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# Stock Liquidity and Corporate Cash Holdings

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**Abstract**

**Stock Liquidity and Corporate Cash Holdings**

The paper contributes to the literature on corporate cash holdings by showing that there is a financial markets channel that affects corporations' cash holdings. Leaning on the literature on stock price feedback to firm fundamentals, we advance the hypothesis that firms with more liquid stocks hold more cash, ceteris paribus, as ammunition to defend against negative cascades or stimulate positive ones. This contrasts with an alternative view that firms with more liquid stocks are less financially constrained and therefore hold relatively less cash. The evidence favors the cascade/cash as ammunition hypothesis, also with respect to its predictions regarding growth opportunities and cash holdings. As a robustness check, we use the introduction of tick size decimalization in 2001 as a natural experiment where liquidity was exogenously shocked. We also find evidence of two-way causality; a higher level of stock liquidity leads to more cash holdings, and vice versa.

Keywords: Stock liquidity, cash holdings, feedback, cascades, information
JEL: G1, G3

# 1 Introduction

Over the past three decades, US corporations have increased the fraction of their assets held as cash (Bates, Kahle, and Stulz, 2009). Much has also been made by the financial press of these seemingly large cash holdings over the course of the financial crisis. The literature discusses both potential costs and benefits of corporate cash holdings; for example, agency costs (Jensen, 1986), on the one hand, and benefits from avoiding the need to tap into external markets, on the other (Myers and Majluf, 1984; Opler, Pinkowitz, Stulz, and Williamson, 1999; Sufi, 2009; Lins, Servaes and Tufano, 2010). With respect to the determinants of corporate cash holdings, the literature has predominantly focused on firm characteristics; for example, size, leverage, market-to-book, cash flow volatility, and measures of financial constraints (Opler, Pinkowitz, Stulz and Williamson, 1999; Almeida, Campello, and Weisbach, 2004; Han and Qiu, 2007; Acharya, Almeida, and Campello, 2007; Bates, Kahle and Stulz, 2009). In this paper, we argue that there is also a channel from financial markets that affect corporate cash holdings. In particular, we provide evidence that the liquidity of a corporation's stock affects its cash holdings.

Theory suggests that a corporation's cash holdings and the liquidity of its stock are related. For example, the larger is the fraction of the firm's assets that is comprised of cash, the smaller should informational asymmetries be and, thus, according to standard market microstructure reasoning (Bagehot, 1971; Glosten and Milgrom, 1985; and Kyle, 1985), the more liquid should the stock be. Evidence in support of this view is provided by Gopalan, Kadan, and Pevzner (2012). But causality can also flow the other way, and this is not examined or controlled for by Gopalan et al. In contrast, in this paper we make the case for two-way causality, by examining the empirical relation between cash holdings and stock liquidity.

Our motivation for investigating the effect of stock liquidity on corporate cash holdings comes from two strands of the theoretical literature. The first idea relates to the theory of positive feedback from stock prices to cash flows developed by Subrahmanyam and Titman (2001). The view that stock prices can affect fundamentals is also central in Hirshleifer, Subrahmanyam, and Titman's (2006) theory of stock price feedback and sentiment traders.

As discussed by these authors, a firm's stock price can, for example, affect customers' perceptions of the firm's products and services and its ability to retain or attract key personnel. As demonstrated by Goldstein, Ozdenoren, and Yuan (2013), the feedback mechanism can also work through the cost and availability of capital.[1] Empirical support for the feedback hypothesis is provided by, for example, Fang, Noe, and Tice (2009). Subrahmanyam and Titman (2001) show that positive feedback can affect cash flows from assets-in-place as well as the value of future growth opportunities and that this can give rise to positive feedback loops, or cascades, between stock prices and fundamentals. Our idea is that corporations therefore have an incentive to hold cash to nip negative cascades in the bud, or to attempt to stimulate positive cascades if the opportunity should arise, for example by buying their own stock in the market. Because it takes more cash to move the price of liquid stocks, under the cascade hypothesis we expect a corporation's cash holdings to be increasing in the liquidity of its stock. In addition, Goldstein et al. argue that negative cascades ("trading frenzies") are more likely to occur in the first place for more liquid stocks. This reinforces the need for corporations with more liquid stock to hold more cash, as ammunition to ward off negative cascades.

The second theoretical idea relates to result from the market microstructure literature that the liquidity of a stock is inversely related to the degree of information asymmetries between investors and market makers (Glosten and Milgrom, 1985; Kyle, 1985). Using the logic in Grossman and Stiglitz (1980), we would expect a relatively high degree of information asymmetry to be associated with relatively large costs of information acquisition. Thus, we would expect this to be associated with a relatively large degree of information asymmetry between insiders and investors, as well, implying a relatively large adverse selection problem with respect to outside financing (Myers and Majluf, 1984). In other words, firms with less liquid stocks are more "financially constrained;" they face larger costs of external financing, and would therefore be expected to hold more cash. This is the opposite prediction of what we get from the cascade hypothesis. We seek to see which

[1] These ideas are also present in the popular press. See, for example, "Does it matter to a company if its stocks lose value " by Brian Palmer on slate.com, 9 August, 2011 (www.slate.com/articles/news_and_politics/explainer/2011/08/watch_out_for_falling_stock_prices.html).

of these two potential effects dominate in the data.

These two theoretical ideas also involve differing perspectives on the role of cash with respect to growth opportunities and investments. Subrahmanyam and Titman (2001) show that cascades have bigger impact for firms with larger intrinsic growth opportunities. The cascade perspective is thus essentially that firms hold cash to protect or enhance (the value of) growth opportunities. The information/financial constraint perspective represents the traditional precautionary motive emphasized in the literature that holding cash protects the ability to invest, or existing shareholders' share of the NPV from new investments (Myers and Majluf, 1984). Hence, under the cascade hypothesis, we would expect the cash ratio sensitivity to stock liquidity to be higher for firms with higher growth opportunities; whereas, under the information/financial constraints hypothesis, we would expect the opposite. In either case, we expect to see firms with higher growth opportunities holding more cash, consistent with what is already documented in the literature (Opler, Pinkowitz, Stulz, and Williamson, 1999; Bates, Kahle, and Stulz, 2009).

We employ two standard measures of stock liquidity, namely Amihud's (2002) *ILLIQ* measure of price impact and the relative effective bid-ask spread (Chordia, Roll, and Subrahmanyam, 2001). *ILLIQ* has the advantage of being computable for all CRSP stocks. The relative effective bid-ask spread is calculated using the NYSE's TAQ database, which limits both the available time period and the set of stocks. However, our findings do not depend in a significant way on which liquidity measure is used. To control for information flow, in some tests we also use Roll's (1988) price-nonsynchronicity measure (as modified by Durnev, Morck, and Yeung, 2004). This measure is typically interpreted as capturing the private information content of prices (Morck, Yeung, and Yu, 2000; Durnev, Morck, and Yeung, 2004; Bushman, Piotroski, and Smith, 2002). The qualitative findings on the effects on cash holdings of stock liquidity do not depend on whether the price-nonsynchronicity measure is included in the regressions.

The price-nonsynchronicity measure is interesting to consider also because there is evidence that increased price-nonsynchronicity is associated with more efficient investments (Durnev, Morck, and Yeung, 2004), the idea being that high price-nonsynchronicity implies more informative stock prices which, in turn, help managers make more efficient investment decisions, as per the theories of Dow and Gorton (1997) and Subrahmanyam and Titman (1999). Empirical support for this view is also provided by, for example, Chen, Goldstein, and Jiang (2007) and Bakke and Whited (2010). In addition, Fresard (2012) provides evidence that price-nonsynchronicity has an impact on cash savings (yearly changes in cash holdings). With respect to cash holdings, as we study in this paper, we find that stock liquidity has a more consistently statistically significant effect than price-nonsynchronicity.

We carry out several pieces of analyses. First, we regress firms' cash ratios on measures of lagged stock liquidity and a host of control variables, including price-nonsynchronicity and all the main variables used by Bates, Kahle, and Stulz (2009). Cash holdings and other accounting data are sourced from COMPUSTAT, with CRSP and TAQ being used to calculate measures of stock liquidity. We also use Thomson Reuters (13f) to obtain measures of institutional ownership, as this may affect the propensity of cascades in a stock, and IBES for analyst coverage data. These first regressions are run over several different time periods, determined by the availability of the liquidity and control variables. Regardless of which time period,- stock liquidity measure,- or set of control variables we use, we find that firms with more liquid stocks hold more cash as a fraction of their assets. This is consistent with the cascade perspective.

Second, we examine the impact of stock liquidity on cash holdings for firms with different growth opportunities, as measured by market-to-book ratios and R&D expenditures. Again, consistent with the cascades perspective, we find that the cash ratio sensitivity to stock liquidity is higher for firms with higher growth opportunities (higher market-to-book ratios or R&D expenditures). Endogeneity is addressed in both the first and second set of regressions by using lagged values of the liquidity measures.

Third, to further address endogeneity concerns, we follow Chordia, Roll, and Subrahmanyam (2008) and Fang, Noe, and Tice (2009) by using the introduction of tick-size decimalization on the New York Stock Exchange (NYSE), American Stock Exchange (AMEX), and NASDAQ in 2001 as a natural experiment where liquidity is exogenously shocked. As in Fang et al., we construct a test using the insight that decimalization improves liquidity more for more actively traded stocks (Bessembinder, 2003; Furfine, 2003). Robustness is examined through the use of placebo years. Our findings support the hypothesis that higher stock liquidity leads to an increase in cash holdings.

Fourth, to address two-way causality, we run two-stage least squares on a system of simultaneous equations that allows for cash ratios and stock liquidity to be jointly determined. We find support for joint causality. Increased cash holdings lead to higher stock liquidity, as argued by Gopalan, Kadan, and Pevzner (2012), but higher stock liquidity also leads to higher cash holdings, consistent with the idea that firms hold cash to fend off negative cascades or stimulate positive ones.

The rest of the paper is organized as follows: Section 2 describes the data and the variables. The control variables are mostly drawn from the extant literature on corporate cash holdings, as discussed in Section 2. Section 3 contains the first and second set of regression results. Section 4 contains the analysis using the introduction of decimalization as a natural experiment of an exogenous liquidity shock. Section 5 looks at joint causality, and Section 6 concludes.

## 2 Data, variables, and descriptive statistics

The main datasource is the CRSP/COMPUSTAT Merged (CCM) database, 1963-2010 inclusive. We exclude financial firms (SIC code between 6000 and 6999) and utilities (SIC code between 4900 and 4999). We only keep firm-years with positive total assets, positive sales, and with a ratio of total debt (long term debt plus current liabilities) to total assets that is between 0 and 1. We only include common stocks traded on NYSE, AMEX and NASDAQ. To be included, within a fiscal year stocks need to trade on no less than 100 days, not change exchanges, and have prices not exceeding US$ 999 per share. Some firms may have multiple classes of common shares. In the case of two classes of common shares for a given firm-year, we take the one with the higher turnover. We delete firm-years with more than two classes of common shares. In total, over the 1963-2010 period, this leaves us with 92,415 firm-year observations. Because our liquidity measures are calculated on an annual basis and we use them with a lag of one year in most regressions, the effective sample period is 1964-2010, which yields a sample size of 92,169 firm-years. The variables we use and supplementary databases are described below.

## 2.1 Liquidity measures

In our main analysis, we use two stock liquidity measures, one using low frequency and one using high frequency data. The low frequency measure is Amihud's (2002) *ILLIQ*,[2] originally defined as

$$ILLIQ\_\text{Amihud}_{i,t} = \frac{1}{N_i} \sum_{d=1}^{N_i} \frac{|r_{i,t,d}|}{DVol_{i,t,d}},$$

where $r_{i,t,d}$ is stock $i$'s rate of return on day $d$ in year $t$, $DVol_{i,t,d}$ is the corresponding dollar volume (in USD millions), and $N_i$ is the number of trading days of stock $i$ in year $t$. Returns and volume data are from CRSP. Atkins and Dyl (1997) and Anderson and Dyl (2007) note that the dealer structure on NASDAQ leads to a double counting problem of trading volume. As suggested by Atkins and Dyl (1997) and Nagel (2005), we address this double counting problem by dividing the reported dollar volume of NASDAQ stocks by two. Furthermore, following Nyborg and Östberg (2011), we exclude daily CRSP observations with positive volume but no recorded closing price on either day $d$ or $d-1$ and a zero return on day $d$, as this is highly suggestive of stale prices and spurious volume. Finally, following Acharya and Pedersen (2005), we adjust Amihud's *ILLIQ* by stock price "inflation," cap it to reduce the impact of extreme values, and bound it away from zero, leaving us with the following final measure:

$$ILLIQ_{i,t} = \min\left(0.25 + 0.30 \times ILLIQ\_\text{Amihud}_{i,t} \times P^M_{t-1},\ 30.00\right), \tag{1}$$

where $P^M_{t-1}$ is the ratio of the capitalizations of the market portfolio at the end of fiscal year $t-1$ and July 1962. To deal with endogeneity concerns, in our regressions we always used lagged values of our liquidity measures.

The high frequency liquidity measure, which we use TAQ to compute, is the relative effective bid-ask spread (Chordia, Roll, and Subrahmanyam 2001, Fang, Noe, and Tice 2009). The effective spread is defined as the difference between the execution price and

[2] In their tests of liquidity measures, Goyenko, Holden, and Trzcinka (2009) find that *ILLIQ* performs well.

the mid-point of the prevailing bid-ask quote. The relative effective bid-ask spread is the effective spread divided by the mid-point of the prevailing bid-ask quote.

