On the Positive Relation between Cash Holdings and Stock Returns[☆]

F.Y. Eric C. Lam
Department of Finance and Decision Sciences
Hong Kong Baptist University
Kowloon Tong, Hong Kong
Email: fyericcl@hkbu.edu.hk
Tel: (852)-3411-5218; Fax: (852)-3411-5585

Tai Ma
Department of Finance
National Sun Yat-sen University
Kaohsiung, Taiwan
Email: matai@finance.nsysu.edu.tw
Tel: (886)-7-525-2000 ext. 4810; Fax: (886)-7-525-1523

Shujing Wang
Shanghai Finance University
Pudong, Shanghai, China
Email: shujingwang@ust.hk
Tel: (852)-2358-7666; Fax: (852)-2358-1749

K.C. John Wei[*]
Department of Finance
The Hong Kong University of Science and Technology
Clear Water Bay, Kowloon, Hong Kong
Email: johnwei@ust.hk; Tel: (852)-2358-7676
Fax: (852)-2358-1749

This version: July 2015

[☆]We appreciate the helpful comments from Alex Barinov, Jay Cao (FMA Asian discussant), Charles Clarke, John Crosby (AFBC discussant), Gerald Garvey, Gianluca Marcato (EFMA discussant), Clinton Newman, Anna-Leigh Stone (Eastern FA discussant), and participants in the 2014 European Financial Management Association (EFMA) Annual Meeting in Rome, the 2014 Financial Management Association Asian (FMA Asian) Conference in Tokyo, the 2014 Eastern Finance Association (Eastern FA) Annual Meeting in Pittsburgh, and the 2013 Australasian Finance and Banking Conference (AFBC) in Sydney. All errors are ours.

[*]Corresponding author: K.C. John Wei, Department of Finance, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong. Tel: (852)-2358-7676; Fax: (852)-2358-1749. Email: johnwei@ust.hk.

On the Positive Relation between Cash Holdings and Stock Returns

Abstract

Consistent with investors overreacting to the salient agency problem pertaining to high cash holdings but underreacting to the implicit concern of real illiquidity associated with low cash holdings, there is a positive empirical relation between cash holdings and future abnormal stock returns. Positive returns on high cash holders with low leverage, i.e. stronger agency conflicts, are higher hence the relation is stronger when leverage is low. Negative returns on low cash holders that are unprofitable, i.e. have poorer liquidity, are lower therefore the relation is stronger among unprofitable firms. Cash holdings is positively correlated with relative misvaluation, suggesting that high (low) cash holdings proxies for undervaluation (overvaluation). In particular, high cash-holdings firms that are more clearly identified as relatively undervalued generate higher returns than low cash-holdings firms that are more clearly identified relatively overvalued but the former that are more precisely identified as relatively overvalued do not generate higher returns than the latter that are more precisely identified as relatively undervalued. The relation is strong when arbitrage is limited but vanishes when limits to arbitrage are weak.

JEL Classification: G12, G14, G32

Keywords: Cash holdings; Limits to arbitrage; Leverage, Misvaluation; Profitability; Stock returns

1. Introduction

We hypothesize that investors overreact to the salient agency problem pertaining to high cash holdings but underreact to the implicit real-illiquidity concern associated with low cash holdings. On one hand, the agency theory of Jensen and Meckling (1976) and Jensen (1986) argues that self-interested managers might overspend cash reserves for their own benefits at the expense of outside shareholders. Harford (1999), Titman, Wei, and Xue (2004), and Harford, Mansi, and Maxwell (2008) show that, due to agency problems, firms with high cash holdings spend cash reserves quickly on value-destroying acquisitions and capital expenditures. If investors overly emphasize the salient agency costs and excessively discount high cash-holdings firms, then these firms might be temporarily undervalued.

On the other hand, low cash holdings could have detrimental effects on firmsí liquidity. Bolton, Chen, and Wang (2011), Bolton, Chen, and Wang (2013), and Harford, Klasa, and Maxwell (2014) argue that firms especially financially constrained ones concern for corporate liquidity and higher cash holdings helps firms cope with uncertainty in financing conditions and mitigate refinancing risk. If investors neglect the implicit real-illiquidity costs and fail to sufficiently discount low cash-holdings firms, then these firms might be temporarily overvalued. Taken together, the misvaluation and the subsequent correction of such should lead high cash-holding firms to realize abnormally high future stock returns while low cash-holdings firms to realize abnormally low returns, generating a positive empirical relation between cash holdings and subsequent average abnormal stock return.

