modified OPSW model. The results are again striking. The OPSW model estimated using the 1980s predicts cash holdings of S&P 500 firms well. The unexpected cash holdings are not significantly different from zero in 2002, 2003 and 2004. Over the same period, the unexpected cash holdings of the non-S&P 500 firms average to 0.07% and only one t-statistic is significant. Though we do not reproduce the results, the model does poorly with recent IPO firms. For these firms, the prediction errors slightly exceed 8% in 2002, 2003 and 2004. As a result, the model substantially underpredicts the cash ratios of firms with an IPO during the past five years and overpredicts the cash holdings of the other firms. An

additional unreported analysis indicates that firms with foreign taxable income always hold less cash than predicted, but the extent to which they do so is rather trivial in recent years.

We turn finally to dividend and non-dividend payers. Column 8 of Table 4 shows the predicted average cash ratio for dividend payers. The model predicts an increase in the average cash ratio of 47.66% from 1990 to 2004 for non-dividend payers, but an increase of only 31.87% for dividend payers. In fact, however, the actual increase in the ratio for dividend payers is even smaller, so that dividend payers hold less cash than predicted. When we turn to non-dividend payers, we see that the errors of the model are typically small and insignificant.

The model predicts an increase in the average cash ratio from 1990 to 2004 for the whole sample of 49.23%. How can such a large increase be explained? To answer this question, we investigate how firm characteristics change over time and how this change affects cash ratios. To understand our procedure, consider a firm that has average industry cash flow volatility throughout the 1980s. The volatility would be 7.05%. The coefficient on industry cash flow volatility in the Fama-McBeth regression is 0.2334. Consequently, in 1980 we would expect a cash ratio of 1.65% due to industry cash flow volatility (0.2334*7.05%). Average industry cash flow volatility increases sharply during our sample period. A firm that has average cash flow volatility in 2004 would have cash flow volatility of 16.44%. In 2004, a cash ratio of 3.84% would be explained by average cash flow volatility. If all explanatory variables except cash flow volatility had stayed the same, we would expect the average cash ratio to have increased by 2.19% from 1980 to 2004 because of the increase in cash flow volatility.

Table 5 attributes the increase in the predicted cash ratio to changes in the determinants of that ratio. The increase in the cash ratio is the difference between the average over 2000-2004 and the average for the 1980s. The first column of Table 5 shows the decomposition for the whole sample. Most of the change in predicted cash holdings is explained by three variables. In order of importance, these variables are the change in net working capital net of cash, the change in cash flow risk, and the change in capital expenditures.

In risk management theories, greater volatility of cash flow imposes deadweight costs of financial distress.[5] One would expect firms with greater volatility of cash flow to hedge more, but if they have unhedgeable risks, they would hold more cash. It is therefore not surprising that firms hold more cash as cash flow risk increases. Average industry cash flow risk increases from an average of 7.05% in the 1980s to an average of 15.93% in the 2000s. It is interesting to note, however, that the increase in cash flow risk has stagnated over the recent years. Net working capital falls by more than 10% of assets from the 1980s to the 2000s. The largest contributor to that fall is the decrease in inventories. In the 1980s, inventories average to 19.88% of assets. In contrast, in the 2000s, the average is 12.13%. The decrease in inventories is more dramatic when we look at the median (not reported) since the median averages 18.33% in the 1980s, but only 7.47% in the 2000s. In addition to the decrease in inventories, a decrease in accounts receivable also contributes substantially to the fall in net working capital. In the 1980s, accounts receivable averages to 20.33%. In contrast, in the 2000s, the average of accounts receivable for the whole sample is 15.07%.

