Why do U.S. firms hold so much more cash than they used to?

Thomas W. Bates, Kathleen M. Kahle, and René M. Stulz*

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* Respectively, assistant professor and associate professor, Eller College of Business, University of Arizona, and Everett D. Reese Chair of Banking and Monetary Economics, Fisher College of Business, Ohio State University, NBER, and ECGI. We are grateful to Viral Acharya, Heitor Almeida, Murillo Campello, Gene Fama, Mike Lemmon, and Bill Maxwell for helpful comments.

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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, firms at the end of the sample period can pay back all of 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, but is more pronounced for firms that do not pay dividends. The average cash ratio increases over the sample period because firms change: their cash flow becomes riskier, they hold fewer inventories and accounts receivable, and are increasingly R&D intensive. The precautionary motive for cash holdings appears to explain the increase in the average cash ratio.

Considerable media attention has been devoted to the increase in cash holdings of U.S. 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 the cash holdings of American firms have evolved since 1980 and whether existing models of cash holdings help explain this evolution. We find that there is a secular increase in the cash holdings of the typical firm from 1980-2004. In a regression of the average cash-to-assets ratio on a constant and time, 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 over our sample period, from 10.48% in 1980 to 24.03% in 2004.

This increase in cash holdings is paradoxical. We would expect improvements in financial technology to reduce cash holdings. For example, firms can hedge more effectively as more types of derivatives become available, so the precautionary demand for cash should fall. We would also expect information technology developments to have made it easier for firms to forecast their cash needs and to 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 uses the ratio of debt to assets or debt to equity to measure leverage. Using these popular definitions of leverage, there is little evidence of a decrease in leverage for the firms in our sample. 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 U.S. firms is negative in 2004. In other words, on average, firms could have paid off their debt with their cash holdings.

After documenting the increase in cash holdings and decrease in net debt, we investigate why the increase in cash holdings has occurred. Much attention has been paid to the cash hoards (in excess of $30

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

billion in mid-2006) of large 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. While large firms have experienced a substantial recent cash buildup, the average cash ratio has a significantly positive time trend for all size quintiles. Recently, Foley, Hartzell, Titman, and Twite (2007) show that one reason for the cash buildup is that U.S. firms had profits trapped abroad that would have been taxed had they been repatriated. Assuredly, tax laws made it advantageous for multinational firms to accumulate liquid assets abroad rather than repatriate profits. However, in our sample, we find that firms with no foreign taxable income also experience a secular increase in the cash-to-assets ratio.

The increase in cash holdings is closely related to the disappearing dividends and new listings phenomena documented by Fama and French (2001, 2004). While 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 dividend payers. In other words, average cash holdings of established stable firms barely increase over our sample period, and newly listed firms tend not to pay dividends. For firms that do not pay a regular dividend, the mean cash ratio more than doubles from 1980 to 2004 and the median 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 evaluate whether the increase in cash holdings is due to a change in the composition of listed firms, we sort the firms in our sample into discrete cohorts based on their listing year. We then track the cash holdings for the average firm in each cohort beginning six years after their listing (to give them time to use the cash raised in the IPO). Our results suggest that the average cash ratios for cohorts listing later in the sample is higher than the average cash ratio for cohorts with an IPO earlier in the sample period. We therefore infer that a portion of the increase in cash holdings can be explained by changes in the composition of firms listed in U.S. markets.

[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.

To understand why cash holdings increase, we follow two separate approaches. Both approaches start from the equation estimated in Opler, Pinkowitz, Stulz, and Williamson (1999) (henceforth 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 recent capital raising as a predictor of cash holdings, we do so and find that doing so increases the adjusted R-square of the regression by about 4%. With this approach, there is no evidence of an increase in the demand for cash by corporations that is not captured by existing models of the demand for cash.

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 parameters of the model estimated over the 1980s do help explain why cash holdings have increased 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 prediction errors are that the model overstates cash holdings by dividend payers by about 3% of assets, understates holdings of firms within five years of their IPO by 8%, and understates holdings of high-tech firms by slightly less than 5%.