Using TAQ, we proceed in the usual way to compute the relative effective bid ask spread: Quotes established before the opening of the market or after the close of the market are excluded. Quotes are also discarded if the offer price is lower than the bid price. The trade record is excluded if it does not have a positive price or trading size. The Lee and Ready (1991) algorithm is then used to match trades and quotes: for a trade between 1993 and 1998, the five-second rule is used; for a trade between 1999 and 2010, the trade is matched to the first quote before the trade. The same matching methodology is used by Chordia, Roll, and Subrahmanyam (2008) and Fang, Noe, and Tice (2009). To eliminate potential errors in trades and quotes, following Chordia, Roll, and Subrahmanyam (2001), after the matching process, we exclude observations which satisfy the following four conditions:

1. Quoted spread > $5;

2. Effective spread/Quoted spread > 4.0;

3. Relative effective spread/Relative quoted spread > 4.0;

4. Quoted spread/Transaction price > 0.4,

where Quoted spread is the difference between the prevailing quoted bid and ask, and the Relative quoted spread is Quoted spread divided by the mid-point of the corresponding quoted bid and ask.

The daily relative effective bid-ask spread is calculated by taking the arithmetic mean of the transaction-level relative effective bid-ask spreads over the day. The annual relative effective bid-ask spread is the average of daily relative effective bid-ask spreads within the relevant fiscal year. Following Fang, Noe, and Tice (2009), we use the logarithm of the annual relative effective bid-ask spread in our analysis, which we denote by *Log_resprd*.

TAQ data is available from 1993. Because we used lagged measures of liquidity in most regressions, this means that those regressions have sample periods from 1994-2010.

## 2.2 Additional variables, datasources, and descriptive statistics

Cash holdings are measured for each firm-year by the Cash Ratio, i.e. cash and short-term investment (CHE) over the total book assets (AT), where the COMPUSTAT variable names are in parentheses. Because our main objective is to investigate the impact of stock liquidity on corporate cash holdings, the dependent variable in our regressions is the Cash Ratio and the main regressors are measures of stock liquidity. Control variables are discussed below, with details provided in the Appendix.

The control variables can be divided into three subsets. First, we follow Bates, Kahle, and Stulz (2009) by including Firm Size, MTB (market-to-book ratio), Leverage, Net Working Capital, Net Equity Issuance, Net Debt Issuance, Dividend Dummy, R&D, Capital Expenditure, Acquisition, Cash Flow, Industry Sigma, and IPO2-IPO5 (dummies for years after an IPO). Some of these variables, such as Firm Size and Dividend Dummy, are also often used in the literature as measures of financial constraints. Like the Cash Ratio, dollar denominated variables such as R&D are normalized by total assets (see the Appendix). Not all of these COMPUSTAT variables are available over the whole 1963-2010 period. Net Equity Issuance, Net Debt Issuance, and Acquisition are only available from 1971. Some regressions are therefore run over the period 1971-2010.

Second, we use some controls that are found to be associated with cash holdings by other authors. In particular, we use Analyst Coverage (Chang, 2012), Inst. Turnover (institutional turnover) (Brown, Chen, and Shekhar, 2011), and Price-nonsynchronicity (Fresard, 2012). Analyst coverage data are from IBES, which is available from 1976. The data on institutional investors' stock holdings are from Thomson Reuters (13f), which is available from 1980. Thus, we run some regressions over a sample period from 1980-2010. We also use institutional ownership, as in Brown et. al, but we break it up into two parts: Inst. Own ($> 5\%$) and Inst. Own ($< 5\%$). Inst. Own ($> 5\%$) is the proportion of shares owned by institutional investors individually holding more than 5% of shares outstanding. We use it as a proxy for corporate governance, as in Dittmar and Mahrt-Smith (2007). Better corporate governance can increase the value of cash holdings and thereby encourage more cash holdings (Dittmar and Mahrt-Smith 2007, Harford, Mansi, and Maxwell 2008).

Inst. Own (< 5%) is the remaining institutional ownership. Smaller holdings may be less costly to unload, potentially making the stock price more vulnerable to negative news. We expect the institutional investor turnover and both institutional ownership variables to have positive impact on cash holdings.[3]

Price-nonsynchronicity is defined as $\ln[(1 - R^2_{i,t})/R^2_{i,t}]$ following Durnev, Morck and Yeung (2004), where $R^2_{i,t}$ is estimated for each stock $i$ for each year from the regression $r_{i,j,w} = \alpha_i + \beta_{i,m} r_{m,w} + \beta_{i,j} r_{j,w} + \varepsilon_{i,w}$. $r_{i,j,w}$ is the weekly stock return of firm $i$ in industry $j$ and week $w$, $r_{m,w}$ is the weekly value-weighted market return, and $r_{j,w}$ is the weekly value-weighted industry return, where industries are classified by three-digit SIC codes. As discussed by Roll (1988) and Durnev, Morck and Yeung (2004), Price-nonsynchronicity can be viewed as a measure of the quantity of private information flowing into stock prices. We include this here as a control because, as discussed in the Introduction, stock liquidity may reflect information asymmetries among investors and market makers. Furthermore, Fresard (2012) provides some evidence that price-nonsynchronicity affects cash savings (changes in cash holdings), which we discuss in more detail below in Subsection 3.2.

Third, we introduce two new control variables, namely Firm Age and Equity Beta. Firm Age is expected to have a negative effect on cash holdings because young firms tend to have relatively weak connections with corporate stakeholders, such as customers, suppliers, employees, and investors. Thus, negative cascades are more likely to take place for young firms (Subrahmanyam and Titman, 2001; Almanzan, Suarez, and Titman, 2009). Equity Beta can be regarded as a proxy for the systematic risk of a business. We expect it to have a positive impact on cash holdings, for precautionary reasons.

The sample is winsorized as follows. R&D, Acquisition, Capital Expenditure, and Industry Sigma are winsorized on both sides at 1%. Equity Beta is winsorized on both sides at 0.5%. Net Working Capital and Cash Flow are winsorized from the bottom at 1% and MTB is winsorized from the top at 1%.

**Insert Table 1 here.**

[3]Quarterly institutional investor data are from Thomson Reuters 13f. Relevant variables are calculated for each quarter and then averaged across the fiscal year to generate the annual measure.

Table 1 displays descriptive statistics of all the variables. Statistics on the main variables, Cash Ratio and *ILLIQ*, are provided for four sample periods; 1964-2010, 1971-2010, 1980-2010, and 1994-2010. The average Cash Ratio ranges from 0.14 (1964-2010) to 0.18 (1994-2010), reflecting the upward drift in cash holdings documented by Bates, Kahle, and Stulz (2009). Over the same periods, average *ILLIQ* is 7.84 and 8.8, respectively. Statistics for the other variables are provided for the full period for which data is available and as indicated in the table.

## 2.3 Correlations and orthogonalization

Table 2 provides the correlation matrix of all variables. The correlation between the two liquidity measures and the Cash Ratio is 0.02, showing that unconditionally, the relation between cash holdings and stock liquidity is weak. The variables with the largest positive correlations with the Cash Ratio are R&D (0.48), Industry Sigma (0.38), and MTB (0.37), which is consistent with the notions that firms hold cash to invest and for precautionary reasons.

**Insert Table 2 here.**

Firm size is also a key determinant of cash holdings (Opler, Pinkowitz, Stulz, and Williamson, 1999; Bates, Kahle and Stulz, 2009), but is highly correlated with some of the other regressors, leading to a potential collinearity problem when we come to run regressions. Its correlations with *ILLIQ*, Log_resprd, Price-nonsynchronicity, Analyst Coverage, and Inst. Own ($< 5\%$), are $-0.64$, $-0.81$, $-0.57$, 0.68, and 0.73, respectively. To address this, for each year $t$, we orthogonalize these variables with respect to size by running OLS as follows:

$$X_{i,t} = \gamma_0 + \gamma_1 \text{Firm Size}_{i,t} + \eta_{i,t} \tag{2}$$

where $X$ is one of the mentioned variables, $i$ is a firm. In the analysis below, we replace the original variable, $X$, by the residual $\eta$ from (2). We denote the size-orthogonalized variable $X$ by $X\_res$; e.g., *ILLIQ* becomes *ILLIQ_res* and Price-nonsynchronicity becomes Price-nonsynch_res.

# 3 Regression results

This section contains the first two sets of results on the relation between stock liquidity and cash holdings. We first run a set of regressions of cash ratios on stock liquidity, captured by the size-orthogonalized liquidity measure *ILLIQ_res*, Price-nonsynch_res, and the other control variables discussed in Section 2. These regressions are run over different time periods that depend on the availability of the control variables. To further examine the cascade versus information/financial constraint hypothesis with respect to the effect of stock liquidity on cash holdings, we run a second set of regressions using both measures of liquidity, *ILLIQ_res* and *Log_resprd_res*, to study the cash ratio sensitivity to stock liquidity as a function of growth opportunities. We capture growth opportunities by two measures, namely MTB and R&D expenditures.

## 3.1 Baseline regressions of cash holdings on stock liquidity

To examine the relation between cash holdings and stock liquidity, we initially use the following specification over firm-years $(i, t)$

$$\text{Cash Ratio}_{i,t} = \beta_0 + \beta_1 \mathit{ILLIQ\_res}_{i,t-1} + \mathbf{\Gamma}'\mathbf{Z}_{i,t} + \varepsilon_{i,t}, \tag{3}$$

where $\mathbf{Z}$ is a vector of control variables and $\mathbf{\Gamma}$ the corresponding vector of regression coefficients. The controls are as discussed in Section 2. Not all of these are available over the whole sample period. We therefore run (3) over three time periods, namely: 1964-2010 (the full sample period), 1971-2010 (Net Equity Issuance, Net Debt Issuance, and Acquisition are available from 1971), and 1980-2010 (analyst coverage and institutional holding data are available from 1976 and 1980, respectively). In this subsection, we use only *ILLIQ_res* to measure size-orthogonalized stock liquidity, because TAQ, which we use to calculate the effective bid-ask spread, is not available before 1993. Since one of the competing hypotheses we wish to examine is the information/financial constraint hypothesis of the effect of stock liquidity on cash holdings, we run two sets of regressions for each time period; one with and one without lagged Price-nonsynch_res as a control.

**Insert Table 3 here.**

Table 3 reports on the results from running (3) using the Fama-MacBeth procedure ($t$-statistics are calculated using Newey-West standard errors with two lags).[4] In all specifications and all time periods, the coefficient on $ILLIQ\_res_{i,t-1}$ is negative and statistically significantly at the 1% level. Since stock liquidity is decreasing in *ILLIQ*, this means that firms with more liquid stocks hold more cash. This is consistent with the cascade hypothesis. The coefficient ranges from -0.0015 (1980-2010 period) to -0.0025 (1964-2010 period). So, for example over the 1964-2010 period, a one standard deviation decrease in *ILLIQ_res* increases the cash ratio by 2.02%. The economic significance of this can be seen in light of the fact that the average cash holding across firm-years over this period is 14% of assets, with a standard deviation of 18%. Thus, the 2.02% increase represents an increase of approximately 15% of an average firm's cash holdings.

The coefficient on Price-nonsynch_res is statistically significantly negative, which one can interpret as saying that the more informative is the stock price, the less cash do firms hold, if one accepts the interpretation of Price-nonsynchronicity as a measure of the informativeness of stock prices. This appears to be in conflict with the negative coefficient on *ILLIQ_res*, if one views more liquid stocks as having more informative prices. It is possible that Price-nonsynchronicity and *ILLIQ* capture different elements of private information and price informativeness. We will come back to the impact of Price-nonsynch_res in the next subsection, when we also include interaction variables and can assess the robustness of the initial findings in this subsection.

**Insert Table 4 here.**

The coefficients on the control variables and their statistical significance is consistent with what is documented in the extant literature, as summarized in Table 4. For example, we see that large firms hold less cash as a fraction of their assets, which is consistent with their being less financially constrained, for example due to smaller information asymmetry problems. With respect to the new control variables introduced in this paper, the

[4]We have also run (3) as a panel regression with industry and year fixed effects and with standard errors clustered on firm. The results are qualitatively the same. The regressions have also been run during the 1994-2010 sample period using both *ILLIQ_res* and *Log_resprd_res*. Again the results are qualitatively the same, except that Price-nonsynch_res is now not significant at conventional levels. Details are available from the authors upon request. We report on regressions using *Log_resprd_res* in the next subsection.

coefficients on Equity Beta and Firm Age are positive and negative, respectively. This is in line with the view that firms with higher equity betas and those that are younger are more financially constrained. The coefficients on Analyst Coverage is positive, consistent with the cascade hypothesis, as more analyst coverage brings more attention to the firm. Inst. Ownership ($> 5\%$) also has a statistically significant positive coefficient, consistent with the view that it improves corporate governance and thus increases the value of cash holdings, which in turn leads to larger cash holdings. The coefficient on Inst. Ownership ($< 5\%$) is also statistically significantly positive, which we interpret as consistent with the cascade hypothesis as discussed in Section 2.