We turn next to the question of why the average predicted cash ratio grew more for some firms than others. The third and fourth columns of Table 5 decompose the change in the predicted cash ratio for S&P 500 firms and non-S&P 500 firms. For this decomposition, we use the change in the determinants of the cash ratio for the subsample we consider. For instance, when we attribute the change in the predicted cash ratio for S&P 500 firms, we consider the impact on the predicted cash ratio of the change in the average value of the explanatory variables in the OPSW model from the 1980s to 2000-2004 for these firms. The fifth column of Table 5 decomposes the difference in the change in the predicted cash ratio between the S&P 500 firms and the non-S&P 500 firms. Considering first the non-S&P 500 firms, we see that the change in net working capital and the change in cash flow risk together explain an increase in the cash ratio corresponding almost to 5%. The only other variable that has a contribution in excess of 1% is the change in capital expenditures. When we turn to the S&P 500 firms, the same three variables are

[5] See, for instance, Smith and Stulz (1983) and Froot, Scharfstein, and Stein (1993). Minton and Schrand (1999) examine cash flow volatility and its deadweight costs empirically.

important, but their contribution is slightly less than for the non-S&P 500 firms. From the average of the 1980s to the average of the 2000s, the difference in the increase in the predicted cash ratio between non-S&P 500 and S&P 500 firms is 1.66%. As seen from the decomposition of this difference, the two largest components in absolute value are leverage and R&D. In the OPSW regression, the cash ratio falls with leverage and increases with R&D. Leverage falls slightly for the non-S&P 500 firms but stays roughly constant for the S&P 500 firms. More strikingly, R&D increases much more for non-S&P 500 firms than for the S&P 500 firms.

The last three columns of Table 5 illustrate the determinants of changes in predicted cash holdings for dividend-payers and non-dividend-payers. We consider first the decomposition for the non-dividend payers. We see that the increase in cash flow risk and the decrease in net working capital explain a 2.14% and 2.20% increase in the cash ratio, respectively. Further, a leverage decrease, a decrease in capital expenditures and an increase in R&D together explain roughly a 4% increase in the cash ratio. When we turn to dividend payers, the contribution of the decrease in net working capital and of the increase in cash flow risk stands out. The leverage of non-dividend payers decreased relative to the leverage of the dividend payers. This differential evolution explains an increase in the cash ratio of non-dividend payers compared to the cash ratio of dividend payers of 1.97%. R&D expenses increased more for non-dividend payers which explains a differential of 0.99% in the cash flow ratio change. Finally, the cash flow risk of dividend payers increased less than the cash flow risk of non-dividend payers.

Section 6. Conclusion

We document a dramatic increase in the average cash ratio for U.S. firms between 1980 and 2004. We show that this increase is concentrated among firms that do not pay a regular dividend. The main reasons for the increase in the cash ratio is that cash flow risk for American firms has increased, inventories have fallen, capital expenditures have fallen, and R&D expenditures have increased. The increase in cash flow risk is connected to the widely studied increase in idiosyncratic risk. Recent

evidence of a decrease in idiosyncratic risk might lead American firms to hold less cash.[6] However, the decrease in inventories is probably here to stay. Further, the greater importance of R&D relative to capital expenditures also has a permanent effect on the cash ratio. The cash ratio is sharply increasing in R&D. R&D investment opportunities are difficult to finance for firms that face financial difficulties, so that such firms require a greater cash buffer.

Our evidence shows that the increase in cash ratios, while dramatic, can be explained by the change in firm characteristics over our sample period. There is no evidence of an exogenous change in the demand for cash. The data are consistent with existing evidence showing that the precautionary motive to hold cash is a critical determinant of the demand for cash. Though the market for derivatives has grown dramatically, our evidence suggests that firms face many risks that they cannot hedge or are reluctant to use derivatives to hedge risks. It seems much harder to explain our evidence by an increase in agency problems that lead managers to hoard cash because the drivers of the increase in the cash ratio are not generally considered to be proxies for agency problems.