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 explain the increase in cash holdings. Four 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 fewer inventories and accounts receivable. Since the non-cash components of working capital and cash are substitutes in that these components can be converted into cash quickly, the decrease in the non-cash components of working

capital leads to an increase in cash holdings. Specifically, 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. Fourth, R&D expenditures increase and firms with higher R&D expenditures hold more cash.

The paper proceeds as follows. In the next section, we briefly review the theoretical determinants of cash holdings and the existing evidence. We then describe how our sample is constructed in Section II and show that there is a secular trend in cash holdings and net debt for our sample. In Section III, we examine subsamples to understand whether this trend is driven by certain types of firms. In Section IV, we estimate the OPSW model, allowing for changes in slopes and intercepts for the 1990s and 2000s and taking into account fund-raising and acquisition activities. In Section V, we estimate the model of cash holdings for the 1980s and use it to identify the changes in firm characteristics that explain the increase in cash holdings. We conclude in Section VI.

I. 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 the optimal demand for cash when a firm incurs transaction costs associated with converting a non-cash financial asset into cash and uses cash for payments. Since there are economies of scale with the transactions motive, 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. Consistent with this perspective, OPSW find that firms with riskier cash flows and poor access to external capital hold more

cash. The precautionary motive also suggests that firms with better investment opportunities hold more cash because adverse shocks and 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 in order to fund investment in all states of the world, including those with low cash flow.

c) The tax motive. Foley, Hartzell, Titman, and Twite (2007) find that U.S. corporations that would incur a tax consequence associated with repatriating foreign earnings hold higher levels of cash. This is particularly true for affiliates where the implied tax consequences of repatriation are the highest. Consequently, multinational firms are more likely to accumulate cash.

d) The agency motive. As argued by Jensen (1986), entrenched managers would rather retain cash than increase payouts to shareholders when the firm has poor investment opportunities. These discretionary cash holdings are typically estimated as the excess or residual cash holdings derived from models controlling for the transactions costs and precautionary motives for holding cash balances. Numerous recent studies find evidence consistent with this motive. 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 managers are more likely to build excess cash balances, but spend excess cash quickly.

These four motives for holding cash have different implications for the causes and consequences of the secular increase in cash that we document for U.S. firms. We expect that firms and financial intermediaries have become more efficient in handling transactions, reducing the transactions-based requirements for cash holdings. The growth in derivatives markets and improvements in forecasting and control suggest that everything else equal, the precautionary motive would also require lower cash holdings. 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 is 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 newly listed firms also have permanently higher idiosyncratic risk, so that the market-wide increase in idiosyncratic risk is due to a change in the composition of listed firms over time. These firms would be more concerned about being financially constrained and hence would hold more cash. Given these conclusions, we expect cash holdings to be higher for newly public firms, and for firms that go public later in the sample.

As discussed in Foley et al. (2007), over our sample period U.S. multinationals elected to defer the taxes associated with repatriated foreign earnings, suggesting that firms with foreign operating subsidiaries are more likely to hold higher cash balances throughout the sample period. The 2004 Job Creation Act allowed firms to repatriate these foreign cash balances in 2003 and 2004 at a substantially lower marginal 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.

For the increase in the average cash ratio to be explained by Jensen's (1986) free cash flow theory, firms generating free cash flow would have to face little pressure to pay out accumulated cash holdings. These cash holdings cannot be explained by transaction, precautionary, or tax motives that would otherwise make holding cash balances optimal for a firm's equity holders, but rather reflect management's predilection to hold discretionary cash balances. The use and value of excess cash holdings have been explored extensively in the literature. We explore the characteristics of excess cash holdings over time to determine whether U.S. managers have become more entrenched and better able to hoard discretionary cash flows. In particular, for agency theory to explain the increase in cash holdings, we would expect firms with excess cash to experience a greater growth rate in cash holdings.