## 3.2 Stock liquidity and growth opportunities

In this subsection, we investigate how the cash ratio sensitivity to stock liquidity varies with growth opportunities. Under the cascade view, more potential growth makes firm value more sensitive to cascades, implying that cash holdings should be increasing in stock liquidity as growth opportunities increase. The information/financial constraint view leads to the opposite prediction. We measure growth opportunities by MTB (market-to-book) and R&D expenditures (normalized by assets).

This subsection expands on the analysis in the previous subsection in the following ways. First, we use both (size-orthogonalized) measures of stock liquidity, *ILLIQ_res* and *Log_resprd_res*. Second, to study how the cash ratio sensitivity to stock liquidity varies with growth opportunities, we include variables that interact our measures of growth opportunities with our liquidity measures. Third, we also interact the growth opportunity measures with Price-nonsynch_res and Firm Size.

Table 5 reports on the results from running panel regressions, with industry and year fixed effects and standard errors clustered on firm, as well as Fama-MacBeth regressions. The sample period is 1994-2010, which matches the availability of TAQ data to calculate *Log_resprd_res* (we used lagged measures of stock liquidity). Growth opportunities are captured by MTB in Panel A and by R&D in Panel B. For each procedure (fixed effects or Fama-MacBeth), we run four specifications, two each for each liquidity measure. The first specification interacts the growth opportunity measure with the stock liquidity measure only. The second specification also interacts growth opportunities with Price-nonsynch_res and Firm Size. Thus, we run sixteen specifications in total.

**Insert Table 5 here.**

We see in Table 5 that in thirteen (three) of the sixteen specifications, the coefficient on the stock liquidity measure is negative and statistically significant at the 1% (5%) level. Thus, the result from the previous subsection that the cash ratio is increasing in stock liquidity is shown to be robust to including interaction terms and to using *Log_resprd_res* instead of *ILLIQ_res*. Furthermore, and more specific to our main subject of interest in this subsection, in fourteen (one) of the sixteen specifications, the *liquidity measure* × *growth opportunity measure* is negative and statistically significant at the 1% (5%) level. Given that we retain all control variables and have size-orthogonalized the two liquidity measures, this is strong evidence that the cash ratio is increasingly sensitive to stock liquidity as growth opportunities increase. The more growth opportunities a firm has, the more cash does it hold (as a fraction of assets) as its stock liquidity increases. This is consistent with the cascade perspective, whereby holding cash serves to protect growth opportunities from negative cascades or enhance growth opportunities from positive ones.

The results on price-nonsynchronicity are weak. Across all sixteen specifications, there are only two instances where the coefficient on Price-nonsynch_res is statistically significant at conventional levels, and in both cases it is at the 10% level. In these two cases, the coefficient is negative as before. In Panel A, Price-nonsynch_res is interacted with our first growth opportunity measure, MTB, in four specifications. The coefficient is positive in all four specifications, but only statistically significant in one specification (when using *Log_resprd_res* as the liquidity measure under the Fama-MacBeth procedure). When interacting Price-nonsynch_res with the other growth opportunity measure, R&D, in Panel B, the coefficient is negative and statistically significant in three out of four cases. The results on price-nonsynchronicity are thus substantially weaker and less consistent than the results on stock liquidity.

Our results on price-nonsynchronicity stand in contrast to those of Fresard (2012), who finds that when regressing cash savings on MTB, MTB × Price-nonsynchronicity, firm size, and other controls, the coefficient on the interaction term is positive and statistically significant. While we study cash holdings and Fresard studies cash savings, it may nevertheless be useful to briefly discuss our seemingly different results. We have re-examined Fresard's regressions in his Table IV (details available upon request) and found that in his regressions, if we include an additional interaction term, MTB × Size, the coefficient on MTB × Price-nonsynchronicity becomes insignificant. Recall, however, from above that the correlation between Firm Size and Price-nonsynchronicity is large in absolute value, so including these in the same regression as Fresard does is problematic. If instead of including MTB × Size in Fresard's regressions, we simply replace Price-nonsynchronicity by Price-nonsynch_res, we find that the coefficient on the interaction term is insignificant (details available from the authors upon request). This parallels our findings on cash holdings (rather than savings) in Table 5, Panel A.

Our finding that the cash ratio sensitivity to Price-nonsynch_res falls as R&D expenditures increase can be interpreted in light of a standard Myers and Majluf (1984) style argument, predicated on the idea that Price-nonsynchronicity measures the informativeness of prices. First, when the flow of private information into prices is larger, this may also involve a lower degree of information asymmetries between managers and outsiders. In turn, this reduces the costs of external financing and therefore also the importance of holding financial slack (cash). This is especially relevant for firms with large R&D expenditures because, in the first instance, the R&D needs to be financed and, in the second, so do the opportunities that the R&D lead to. Indeed, the regression coefficients in Table 5 on R&D itself is positive. Our finding can therefore be interpreted as follows: While cash holdings increase in R&D, the effect is reduced for firms with more informative stock prices because this is associated with less costly external financing.

It may seem surprising that we do not find a similar effect for the market-to-book ratio. An explanation may be that information asymmetries between investors and managers relate mostly to the likelihood of success of R&D and new technologies rather than to the growth of existing lines of business. This may explain why price-nonsynchronicity works better when interacted with R&D than with MTB, as the latter measure also captures projected growth from expanding current lines of business.

With respect to our other controls, we note that in all specifications, the coefficient on the growth opportunity × Firm Size interaction variable is positive, showing that larger firms hold relatively more cash as their growth opportunities increase. This may reflect that more is at stake for larger firms. All other controls are in line with the findings in the previous subsection and the extant literature, as summarized above in Table 4.

# 4 Endogeneity: Decimalization test

In the previous section, we dealt with the potential endogeneity of stock liquidity by lagging it. Orthogonalizing the liquidity measures by size, which we did because of the high correlation coefficient with Firm Size, also helps with respect to endogeneity as it reduces persistence in the measure of stock liquidity we use in the regressions. In this section, we take an alternative tack. We use the introduction of decimalization in stock exchanges as a natural experiment where stock liquidity is exogenously shocked. Specifically, on January 29, 2001, the New York Stock Exchange (NYSE) and American Stock Exchange (AMEX) changed the minimal tick size from 1/16th of a dollar (6.25 cents) to 1 cent. NASDAQ decimalized on April 9, 2001.[5]

The extant literature shows that the introduction of tick size decimalization affected stock liquidity heterogeneously. Bessembinder (2003) and Furfine (2003) find that the quoted bid-ask spreads and price impact declined more for more actively traded stocks. Fang, Noe, and Tice (2009) use this exogenous and asymmetric effect on stock liquidity to study the effect of stock liquidity on firm performance. Under the cascade hypothesis, we expect that more actively traded stocks, which experienced a bigger improvement in their liquidity as a result of decimalization, should have a larger increase in cash holdings than less actively traded stocks.

We measure how actively a stock is traded by the total number of trades (*Num_trades*) in a fiscal year. This is extracted from TAQ. The test sample includes observations in the year before and the year after the introduction of decimalization. This relatively long

[5]Pilot programs were carried out before trading on all listed stocks were decimalized. For example, at the NYSE, decimalization was introduced for 159 securities between August and December in 2000. At the NASDAQ, decimalization was introduced for 211 securities in March 2001.

window around the introduction of decimalization follows Fang, Noe, and Tice (2009) and provides time for the change in liquidity to affect a firm's cash holdings. We divide the test sample into the 50% most active and the 50% least active stocks, based on the number of trades in the year before the introduction of decimalization.

We use the following specification:

$$\Delta \text{Cash ratio}_i = \beta_0 + \beta_1 \text{Dummy\_Active}_i + \mathbf{\Gamma}'(\Delta \mathbf{Z}_i) + \varepsilon_i, \tag{4}$$

where $\Delta$Cash ratio$_i$ is the change in the cash ratio for firm $i$ from the fiscal year prior to decimalization (2000) to the year after (2002), *Dummy_Active* is an indicator variable that equals 1 for the 50% most active stocks and 0 for the least active stocks, $\Delta \mathbf{Z}_i$ is a vector of changes in the control variables for firm $i$ from the year prior to decimalization to the year after, and $\mathbf{\Gamma}$ is the corresponding vector of regression coefficients. The control variables include all those in Table 3 and IPO1, which is a dummy for the first year after an IPO.[6] The regression (4) is run using OLS. Reported $t$-values are calculated using White's (1980) correction for heteroskedasticity.

**Insert Table 6 here.**

The regression results are shown in Table 6, Panel A. The coefficient on Dummy_Active is positive and statistically significant at the 1% level. In other words, more active stocks, whose liquidity improved the most as a result of decimalization, experienced a larger increase in cash holdings after decimalization than less active stocks. This is consistent with the cascade hypothesis and the results in Section 3.

As a robustness check to our decimalization test, we carry out a placebo test where we re-run (4) for each year from 1996 to 2006 (i.e. where 1996, for example, takes the place of 2001 in the original test). As seen in Panel B of Table 6, the coefficient on $\Delta$Cash Ratio is significantly different from zero only for 2001, the year decimalization was introduced. Thus, our findings in this section support the hypothesis that higher stock liquidity leads to more cash holdings. It is consistent with the cascade hypothesis, but hard to reconcile

[6]Unlike the regressions in Table 3, no lagged variable is used in the current test, allowing us to include IPO1 among the regressors.

with the financial constraint hypothesis with respect to stock liquidity.

# 5 Joint causality: Simultaneous equation system

In this section, we use a simultaneous equation system to investigate two-way causality between stock liquidity and corporate cash holdings. Because of the availability of all variables, we focus on the 1994-2010 period. The specification of the linear equation system is as follows:

$$\text{Cash Ratio}_{i,t} = \alpha_0 + \alpha_1 Liq\_res_{i,t} + \sum_{k=2}^{K} \alpha_k Z_{k,i,t-1} + \varepsilon_{i,t} \quad (5)$$

$$Liq\_res_{i,t} = \beta_0 + \beta_1 \text{Cash Ratio}_{i,t} + \sum_{l=2}^{L} \beta_l X_{l,i,t-1} + \eta_{i,t} \quad (6)$$

where *Liq* is *ILLIQ_res* or *Log_resprd_res*. $Z_{k,i,t-1}$ represent lagged controls in the Cash Ratio equation, (5). These include the same variables as in our baseline regression in Table 3 (column 6), except that we now use lagged values for all controls, as well as dummies for the 48 Fama-French industry categories. $X_{l,i,t-1}$ are the control variables in the stock liquidity regression, (6).

Our choice of controls in the liquidity equation draws on the extant literature. As in the literature, we use stock characteristics, firm characteristics, and institutional related variables. In particular, we use the following stock characteristic variables: Market Capitalization, Stock Price, and Return Volatility, Equity Beta (Heflin and Shaw, 2000; Loughran and Stulz, 2005; Chordia, Huh, Subrahmanyam, 2007; Agarwal, 2007; Rubin, 2007; Brockman, Chung, and Yan, 2009). With respect to firm characteristics, we use MTB, Firm Age, and Leverage (Chordia, Huh, and Subrahmanyam, 2007) and R&D and Cash Flow (Agarwal, 2007). Motivated by the investor recognition idea of Merton (1987), we also use IPO year dummies and Acquisition, as IPOs and acquisitions may attract investor attention, which in turn may affect trading activity and stock liquidity. With respect to institutional related variables, we use Analyst Coverage (Chordia, Huh, and Subrahmanyam, 2007), institutional turnover (Agarwal, 2007), and institutional ownership (Heflin and Shaw, 2000; Agarwal, 2007; and Brockman, Chung, and Yan, 2009), which we break up into Inst. Own (> 5%) and Inst. Own (< 5%) as before. The new variables we use are thus IPO year dummies, Acquisition, and Inst. Own (< 5%). The controls in (6), as in (5), also include dummies for the 48 Fama-French industry categories.

The two equation system, (5) and (6), is estimated by the Fama-MacBeth procedure, using two-stage least squares (2SLS) for each yearly cross-section. In particular, for each year $t$, using OLS we regress *Liq_res* (Cash Ratio) on all controls from both equations and obtain the fitted values $\widehat{Liq\_res}$ $(\widehat{\text{Cash Ratio}})$, which we then use in the Cash Ratio (*Liq_res*) regression in place of *Liq_res* (Cash Ratio). The estimated coefficients are then averaged over all years. $t$ values are calculated using Newey and West (1987) standard errors with two lags. This is the same procedure used by Chordia, Huh, and Subrahmanyam (2007) in their examination of trading activity and analyst coverage.

**Insert Table 7 here.**

Table 7, Panel A reports on the results for the Cash Ratio equation. The first column is based on *Log_resprd_res* as the liquidity measure (with t-statistics in the second column), while the third column is based on *ILLIQ_res* as the liquidity measure (t-statistics in the fourth column). The results confirm our findings in Tables 3 and 5 that cash holdings are increasing in stock liquidity, regardless of which of the two measures of stock liquidity we use. Statistical significance is at the 1% level in either case. Panel B reports on the results for the liquidity equation. For either of the two liquidity measures, we see that stock liquidity is increasing in cash holdings. Statistical significance is at the 1% level in either case here as well. These results support the hypothesis that the causality between stock market liquidity and corporate cash holdings is bi-directional, as predicted by theory. In particular, this is consistent with (i) the theoretical idea that a higher level of corporate cash holdings reduces information asymmetries and therefore increases the liquidity of the corporation's stock, and (ii) the more liquid a corporation's stock is the more cash does it hold in order protect itself from negative cascades or to stimulate positive ones.