We also document a dramatic decrease in net debt for American firms. If cash is simply negative debt, leverage ought to be measured using net debt. In this case, the popular measures of leverage used in the finance literature miss a stunning evolution in the leverage of American firms. By 2004, using net debt, the average American firm had no leverage. However, if cash is not simply negative debt, its importance for the typical American firm is greater than its long-term debt (since cash greater than total debt). Assuredly, cash enables firms to forestall distress and default. It follows that the growing importance of cash should be taken into account seriously when evaluating the financial condition of firms and when assessing the capital structure decisions of firms.

[6] See Brandt, Brav, and Graham (2005).

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Table 1: Average and median cash and leverage ratios over time

The sample includes all Compustat firm-year observations from 1980 to 2004 with non-missing data for the book value of total assets and sales revenue for firms incorporated in the U.S. Financial firms (SIC code 6000-6999) and utilities (SIC codes 4900-4999) are also excluded from the sample, yielding a panel of 110,599 observations for 13,237 unique firms. The cash ratio is measured as the ratio of cash and marketable securities to the book value of total assets. Leverage is defined as the ratio of total debt to the book value total assets, where debt includes long-term debt plus debt in current liabilities. Net leverage is computed as the difference between total debt and cash and marketable securities, divided by the book value of total assets.

Year	N	Average Cash Ratio	Median Cash Ratio	Average Leverage	Median Leverage	Average Net Leverage	Median Net Leverage
1980	3519	0.1048	0.0548	0.2692	0.2433	0.1645	0.1784
1981	3748	0.1207	0.0583	0.2534	0.2275	0.1327	0.1602
1982	3752	0.1211	0.0643	0.2613	0.2324	0.1402	0.1579
1983	4120	0.1589	0.0868	0.2458	0.2040	0.0867	0.1111
1984	4172	0.1399	0.0687	0.2543	0.2177	0.1142	0.1407
1985	4127	0.1420	0.0704	0.2696	0.2302	0.1275	0.1508
1986	4261	0.1574	0.0812	0.2732	0.2363	0.1155	0.1431
1987	4407	0.1564	0.0771	0.2726	0.2411	0.1162	0.1531
1988	4237	0.1412	0.0683	0.2805	0.2438	0.1393	0.1631
1989	4095	0.1375	0.0633	0.2859	0.2534	0.1483	0.1735
1990	4042	0.1341	0.0615	0.2817	0.2444	0.1475	0.1678
1991	4137	0.1545	0.0722	0.2589	0.2145	0.1044	0.1287
1992	4307	0.1626	0.0791	0.2452	0.1931	0.0823	0.1110
1993	4713	0.1713	0.0828	0.2247	0.1794	0.0532	0.0914
1994	4985	0.1553	0.0703	0.2304	0.1873	0.0751	0.1055
1995	5165	0.1707	0.0724	0.2298	0.1874	0.0592	0.1048
1996	5568	0.1926	0.0879	0.2216	0.1700	0.0289	0.0775
1997	5605	0.1908	0.0893	0.2361	0.1795	0.0457	0.0854
1998	5263	0.1783	0.0748	0.2887	0.2052	0.1103	0.1189
1999	4971	0.1943	0.0771	0.2470	0.1979	0.0527	0.1044
2000	4947	0.2081	0.0884	0.2420	0.1734	0.0337	0.0748
2001	4540	0.2141	0.1070	0.2676	0.1732	0.0537	0.0619
2002	4233	0.2139	0.1144	0.2580	0.1717	0.0447	0.0537
2003	3992	0.2267	0.1332	0.2346	0.1601	0.0084	0.0158
2004	3693	0.2403	0.1473	0.2251	0.1450	-0.0148	-0.0030

Table 2a: Average cash ratios by firm size quintile

The sample includes all Compustat firm-year observations from 1980 to 2004 with non-missing data for the book value of total assets and sales revenue for firms incorporated in the U.S. Financial firms (SIC code 6000-6999) and utilities (SIC codes 4900-4999) are also excluded from the sample, yielding a panel of 110,599 observations for 13,237 unique firms. The cash ratio is measured as the ratio of cash and marketable securities to the book value of total assets. Size quintiles are established based on the book value of sample firm assets in the fiscal year prior to the calendar year in the left most column. Differences in the average cash ratio between the largest and smallest quintiles are statistically different from zero at better than a 1.0% level for each reported year.