II. The increase in cash holdings and the decrease in net debt

We construct our sample from the Compustat annual industrial files on the WRDS database for the period 1980-2004. These data include surviving and non-surviving firms 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 nine years and increases in fifteen years over the sample period. At the end of the sample period the average cash ratio is 24.03%.

[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.

The same trend is conveyed by the median cash ratio, which is reproduced in column four. The median ratio is 5.48% in 1980 and actually increases more than the mean. The median cash ratio in 2004 is 269% of the median cash ratio in 1980, while the mean is 229% of its value in 1980.

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 corresponds to a yearly increase of 0.45% and has a p-value below 0.01. The R-square of the regression is 86%. For the median, the slope coefficient represents a 0.23% yearly increase, but it also has a p-value below 0.01. The R-square is 55%. This evidence is consistent with 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 although leverage falls over the period 2001 to 2004, leverage in 2004 is almost the same as leverage ten years earlier. Median leverage, reported in column six, is low in the first half of the 1990s, and then increases before falling from 1998 to 2004. When we consider the average net debt ratio, which nets cash from debt and is shown in column seven, we obtain a dramatically different perspective regarding the time trend in leverage for U.S. firms. The net debt ratio is 16.45% in 1980. It falls during fourteen 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 represents a decrease of -0.56% per year and has a p-value of less than 0.01. The last column of the table shows the median net debt ratio. This ratio also falls from 17.84% to -0.30% over the sample period.

III. How pervasive is the increase in cash holdings?

The evidence summarized in Section II illustrates a secular increase in the average cash ratio and a corresponding 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. The financial press has recently

focused on the hoards of cash held by the largest U.S. firms. It is possible that the increase in cash holdings is due primarily 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.

Table 2a and Figure 1 illustrate the average cash ratios for the firm size quintiles over our sample period. The average cash ratio increases across all firm size quintiles, but the increase is more pronounced for smaller firms. The increase in the average cash ratio for the largest firms is especially strong in the later years of our sample. From 1980 to 2004, 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 outliers cannot have much of an impact. The median cash ratio, however, is lower than the average cash ratio and the distribution of cash ratios appears skewed to the right. Though not reproduced in Table 2a, the medians also increase through time across all size quintiles. However, the time trend is not significant for the medians for the two largest size quintiles. Given this evidence we conclude that the secular increase in cash ratios is not driven by the largest firms in our sample, but instead is more pronounced in smaller firms.

The recent increase in cash holdings that the financial press has focused on is most visible when we compare 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 have more cash because of the IPO and because they often issue equity in a seasoned 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. The average cash ratio more than doubles for the non-IPO firms during our sample period from 9.94% to 21.69% and nearly doubles for the IPO firms from 21.07% to 40.25%. Though we do not reproduce the medians, the median cash ratio for IPO firms triples over our sample period. When we estimate the time trend, it is significant for the average and the median for both groups of firms. Given this evidence we conclude that the increase in cash holdings is not due exclusively to the capital raising activities of the IPO firms in our sample.

We turn next to the role of dividends. Fama and French (2001) show that firms have become less likely to pay dividends. 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. 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) for firms not paying a dividend. In 1980 the median cash ratio is 5.98%, but in 2004 it is 19.39% (a 224.25% increase).

The evidence that non-dividend paying firms increase their cash ratio more than dividend paying firms is consistent with the evidence in Brown and Kapadia (2006) that the idiosyncratic risk of newly listed firms, which are less likely to pay dividends, has increased over time. We investigate this possibility directly by examining whether firms that recently went public have higher cash ratios. Following Brown and Kapadia, we construct cohorts of firms according to their listing date. The 1960s cohort includes all firms that have a listing prior to 1970. The 1970s cohort includes all firms that list from 1970 to 1975. We continue in this manner, constructing cohorts of firms that list within a five-year period. We then track the cash holdings of cohorts from the sixth year following the listing year, to ensure that the cash accumulated at the IPO has been used. Figure 2 summarizes the average cash ratios of our

cohorts. First, each successive cohort has a higher average cash ratio (except for the 1990 cohort in one year). Second, while cash ratios of pre-1980 cohorts first decrease before experiencing a sharp increase at the end of the sample period, the cash ratios of the other cohorts mostly increase, although they also experience a sharp increase at the end of the sample period. The figure illustrates that the later cohorts do not see a reduction in cash ratios as they mature, so that they hold more cash than firms in earlier cohorts at the same stage of their lifecycle. Thus, while the increase in cash holdings is not being driven by the capital raising activities of IPO firms per se, the increase in cash holdings can be attributed to the changing nature of newly listed firms over time. This result is the cash ratio counterpart of the disappearing dividends result of Fama and French (2001).