With respect to the control variables, we see in Panel A that their effect on cash holdings are largely the same as documented in Table 3. Given that all controls are lagged in Table 7, this supports the robustness of the previous findings on their impact on cash holdings. When using *ILLIQ_res* as the liquidity measures, the most noteworthy difference is the coefficient on Inst. Own (< 5%), which goes from significantly positive (Table 3) to significantly negative (Table 7, Panel A). Industry Sigma is not significant in Table 7, unlike in Table 3, because the system in Table 7 is estimated with industry dummies. When industry dummies are not included, Industry Sigma is significantly positive (details available upon request).

Price-nonsynch_res has opposite signs when using *ILLIQ_res* (negative, significant at 1% level) as compared with *Log_resprd_res* (positive, significant at 10% level). Recall, however, from Table 5 that the effect of Price-nonsynch_res disappears when including interaction terms. Still, the change in sign here is reminiscent of the change in sign in Table 5 on the interaction variable of size and Price-nonsynch_res when using *R&D* rather than MTB as the growth opportunity measure. This suggests that more work may be needed in order to understand the price-nonsynchronicity measure better and that caution needs to be exercised when interpreting regression coefficients on Price-nonsynchronicity or Price-nonsynch_res.

Panel B summarizes our findings on the relation between stock liquidity and the control variables. With respect to the new variables we have introduced, we observe that Inst. Own (< 5%) has a statistically significantly negative effect (1% level) on both liquidity measures, i.e., a high fraction of relatively small institutional owners is positively associated with stock liquidity. Acquisition and R&D expenditures as a fraction of total assets also decrease *ILLIQ_res*, which is consistent, for example, with the view that acquisition activity and R&D intensity increases investor recognition and thus stock liquidity. With respect to the other variables, our results are broadly consistent with the extant literature. Stock liquidity, regardless of measure, is positively related to MTB, Stock Return, Equity Beta, and Analyst Coverage; and negatively related to Return Volatility and Leverage.

Our main point, here, however is that the results from our estimation of the simultaneous equation system of cash ratio and stock liquidity support the view that there is joint causality between cash holding and stock liquidity. A more liquid stock causes higher cash holdings, and vice versa.

# 6 Concluding remarks

We have provided evidence that supports the idea that there is a channel from the stock market to corporate financial policy. In particular, controlling for firm size and other standard variables in the cash holding literature, we have found that corporations with more liquid stock have higher cash ratios. Furthermore, the cash ratio sensitivity to stock liquidity is increasing in growth opportunities, measured by the market-to-book ratio or R&D expenditures normalized by total assets. This is consistent with the idea that the stock market channel with respect to cash holdings relates to positive feedback effects between stock markets and cash flows, along the lines of the theoretical contributions of Subrahmanyam and Titman (2001) or Goldstein, Ozdenoren, and Yuan (2013). Our analysis also provides support for the view that there is two-way causality between stock liquidity and cash holdings. Given our findings, an interesting avenue for future research would be to investigate whether market characteristics of a corporation's stock also affects other elements of its financial policy.

With respect to control variables, our analysis introduces two variables that have not previously been studied in the corporate cash literature. We find that the age of a firm is negatively associated with its cash ratio, consistent with the idea that younger firms face harder financial constraints. It is also consistent with the idea that cascades are more likely in younger firms, as they have less strong relations with customers and other stakeholders that can affect their value. With respect to the second new variable we introduce, we find that the beta of a firm's stock is positively related with its cash ratio, which is perhaps not surprising from a precautionary perspective.

One of the many control variables we use in this study is price-nonsynchronicity (Roll, 1988; Durnev, Morck, and Yeung, 2004). This variable is of separate interest, since it is widely used in the literature to gauge price informativeness. Because it is highly correlated with firm size, we size-orthogonalize it, as we do our stock liquidity measures. We find that firms with large R&D expenditures, which tend to hold more cash, reduce their cash holdings when price-nonsynchronicity becomes large. This is consistent with the view that more informative prices reduces the costs of external financing and thus reduces the relative value of financial slack (Myers and Majluf, 1984). Interestingly, we do not find the same effect when measuring growth opportunities using the market-to-book ratio. This suggests that price-nonsynchronicity captures informativeness about growth opportunities from new products or technologies, rather than from existing lines of business.

In addition to our main finding that a higher level of stock liquidity leads to more cash holdings, and vice versa, we have also provided evidence on factors other than cash holdings that seem to affect stock liquidity. Our findings are broadly in line with the extant literature on this topic and supplement it by showing that stock liquidity is positively related to acquisition and R&D expenditures as well as the quantity of small institutional stakes in the stock. Gaining a deeper understanding of stock liquidity and its effects remains an important direction for future research.

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**Appendix: Descriptions of variables**

The names of variables in COMPUSTAT are shown in parentheses. *Used in equation (6) only.

| Variable | Data source | Description |
|---|---|---|
| Acquisition | COMPUSTAT | The ratio of acquisition expenditures (AQC) relative to total book assets (AT). |
| Analyst Coverage | IBES | Take average of the number of estimates across months within a fiscal year. Then take logarithm of one plus the average. If a stock is not covered in IBES, set the Analyst Coverage to zero. |
| Cash Flow | COMPUSTAT | [EBITDA (OIBDP) − interest (XINT) − taxes (TXT) − common dividends (DVC)]/total assets (AT). |
| Capital Expenditure | COMPUSTAT | The ratio of capital expenditures (CAPX) to the book value of total assets (AT). |
| Cash Ratio | COMPUSTAT | The ratio of cash and short-term investment (CHE) to the book value of total assets (AT). |
| Dividend Dummy | COMPUSTAT | A dummy variable equal to one if a firm paid common dividend (DVC) in that year; zero otherwise. |
| Equity Beta | CRSP | Annual Scholes-Williams (1977) beta. Available from CRSP. |
| Firm Age | CRSP | Calculate the number of months since a stock first appears in CRSP. Then take logarithm of one plus the number of months. |
| Firm Size | COMPUSTAT | Logarithm of total assets, where the total assets are deflated to 1962 dollars. |
| Industry Sigma | COMPUSTAT | The industry (2-digit SIC codes) mean of firm level Cash Flow standard deviations (over 10 years, at least 3 firm-year observations required). Follows the definition in Bates, Kahle, and Stulz (2009). |

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**Appendix** – continued from previous page

| Variable | Data source | Description |
|---|---|---|
| *ILLIQ* | COMPUSTAT | Acharya and Pedersen's (2005) adjusted version of Amihud's (2002) original illiquidity measure. See equation (1) in the text. |
| Inst. Turnover | Thomson Reuters (13f) | First, calculate institutional churn ratio following Yan and Zhang (2009): $\text{Churn Ratio}_{k,t} = \frac{\min(\text{Churn\_buy}_{k,t}, \text{Churn\_sell}_{k,t})}{\sum_{i=1}^{N_k} (S_{k,i,t}P_{i,t} + S_{k,i,t-1}P_{i,t-1})/2}$, where $N_k$ is the total number of stocks in the portfolio of institution $k$, $S_{k,i,t}$ is the number of shares of stock $i$ held by institution $k$ in quarter $t$, $P_{i,t}$ is the price of stock $i$ in quarter $t$, $\text{Churn\_buy}_{k,t} = \sum_{i=1,\ S_{k,i,t}>S_{k,i,t-1}}^{N_k} \lvert S_{k,i,t}P_{i,t} - S_{k,i,t-1}P_{i,t-1} - S_{k,i,t-1}\Delta P_{i,t}\rvert$, $\text{Churn\_sell}_{k,t} = \sum_{i=1,\ S_{k,i,t}\leq S_{k,i,t-1}}^{N_k} \lvert S_{k,i,t}P_{i,t} - S_{k,i,t-1}P_{i,t-1} - S_{k,i,t-1}\Delta P_{i,t}\rvert$, $\Delta P_{i,t}$ is the change in price, $P_{i,t} - P_{i,t-1}$. Second, following Gaspar, Massa, and Matos (2005), Inst. Turnover is calculated as $\sum_{k\in\mathcal{S}} w_{i,k,t} \left(\frac{1}{4}\sum_{r=1}^{4} \text{Churn Ratio}_{k,t-r+1}\right)$, where $\mathcal{S}$ is the set of institutional shareholders of stock $i$, and $w_{i,k,t}$ is the weight of investor $k$ in the total percentage held by institutional investors in year-quarter $t$. Then an annual Inst. Turnover is calculated as the average across a year. |

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**Appendix** – continued from previous page

| Variable | Data source | Description |
|---|---|---|
| Inst. Own (< 5%) | Thomson Reuters (13f) | Total proportion of shares outstanding held by institutional investors with less than 5% of shares outstanding each. |
| Inst. Own (> 5%) | Thomson Reuters (13f) | Total proportion of shares outstanding held by institutional investors with more than 5% of shares outstanding each. |
| IPO1-IPO5 | CRSP | Dummy variables equal to one if the firm went public 1 to 5 years ago respectively. |
| Leverage | COMPUSTAT | Total debt divided by total assets (AT), where total debt is long-term debt (DLTT) plus debt in current liabilities (DLC). |
| Log_resprd | TAQ | Logarithm of relative effective bid-ask spread. Relative effective bid-ask spread is the difference between the execution price and the mid-point of the prevailing bid-ask quote divided by the mid-point of the prevailing bid-ask quote. |
| Market Capitalization - log* | COMPUSTAT | Logarithm of market capitalization, which is computed as PRCC_F×CSHO, and then adjusted for inflation based on CPI in 1962. |
| MTB | COMPUSTAT | [Book value of total assets (AT) − book value of equity (CEQ) + market value of equity (PRCC_F× CSHO)]/book value of total assets (AT). |
| Net Debt Issuance | COMPUSTAT | [Annual total debt issuance (DLTIS) − debt retirement (DLTR)]/the book value of total assets (AT). |
| Net Equity Issuance | COMPUSTAT | [Equity sales (SSTK)− equity purchases (PRSTKC)]/the book value of total assets (AT). |
| Net Working Capital | COMPUSTAT | [Net working capital (WCAP) − cash and short-term investment (CHE)]/total assets (AT) |

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**Appendix** – continued from previous page

| Variable | Data source | Description |
|---|---|---|
| Price-nonsynchronicity | CRSP | Firm specific stock return variation of firm $i$ in year $t$. Specifically, it is $\ln[(1-R^2_{i,t})/R^2_{i,t}]$, where $R^2_{i,t}$ is estimated each year for the regression $r_{i,j,w} = \alpha_i + \beta_{i,m} r_{m,w} + \beta_{i,j} r_{j,w} + \varepsilon_{i,w}$. $r_{i,j,w}$ is the weekly stock return of firm $i$ in industry $j$ week $w$, $r_{m,w}$ is the weekly market return, $r_{j,w}$ is the weekly industry (3-digit SIC code) return. Market and industry returns are value-weighted averages. Defined as in Durnev et al. (2004). |
| R&D | COMPUSTAT | The ratio of research and development expense (XRD) to total assets (AT). If XRD is missing then set R&D to zero. |
| Stock Price - log* | CRSP | Logarithm of stock price. Adjusted to 1962 dollars by the CPI. |
| Stock Return Volatility* | CRSP | Standard deviation of daily stock return within a fiscal year. |

**Table 1**
Descriptive statistics

Panel A displays summary statistics of the main variables. Variable names followed by a year means the statistics are calculated using data starting from that year and ending in 2010. E.g., *CashRatio_1964* has a sample period of 1964 – 2010. Panel B shows summary statistics for the control variables. The start year of the sample period for a variable is indicated in the second column. All sample periods end in 2010. Definitions of all variables are in the Appendix. N denotes the number of firm-year observations.