Year	Smallest Quintile	Q2	Q3	Q4	Largest Quintile
1980	0.1788	0.1133	0.0897	0.0770	0.0653
1981	0.2132	0.1387	0.1027	0.0852	0.0637
1982	0.1843	0.1412	0.1120	0.0982	0.0698
1983	0.2483	0.1755	0.1563	0.1272	0.0872
1984	0.2305	0.1466	0.1358	0.1060	0.0807
1985	0.2249	0.1515	0.1338	0.1162	0.0835
1986	0.2374	0.1787	0.1496	0.1327	0.0889
1987	0.2389	0.1811	0.1483	0.1251	0.0887
1988	0.2082	0.1715	0.1383	0.1106	0.0771
1989	0.1945	0.1696	0.1371	0.1125	0.0741
1990	0.1832	0.1686	0.1343	0.1136	0.0706
1991	0.2066	0.1864	0.1770	0.1275	0.0751
1992	0.2274	0.2057	0.1822	0.1208	0.0772
1993	0.2330	0.2241	0.1841	0.1355	0.0800
1994	0.2266	0.2027	0.1611	0.1123	0.0737
1995	0.2330	0.2387	0.1867	0.1240	0.0713
1996	0.2569	0.2770	0.2206	0.1325	0.0761
1997	0.2558	0.2692	0.2157	0.1326	0.0806
1998	0.2502	0.2554	0.1873	0.1214	0.0772
1999	0.2666	0.2584	0.2148	0.1404	0.0910
2000	0.2612	0.2671	0.2543	0.1616	0.0964
2001	0.2728	0.2655	0.2520	0.1716	0.1085
2002	0.2712	0.2659	0.2528	0.1645	0.1149
2003	0.2965	0.2849	0.2599	0.1728	0.1196
2004	0.3292	0.3271	0.2594	0.1618	0.1241

Table 2b: Average cash ratios delineated by new issue status, accounting performance, and the payment of a regular dividend

The sample includes all Compustat firm-year observations from 1980 to 2004 with non-missing data for the book value of total assets and sales revenue for firms incorporated in the U.S. Financial firms (SIC code 6000-6999) and utilities (SIC codes 4900-4999) are also excluded from the sample, yielding a panel of 110,599 observations for 13,237 unique firms. The cash ratio is measured as the ratio of cash and marketable securities to the book value of total assets. Firms are assigned to the IPO subsample if they have gone public within the prior five calendar years and the non-IPO subsample otherwise. Firms with accounting losses at the fiscal end of the designated year are assigned to the negative net income subsample. A firm's dividend status is defined by the distribution of a regular dividend in the designated calendar year. Differences in the average cash ratio between the new issues, accounting performance, and dividend status subsamples are statistically different from zero at better than a 1.0% level for each reported year with the exception of differences in accounting performance for 1982.