During the 1990s, an increasing proportion of newly public firms came from high tech industries. If technology firms are more reliant on precautionary cash holdings, then it is possible that the above results are due specifically to an increase in the proportion of high technology firms in our sample. We use the definitions in Loughran and Ritter (2004) to categorize technology firms, and define "old-economy" manufacturing firms as firms with SIC codes 2000-3999 that are not high technology firms. In 1980, the proportion of firms classified as high tech relative to manufacturing firms was 28%. By 2000 this proportion had increased to 45%. We find that in every year of our sample the average cash ratio of high tech firms is higher than the average cash ratio of other manufacturing firms. In the first five years (i.e., 1980-1984), the average cash ratio of high tech firms exceeds the average cash ratio of other manufacturing firms by 54%; in the last five years, it does so by 60%. Throughout the sample period, the cash ratios of both types of firms increase. The average cash ratio increases only slightly more for high tech firms than for other manufacturing firms – from the first five years to the last five years, the increase in the average cash ratio is 88% for high tech firms and 80% for other manufacturing firms. There is a significant positive time trend for the average and median cash ratios for both groups of firms and both groups exhibit a negative trend in net leverage. Consequently, while the increase in cash holdings and

the decrease in net leverage can be ascribed to a change in the composition of listed firms over time, this effect cannot be attributed specifically to an increase in the proportion of technology firms in our sample.

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 more likely to be financially constrained than firms with positive net income. Almeida, Campello, and Weisbach (2004) show that financially constrained firms hold more cash. Using negative net income as a proxy for financial constraint, we split the sample into firms with negative net income and other firms. We 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. Over the sample period, the average cash ratio of these firms almost triples while the median cash ratio (not reported) almost quadruples. 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.

Finally, Foley et al. (2007) point out that over our sample period multinationals benefited from retaining the cash they earned abroad given that repatriation of foreign earnings would often result in a negative tax consequence. At the end of our sample period, firms were allowed to repatriate cash held in foreign countries at a lower tax rate. We use 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 in our sample period.

The agency explanation for the increase in cash holdings would predict that cash holdings should increase for firms with high free cash flow. Our evidence on the changes in cash holdings for subsamples of firms is largely inconsistent with the agency explanation. In particular, we find that the increase in cash holdings is greater for firms that are financially constrained, as proxied by negative net income, than for other firms. Further, one would expect older, larger, more established firms to be more likely to have

agency problems of free cash flow that could lead to an increase in cash holdings. However, our evidence is that the increase in cash holdings is much more significant for smaller and recently listed firms.

IV. 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. Data requirements limit the size of the sample. For example, the unrestricted sample has 3,693 observations in 2004, compared to 3,218 observations in the sample with sufficient data to estimate the OPSW regressions. The sample that meets the data requirements has an average increase in the cash ratio of 120.72% over the sample period, close to the increase of 129.29% for the unrestricted sample.

The firm characteristics modeled in the regression are motivated by the transaction and precautionary motives for corporate cash holdings discussed in Section I. We incorporate the ratio of a firm's acquisition expense to assets as an additional variable in the model since acquisitions and capital expenditures would seem to be substitutes.

The variables used 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 book value of 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 value of assets, where acquisition expenditures reflect only the cash outflows associated with acquisitions.

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 an optimum. Given capital constraints, one would not expect firms 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.