| Name | Start year | Unit | Mean | Median | Std. Dev. | Std. Err. | Min. | Max. | N |
|---|---|---|---|---|---|---|---|---|---|
| *Panel A: Main Variables* | | | | | | | | | |
| CashRatio_1964 | 1964 | | 0.14 | 0.07 | 0.18 | 0.0006 | 0.00 | 0.99 | 92,169 |
| CashRatio_1971 | 1971 | | 0.15 | 0.07 | 0.19 | 0.0006 | 0.00 | 0.99 | 86,002 |
| CashRatio_1980 | 1980 | | 0.16 | 0.08 | 0.20 | 0.0007 | 0.00 | 0.99 | 73,159 |
| CashRatio_1994 | 1994 | | 0.18 | 0.09 | 0.21 | 0.0010 | 0.00 | 0.99 | 41,590 |
| | | | | | | | | | |
| ILLIQ_1964 | 1964 | 1/Million$ | 7.84 | 1.27 | 11.22 | 0.0370 | 0.25 | 30 | 92,169 |
| ILLIQ_1971 | 1971 | 1/Million$ | 8.33 | 1.50 | 11.45 | 0.0390 | 0.25 | 30 | 86,002 |
| ILLIQ_1980 | 1980 | 1/Million$ | 9.04 | 1.74 | 11.84 | 0.0438 | 0.25 | 30 | 73,159 |
| ILLIQ_1994 | 1994 | 1/Million$ | 8.80 | 1.37 | 11.91 | 0.0584 | 0.25 | 30 | 41,590 |
| | | | | | | | | | |
| Log_resprd | 1994 | | -5.18 | -5.02 | 1.29 | 0.0063 | -9.17 | -1.61 | 41,573 |
| *Panel B: Control Variables* | | | | | | | | | |
| Price-nonsynchronicity | 1964 | | 1.66 | 1.63 | 1.81 | 0.0061 | -12.07 | 16.35 | 88,136 |
| Firm Size | 1964 | log(Million$) | 3.49 | 3.39 | 1.94 | 0.0064 | -2.14 | 10.73 | 92,169 |
| Market Capitalization - log | 1964 | log(Million$) | 3.26 | 3.10 | 1.95 | 0.0064 | -2.17 | 11.32 | 92,169 |
| Leverage | 1964 | | 0.23 | 0.21 | 0.19 | 0.0006 | 0.00 | 1.00 | 92,169 |
| MTB | 1964 | | 1.69 | 1.29 | 1.26 | 0.0042 | 0.17 | 29.70 | 92,169 |
| Firm Age | 1964 | log(month) | 4.66 | 4.84 | 1.03 | 0.0034 | 1.61 | 6.60 | 92,169 |
| Net Working Capital | 1964 | | 0.15 | 0.14 | 0.19 | 0.0006 | -0.67 | 0.92 | 92,169 |
| Net Equity Issuance | 1971 | | 0.04 | 0.00 | 0.16 | 0.0005 | -2.11 | 2.95 | 86,002 |
| Net Debt Issuance | 1971 | | 0.01 | 0.00 | 0.11 | 0.0004 | -5.27 | 1.22 | 86,002 |
| Dividend Dummy | 1964 | | 0.42 | 0 | 0.49 | 0.0016 | 0 | 1 | 92,169 |
| R&D | 1964 | | 0.03 | 0 | 0.07 | 0.0002 | 0.00 | 0.85 | 92,169 |

Continued on next page

**Table 1** – continued from previous page

| Name | Start year | Unit | Mean | Median | Std. Dev. | Std. Err. | Min. | Max. | N |
|---|---|---|---|---|---|---|---|---|---|
| Capital Expenditure | 1964 | | 0.07 | 0.05 | 0.06 | 0.0002 | 0.00 | 0.51 | 92,169 |
| Acquisition | 1971 | | 0.02 | 0.00 | 0.05 | 0.0002 | 0.00 | 0.44 | 86,002 |
| Cash Flow | 1964 | | 0.04 | 0.07 | 0.15 | 0.0005 | -1.51 | 1.63 | 92,169 |
| Industry Sigma | 1964 | | 0.07 | 0.06 | 0.04 | 0.0001 | 0.01 | 0.19 | 92,169 |
| Stock Price - log | 1964 | log($) | 1.00 | 1.09 | 1.32 | 0.0044 | -4.52 | 6.16 | 92,169 |
| Stock Return, Annualized | 1964 | | 0.12 | 0.04 | 0.61 | 0.0021 | -1.00 | 8.73 | 87,333 |
| Stock Return Volatility | 1964 | | 0.04 | 0.03 | 0.02 | 0.0001 | 0.00 | 1.22 | 92,169 |
| Equity Beta | 1964 | | 0.88 | 0.84 | 0.62 | 0.0021 | -2.00 | 3.49 | 90,918 |
| Analyst Coverage | 1976 | | 1.09 | 0.98 | 1.02 | 0.0036 | 0.00 | 3.89 | 78,857 |
| Inst. Own ($< 5\%$) | 1980 | | 0.11 | 0.07 | 0.12 | 0.0005 | 0.00 | 0.91 | 70,449 |
| Inst. Own ($> 5\%$) | 1980 | | 0.23 | 0.17 | 0.21 | 0.0008 | 0.00 | 0.99 | 70,449 |
| Inst. Turnover | 1980 | | 0.09 | 0.09 | 0.04 | 0.0002 | 0.00 | 0.58 | 70,707 |
| IPO1 | 1964 | | 0.06 | 0 | 0.24 | 0.0008 | 0 | 1 | 92,169 |
| IPO2 | 1964 | | 0.06 | 0 | 0.24 | 0.0008 | 0 | 1 | 92,169 |
| IPO3 | 1964 | | 0.06 | 0 | 0.23 | 0.0008 | 0 | 1 | 92,169 |
| IPO4 | 1964 | | 0.05 | 0 | 0.22 | 0.0007 | 0 | 1 | 92,169 |
| IPO5 | 1964 | | 0.05 | 0 | 0.22 | 0.0007 | 0 | 1 | 92,169 |

# Table 2

Correlations

Pairwise correlations of the variables listed in Table 1. The reported correlations are taken over the longest overlapping sample periods of each pair of variables. The sample period is from 1964 to 2010 for all variables, except Net Equity Issuance, Net Debt Issuance, and Acquisition (1971-2010); Analyst Coverage (1976-2010); Inst. Own (< 5%), Inst. Own (> 5%), and Inst. Turnover (1980-2010); and Log_resprd (1993-2010).

| | Cash Ratio | *ILLIQ* | Log_resprd | *Prc-Nschr* | Firm Size | Lever-age | MTB | Firm Age | Net WCap | Net Equity | Net Debt | Div. Dum. | R&D | CapX | Acq | Cash Flow | Ind. Sigma | Equity Beta | Ana. Cov. | InstO (> 5%) | InstO (< 5%) | Inst. T.O. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cash Ratio | 1 | | | | | | | | | | | | | | | | | | | | | |
| *ILLIQ* | 0.02 | 1 | | | | | | | | | | | | | | | | | | | | |
| Log_resprd | 0.02 | 0.75 | 1 | | | | | | | | | | | | | | | | | | | |
| Price-nonsynchronicity | 0.08 | 0.45 | 0.59 | 1 | | | | | | | | | | | | | | | | | | |
| Firm Size | -0.25 | -0.64 | -0.81 | -0.57 | 1 | | | | | | | | | | | | | | | | | |
| Leverage | -0.42 | 0.05 | 0.01 | -0.01 | 0.17 | 1 | | | | | | | | | | | | | | | | |
| MTB | 0.37 | -0.12 | -0.15 | -0.02 | -0.14 | -0.22 | 1 | | | | | | | | | | | | | | | |
| Firm Age | -0.21 | -0.16 | -0.29 | -0.22 | 0.39 | 0.01 | -0.20 | 1 | | | | | | | | | | | | | | |
| Net Working Capital | -0.26 | -0.05 | 0.11 | 0.02 | -0.07 | -0.16 | -0.16 | 0.08 | 1 | | | | | | | | | | | | | |
| Net Equity Issuance | 0.34 | 0.04 | 0.17 | 0.10 | -0.24 | -0.12 | 0.32 | -0.36 | -0.11 | 1 | | | | | | | | | | | | |
| Net Debt Issuance | -0.02 | -0.07 | -0.04 | -0.04 | 0.06 | 0.17 | 0.00 | -0.01 | 0.02 | -0.11 | 1 | | | | | | | | | | | |
| Dividend Dummy | -0.22 | -0.37 | -0.36 | -0.31 | 0.46 | -0.05 | -0.13 | 0.36 | 0.17 | -0.19 | 0.04 | 1 | | | | | | | | | | |
| R&D | 0.48 | 0.07 | 0.09 | 0.12 | -0.22 | -0.24 | 0.31 | -0.12 | -0.12 | 0.24 | -0.01 | -0.24 | 1 | | | | | | | | | |
| Capital Expenditure | -0.15 | -0.10 | -0.02 | -0.08 | 0.07 | 0.09 | 0.04 | -0.10 | -0.21 | 0.04 | 0.17 | 0.06 | -0.11 | 1 | | | | | | | | |
| Acquisition | -0.08 | -0.08 | -0.11 | -0.04 | 0.10 | 0.09 | 0.01 | -0.04 | -0.06 | 0.02 | 0.23 | -0.02 | -0.04 | -0.08 | 1 | | | | | | | |
| Cash Flow | -0.30 | -0.25 | -0.29 | -0.19 | 0.33 | -0.02 | -0.14 | 0.17 | 0.22 | -0.40 | -0.03 | 0.21 | -0.44 | 0.13 | 0.06 | 1 | | | | | | |
| Industry Sigma | 0.38 | 0.17 | -0.02 | 0.16 | -0.21 | -0.18 | 0.27 | -0.08 | -0.23 | 0.14 | -0.02 | -0.36 | 0.42 | -0.14 | 0.08 | -0.20 | 1 | | | | | |
| Equity Beta | 0.06 | -0.39 | -0.41 | -0.38 | 0.26 | 0.01 | 0.10 | 0.00 | 0.00 | 0.05 | 0.04 | 0.03 | 0.06 | 0.06 | 0.01 | 0.06 | -0.07 | 1 | | | | |
| Analyst Coverage | -0.01 | -0.55 | -0.70 | -0.47 | 0.68 | -0.06 | 0.12 | 0.20 | -0.09 | -0.12 | 0.05 | 0.26 | 0.02 | 0.10 | 0.09 | 0.23 | 0.05 | 0.29 | 1 | | | |
| Inst. Own (> 5%) | 0.00 | -0.21 | -0.29 | -0.12 | 0.27 | 0.01 | -0.08 | 0.10 | -0.03 | -0.12 | -0.01 | 0.02 | -0.02 | -0.07 | 0.06 | 0.11 | 0.05 | 0.07 | 0.19 | 1 | | |
| Inst. Own (< 5%) | -0.03 | -0.58 | -0.85 | -0.51 | 0.73 | -0.06 | 0.09 | 0.29 | -0.09 | -0.16 | 0.04 | 0.28 | -0.06 | 0.00 | 0.13 | 0.27 | 0.06 | 0.32 | 0.70 | 0.33 | 1 | |
| Inst. Turnover | 0.16 | -0.18 | -0.09 | -0.06 | 0.03 | -0.06 | 0.15 | -0.25 | -0.08 | 0.18 | 0.03 | -0.15 | 0.08 | 0.05 | 0.07 | -0.01 | 0.09 | 0.18 | 0.11 | 0.08 | 0.15 | 1 |

**Table 3**

Fama-MacBeth regressions of Cash Ratio on *ILLIQ_res* and controls

This table presents Fama-MacBeth (1973) estimators for regressions of the type:

$$\text{Cash Ratio}_{i,t} = \beta_0 + \beta_1 ILLIQ\_res_{i,t-1} + \mathbf{\Gamma}'\mathbf{Z}_{i,t} + \varepsilon_{i,t},$$

where $\mathbf{Z}$ is a vector of control variables and $\mathbf{\Gamma}$ the corresponding vector of regression coefficients. Regressions are run over the following three time periods: 1964-2010 (the full sample period), 1971-2010 (Net Equity Issuance, Net Debt Issuance, and Acquisition are available from 1971), and 1980-2010 (analyst coverage and institutional holding data are available from 1976 and 1980, respectively). Two sets of regressions are run for each time period: one with and one without lagged Price-nonsynch_res as a control. $t$ values are calculated based on Newey-West (1987) standard errors with 2 lags. Statistical significance at the 1%, 5% and 10% level are indicated by ***a***, ***b***, and ***c*** respectively.

| Cash Ratio | Since 1964 | | Since 1971 | | Since 1980 | |
|---|---|---|---|---|---|---|
| Intercept | 0.2304$^a$ | 0.2290$^a$ | 0.2636$^a$ | 0.2641$^a$ | 0.2672$^a$ | 0.2685$^a$ |
| | (14.37) | (13.77) | (20.92) | (20.78) | (26.16) | (28.62) |
| Lag(*ILLIQ*_res) | -0.0025$^a$ | -0.0024$^a$ | -0.0016$^a$ | -0.0016$^a$ | -0.0015$^a$ | -0.0015$^a$ |
| | (-3.81) | (-3.95) | (-7.98) | (-8.07) | (-13.70) | (-12.92) |
| Lag(Price-nonsynch_res) | | -0.0010$^a$ | | -0.0009$^a$ | | -0.0008$^b$ |
| | | (-3.33) | | (-3.40) | | (-2.13) |
| Firm Size | -0.0098$^a$ | -0.0096$^a$ | -0.0094$^a$ | -0.0091$^a$ | -0.0104$^a$ | -0.0101$^a$ |
| | (-12.52) | (-11.79) | (-10.65) | (-10.06) | (-10.86) | (-10.46) |
| Leverage | -0.2633$^a$ | -0.2612$^a$ | -0.2897$^a$ | -0.2878$^a$ | -0.3110$^a$ | -0.3108$^a$ |
| | (-15.22) | (-14.68) | (-19.80) | (-18.69) | (-29.39) | (-28.66) |
| MTB | 0.0211$^a$ | 0.0207$^a$ | 0.0192$^a$ | 0.0188$^a$ | 0.0160$^a$ | 0.0154$^a$ |
| | (13.39) | (12.56) | (9.28) | (8.63) | (11.02) | (11.07) |
| Firm Age | -0.0013 | -0.001 | -0.0045$^b$ | -0.0047$^b$ | -0.0048$^b$ | -0.0052$^b$ |
| | (-0.42) | (-0.32) | (-2.18) | (-2.25) | (-2.19) | (-2.49) |
| Net Working Capital | -0.2386$^a$ | -0.2370$^a$ | -0.2585$^a$ | -0.2582$^a$ | -0.2762$^a$ | -0.2778$^a$ |
| | (-25.34) | (-23.88) | (-26.19) | (-25.03) | (-30.02) | (-30.87) |
| Net Equity Issuance | | | 0.0891$^a$ | 0.0896$^a$ | 0.1109$^a$ | 0.1132$^a$ |
| | | | (4.98) | (4.84) | (6.19) | (6.29) |
| Net Debt Issuance | | | 0.1909$^a$ | 0.1901$^a$ | 0.2123$^a$ | 0.2141$^a$ |
| | | | (10.98) | (10.64) | (10.65) | (10.80) |
| Dividend Dummy | -0.0095$^a$ | -0.0099$^a$ | -0.0099$^b$ | -0.0104$^a$ | -0.0131$^a$ | -0.0134$^a$ |
| | (-2.71) | (-2.78) | (-2.71) | (-2.88) | (-5.18) | (-4.96) |
| R&D | 0.2491$^a$ | 0.2557$^a$ | 0.3057$^a$ | 0.3121$^a$ | 0.3777$^a$ | 0.3845$^a$ |
| | (3.67) | (3.76) | (4.86) | (5.00) | (6.74) | (6.95) |
| Capital Expenditure | -0.4330$^a$ | -0.4365$^a$ | -0.5469$^a$ | -0.5509$^a$ | -0.5985$^a$ | -0.6032$^a$ |
| | (-14.24) | (-14.81) | (-16.19) | (-16.16) | (-16.35) | (-16.51) |
| Acquisition | | | -0.3713$^a$ | -0.3711$^a$ | -0.4198$^a$ | -0.4202$^a$ |
| | | | (-11.52) | (-11.30) | (-11.69) | (-11.45) |
| Cash Flow | -0.0644$^a$ | -0.0607$^a$ | -0.0079 | -0.005 | -0.0175 | -0.0144 |
| | (-5.45) | (-5.33) | (-0.82) | (-0.51) | (-1.54) | (-1.32) |