From a sample of monthly returns on U.S. listed firms from July 1963 to December 2014, we find that the future average abnormal stock return, adjusting for characteristics of market capitalization and the book-to-market equity ratio, the Fama and French (2015) five-factor

model, or the Chen, Roll, and Ross (1986) macroeconomic-factor model, on high cash-holding firms is significantly positive while the average abnormal return on low cash-holding firms is largely negative. The differences in abnormal returns between high and low cash-holdings firms are positive and statistically significant. Cash holdings is positively related to future stock returns in the Fama and MacBeth (1973) regression, after controlling for firm size and the book-to-market equity ratio. The relation remains after controlling for industry dummy variables based on Fama and French (1997) 49 industries.[1]

If investors overreact to the salient agency problems pertaining to high cash holdings, then the undervaluation of high cash-holdings firms should be less severe for those with high leverage since these firms tend to be perceived as having weaker agency conflicts (e.g., Jensen, 1986). We expect and do find that the positive abnormal returns on high cash-holdings firms turn much weaker when leverage is high but remain significant when leverage is low. Consequently, the positive relation between cash holdings and returns is stronger among firms with low leverage than among firms with high leverage.

Moreover, if investors underreact to the implicit real-illiquidity concern associated with low cash holdings, then the overvaluation of low cash-holdings firms should be less severe for those that are profitable as these firms tend to have better liquidity. We expect and do find that the negative abnormal returns on low cash-holdings firms that are profitable are insignificant while the negative abnormal returns on low cash-holdings firms that are unprofitable remain strong. Again, the positive relation between cash holdings and returns is stronger among unprofitable firms than among profitable firms.

[1] Cash hoarding is common in some industries but not so much in others. For example, Bates, Kahle, and Stulz (2009) report that the average cash ratio of high-tech firms is greater than that of manufacturing firms. In our sample we observe that more firms in medical equipment, pharmaceutical products, business services, computer hardware, and computer software industries are high cash holders while more firms in utilities, petroleum and natural gas, communication, and wholesale industries are low cash holders.

To substantiate our misvaluation argument, we further show that cash holdings is positively correlated with a measure of relative misvaluation similar to the one in Stambaugh, Yu, and Yuan (2012; 2015) and is identified with 11 cross-sectional stock return anomalies well documented in the literature. The correlation suggests that cash holdings proxies for relative misvaluation and high (low) cash-holdings firms are in general relatively undervalued (overvalued). Next we show that the abnormal returns on low cash-holdings firms are significantly negative for those that our measure more clearly identify as relatively overvalued but not significantly so for those that are not identified as such. The abnormal returns on high cash-holdings firms are significantly positive for those that our measure more precisely identify as relatively undervalued but not significantly so for those that are identified as relatively overvalued. We also show that high cash-holdings firms that are relatively undervalued generate significantly higher abnormal returns than low cash-holdings firms that are relatively overvalued. By contrast, high cash-holdings firms that are not relatively undervalued only mildly outperform low cash-holdings firms that are not relatively overvalued. High cash-holdings firms that are relatively undervalued do not outperform low cash-holdings firms that are overvalued. These findings suggest that the misvaluation as we hypothesize plays an important role in the relation between cash holdings and returns.

Last but not least, we construct a measure of limits to arbitrage based on three common aspects of arbitrage barriers including arbitrage risk, transaction cost, and liquidity. Cash holdings is positively correlated with limits to arbitrage, suggesting that high cash-holdings firms are not necessarily easy to long. We show that when limits to arbitrage are weak, abnormal returns on low cash-holdings firms are insignificant but largely turn negative when limits to arbitrage become more severe. The positive abnormal returns on high cash-holdings firms are

mild when limits to arbitrage are weak and are much stronger when limits to arbitrage become more severe. We also show that the positive relation between cash holdings and returns is strong when arbitrage is limited. The relation diminishes as limits to arbitrage gets less severe and the relation vanishes when limits to arbitrage are weak. These findings suggest that limits to arbitrage hence misvaluation is important for the relation between cash holdings and returns.

Cash holdings, an important firm characteristic, have been widely studied in the corporate finance literature.[2] However, the pricing of cash holdings, especially the equity pricing from the behavioral perspective, has been much less examined. Archarya, Davydenko, and Strebulaev (2012) argue that firms subject to higher credit risk optimally hold more cash as a buffer against cash flow shortfall hence bonds of these firms carry higher credit spreads. On one hand, Simutin (2012) argues that excess cash holdings proxies for risky growth options. Palazzo (2012) argues that systematically riskier firms, which have higher expected returns, optimally hold more cash as a hedge against future cash flow shortfall to avoid costly external financing. On the other hand, Ortiz-Molina and Phillips (2014) argue that, in the absence of agency problems, the expected returns for firms with high cash holdings should be lower as cash is more liquid and less risky as an asset. Therefore, the relation between cash holdings and stock returns is still debatable and requires more research attention. Our paper adds to the literature by clarifying a positive relation and providing evidence that support behavioral pricing as a potential driver of the relation.