	New Issues		Accounting Performance		Dividend Status	
Year	Non-IPO Firms	IPO Firms	Negative Net Income	Non-Negative Net Income	Regular Dividend	No Regular Dividend
1980	0.0994	0.2107	0.1219	0.1011	0.0862	0.1301
1981	0.1091	0.2313	0.1400	0.1155	0.0915	0.1513
1982	0.1095	0.2095	0.1195	0.1217	0.1031	0.1377
1983	0.1308	0.2748	0.1728	0.1531	0.1178	0.1887
1984	0.1171	0.2135	0.1592	0.1318	0.1010	0.1654
1985	0.1203	0.2061	0.1496	0.1378	0.1060	0.1637
1986	0.1323	0.2254	0.1695	0.1505	0.1113	0.1813
1987	0.1342	0.2091	0.1815	0.1425	0.1089	0.1785
1988	0.1264	0.1872	0.1649	0.1289	0.1026	0.1591
1989	0.1254	0.1808	0.1467	0.1324	0.0976	0.1564
1990	0.1200	0.1874	0.1455	0.1277	0.0969	0.1513
1991	0.1324	0.2448	0.1718	0.1442	0.1029	0.1773
1992	0.1354	0.2616	0.1931	0.1458	0.1036	0.1884
1993	0.1356	0.2645	0.2142	0.1477	0.1047	0.1976
1994	0.1252	0.2220	0.2056	0.1318	0.0917	0.1785
1995	0.1312	0.2476	0.2073	0.1516	0.0960	0.1976
1996	0.1429	0.2761	0.2618	0.1538	0.0966	0.2238
1997	0.1491	0.2631	0.2524	0.1541	0.1023	0.2177
1998	0.1431	0.2513	0.2347	0.1404	0.0876	0.2054
1999	0.1459	0.3017	0.2650	0.1450	0.0842	0.2246
2000	0.1574	0.3269	0.2801	0.1435	0.0786	0.2393
2001	0.1752	0.3451	0.2726	0.1471	0.0903	0.2431
2002	0.1807	0.3622	0.2664	0.1600	0.0985	0.2414
2003	0.2004	0.3800	0.2889	0.1822	0.1259	0.2556
2004	0.2169	0.4025	0.3370	0.1887	0.1305	0.2757

Table 3: Regressions estimating the determinants of cash/assets.

The sample includes all Compustat firm-year observations from 1980 to 2004 with non-missing data for the book value of total assets and sales revenue for firms incorporated in the U.S. Financial firms (SIC code 6000-6999) and utilities (SIC codes 4900-4999) are also excluded from the sample, yielding a panel of 110,599 observations for 13,237 unique firms. Missing explanatory values reduce the panel used here to 94,699 firm-year observations for 12,441 unique firms. The dependent variable in all regressions is the ratio of cash and marketable securities to the book value of total assets (the cash ratio). Industry sigma is the mean of standard deviations of cash flow/assets over 10 years for firms in the same industry as defined by two-digit SIC code. Market to book is measured as: (book value of total assets - book value of equity + market value of equity)/book value of total assets. Real size is the natural log of the book value of total assets in 2004 dollars. Cash flow is defined as (earnings before interest and taxes - interest - taxes - common dividends). NWC is defined as net working capital minus cash and marketable securities. Capex is the ratio of capital expenditures to the book value of total assets. Leverage is defined as the ratio of total debt to the book value of total assets. Dividend is a dummy variable set to one if the firm paid a regular dividend in the year, and 0 if it did not. Acquisition activity is measured as the ratio of expenditures on acquisitions (Compustat data item #129) relative to the book value of total assets. Net debt issuance is computed as the annual total debt issuance minus debt retirement in the fiscal year, divided by the book value of total assets. Net equity issuance is calculated as equity sales minus equity purchases, divided by the book value of total assets. Loss is a dummy variable equal to 1 if net income is less than zero, and 0 otherwise. IPO1 through IPO5 are dummy variables equal to 1 if the firm went public 1, 2, 3, 4, or 5 years ago respectively. Models 2, 3, and 4 include separate intercepts for firm year observations from 1990s to the end of the sample period, and for 2000 through 2004. When included, industry dummy variables are formed using two-digit SIC codes of sample firms. T-statistics based on standard errors robust to clustering by firms over time are reported in parentheses.