We report our regression results in Table 3. Our standard errors allow for clustering by firm and by year. 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 do not use dummy variables for years or for industries in this regression. As in OPSW, market-to-book and cash flow risk have consistently positive coefficients across our specifications. The sign and significance of our coefficients on size, net working capital, leverage, R&D, and the dividend dummy are also similar to those documented in OPSW. 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 divided by assets minus cash. This measure is the one that OPSW use. This measure generates extreme outliers for firms with almost no assets but cash. Foley et al. (2007) use the logarithm of this measure, which reduces the magnitude of this problem but does not eliminate it in our sample, which includes smaller firms with assets less than $100 million. If we use this measure, the regression coefficients are qualitatively the same but the coefficients are much larger.

We also perform several robustness checks. We 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 have no impact on the regression coefficients we examine. We do not report the regression with yearly dummies because we allow for changes in the intercept in the regressions we discuss next. Finally, we use 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 this alternate measure.

To investigate whether there is a regime change in the 1990s or the 2000s for the demand for cash, we estimate the 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 equals one for years 1990 and after; the second indicator variable equals 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 increases for reasons not captured by the estimated model for cash demand, we would expect these indicator variables to have positive and significant coefficients. We find that the estimates of the indicator variables are significantly negative, indicating a decrease of 2.78% for the 1990s and of 0.86% for the 2000s. Consequently, the regression implies that firm characteristics 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 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, as is the coefficient on size. Interestingly, by the 2000s, the traditional negative relation between cash holdings and size is not significant. 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 III 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 five percent. As expected, IPO firms hold more cash, but the cash ratio falls as the IPO gets more distant.[4] 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 for the 1990s and 2000s. These intercepts stay negative and significant.

There are several important lessons from the regressions of Table 3. 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 change 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.

[4] In unreported specifications we find that the correlation between cash and a firm's temporal distance from the IPO year is insignificant beyond the sixth year.

Though we do not report the results in a table, we perform two additional experiments. First, we estimate the first regression of Table 3 cross-sectionally for each year. This approach confirms the results of the regressions we reproduce in the table. In particular, the intercept of the regression falls over time. Interestingly, the explanatory variables explain more of the cross-sectional distribution of cash holdings in recent years. The evolution of two coefficients is particularly interesting. First, the cash flow risk coefficient tends to be insignificant in the early years of the sample. Second, the firm size coefficient becomes significantly positive in 2000. The latter result most likely reflects the increase in cash holdings of large firms starting in 2000. Second, we estimate the regression using changes instead of levels, allowing for the intercepts to differ in the 1990s and in the 2000s. We find that the intercept for the 1990s is not significantly different from the intercept for the 1980s, so that the increase in cash holdings in the 1990s can be explained by changes in the determinants of cash holdings. There is an increase in the intercept for the 2000s, indicating that there is an increase in cash holdings that cannot be explained by changes in the determinants of cash holdings. Allowing for changes in the intercepts does not add meaningfully to the explanatory power of the regression. These additional experiments show that our regression model captures the changes in cash holdings well before 2000, but that there are limits to its ability to explain the changes in cash holdings in the 2000s.

V. Why did the cash ratio increase?

Section IV 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 in the 1990s and 2000s differ from cash holdings predicted by that model. 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 and the coefficients are not substantially different from the regression coefficients reported in Model 1 of Table 3.

Column 2 of Table 4 reports the predicted cash ratios for the whole sample. 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. For example, in 2004, the difference between the predicted and actual cash ratios is half a percent, but is not significantly different from zero. Remarkably, all differences that are statistically significant 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 ratio late in the post-estimation period with deviations occurring not for the high cash ratios of the last few years but for 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.

The fact that a model estimated for the 1980s overpredicts cash holdings in the 2000s is inconsistent with an agency explanation for the increase in cash holdings if the model accurately describes optimal cash holdings by firms. In particular, measured using the model estimated for the 1980s as a benchmark, excess cash holdings would be low in the 2000s – i.e., their average would be negative. With the agency explanation, the opposite would have to be true.

In the next three columns of Table 4, we focus on firms in the S&P 500 index that meet our data restrictions. The cash holdings model estimated using the 1980s data predicts future 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 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.