Our paper proceeds as follows. Section 2 reviews the literature and formalizes our test objectives. Section 3 describes the variables and our sample. Section 4 examines the relation

[2] E.g., Pinkowitz and Williamson (2001) study the relation between bank power and corporate cash holdings. Klasa, Maxwell, Ortiz-Molina (2009) study the strategic use of cash holdings in collective bargaining with labor unions. Duchin (2010) studies the relation between cash holdings and corporate diversification. Fresard (2010) studies the impact of cash holdings on product market performance. Liu and Mauer (2011) study the relation between CEO compensation and cash holdings. Lee and Song (2012) study the effect of Asian financial crisis on cash holdings.

between cash holdings and future average abnormal stock returns. Section 5 examines the relation across leverage and profitability. Section 6 examines the roles of relative misvaluation in the relation. Section 7 examines the roles of limits to arbitrage in the relation. Section 8 concludes the paper.

2. Literature Review and Test Developments

As mentioned in the introduction, agency theory argues that self-interested managers might overspend cash reserves for their own benefits at the expense of outside shareholders. For example, Harford (1999) find that cash-rich firms are more likely to bid for bad targets in the takeover market. Harford, Mansi, and Maxwell (2008) show that poorly governed firms spend cash reserves quickly on value-destroying acquisitions and capital expenditures. Moreover, Titman, Wei, and Xue (2004) document that the negative relation between capital investment and future abnormal stock returns is stronger for firms with more severe agency problems of free cash flow, suggesting that managers of firms holding large piles of cash have a general tendency to overinvest. Investors might excessively concern self-interested managers of high cash-holdings firms wasting the cash reserves in one way or another. If investors overly emphasize the salient agency costs and excessively discount high cash-holdings firms, then these firms might be temporarily undervalued.

Low cash holdings could be detrimental to firmsí real liquidity. Bolton, Chen, and Wang (2011) show that corporate liquidity endogenously arises in a model of dynamic investment for financially constrained firms. Bolton, Chen, and Wang (2013) also find that firms optimally put away cash for both market-timing and precautionary-savings purposes when financing conditions are stochastic. Furthermore, Harford, Klasa, and Maxwell (2014) provide evidence that cash

holdings can help firms mitigate refinancing risk. Investors might overlook the threat to corporate liquidity due to low cash holdings. If investors neglect the implicit real-illiquidity costs and insufficiently discount low cash-holdings firms, then these firms might be temporarily overvalued. The misvaluation and the future correction of such should lead high cash-holding firms to realize abnormally high future stock returns while low cash-holdings firms to realize abnormally low returns. Our first test is to examine whether *the cash holdings and subsequent average abnormal stock return is positively related*.

If the high abnormal return on high cash-holdings firms is due to investors overreact and excessively discount the salient agency problems pertaining to high cash holdings, the undervaluation of high cash-holdings firms should be more severe for those with low leverage as these firms tend to have stronger agency conflicts. Our second test is to examine whether *the positive relation between cash holdings and returns is stronger among low-leverage firms.* If the low abnormal return on low cash-holdings firms is due to investors underreact and insufficiently discount the implicit threat to real illiquidity associated with low cash holdings, the overvaluation of low cash-holdings firms should be more severe for those that are unprofitable as these firms tend to have poorer liquidity. Our third test is to examine whether *the positive relation between cash holdings and returns is stronger among unprofitable firms.*

Our argument suggests that cash holdings should serve as a proxy for relative misvaluation therefore it should be correlated with relative misvaluation such that in general high cash holdings is associated with undervaluation while low cash holdings is associated with overvaluation. Furthermore, the abnormal returns on low cash-holdings firms should be particularly low among those that overvaluation is more clearly identified. The abnormal returns on high cash-holdings firms should be especially high among those that undervaluation is more

precisely identified. Thus the fourth test is to examine whether *the positive relation between cash holdings and returns is stronger when high cash holders are undervalued and low cash holders are overvalued*.

Profitable opportunities arising from misvaluation of cash holdings should attract arbitrage attention. Arbitrageurs should correct the mispricing quickly when the trades to exploit the opportunities involve low risk or cost. However, De Long, Shleifer, Summers, and Waldmann (1990) suggest that noise trading would cause prices to diverge from fundamental values, adding risk to arbitrage. Shleifer and Vishny (1997) argue that arbitrageurs are typically capital constrained and might have to prematurely close arbitrage positions due to margin calls and suffer significant losses. Liu and Longstaff (2004) show that when arbitrage is risky, even optimized trades can experience losses before prices converge.

Pontiff (1996, 2006) show that arbitrageurs are typically under-diversified hence the idiosyncratic risk involved in arbitraging a small number of stocks adds substantially to the total risk of their overall positions. The extra risk should concern arbitrageurs since whether higher returns can be expected from such risk are still unclear.[3] Transaction costs would be another barrier to arbitrage. Trading expenses obviously reduce the profitability of arbitrage trades, which lowers their attractiveness to arbitrageurs. Finally, a lack of liquidity might further make arbitrage opportunities technically harder to exploit. Therefore the correction of misvaluation of cash holdings could be delayed when arbitrage is highly risky and costly. Our final test is to examine whether *the positive relation between cash holdings and returns is stronger when limits to arbitrage are more severe.*

[3] For example, while Fu (2009) shows that stock returns are positively associated with idiosyncratic risk, Ang, Hodrick, Xing, and Zhang (2006, 2009) and Stambaugh, Yu, and Yuan (2015) find the opposite.