Table 3 (continued)

	Model 1	Model 2	Model 3			Model 4		
Variable	Estimate	Estimate	Estimate	Interaction 1990s	Interaction 2000s	Estimate	Interaction 1990s	Interaction 2000s
Intercept	0.2591 (48.16)	0.2623 (48.72)	0.3062 (39.78)			0.3017 (20.50)		
Industry sigma	0.3686 (17.15)	0.4772 (20.27)	0.1462 (3.04)	0.3289 (6.28)	0.0617 (1.76)	-0.0750 (-1.51)	0.3276 (6.68)	0.0853 (2.51)
Market to book	0.0163 (25.41)	0.0165 (25.71)	0.0115 (10.90)	0.0073 (5.91)	-0.0020 (-1.18)	0.0048 (4.27)	0.0072 (5.50)	0.0042 (2.54)
Real size	-0.0056 (-8.93)	-0.0040 (-6.28)	-0.0089 (-10.70)	0.0052 (5.31)	0.0062 (4.87)	-0.0086 (-10.18)	0.0055 (5.61)	0.0045 (3.59)
Cash flow/ assets	-0.0151 (-2.74)	-0.0122 (-2.23)	0.0130 (1.61)	-0.0336 (-3.21)	-0.0198 (-1.46)	0.0479 (5.02)	-0.0054 (-0.43)	-0.0690 (-4.50)
NWC/ assets	-0.1946 (-36.49)	-0.1998 (-37.16)	-0.2034 (-28.13)	-0.0028 (-0.31)	0.0350 (2.96)	-0.2501 (-29.28)	0.0235 (2.49)	0.0432 (3.68)
Capex	-0.2840 (-27.51)	-0.3010 (-28.70)	-0.2554 (-19.75)	-0.0676 (-3.74)	-0.1154 (-3.39)	-0.3474 (-21.93)	-0.0690 (-3.11)	-0.0163 (-0.45)
Leverage	-0.3734 (-63.00)	-0.3752 (-63.10)	-0.3732 (-45.39)	-0.0034 (-0.34)	0.0106 (0.85)	-0.3672 (-41.50)	-0.0051 (-0.47)	-0.0007 (-0.05)
R&D/ sales	0.0441 (32.78)	0.0440 (32.85)	0.0434 (13.46)	-0.0002 (-0.05)	-0.0009 (-0.31)	0.0350 (10.83)	0.0011 (0.32)	0.0045 (1.67)
Dividend	-0.0413 (-17.27)	-0.0462 (-18.52)	-0.0355 (-10.77)	-0.0154 (-3.99)	-0.0156 (-3.31)	-0.0185 (-5.62)	-0.0174 (-4.44)	-0.0243 (-5.09)
Acquisition activity	-0.1579 (-20.17)	-0.1576 (-20.16)	-0.0748 (-5.73)	-0.1104 (-6.90)	-0.0679 (-2.97)	-0.1923 (-10.37)	-0.1574 (-6.60)	0.0803 (3.04)
Net equity issuance						0.0816 (6.19)	0.0250 (1.40)	-0.1231 (-6.34)
Net debt issuance						0.1561 (9.33)	0.0301 (1.21)	-0.1436 (-5.78)
Loss dummy						0.0022 (1.15)		
IPO1						0.0998 (19.12)		
IPO2						0.0660 (23.86)		
IPO3						0.0421 (15.81)		
IPO4						0.0284 (10.73)		
IPO5						0.0280 (10.36)		
1990s dummy		-0.0278 (-15.67)	-0.0741 (-8.23)			-0.0745 (-8.01)		
2000s dummy		-0.0086 (-3.64)	-0.0417 (-3.81)			-0.0274 (-2.48)		
Industry Dummies	No	No	No			Yes		
Adj. R^2	0.4376	0.4376	0.4450			0.4969		

Table 4: Predicted cash ratios and their deviations from actual cash holdings over time