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.

Though we do not report the results in the table, we also compare the predicted cash ratio to the actual cash ratio for high tech firms and for all other firms. Except for 1990 and 1991, the model underpredicts cash holdings by high tech firms. Over the last five years of the sample period, the underprediction averages 4.53% of assets. Consequently, the model overpredicts the cash holdings of the other firms. Over the last five years, the average overprediction is 1.92% of assets.

The model predicts a 49.23% increase in the average cash ratio from 1990 to 2004 for the whole sample. 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. Consider a firm that has the 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 four variables. In order of importance, these variables are the change in net working capital net of cash, the change in cash flow risk, the change in capital expenditures, and the change in R&D.

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. 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

[5] See, for instance, Smith and Stulz (1985) and Froot, Scharfstein, and Stein (1993). Minton and Schrand (1999) examine cash flow volatility and its deadweight costs empirically.

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 to almost 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 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.

The evidence presented is consistent with an explanation for the change in cash holdings that relies on the precautionary motive and changes in firm characteristics which affect the demand for cash by firms. If firms are holding cash because of the precautionary motive and their risk has increased, we would expect the volatility of cash holdings to have increased as well. To investigate this possibility, we proceed as follows. For each firm in year t, we compute the standard deviation of cash holdings for the prior five years. We require at least three observations for a firm to be included. We then compute an equally-weighted average of the standard deviation across firms in an industry to obtain that industry's standard deviation of cash. We would expect (1) that the industry standard deviation of cash holdings increases over the sample period and (2) that there is a high correlation between the standard deviation of cash holdings and cash flow risk. We find that the mean and the median of the standard deviation of cash holdings increase over time. The average of the median is 15.32% in the 1990s, 25.29% in the 1990s, and 35.00% in 2000. We also find that the correlation between the median standard deviation of cash holdings and the median cash flow volatility is 88%.

Lastly, we conduct one more investigation (but do not report the results in a table) that is helpful to understand the extent to which agency theory can explain the increase in cash holdings. In a given year, we would expect firms with high excess cash (i.e., firms with a high residual in the cross-sectional regression) to be more likely to have high agency problems. For agency theory to explain the growth in cash holdings, these firms should experience higher growth in cash holdings relative to firms with low excess cash. We investigate this possibility as follows. Every five years, we rank firms according to their excess cash using the residuals from the cross-sectional regression estimated using parameters from the modified OPSW discussed earlier. We then estimate the growth in cash holdings over the next five years for the average and median firm in each excess cash quintile. We find that for each quintile, there is a negative relation between excess cash and the growth rate of the cash ratio. This result is inconsistent with an agency explanation for the increase in cash holdings over time.

VI. 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 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 the firms in our sample to eventually reduce their cash holdings.[6] The decrease in inventories, however, 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 increasing in R&D. Given lower asset tangibility, R&D investment opportunities are costly to finance using external capital so that such firms require a greater cash buffer against future shocks to internally generated cash flow.

Our evidence shows that the increase in cash ratios, while dramatic, can be explained by the change in firm characteristics over our sample period. 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. There is, of course, substantial cross-sectional variation in cash holdings that is not explained by our model. Consequently, our results are not inconsistent with the hypothesis that some firms hold too much cash because of agency problems. Modeled residuals (often referred to as "excess cash"), however, are negatively correlated with the future growth rate in the cash ratio suggesting that agency problems cannot provide a systematic explanation for the growth in cash holdings over the sample period.

We also document a dramatic decrease in net debt for U.S. firms over the sample period. If cash is simply negative debt, leverage ought to be measured using net debt. In this case, the standard measures of

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

leverage used in the finance literature miss a stunning evolution in the leverage of U.S. firms. By 2004, using net debt, the average firm had no leverage. Assuredly, cash enables firms to forestall distress and default. It follows that the growing importance of cash should be taken into account when evaluating the financial condition of firms and when assessing the capital structure decisions of firms.