Continued on next page

**Table 3** – continued from previous page

| Cash Ratio | Since 1964 | | Since 1971 | | Since 1980 | |
|---|---|---|---|---|---|---|
| Lag(Industry Sigma) | 0.3812[a] | 0.3349[a] | 0.3340[a] | 0.3085[a] | 0.3304[a] | 0.3268[a] |
| | (5.25) | (4.76) | (7.70) | (6.32) | (8.56) | (7.52) |
| Lag(Equity Beta) | 0.0109[a] | 0.0106[a] | 0.0115[a] | 0.0112[a] | 0.0129[a] | 0.0127[a] |
| | (4.95) | (4.71) | (4.75) | (4.49) | (4.61) | (4.38) |
| Analyst Coverage_res | | | | | 0.0035[b] | 0.0035[c] |
| | | | | | (2.07) | (1.90) |
| Inst. Own. (> 5%) | | | | | 0.0401[a] | 0.0407[a] |
| | | | | | (5.83) | (5.81) |
| Inst. Own. (< 5%)_res | | | | | 0.0197[a] | 0.0188[b] |
| | | | | | (3.09) | (2.65) |
| Inst. Turnover | | | | | 0.1140[a] | 0.1170[a] |
| | | | | | (3.73) | (4.05) |
| IPO2 | 0.0119[b] | 0.0140[b] | 0.0104[c] | 0.0117[c] | 0.0191[b] | 0.0196[b] |
| | (2.10) | (2.47) | (1.73) | (1.95) | (2.58) | (2.67) |
| IPO3 | 0.0011 | 0.0019 | -0.0015 | -0.0016 | 0.0012 | 0.0007 |
| | (0.27) | (0.44) | (-0.38) | (-0.40) | (0.26) | (0.13) |
| IPO4 | 0.0023 | 0.0021 | 0.0003 | 0.0002 | 0.0013 | 0.0011 |
| | (0.60) | (0.54) | (0.06) | (0.05) | (0.31) | (0.24) |
| IPO5 | 0.0015 | 0.0019 | -0.0009 | -0.0000 | 0.0017 | 0.0022 |
| | (0.39) | (0.45) | (-0.19) | (-0.01) | (0.33) | (0.40) |
| $R^2$ | 0.40 | 0.40 | 0.43 | 0.43 | 0.47 | 0.47 |
| $N$ | 78,500 | 75,157 | 73,597 | 70,604 | 59,921 | 57,611 |

**Table 4**

How different variables affect cash holdings: Our baseline results compared with the literature

This table compares the signs of the regression coefficients in the last column of Table 3 (Sign Us) to what has been found in standard references in the literature (Sign Lit.). '+' or '−' means that the coefficient of the variable is significant at the 5 or 1% levels. $NS$ stands for not significant at conventional levels (10% or better). †The statistical significance of Price-nonsynchronicity is not robust to adding variables that interact stock liquidity with the growth opportunity measures, MTB or R&D (see Table 5 for details).

*These papers study cash savings rather than cash holdings.

| Variable | Sign Us | Sign Lit. | Literature |
|---|---|---|---|
| *Panel A: New variables in this paper* | | | |
| Stock Liquidity | + | | |
| Firm Age | − | | |
| Equity Beta | + | | |
| *Panel B: Variables used in the cash holding literature* | | | |
| Price-nonsynchronicity | $-/NS^{\dagger}$ | + | Fresard (2012)* |
| Firm Size | − | − | Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009) |
| MTB | + | + | Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009) |
| Leverage | − | − | Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009) |
| Industry Sigma | + | + | Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009), Han and Qiu (2007) |
| R&D | + | + | Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009), Brown and Petersen (2011) |
| Net Equity Issuance | + | + | Bates, Kahle, and Stulz (2009), McLean (2011) |
| Net Debt Issuance | + | + | Bates, Kahle, and Stulz (2009) |
| Net Working Capital | − | − | Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009) |
| Capital Expenditure | − | − | Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009) |
| Acquisition | − | − | Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009) |
| Dividend Dummy | − | − | Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009) |
| Cash Flow | $NS$ | mixed | Opler, Pinkowitz, Stulz, and Williamson (1999), Bates, Kahle, and Stulz (2009),Riddick and Whited (2009)* |
| Analyst Coverage | + | + | Chang (2012) |
| Institutional ownership | + | + | Brown, Chen and Shekhar (2011) |
| Institutional Turnover | + | + | Brown, Chen and Shekhar (2011) |
| IPO2 | + | + | Bates, Kahle, and Stulz (2009) |
| IPO3 | $NS$ | + | Bates, Kahle, and Stulz (2009) |
| IPO4 | $NS$ | + | Bates, Kahle, and Stulz (2009) |
| IPO5 | $NS$ | + | Bates, Kahle, and Stulz (2009) |

**Table 5**

Cash ratio sensitivity to growth opportunities

This table presents Fama-MacBeth (1973) and industry and year fixed effect estimators for the specification

$$\text{Cash Ratio}_{i,t} = \alpha_0 + \alpha_1 Liq\_res_{i,t-1} + \alpha_2 \cdot G_t \times Liq\_res_{i,t-1} + \mathbf{\Gamma}_1' \mathbf{X}_{i,t} + \varepsilon_{i,t}$$

in columns (1), (2), (5), and (6), and the specification

$$\text{Cash Ratio}_{i,t} = \beta_0 + \beta_1 Liq\_res_{i,t-1} + \beta_2 \cdot G_t \times Liq\_res_{i,t-1} + \beta_3 \cdot G_t \times \text{Firm Size}_{i,t-1} + \beta_4 \cdot G_t \times \text{Price-nonsynch\_res}_{i,t-1} + \mathbf{\Gamma}_2' \mathbf{Z}_{i,t} + \eta_{i,t}$$

in columns (3), (4), (7), and (8), where *Liq_res* is *Log_resprd_res* or *ILLIQ_res*, $G$ is $MTB$ in Panel A and $R\&D$ in Panel B, $X$ and $Z$ are vectors of control variables and $\mathbf{\Gamma}_1$ and $\mathbf{\Gamma}_2$ are the corresponding vectors of regression coefficients. The sample period is from 1994 to 2010. $t$ values for the Fama-MacBeth estimators are calculated based on Newey-West (1987) standard errors with 2 lags. $t$ values for the industry and year fixed effect estimators are adjusted for heteroskedasticity by firm cluster. Statistical significance at the 1%, 5% and 10% level are indicated by ***a***, ***b***, and ***c*** respectively.

| | Fama-MacBeth | | | | Fixed Effect (Industry and Year) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| *Panel A: MTB* | | | | | | | | |
| Intercept | $0.2617^{a}$ | $0.2577^{a}$ | $0.2769^{a}$ | $0.2808^{a}$ | $0.3055^{a}$ | $0.2995^{a}$ | $0.3135^{a}$ | $0.3125^{a}$ |
| | (33.21) | (31.75) | (38.11) | (31.15) | (21.25) | (20.87) | (21.38) | (21.28) |
| Lag(Log_resprd_res) | $-0.0127^{b}$ | | $-0.0110^{b}$ | | $-0.0121^{a}$ | | $-0.0111^{a}$ | |
| | (-2.86) | | (-2.36) | | (-3.10) | | (-2.83) | |
| Lag(*ILLIQ*_res) | | $-0.0007^{a}$ | | $-0.0005^{a}$ | | $-0.0007^{a}$ | | $-0.0005^{b}$ |
| | | (-4.96) | | (-3.15) | | (-2.58) | | (-2.01) |
| MTB × Lag(Log_resprd_res) | $-0.0051^{a}$ | | $-0.0054^{a}$ | | $-0.0048^{a}$ | | $-0.0049^{a}$ | |
| | (-3.28) | | (-4.08) | | (-2.61) | | (-2.67) | |
| MTB × Lag(*ILLIQ*_res) | | $-0.0004^{a}$ | | $-0.0006^{a}$ | | $-0.0003^{b}$ | | $-0.0004^{a}$ |
| | | (-6.01) | | (-6.42) | | (-2.46) | | (-3.33) |
| MTB × Lag(Price-nonsynch_res) | | | $0.0013^{b}$ | 0.0011 | | | 0.0008 | 0.0007 |
| | | | (2.34) | (1.74) | | | (1.37) | (1.19) |
| MTB × Lag(Firm Size) | | | $0.0030^{a}$ | $0.0043^{a}$ | | | $0.0017^{a}$ | $0.0027^{a}$ |
| | | | (4.61) | (6.52) | | | (2.80) | (4.23) |
| Lag(Price-nonsynch_res) | 0.0004 | -0.0002 | -0.0018 | $-0.0021^{c}$ | -0.0003 | -0.001 | -0.0015 | $-0.0019^{c}$ |
| | (-0.94) | (-0.52) | (-1.72) | (-1.91) | (-0.52) | (-1.51) | (-1.44) | (-1.79) |
| Lag(Firm Size) | | | $-0.0161^{a}$ | $-0.0180^{a}$ | | | $-0.0147^{a}$ | $-0.0162^{a}$ |
| | | | (-11.00) | (-12.22) | | | (-10.32) | (-11.27) |

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**Table 5** – continued from previous page