This table summarizes the predicted cash ratios of sample firms from 1990 through 2004, and deviations of the actual cash ratios from those predicted by an out of sample model. Predicted cash holdings each year are derived from a Fama-McBeth model predicting cash ratios, the coefficients of which are the average coefficients from annual cross-sectional regressions estimated over the period 1980-1989. The cash ratio is computed as the ratio of cash and marketable securities to the book value of total assets. Estimates from this regression are as follows: Cash ratio = 0.3099 + 0.2334 Industry cash flow volatility + 0.0069 Market-to-book – 0.0092 Log size + 0.0579 Cash-flow/Assets – 0.2339 Net working capital/Assets – 0.3560 Capital expenditures/Assets – 0.3693 Leverage + 0.0361 R&D/Sales – 0.0269 Dividends/Assets – 0.2046 Acquisitions/Assets + 0.1155 Net equity/Assets + 0.1743 Net debt/Assets. The table summarizes differences between actual and predicted cash ratios, by year, for the whole sample (n = 58,414 firm-year observations), for firms in the S&P 500 index (n=4,496), and for firms paying and not paying a regular dividend (n= 14,611 and 43,803 respectively) during a particular year. T-statistics summarize the statistical significance of differences between predicted and actual cash ratios for the whole sample and each of the observed subsamples independently.

	Whole Sample			S&P 500 Firms			Firms Paying a Dividend			Firms not Paying a Dividend		
Year	Predicted	Actual - Predicted	t-statistic	Predicted	Actual - Predicted	t-statistic	Predicted	Actual - Predicted	t-statistic	Predicted	Actual - Predicted	t-statistic
1990	0.1497	-0.0155	-6.44	0.0987	-0.0236	-4.92	0.1092	-0.0114	-3.55	0.1689	-0.0174	-5.45
1991	0.1697	-0.0147	-5.98	0.1093	-0.0350	-8.97	0.1196	-0.0155	-4.9	0.1918	-0.0144	-4.4
1992	0.1749	-0.0140	-5.82	0.1159	-0.0390	-9.27	0.1263	-0.0218	-7.15	0.1960	-0.0107	-3.35
1993	0.1841	-0.0141	-6.01	0.1207	-0.0459	-10.73	0.1324	-0.0244	-7.9	0.2049	-0.0099	-3.27
1994	0.1765	-0.0245	-11.18	0.1183	-0.0504	-12.25	0.1255	-0.0348	-12.67	0.1953	-0.0208	-7.35
1995	0.1796	-0.0172	-7.64	0.1178	-0.0477	-10.84	0.1226	-0.0308	-10.45	0.1997	-0.0124	-4.34
1996	0.1905	-0.0063	-2.74	0.1204	-0.0484	-10.5	0.1241	-0.0301	-10.12	0.2123	0.0015	0.54
1997	0.1859	-0.0042	-1.78	0.1216	-0.0498	-11.21	0.1272	-0.0250	-7.43	0.2041	0.0022	0.75
1998	0.1725	-0.0056	-2.26	0.1199	-0.0475	-10.03	0.1150	-0.0304	-9.2	0.1900	0.0020	0.66
1999	0.1899	-0.0110	-4.33	0.1276	-0.0441	-7.91	0.1146	-0.0314	-9.15	0.2116	-0.0051	-1.64
2000	0.2005	-0.0072	-2.66	0.1389	-0.0369	-5.92	0.1174	-0.0383	-11.26	0.2216	0.0007	0.2
2001	0.2027	-0.0052	-1.74	0.1454	-0.0220	-3.23	0.1225	-0.0345	-9.13	0.2226	0.0020	0.55
2002	0.2024	-0.0038	-1.27	0.1485	-0.0068	-0.9	0.1310	-0.0358	-9.13	0.2200	0.0041	1.12
2003	0.2141	-0.0012	-0.38	0.1542	-0.0045	-0.61	0.1426	-0.0238	-5.76	0.2350	0.0054	1.41
2004	0.2234	0.0051	1.64	0.1571	-0.0077	-1.08	0.1440	-0.0212	-5.17	0.2494	0.0138	3.51