References

Acharya, A., H. Almeida, and M. Campello, 2006, Is cash negative debt? A hedging perspective on corporate financial policies, London Business School working paper, London, England.

Almeida, H., M. Campello, and M. S. Weisbach, 2004, The cash flow sensitivity of cash, Journal of Finance 59, 1777-1804.

Baumol, W. J., 1952, The transactions demand for cash: An inventory theoretic approach, Quarterly Journal of Economics 66, 545-556.

Brandt, M. W., A. Brav, and J. R. Graham, 2005, The idiosyncratic volatility puzzle: Time trend or speculative episodes?, unpublished working paper, Duke University, Durham, NC.

Brown, G., and N. Kapadia, 2007, Firm-specific risk and equity market development, Journal of Financial Economics, forthcoming.

Campbell, J. Y., M. Lettau, B. G. Malkiel, and Y. Xu, 2001, Have individual stocks become more volatile? An empirical exploration of idiosyncratic risk, Journal of Finance 56, 1-43.

Dittmar, A., and J. Mahrt-Smith, 2007, Corporate governance and the value of cash holding, Journal of Financial Economics, forthcoming.

Dittmar, A., J. Mahrt-Smith, and H. Servaes, 2003, International corporate governance and corporate cash holdings, Journal of Financial and Quantitative Analysis 38, 111-133.

Fama, E. F., and K. R. French, 2001, Disappearing dividends: Changing firm characteristics or lower propensity to pay?, Journal of Financial Economics 60, 3-43.

Fama, E. F., and K. R. French, 2004, New lists: Fundamentals and survival rates, Journal of Financial Economics 73, 229-269.

Foley, C. F., J. Hartzell, S. Titman, and G. J. Twite, 2007, Why do firms hold so much cash? A tax based explanation, Journal of Financial Economics, forthcoming.

Froot, K. A., D. S. Scharfstein, and J. C. Stein, 1993, Risk management: Coordinating corporate investment and financing policies, Journal of Finance 48, 1629-1658.

Harford, M., S. Mansi, and W. F. Maxwell, 2006, Shareholder rights and corporate cash holdings, working paper, Eller College of Management, University of Arizona, Tucson, AZ.

Irvine, P. J., and J. E. Pontiff, 2005, Idiosyncratic return volatility, cash flows, and product market competition, unpublished working paper, Boston College, Newton, MA.

Jensen, M., 1986, Agency costs of free cash flow, corporate finance and takeovers, American Economic Review 76, 323-329.

Loughran. T. and J. Ritter, 2004, Why has IPO underpricing changed over time?, Financial Management 33, 5-37.

Miller, M. H., and D. Orr, 1966, A model of the demand for money by firms, Quarterly Journal of Economics 80, 413-435.

Minton, B. A., and C. Schrand, 1999, The impact of cash flow volatility on discretionary investment and the costs of debt and equity financing, Journal of Financial Economics 54, 423-460.

Mulligan, C. B., 1997, Scale economies, the value of time, and the demand for money: Longitudinal evidence from firms, Journal of Political Economy 105, 1061-1079.

Opler, T., L. Pinkowitz, R. M. Stulz, and R. Williamson, 1999, The determinants and implications of corporate cash holdings, Journal of Financial Economics 52, 3-46.

Pinkowitz, L., R. M. Stulz, and R. Williamson, 2006, Do firms in countries with poor protection of investor rights hold more cash?, Journal of Finance, forthcoming.

Smith, C. W., and R. M. Stulz, 1985, The determinants of firms' hedging policies, Journal of Financial and Quantitative Analysis 20, 391-405.

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 of 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 firms' 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 the 1% 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 the 1% 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 (EBITDA - 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 firm and year 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 (EBITDA - 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.