3. Variables Description and Sample Selection

This section briefly describes the variables and the data we use in our tests while Appendix 1 provides detailed definitions of the variables.

3.1. Cash holdings

We measure firm cash holdings (*CH*) by the cash-to-assets ratio at the end of fiscal year *t*. This ratio measures the proportion of total assets that the firm holds in cash and cash equivalents. A higher value means the firm hoards cash more intensively.

3.2. Leverage and profitability

We measure firm leverage by the debt-to-assets ratio (*D*/*A*) at the end of fiscal year *t*. We identify firms with low (high) leverage as those with leverage below (above) the cross-sectional median at the end of fiscal year *t*. We classify firms into unprofitable versus profitable ones according to their return on assets (*ROA*) at the end of fiscal year *t*. Specifically we identify unprofitable (profitable) firms as those that have non-positive (positive) *ROA* at the end of fiscal year *t*.

3.3. Relative misvaluation

We follow the scheme in Stambaugh, Yu, and Yuan (2012, 2015) to measure relative misvaluation in the cross section of firms. Specifically we summarize the following 11 stock return anomalies into a comprehensive proxy. (1) Cooper, Gulen, and Schill (2008) find that firms with lower total asset growth (*TAG*) have higher future abnormal returns. They suggest that investors overreact to business expansions or contractions. (2) Sloan (1996) documents that firms

with lower accruals (*Acc*) have higher future abnormal returns. He suggests that investors overestimate the persistence of the non-cash component of earnings. (3) Hirshleifer, Hou, Teoh, and Zhang (2004) find that firms with lower net operating assets (*NOA*) have higher future abnormal returns. They suggest that investors have limited attention hence they focus on accounting profitability but neglect cash profitability. (4) Titman, Wei, and Xie (2004) document that firms with lower capital investment (*I/A*) have higher future abnormal returns. They suggest that investors underreact to the overinvestment by empire-building managers. (5) Bradshaw, Richardson, Sloan (2006) find that firms with lower external financing (*XF*) have higher future abnormal returns. They suggest that firm managers time the market and opportunistically issuing (retiring) overvalued (undervalued) securities.

(6) Daniel and Titman (2006) document that firms with lower net share issuance (*NSI*) have higher future abnormal returns. They suggest that firm managers tend to issue (retire) shares in response to favorable (unfavorable) intangible information that signals overvaluation (undervaluation). (7) Dichev (1998) finds that firms with lower bankruptcy risk, proxied by Ohlsonís (1980) bankruptcy score (*O*), have higher future abnormal returns. Campbell, Hilscher, and Szilagyi (2008) show that the effect is stronger among firms with more informational frictions and suggest that it is due to misvaluation. (8) Novy-Marx (2013) documents that firms with higher gross profitability (*GP*) have higher future abnormal returns. (9) Fama and French (2006) find that firms with higher return on assets (*ROA*) have higher future abnormal returns. Wang and Yu (2013) show that the profitability effect is stronger when limits to arbitrage are more severe and suggest that the effect is due to misvaluation. (10) Lakonishok, Shleifer, and Vishny (1994) show that firms with higher book-to-market equity ratio (*B*/*M*) have higher future abnormal returns due to extrapolation bias. (11) Jegadeesh and Titman (1993, 2001) show that

firms with higher past six-months cumulative stock returns (*PRet*) have higher future abnormal returns in the following six months. They suggest that it is due to investorsí misvaluing firm information.[4]

Stocks with lower total asset growth, accruals, net operating assets, capital investment, external financing, net share issuance, bankruptcy score, or higher gross profitability, return on assets, book-to-market equity ratio, past six-months cumulative stock returns should be relatively undervalued and vice versa. We compute the first 10 variables at the end of fiscal year *t* and the last one at the end of June of calendar year *t*+1. We then independently sort stocks into terciles in descending order based on each of the first seven variables and in ascending order based on each of the final four variables. Afterwards, we average out the rankings on each firm to obtain a precise measure and concise presentation of relative misvaluation (*RM*). Higher relative misvaluation corresponds to relative undervaluation while lower relative misvaluation corresponds to relative overvaluation.