Table 5: Determinants of changes in predicted cash between 1990 and 2004

This table summarizes the determinants of the change in predicted cash ratios between 1990 and 2004. The change in the cash ratio is measured as the difference between the average cash ratio from 2000 through 2004 and the average cash ratio from 1980 through 1989. The cash ratio is computed as the ratio of cash and marketable securities to the book value of total assets. The determinants of the cash ratio are modeled as: Cash ratio = 0.3099 + 0.2334 Industry cash flow volatility + 0.0069 Market-to-book – 0.0092 Log size + 0.0579 Cash-flow/Assets – 0.2339 Net working capital/Assets – 0.3560 Capital expenditures/Assets – 0.3693 Leverage + 0.0361 R&D/Sales – 0.0269 Dividends/Assets – 0.2046 Acquisitions/Assets + 0.1155 Net equity/Assets + 0.1743 Net debt/Assets. Industry sigma is the mean of standard deviations of cash flow/assets over 10 years for firms in the same industry as defined by two-digit SIC code. Market to book is measured as: (book value of total assets - book value of equity + market value of equity)/book value of total assets. Real size is the natural log of the book value of total assets in 2004 dollars. Cash flow is defined as (earnings before interest and taxes - interest - taxes - common dividends). NWC is defined as net working capital minus cash and marketable securities. Capex is the ratio of capital expenditures to the book value of total assets. Leverage is defined as the ratio of total debt to the book value of total assets. Dividend is a dummy variable set to one if the firm paid a regular dividend in the year, and 0 if it did not. Acquisition activity is measured as the ratio of expenditures on acquisitions relative to the book value of total assets. Net debt issuance is computed as the annual total debt issuance minus debt retirement in the fiscal year, divided by the book value of total assets. Net equity issuance is calculated as equity sales minus equity purchases, divided by the book value of total assets.

		Whole Sample		S&P 500 Index	Non-S&P 500 Index	Difference		Dividend Paying Firms	Non-Dividend Paying Firms	Difference
Industry sigma		0.0206		0.0184	0.0208	0.0024		0.0145	0.0214	0.0069
Market to book		0.0025		0.0069	0.0020	-0.0049		0.0027	0.0014	-0.0013
Real size		-0.0072		-0.0067	-0.0076	-0.0010		-0.0092	-0.0120	-0.0028
Cash flow/ assets		-0.0021		0.0014	-0.0024	-0.0038		0.0005	-0.0014	-0.0019
NWC/ assets		0.0250		0.0232	0.0252	0.0020		0.0203	0.0220	0.0016
Capex		0.0128		0.0120	0.0128	0.0008		0.0107	0.0143	0.0035
Leverage		0.0077		-0.0026	0.0088	0.0114		-0.0037	0.0160	0.0197
R&D/ sales		0.0089		0.0012	0.0096	0.0084		0.0002	0.0101	0.0099
Dividend		0.0051		0.0057	0.0049	-0.0008		n/a	n/a	n/a
Acquisition activity		-0.0008		-0.0008	-0.0008	0.0000		-0.0018	-0.0006	0.0012
Net equity issuance		0.0006		-0.0016	0.0007	0.0023		-0.0012	-0.0018	-0.0006
Net debt issuance		-0.0015		-0.0013	-0.0015	-0.0002		-0.0023	-0.0009	0.0014
TOTAL				0.0560	0.0725	0.0166		0.0307	0.0684	0.0377

Figure 1: Average cash ratios by firm size quintile from 1980 to 2004

The sample includes all Compustat firm-year observations from 1980 to 2004 with non-missing data for the book value of total assets and sales revenue for firms incorporated in the U.S. Financial firms (SIC code 6000-6999) and utilities (SIC codes 4900-4999) are also excluded from the sample, yielding a panel of 110,599 observations for 13,237 unique firms. The cash ratio is measured as the ratio of cash and marketable securities to the book value of total assets. Quintiles are sorted on firm size based on the book value of sample firm assets in the fiscal year prior. The first quartile (Q1) is comprised of the smallest firms in the sample while the fifth quartile (Q5) is comprised of the largest firms in the sample.