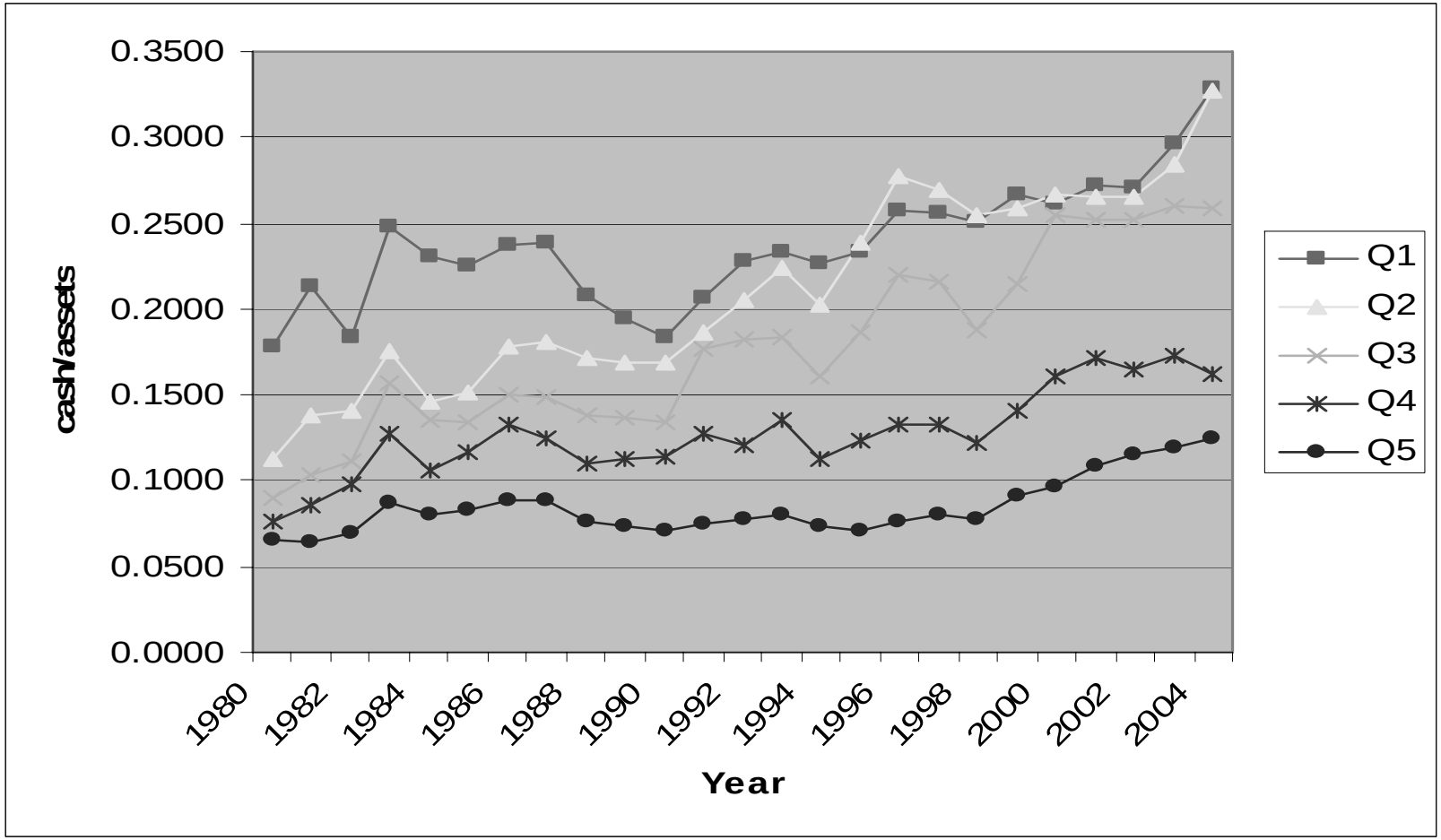

Figure 2: Average cash ratios by IPO cohort

The figure summarizes the average cash/assets ratio for cohorts of firms constructed by listing date. The 1960s cohort includes all firms that have a listing prior to 1970. The 1970s cohort includes all firms that list from 1970 to 1975. We then construct cohorts of firms that list within a five-year period. Cash holdings for each firm in each cohort are estimated beginning in the sixth year after the listing date. 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.