| | Fama-MacBeth | | | | Fixed Effect (Industry and Year) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Firm Size | -0.0097$^{a}$ | -0.0092$^{a}$ | | | -0.0105$^{a}$ | -0.0102$^{a}$ | | |
| | (-12.33) | (-12.01) | | | (-10.34) | (-9.95) | | |
| Leverage | -0.3053$^{a}$ | -0.3109$^{a}$ | -0.3023$^{a}$ | -0.3061$^{a}$ | -0.3101$^{a}$ | -0.3155$^{a}$ | -0.3077$^{a}$ | -0.3116$^{a}$ |
| | (-44.38) | (-42.16) | (-44.71) | (-44.02) | (-30.53) | (-30.91) | (-30.37) | (-30.70) |
| MTB | 0.0127$^{a}$ | 0.0146$^{a}$ | 0.0045$^{b}$ | 0.0014 | 0.0088$^{a}$ | 0.0103$^{a}$ | 0.0042$^{b}$ | 0.0025 |
| | (5.09) | (7.35) | (2.55) | (1.25) | (6.27) | (7.32) | (1.99) | (1.09) |
| Firm Age | -0.0077$^{a}$ | -0.0065$^{a}$ | -0.0072$^{a}$ | -0.0060$^{a}$ | -0.0111$^{a}$ | -0.0096$^{a}$ | -0.0106$^{a}$ | -0.0090$^{a}$ |
| | (-3.87) | (-3.66) | (-3.82) | (-3.53) | (-5.11) | (-4.41) | (-4.90) | (-4.15) |
| Net Working Capital | -0.2881$^{a}$ | -0.2894$^{a}$ | -0.2880$^{a}$ | -0.2893$^{a}$ | -0.3130$^{a}$ | -0.3149$^{a}$ | -0.3122$^{a}$ | -0.3139$^{a}$ |
| | (-24.71) | (-23.23) | (-24.96) | (-23.08) | (-27.81) | (-27.73) | (-27.95) | (-27.90) |
| Net Equity Issuance | 0.1295$^{a}$ | 0.1186$^{a}$ | 0.1288$^{a}$ | 0.1226$^{a}$ | 0.1220$^{a}$ | 0.1119$^{a}$ | 0.1176$^{a}$ | 0.1108$^{a}$ |
| | (8.54) | (7.54) | (8.77) | (8.06) | (10.29) | (9.27) | (9.93) | (9.23) |
| Net Debt Issuance | 0.2388$^{a}$ | 0.2449$^{a}$ | 0.2280$^{a}$ | 0.2337$^{a}$ | 0.2054$^{a}$ | 0.2126$^{a}$ | 0.1944$^{a}$ | 0.2011$^{a}$ |
| | (8.48) | (9.01) | (8.28) | (8.71) | (8.71) | (8.92) | (8.46) | (8.67) |
| Dividend Dummy | -0.0173$^{a}$ | -0.0164$^{a}$ | -0.0155$^{a}$ | -0.0145$^{a}$ | -0.0120$^{a}$ | -0.0105$^{a}$ | -0.0104$^{a}$ | -0.0088$^{b}$ |
| | (-4.42) | (-4.31) | (-3.92) | (-3.85) | (-3.25) | (-2.84) | (-2.82) | (-2.39) |
| R&D | 0.5173$^{a}$ | 0.5221$^{a}$ | 0.5171$^{a}$ | 0.5207$^{a}$ | 0.4266$^{a}$ | 0.4184$^{a}$ | 0.4304$^{a}$ | 0.4213$^{a}$ |
| | (14.32) | (12.65) | (14.35) | (12.64) | (14.68) | (14.31) | (14.88) | (14.50) |
| Capital Expenditure | -0.6748$^{a}$ | -0.6779$^{a}$ | -0.6731$^{a}$ | -0.6748$^{a}$ | -0.6165$^{a}$ | -0.6164$^{a}$ | -0.6181$^{a}$ | -0.6181$^{a}$ |
| | (-14.83) | (-15.44) | (-14.93) | (-15.39) | (-23.84) | (-23.70) | (-24.08) | (-23.98) |
| Acquisition | -0.5012$^{a}$ | -0.5001$^{a}$ | -0.5106$^{a}$ | -0.5096$^{a}$ | -0.4458$^{a}$ | -0.4436$^{a}$ | -0.4572$^{a}$ | -0.4551$^{a}$ |
| | (-11.96) | (-12.29) | (-12.30) | (-12.58) | (-22.60) | (-22.18) | (-23.39) | (-23.02) |
| Cash Flow | -0.0126 | -0.0111 | -0.0254$^{c}$ | -0.0254$^{b}$ | -0.0087 | -0.0079 | -0.0207$^{c}$ | -0.0216$^{c}$ |
| | (-1.10) | (-0.95) | (-2.09) | (-2.14) | (-0.73) | (-0.66) | (-1.77) | (-1.84) |
| Lag(Industry Sigma) | 0.4246$^{a}$ | 0.4314$^{a}$ | 0.4040$^{a}$ | 0.4070$^{a}$ | 0.1418$^{b}$ | 0.1537$^{b}$ | 0.1381$^{b}$ | 0.1475$^{b}$ |
| | (10.28) | (9.79) | (10.13) | (9.76) | (2.07) | (2.23) | (2.02) | (2.15) |

Continued on next page

**Table 5** – continued from previous page

| | Fama-MacBeth | | | | Fixed Effect (Industry and Year) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Lag(Equity Beta) | 0.0196[a] | 0.0176[a] | 0.0210[a] | 0.0189[a] | 0.0168[a] | 0.0154[a] | 0.0176[a] | 0.0160[a] |
| | (6.00) | (4.58) | (6.19) | (4.70) | (9.15) | (8.24) | (9.60) | (8.62) |
| Analyst Coverage_res | 0.0060[a] | 0.0081[a] | 0.0049[a] | 0.0065[a] | 0.0077[a] | 0.0092[a] | 0.0070[a] | 0.0081[a] |
| | (5.69) | (4.87) | (5.59) | (4.41) | (4.03) | (4.91) | (3.70) | (4.33) |
| Inst. Own (> 5%) | 0.0585[a] | 0.0538[a] | 0.0672[a] | 0.0629[a] | 0.0621[a] | 0.0593[a] | 0.0687[a] | 0.0663[a] |
| | (8.32) | (7.32) | (9.57) | (8.56) | (5.92) | (5.52) | (6.52) | (6.16) |
| Inst. Own (< 5%)_res | 0.0131 | 0.0281[a] | 0.0145 | 0.0266[b] | 0.0280[b] | 0.0438[a] | 0.0294[a] | 0.0429[a] |
| | (1.64) | (2.98) | (1.62) | (2.53) | (2.53) | (4.03) | (2.66) | (3.97) |
| Inst. Turnover | 0.1916[a] | 0.1610[a] | 0.1870[a] | 0.1613[a] | 0.2023[a] | 0.1728[a] | 0.1962[a] | 0.1693[a] |
| | (5.55) | (3.85) | (5.52) | (4.04) | (5.17) | (4.40) | (5.01) | (4.31) |
| IPO2 | 0.0207[b] | 0.0187[b] | 0.0219[a] | 0.0201[a] | 0.0148[a] | 0.0145[a] | 0.0157[a] | 0.0154[a] |
| | (2.78) | (2.79) | (2.93) | (2.94) | (3.18) | (3.12) | (3.37) | (3.31) |
| IPO3 | 0.0028 | 0.003 | 0.0037 | 0.0041 | 0.0007 | 0.0014 | 0.0015 | 0.0025 |
| | (0.43) | (0.48) | (0.55) | (0.66) | (0.16) | (0.33) | (0.36) | (0.60) |
| IPO4 | -0.0020 | -0.0004 | -0.0010 | 0.0008 | -0.0023 | -0.0013 | -0.0017 | -0.0005 |
| | (-0.40) | (-0.09) | (-0.19) | (-0.17) | (-0.59) | (-0.34) | (-0.44) | (-0.12) |
| IPO5 | -0.0042 | -0.0043 | -0.0035 | -0.0038 | -0.0047 | -0.0047 | -0.0043 | -0.0043 |
| | (-1.24) | (-1.54) | (-1.05) | (-1.40) | (-1.26) | (-1.25) | (-1.17) | (-1.14) |
| $R^2$ | 0.54 | 0.54 | 0.54 | 0.54 | | | | |
| Adj-$R^2$ | | | | | 0.54 | 0.54 | 0.55 | 0.55 |
| $N$ | 34,594 | 33,990 | 34,594 | 33,990 | 34,594 | 33,990 | 34,594 | 33,990 |

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**Table 5** – continued from previous page

| | Fama-MacBeth | | | | Fixed Effect (Industry and Year) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| *Panel B: R&D* | | | | | | | | |
| Intercept | 0.2614[a] | 0.2578[a] | 0.2798[a] | 0.2764[a] | 0.3043[a] | 0.2991[a] | 0.3148[a] | 0.3104[a] |
| | (33.49) | (31.44) | (36.21) | (30.23) | (21.21) | (20.83) | (21.92) | (21.62) |
| Lag(Log_resprd_res) | -0.0160[a] | | -0.0153[a] | | -0.0157[a] | | -0.0154[a] | |
| | (-4.66) | | (-4.45) | | (-6.22) | | (-6.15) | |
| Lag(*ILLIQ*_res) | | -0.0009[a] | | -0.0010[a] | | -0.0009[a] | | -0.0010[a] |
| | | (-9.11) | | (-10.40) | | (-4.83) | | (-5.44) |
| R&D × Lag(Log_resprd_res) | -0.1191[a] | | -0.1019[a] | | -0.1171[a] | | -0.0904[a] | |
| | (-3.73) | | (-3.24) | | (-3.66) | | (-2.85) | |
| R&D × Lag(*ILLIQ*_res) | | -0.0089[a] | | -0.0054[a] | | -0.0060[a] | | -0.0033 |
| | | (-4.45) | | (-3.55) | | (-2.89) | | (-1.60) |
| R&D × Lag(Price-nonsynch_res) | | | -0.0113[c] | -0.0179[a] | | | -0.0177 | -0.0237[b] |
| | | | (-2.10) | (-2.96) | | | (-1.63) | (-2.26) |
| R&D × Lag(Firm Size) | | | 0.1173[a] | 0.1151[a] | | | 0.1180[a] | 0.1180[a] |
| | | | (6.68) | (6.47) | | | (7.98) | (7.84) |
| Lag(Price-nonsynch_res) | 0.0004 | -0.0001 | 0.0002 | -0.0001 | -0.0003 | -0.0009 | -0.0000 | -0.0003 |
| | (-0.84) | (-0.35) | (-0.41) | (-0.18) | (-0.53) | (-1.42) | (-0.01) | (-0.49) |
| Lag(Firm Size) | | | -0.0144[a] | -0.0142[a] | | | -0.0154[a] | -0.0153[a] |
| | | | (-13.77) | (-13.79) | | | (-14.83) | (-14.69) |
| Firm Size | -0.0099[a] | -0.0097[a] | | | -0.0106[a] | -0.0105[a] | | |
| | (-12.75) | (-11.97) | | | (-10.48) | (-10.34) | | |
| Leverage | -0.3071[a] | -0.3118[a] | -0.3016[a] | -0.3055[a] | -0.3111[a] | -0.3158[a] | -0.3055[a] | -0.3095[a] |
| | (-45.08) | (-42.14) | (-43.78) | (-42.31) | (-30.76) | (-30.99) | (-30.64) | (-30.82) |
| MTB | 0.0147[a] | 0.0162[a] | 0.0148[a] | 0.0161[a] | 0.0106[a] | 0.0116[a] | 0.0108[a] | 0.0116[a] |
| | (7.92) | (8.59) | (7.74) | (8.39) | (8.15) | (8.74) | (8.25) | (8.78) |

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**Table 5** – continued from previous page

| | Fama-MacBeth | | | | Fixed Effect (Industry and Year) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Firm Age | -0.0077[a] | -0.0066[a] | -0.0077[a] | -0.0066[a] | -0.0110[a] | -0.0097[a] | -0.0102[a] | -0.0089[a] |
| | (-3.86) | (-3.58) | (-4.36) | (-4.05) | (-5.07) | (-4.44) | (-4.72) | (-4.09) |
| Net Working Capital | -0.2878[a] | -0.2875[a] | -0.2880[a] | -0.2883[a] | -0.3125[a] | -0.3134[a] | -0.3054[a] | -0.3068[a] |
| | (-24.39) | (-22.84) | (-23.54) | (-22.25) | (-27.82) | (-27.57) | (-27.49) | (-27.28) |
| Net Equity Issuance | 0.1261[a] | 0.1182[a] | 0.1336[a] | 0.1267[a] | 0.1196[a] | 0.1123[a] | 0.1241[a] | 0.1170[a] |
| | (7.67) | (7.49) | (9.92) | (10.10) | (10.09) | (9.32) | (10.54) | (9.79) |
| Net Debt Issuance | 0.2380[a] | 0.2442[a] | 0.2288[a] | 0.2346[a] | 0.2062[a] | 0.2133[a] | 0.1960[a] | 0.2024[a] |
| | (8.48) | (9.11) | (8.34) | (8.84) | (8.81) | (8.94) | (8.64) | (8.75) |
| Dividend Dummy | -0.0171[a] | -0.0165[a] | -0.0124[a] | -0.0117[a] | -0.0117[a] | -0.0105[a] | -0.0069[c] | -0.0056 |
| | (-4.35) | (-4.37) | (-3.26) | (-3.31) | (-3.20) | (-2.84) | (-1.87) | (-1.52) |
| R&D | 0.4935[a] | 0.4990[a] | 0.2117[a] | 0.2237[a] | 0.4015[a] | 0.3957[a] | 0.1472[a] | 0.1446[a] |
| | (13.84) | (12.49) | (6.13) | (7.17) | (13.59) | (13.27) | (3.35) | (3.28) |
| Capital Expenditure | -0.6756[a] | -0.6769[a] | -0.6646[a] | -0.6654[a] | -0.6172[a] | -0.6169[a] | -0.6217[a] | -0.6215[a] |
| | (-15.23) | (-15.54) | (-15.37) | (-15.72) | (-23.85) | (-23.70) | (-24.26) | (-24.13) |
| Acquisition | -0.5014[a] | -0.4990[a] | -0.5163[a] | -0.5147[a] | -0.4467[a] | -0.4441[a] | -0.4620[a] | -0.4598[a] |
| | (-12.14) | (-12.59) | (-12.18) | (-12.64) | (-22.67) | (-22.21) | (-23.77) | (-23.34) |
| Cash Flow | -0.0103 | -0.0087 | -0.0329[b] | -0.0312[b] | -0.0069 | -0.0066 | -0.0278[b] | -0.0276[b] |
| | (-0.91) | (-0.80) | (-2.38) | (-2.38) | (-0.58) | (-0.55) | (-2.37) | (-2.34) |
| Lag(Industry Sigma) | 0.4239[a] | 0.4313[a] | 0.3594[a] | 0.3658[a] | 0.1445[b] | 0.1558[b] | 0.1025 | 0.1101 |
| | (10.58) | (9.91) | (8.45) | (8.14) | (2.11) | (2.26) | (1.51) | (1.61) |
| Lag(Equity Beta) | 0.0192[a] | 0.0177[a] | 0.0178[a] | 0.0163[a] | 0.0164[a] | 0.0153[a] | 0.0158[a] | 0.0146[a] |
| | (5.99) | (4.67) | (6.03) | (4.55) | (8.94) | (8.19) | (8.76) | (7.98) |
| Analyst Coverage_res | 0.0058[a] | 0.0078[a] | 0.0041[a] | 0.0059[a] | 0.0074[a] | 0.0089[a] | 0.0056[a] | 0.0070[a] |
| | (5.54) | (4.47) | (5.13) | (4.24) | (3.90) | (4.74) | (2.97) | (3.75) |
| Inst. Own (> 5%) | 0.0590[a] | 0.0562[a] | 0.0623[a] | 0.0592[a] | 0.0624[a] | 0.0609[a] | 0.0643[a] | 0.0622[a] |
| | (8.18) | (7.67) | (8.91) | (8.24) | (5.97) | (5.67) | (6.17) | (5.81) |