3.4. Limits to arbitrage

We use idiosyncratic stock return volatility (*IVol*) to measure arbitrage risk following Pontiff (1996) and others.[5] Our measure of transaction costs is the inverse of stock price (1/*Price*), which is related to the bid-ask spread and brokerage commission (see, e.g., Bhardwaj and Brooks, 1992). Ball, Kothari, and Shanken (1995) also use stock price as an inverse proxy for the bid-ask spread. Furthermore, Stoll (2000) shows that recent stock prices are inversely related to the relative bid-ask spread. Our measure of liquidity is the dollar trading volume

[4] Barber, Shleifer, and Vishny (1998) argue that investors are conservative and response to new evidence too slowly.
[5] Wurgler and Zhuravskaya (2002), Ali, Hwang, and Trombley (2003), Mashruwala, Rajgopal, and Shevlin (2006), Duan, Hu, McLean (2010), McLean (2010), Lam and Wei (2011), and Lipson, Mortal, and Schill (2011) also employ this measure.

(*DVol*), which is inversely related to price pressure and time required to fill an order or to trade a large block of shares (see, e.g., Bhushan, 1994). Stocks with higher arbitrage risk, higher transaction costs, and lower liquidity should have more severe limits to arbitrage. We compute the three variables for each firm at the end of June of calendar year t+1 and independently sort stocks into terciles based on each of the variables. We then average out the rankings on each firm to obtain a precise measure and concise presentation of limits to arbitrage (*LTA*).

3.5. Sample selection

Our sample contains firms traded on NYSE, Amex, and Nasdaq. Their annual financial statements and monthly stock information are from Compustat and the Center for Research in Security Prices (CRSP), respectively. Like Fama and French (1992, 1993), certificates, American depositary receipts (ADRs), shares of beneficial interest (SBIs), unit trusts, closed-end funds, real estate investment trusts (REITs), and financial firms are excluded. We delete firms for which we do not have the data needed to compute all the necessary firm characteristics in a year. We also use delisting returns to mitigate the survivorship bias.[6] The sample covers annual firm attributes from fiscal year 1962 to year 2013, and monthly stock returns from the end of July of 1963 to the end of December of 2014.[7]

4. The Relation between Cash Holdings and Future Abnormal Stock Returns

[6] Shumway (1997) suggests that the returns of stocks delisted for poor performance (delisting codes 500 and 520 to 584) are usually unavailable. Following Shumway and Warther (1999), when the return is missing for an available CRSP month date, we use the delisting return wherever available. When delisting return is not available, we use ñ 30% for poor performance delisting and 0% for other cases.

[7] The relative misvaluation measure includes external financing starting fiscal year 1971 when the data for the financing variable are more widely available.

This Section examines the relation between cash holdings and future abnormal stock returns. Panel A of Table 1 presents summary statistics of cash holdings. A firm on average holds 15% of the total assets in cash. The standard deviation of cash holdings in the average cross section is 17%. While the 10th percentile of cash holdings is 1%, the 90th percentile of cash holdings is 41%. Panel B shows that cash holdings are negatively correlated with the well-documented pricing attributes of market capitalization (*Size*) and the book-to-market equity ratio (*B*/*M*) (see, e.g., Fama and French, 1992).

Panel C reports the decile portfolios, each containing an average of 342 firms per year, grouped annually by cash holdings. Low cash-holdings firms (decile 1) hold 1% of the total assets in cash while high cash-holdings ones (decile 10) hold 54% of the assets in cash. The average of the monthly characteristic-adjusted stock return between July of calendar year *t*+1 and June of calendar year *t*+2 (*aRet*), which is the monthly stock return minus the return on the benchmark matched to the stock accordingly to the five-by-five ranking in *Size* and *B/M* (see, e.g., Daniel and Titman, 1997; Daniel, Titman, and Wei, 2001; Daniel, Grinblatt, Titman, Wermers, 1997) on low cash holders is ñ0.20% (t-stat = ñ2.68). The average characteristic-adjusted return on high cash holders is 0.26% (t-stat = 2.16). High cash holders outperform low cash holders on average by 0.46% (t-stat = 2.60).

Alternatively, we adjust the returns with respect to the Fama and French (2015) five-factor model by estimating the intercept of the following monthly time-series regression

$$Ret_{p,t} - R_{ft} = \alpha_{p,FF}$$

$$+\beta_{p,MKT}MKT_t + \beta_{p,SMB}SMB_t + \beta_{p,HML}HML_t + \beta_{p,RMW}RMW_t + \beta_{p,CMA}CMA_t + \epsilon_{p,t}, \quad (1)$$

where Ret_p is the return on a cash-holdings deilce while R_f is the risk-free rate. *MKT* is the market factor, *SMB* is the size factor, *HML* is the value factor, *RMW* is the profitability factor,

and the *CMA* is the investment factor.[8] The five-factor alpha (α_{FF}) on low cash holders is ñ0.07% (t-stat = ñ0.70). The alpha on high cash holders is 0.71% (t-stat = 4.37). The difference in the alpha between high and low cash holders is 0.78% (t-stat = 4.37).[9]