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**Table 5** – continued from previous page

| | Fama-MacBeth | | | | Fixed Effect (Industry and Year) | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Inst. Own (< 5%)_res | 0.0156[c] | 0.0322[a] | 0.0208[b] | 0.0354[a] | 0.0298[a] | 0.0461[a] | 0.0360[a] | 0.0504[a] |
| | (1.93) | (3.26) | (2.35) | (3.31) | (2.69) | (4.25) | (3.26) | (4.65) |
| Inst. Turnover | 0.1846[a] | 0.1591[a] | 0.1770[a] | 0.1544[a] | 0.1981[a] | 0.1729[a] | 0.1846[a] | 0.1610[a] |
| | (5.34) | (3.59) | (5.34) | (3.65) | (5.05) | (4.39) | (4.73) | (4.11) |
| IPO2 | 0.0212[b] | 0.0195[b] | 0.0217[a] | 0.0202[a] | 0.0154[a] | 0.0149[a] | 0.0170[a] | 0.0165[a] |
| | (2.83) | (2.86) | (2.99) | (2.98) | (3.31) | (3.19) | (3.66) | (3.55) |
| IPO3 | 0.0026 | 0.0031 | 0.0025 | 0.0028 | 0.001 | 0.0013 | 0.0021 | 0.0025 |
| | (0.39) | (0.50) | (0.38) | (0.46) | (0.23) | (0.31) | (0.50) | (0.59) |
| IPO4 | -0.0018 | -0.0007 | -0.0013 | -0.0001 | -0.0017 | -0.0015 | -0.0009 | -0.0004 |
| | (-0.34) | (-0.14) | (-0.27) | (-0.03) | (-0.44) | (-0.37) | (-0.23) | (-0.10) |
| IPO5 | -0.0039 | -0.0043 | -0.0034 | -0.0038 | -0.0044 | -0.0048 | -0.0034 | -0.0037 |
| | (-1.12) | (-1.52) | (-1.11) | (-1.57) | (-1.19) | (-1.27) | (-0.92) | (-0.99) |
| $R^2$ | 0.54 | 0.54 | 0.55 | 0.55 | | | | |
| Adj-$R^2$ | | | | | 0.55 | 0.54 | 0.55 | 0.55 |
| $N$ | 34,594 | 33,990 | 34,594 | 33,990 | 34,594 | 33,990 | 34,594 | 33,990 |

**Table 6**

Endogeneity: Decimalization test with placebo robustness analysis

Panel A shows the OLS estimators of the specification

$$\Delta\text{Cash Ratio}_i = \beta_0 + \beta_1\text{Dummy\_Active}_i + \mathbf{\Gamma}'(\Delta\mathbf{Z}_i) + \varepsilon_i,$$

where $\Delta$Cash Ratio$_i$ is the change in the Cash Ratio for firm $i$ from the fiscal year prior to decimalization (2000) to the year after (2002), *Dummy_Active* is an indicator variable that equals 1 for the 50% most active stocks and 0 for the least active stocks, $\Delta\mathbf{Z}_i$ is a vector of changes in the control variables for firm $i$ from the year prior to decimalization to the year after, and $\mathbf{\Gamma}$ is the corresponding vector of regression coefficients. The control variables include all those in Table 3 and IPO1, which is a dummy for the first year after an IPO. Panel B displays the results of placebo tests, in which the regression is re-run for each year from 1996 to 2006 (i.e. where 1996, for example, takes the place of 2001 in the original test). In Panel B, only $\hat{\beta}_1$ is shown. $t$-values are calculated using White's (1980) adjustment for heteroscedasticity. Statistical significance at the 1%, 5% and 10% level are indicated by ***a***, ***b***, and ***c*** respectively.

| | Coefficient | $t$-value |
|---|---|---|
| *Panel A: Decimalization test* | | |
| Intercept | 0.0045 | 0.82 |
| **Dummy_Active** | **0.0182**$^{a}$ | **3.09** |
| Δ Price-nonsynch_res | 0.0002 | 0.13 |
| Δ Firm Size | -0.0160 | -1.54 |
| Δ Leverage | -0.2548$^{a}$ | -7.10 |
| Δ MTB | 0.0018 | 0.58 |
| Δ Net Working Capital | -0.2198$^{a}$ | -6.30 |
| Δ Net Equity Issuance | 0.1492$^{a}$ | 5.35 |
| Δ Net Debt Issuance | 0.1187$^{a}$ | 2.63 |
| Δ Dividend Dummy | -0.0030 | -0.33 |
| Δ R&D | -0.2210$^{c}$ | -1.77 |
| Δ Capital Expenditure | -0.1864$^{b}$ | -2.50 |
| Δ Acquisition | -0.2334$^{a}$ | -4.88 |
| Δ Cash Flow | 0.0006 | 0.02 |
| Δ Industry Sigma | -0.1698 | -0.68 |
| Δ Equity Beta | -0.0081 | -1.19 |
| Δ Analyst Coverage_res | -0.0035 | -0.58 |
| Δ Inst. Own. (< 5%)_res | 0.0368 | 1.07 |
| Δ Inst. Own. (> 5%) | 0.0737$^{b}$ | 2.21 |
| Δ Inst. Turnover | -0.0751 | -0.72 |
| Δ IPO1 | 0.0075 | 0.33 |
| Δ IPO2 | -0.0126 | -0.77 |
| Δ IPO3 | 0.0252 | 1.49 |
| Δ IPO4 | -0.0047 | -0.38 |
| Δ IPO5 | 0.0060 | 0.49 |
| #Obs | 1387 | |
| Adj-$R^2$ | 0.18 | |

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**Table 6** – continued from previous page

| | $\hat{\beta}_1$ | $t$-value |
|---|---|---|
| *Panel B: Placebo test* | | |
| Placebo year | | |
| 1996 | 0.0034 | 0.72 |
| 1997 | 0.0078 | 1.51 |
| 1998 | 0.0027 | 0.49 |
| 1999 | 0.0017 | 0.29 |
| 2000 | -0.0004 | -0.06 |
| **2001** | **0.0182**[a] | **3.09** |
| 2002 | 0.0073 | 1.35 |
| 2003 | -0.0041 | -0.68 |
| 2004 | -0.0009 | -0.14 |
| 2005 | 0.0082 | 1.44 |
| 2006 | -0.0028 | -0.48 |

**Table 7**

Two-way causality: Simultaneous equation system

This table displays the results from running a system of two simultaneous equations:

$$\text{(i)} \quad \text{Cash Ratio}_{i,t} = \alpha_0 + \alpha_1 Liq\_res_{i,t} + \sum_{k=2}^{K} \alpha_k Z_{k,i,t-1} + \varepsilon_{i,t},$$

$$\text{(ii)} \quad Liq\_res_{i,t} = \beta_0 + \beta_1 \text{Cash Ratio}_{i,t} + \sum_{l=2}^{L} \beta_l X_{l,i,t-1} + \eta_{i,t},$$

where *Liq_res* is *ILLIQ_res* or *Log_resprd_res*, $Z_{k,i,t-1}$ are lagged controls in the Cash Ratio equation (i), and $X_{l,i,t-1}$ are lagged controls in the stock liquidity regression (ii). The system is estimated by a Fama-MacBeth procedure, using two-stage least squares (2SLS) for each yearly cross-section. In particular, for each year $t$, *Liq_res* (Cash Ratio) is regressed on all controls from both equations, yielding fitted values $\widehat{Liq\_res}$ ($\widehat{\text{Cash Ratio}}$), which are then used in the Cash Ratio (*Liq_res*) regression in place of *Liq_res* (Cash Ratio). The estimated coefficients are then averaged over all years. $t$ values are calculated using Newey and West (1987) standard errors with two lags. Panel A shows the results of the Cash Ratio equation. Panel B shows the results of the stock liquidity equation. The sample period is from 1994 to 2010. Fama-French 48 industry dummies are included among the control variables in both equations, but their coefficients are not shown here. Statistical significance at the 1%, 5% and 10% level are indicated by ***a***, ***b***, and ***c*** respectively.

| *Liq_res* is: | *Log_resprd_res* | | *ILLIQ_res* | |
|---|---|---|---|---|
| | Coef. | $t$-value | Coef. | $t$-value |
| *Panel A: Cash Ratio as dependent variable* | | | | |
| Intercept | 0.2837[a] | 29.15 | 0.2917[a] | 19.29 |
| Log_resprd_res | -0.0704[a] | -9.93 | | |
| *ILLIQ*_res | | | -0.0065[a] | -5.23 |
| Price-nonsynch_res | 0.0007[c] | 1.97 | -0.0016[a] | -4.60 |
| Firm Size | -0.0160[a] | -10.13 | -0.0119[a] | -13.30 |
| Leverage | -0.2510[a] | -31.53 | -0.2583[a] | -31.14 |
| MTB | 0.0029[b] | 2.48 | 0.0056[a] | 5.91 |
| Firm Age | -0.0081[a] | -3.58 | -0.0051[b] | -2.52 |
| Net Working Capital | -0.2669[a] | -24.00 | -0.2784[a] | -18.70 |
| Net Equity Issuance | 0.0475[a] | 3.34 | 0.0304[c] | 1.92 |
| Net Debt Issuance | 0.1705[a] | 12.50 | 0.1699[a] | 11.02 |
| Dividend Dummy | -0.0214[a] | -9.13 | -0.0186[a] | -6.80 |
| R&D | 0.4927[a] | 28.39 | 0.4823[a] | 23.37 |
| Capital Expenditure | -0.5815[a] | -14.73 | -0.5857[a] | -14.67 |
| Acquisition | -0.4246[a] | -22.42 | -0.4342[a] | -22.23 |
| Cash Flow | -0.0596[a] | -4.84 | -0.0574[a] | -3.67 |
| Industry Sigma | 0.1696 | 1.42 | 0.1720 | 1.48 |
| Equity Beta | 0.0136[a] | 4.01 | -0.0007 | -0.12 |
| Analyst Coverage_res | 0.0042[b] | 2.40 | 0.0076[a] | 4.06 |
| Inst. Own ($>5\%$) | 0.0460[a] | 10.43 | 0.0076 | 0.62 |
| Inst. Own ($<5\%$)_res | -0.0871[a] | -8.20 | -0.0546[a] | -4.17 |
| Inst. Turnover | 0.1337[a] | 5.32 | 0.0261 | 0.45 |
| IPO2 | 0.0001 | 0.03 | 0.0032 | 0.78 |
| IPO3 | -0.0066[c] | -1.87 | -0.0058 | -1.58 |
| IPO4 | -0.0070 | -1.36 | -0.0069 | -1.49 |
| IPO5 | -0.0097[b] | -2.35 | -0.0096[b] | -2.64 |

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**Table 7** – continued from previous page

| *Liq_res* is: | *Log_resprd_res* | | *ILLIQ_res* | |
|---|---|---|---|---|
| | Coef. | $t$-value | Coef. | $t$-value |
| *Panel B:* Liq_res *as dependent variable* | | | | |
| Intercept | 0.3357[a] | 7.64 | 1.6659 | 1.54 |
| Cash Ratio | -0.8219[a] | -11.24 | -7.4969[a] | -5.21 |
| Market Capitalization - log | -0.0245 | -1.38 | 0.3384[a] | 3.09 |
| Leverage | 0.1986[a] | 5.33 | 2.1723[a] | 3.32 |
| MTB | -0.0762[a] | -10.54 | -0.8518[a] | -6.01 |
| Firm Age | -0.0184 | -1.13 | 0.5191[a] | 5.71 |
| Cash Flow | -0.1704[b] | -2.90 | -0.4416 | -0.68 |
| R&D | 0.0976 | 1.66 | -2.9071[a] | -3.96 |
| Acquisition | -0.1300 | -1.52 | -3.4846[a] | -4.25 |
| Equity Beta | -0.0701[a] | -4.66 | -2.9175[a] | -9.21 |
| Stock Price - log | -0.1142[a] | -3.95 | -0.4354 | -1.56 |
| Stock Annual Return | -0.1398[a] | -8.16 | -1.3929[a] | -7.44 |
| Stock Return Volatility | 3.0627[b] | 2.28 | 77.5268[a] | 3.05 |
| Analyst Coverage_res | -0.0607[a] | -4.55 | -0.4069[a] | -4.79 |
| Inst. Own (> 5%) | 0.0196 | 0.26 | -5.2964[a] | -4.44 |
| Inst. Own (< 5%)_res | -1.3298[a] | -11.99 | -9.9978[a] | -5.95 |
| Inst. Turnover | 0.1396 | 1.21 | -17.9855[a] | -5.10 |
| IPO2 | -0.0005 | -0.03 | 0.4058 | 1.46 |
| IPO3 | -0.0223 | -1.26 | -0.2806 | -1.13 |
| IPO4 | -0.0041 | -0.26 | -0.2101 | -0.61 |
| IPO5 | -0.0294[c] | -1.75 | -0.2996 | -1.48 |

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