Next we examine the relation between cash holdings and future abnormal returns by estimating the slope b_1 of the following Fama and MacBeth (1973) cross-sectional regression

$$Ret_{i,t+1} = a + b_1 CH_{i,t} + b_2 Ln(Size_{i.t}) + b_3 B/M_{i.t} + \varepsilon_{i,t+1}, \quad (2)$$

where Ret_{t+1} is the raw monthly stock return on firm *i* from July of calendar year *t*+1 and June of calendar year *t*+2 and *Ln*(*Size*) is the natural logarithm of market capitalization.[10] Panel D reports the estimation results. The slope b_1 is 0.611 (t-stat = 2.04). Panel D further reports the estimated slope b_1 of the following Fama and MacBeth (1973) cross-sectional regression

$$Ret_{i,t+1} = \sum_{j=1}^{49} a_j IndDV_{i,j} + b_1 CH_{i,t} + b_2 Ln(Size_{i.t}) + b_3 B/M_{i.t} + \varepsilon_{i,t+1}, \quad (3)$$

where *IndDV* is the set of industry dummies each of with equals one if firm *i* belongs to industry *j* according to the industry classification in Fama and French (1997) and zero otherwise.[11] After controlling for the industry effect, the slope b_1 remains positive at 0.354 (t-stat = 1.76).

4.1. Default and macroeconomic risks

Archarya, Davydenko, and Strebulaev (2012) argue that the asset composition, especially the proportion of cash, of a firm depends on its liability status. When a financially constrained firm faces higher default likelihood, it raises the cash position to increase its asset liquidity as a precaution against potential shortfall in future cash flow. As the higher liquidity might not

[8] We obtain the risk-free rates and factors from Kenneth Frenchís data library.
[9] The return spreads based on value-weighted portfolios and NYSE cash-holdings breakpoints are also significantly positive. As the number of firms is highly skewed towards the high cash-holdings decile in such design, we focus the tests on the equal-weighted portfolios based on all firm breakpoints.
[10] We take the natural logarithm of *Size* to alleviate the effect of skewness on the linear regression.
[11] We obtain the updated classification from Kenneth Frenchís data library. As we exclude financial firms, i.e., classifications 45 to 48, from our sample, our sample consists of 45 industries.

completely hedge the default risk, the distressed firm could remain more risky and the market demands higher credit spread on the firmís debt. To examine whether the higher abnormal returns on high cash holders relative to low cash holders might reflect the compensation due to higher default risk or exposure to other standard macroeconomic risks, we adjust the returns with respect to the Chen, Roll, and Ross (1986) macroeconomic-factor model by estimating the intercept of the following monthly time-series regression

$$Ret_{p,t} - R_{ft} = \alpha_{p,CRR} + \beta_{p,MP}F_{MP,t} + \beta_{p,UI}F_{UI,t} + \beta_{p,UTS}F_{UTS,t} + \beta_{p,DEI}F_{DEI,t} + \beta_{p,URP}F_{URP,t} + \epsilon_{p,t}, \quad (4)$$

where Ret_p is the return on a cash-holdings decile while R_f is the risk-free rate. F_{MP}, F_{UI}, F_{UTS}, F_{DE}, and F_{URP} are the returns on the portfolios tracking the industrial-production factor, the unexpected-inflation factor, the factor on the term structure of interest rate, the factor on the change in expected inflation, and the default-risk factor, respectively. See Appendix 2 for the construction of the tracking portfolios.

Panel A of Table 2 presents the average premiums on the tracking portfolios. Consistently with Liu and Zhang (2008) and Cooper and Priestley (2011), the industrial-production tracking portfolio carries a significantly positive premium (1.23%; t-stat = 8.07). Consistently with Cooper and Priestley (2011), the unexpected-inflation portfolio and the portfolio on the change in expected inflation do not carry a significant premium. The portfolio on the term structure of interest rate carries a significantly positive premium (1.11%; t-stat = 2.71) while the default-risk portfolio carries a significantly negative premium (ñ0.23%; t-stat = ñ2.18). The magnitudes of the premiums on the industrial-production portfolio, the portfolio on the term structure of interest rate, and the default-risk portfolio are similar to those reported in Cooper and Priestley (2011).

Panel B of Table 2 reports the estimated of the key parameters of Equation (4). The

exposures of low and high cash-holdings decile portfolios on the default-risk tracking portfolio (β_{URP}) are ñ0.325 and 0.680, respectively. The difference in the exposure is 0.680 (t-stat = 4.78), suggesting that high cash holders are subject to higher default risk than low cash holders. Yet after adjusting for the compensations for default risk and exposure to other classical macroeconomic risks, the macroeconomic-factor alpha (α_{CRR}) on low cash holders is ñ0.26% while that on high cash holders is 0.67% and both are significant at the 5% level. High cash holders still outperform low cash holders by 0.67% (t-stat = 4.97). Overall, these findings suggest that the relation between cash holdings and returns is positive.

5. The Effects of Leverage and Profitability

This Section examines the relation between cash holdings and future abnormal stock returns across leverage and profitability.

5.1. Leverage

Panel A of Table 3 reports the cash-holdings decile portfolios for the subsample of low leverage firms followed by those for the subsample of high leverage firms.[12] Among low leverage firms, low cash-holdings firms hold 1% of the total assets in cash while high cash-holdings ones hold 63% of the assets in cash. The average characteristic-adjusted return, the five-factor alpha, and the macroeconomic-factor alpha on low cash holders are ñ0.19% (t-stat = ñ2.20), ñ 0.05% (t-stat = ñ0.38) and ñ0.29% (t-stat = ñ3.73), respectively. The adjusted return and alphas on high cash holders are 0.37% (t-stat = 2.51), 0.84% (t-stat = 4.41) and 0.49% (t-stat = 3.73). Similar to Tables 1 and 2, abnormal returns on low cash holders are largely negative while those on high

[12] In this sample, which requires data on the debt-to-asset ratio, the magnitudes and statistical significance of the spreads in cash-holdings and abnormal returns between high and low cash holders as well as the slope of return on cash holdings are similar to those reported in Tables 1 and 2.

cash holders are positive. High cash holders outperform low cash holders by 0.56% (t-stat = 2.87), 0.89% (t-stat = 4.22), and 0.78% (t-stat = 4.59) with respect to the three abnormal returns.

Among high leverage firms, low cash-holdings firms hold 1% of the total assets in cash while high cash-holdings ones hold merely 30% of the assets in cash compared to the low leverage ones. The adjusted return and alphas on low cash holders are ñ0.21% (t-stat = ñ2.48), ñ0.04% (t-stat = ñ 0.32) and ñ0.26% (t-stat = ñ3.68) while those on high cash holders are 0.06% (t-stat = 0.59), 0.30% (t-stat = 2.47) and 0.14% (t-stat = 1.37). Although abnormal returns on low cash holders remain similarly negative, the positive abnormal returns on high cash holders are much weaker. Consistent with our argument, high cash holders with high leverage seem to have less salient agency conflicts hence the undervaluation of these firms also seem to be less severe. High cash holders outperform low cash holders much weakly by 0.27% (t-stat = 1.83), 0.34% (t-stat = 2.68), and 0.40% (t-stat = 3.12) with respect to the three abnormal returns.

Although the difference in abnormal returns across low and high leverage on low cash holders are 0.02% (t-stat = 0.33), ñ0.01% (t-stat = ñ0.34), and ñ0.03% (t-stat = ñ0.35), those on high cash holders are 0.31% (t-stat = 2.73), 0.54% (t-stat = 3.78), and 0.35% (t-stat = 2.91). It follows that the dispersions across low and high leverage in the differences in abnormal returns between high and low cash holders are 0.29% (t-stat = 2.15), 0.55% (t-stat = 2.95), and 0.38% (t-stat = 2.68). Panel B reports the estimated slope b_1 of Equation (2) across low and high leverage subsamples. The slope b_1 is 0.699 (t-stat = 2.45) for low leverage firms while the slope b_1 is 0.411 (t-stat = 1.13) for high leverage firms. The difference in the linear slope b_1 is 0.288 and, possibly due to the asymmetric difference in returns across leverage on low versus high cash holders, is barely significant at the 10% level. To summarize, both portfolio analysis and

regression test suggest that the positive relation between cash holdings and returns is stronger among firms with low leverage than among firms with high leverage.

5.2. Profitability

Panel A of Table 4 reports the cash-holdings decile portfolios for the subsample of unprofitable firms followed by those for the subsample of profitable firms.[13] Among unprofitable firms, low cash-holdings firms hold 1% of the total assets in cash while high cash-holdings ones hold 64% of the assets in cash. The average characteristic-adjusted return, the five-factor alpha, and the macroeconomic-factor alpha on low cash holders are ñ0.46% (t-stat = ñ2.78), ñ0.45% (t-stat = ñ 1.60) and ñ0.78% (t-stat = ñ5.29), respectively. The adjusted return and alphas on high cash holders are 0.47% (t-stat = 2.29), 0.84% (t-stat = 3.01) and 0.38% (t-stat = 1.78). Similar to Tables 1 and 2, abnormal returns on low cash holders are largely negative while those on high cash holders are positive. High cash holders outperform low cash holders by 0.93% (t-stat = 3.66), 1.19% (t-stat = 4.01), and 1.21% (t-stat = 4.93) with respect to the three abnormal returns.

Among profitable firms, low cash-holdings firms hold 1% of the total assets in cash while high cash-holdings ones hold 45% of the assets in cash. The adjusted return and alphas on low cash holders are ñ0.12% (t-stat = ñ1.44), 0.10% (t-stat = 0.34) and ñ0.11% (t-stat = ñ1.56) while those on high cash holders are 0.33% (t-stat = 3.05), 0.66% (t-stat = 5.40) and 0.43% (t-stat = 5.31). Although abnormal returns on high cash holders remain significantly positive, the abnormal returns on low cash holders are no longer significantly negative. Consistent with our argument, the overvaluation of profitable low cash-holdings firms, which tend to have better liquidity, seems to be less severe than that of profitable low cash-holdings ones. High cash holders outperform low

[13] In this sample, which requires data on return on assets, the magnitudes and statistical significance of the spreads in cash-holdings and abnormal returns between high and low cash holders as well as the slope of return on cash holdings are similar to those reported in Tables 1 and 2.

cash holders much weakly by 0.45% (t-stat = 2.84), 0.59% (t-stat = 4.35), and 0.53% (t-stat = 4.53) with respect to the three abnormal returns.

Although the difference in abnormal returns across profitability on high cash holders are 0.14% (t-stat = 1.04), 0.18% (t-stat = 0.94), and ñ0.05% (t-stat = ñ0.39), those on low cash holders are ñ0.44% (t-stat = ñ1.94), ñ0.55% (t-stat = ñ1.69), and ñ0.67% (t-stat = ñ4.18). It follows that the dispersions across profitability in the differences in abnormal returns between high and low cash holders are 0.58% (t-stat = 2.49), 0.63% (t-stat = 2.28), and 0.62% (t-stat = 2.46). Panel B reports the estimated slope b_1 of Equation (2) across unprofitable and profitable subsamples. The slope b_1 is 1.686 (t-stat = 2.74) for unprofitable firms while the slope b_1 is 0.606 (t-stat = 1.99) for profitable firms. The difference in the slope b_1 is 1.079 and is significant at the 10% level. To summarize, both portfolio analysis and regression test suggest that the positive relation between cash holdings and returns is stronger among unprofitable firms than among profitable firms.

6. Relative Misvaluation and the Relation between Cash Holdings and Future Abnormal Stock Returns

This Section examines the role of relative misvaluation in the relation between cash holdings and future abnormal stock returns. Panel A of Table 5 presents summary statistics of relative valuation and its constituents. Panel B shows that cash holdings are positively correlated with relative valuation, which suggests that in general high cash holders seem to be relatively undervalued and low cash holders seem to be relatively overvalued. Panel C reports the portfolios independently sorted by relative-valuation terciles and cash-holdings deciles.[14]

[14] In this sample which requires data on relative valuation the average number of firms per cash-holdings decile decreases to 231. The magnitudes and statistical significance of the spreads in cash-holdings and abnormal returns between high and low cash holders as well as the slope of return on cash holdings are similar to those reported in Tables 1 and 2.

Low cash-holdings firms hold 1% of the total assets in cash no matter relative valuation is low, medium or high. When relative valuation is low, the average characteristic-adjusted return, the five-factor alpha, and the macroeconomic-factor alpha are ñ0.45% (t-stat = ñ4.46), ñ0.32% (t-stat = ñ2.56) and ñ0.46% (t-stat = ñ5.14), respectively. When relative valuation is medium, the adjusted return and alphas are 0.00% (t-stat = 0.04), 0.18% (t-stat = 1.34) and ñ0.09% (t-stat = ñ0.94). When relative valuation is high, the adjusted return and alphas are 0.16% (t-stat = 1.27), 0.25% (t-stat = 1.72) and ñ0.02% (t-stat = ñ0.22). Only on the relatively overvalued low cash holders are the abnormal returns significantly negative.

High cash-holdings firms hold close to 46% of the total assets in cash at the three relative-valuation levels. When relative valuation is low, the adjusted return and alphas are 0.38% (t-stat = 0.81), 1.09% (t-stat = 1.09) and 0.60% (t-stat = 1.21), respectively. When relative valuation is medium, the adjusted return and alphas are 0.46% (t-stat = 4.08), 0.78% (t-stat = 5.39) and 0.61% (t-stat = 4.87). When relative valuation is high, the adjusted return and alphas are 0.51% (t-stat = 3.96), 0.93% (t-stat = 6.38) and 0.65% (t-stat = 4.72). The positive abnormal returns on high cash holders are not significant when these firms are relatively overvalued.

Comparing relatively undervalued high cash holders and relatively overvalued low cash holders, the adjusted return and alphas are 0.96% (t-stat = 4.93), 1.25% (t-stat = 6.11) and 1.11% (t-stat = 5.70). Next, comparing high cash holders that are not relatively undervalued and low cash holders that are not relatively overvalued, the adjusted return and alphas decrease to 0.45% (t-stat = 1.82), 0.83% (t-stat = 1.79) and 0.73% (t-stat = 2.89). Moving to relatively overvalued high cash holders and relatively undervalued low cash holders, the adjusted return and alphas further decrease to 0.22% (t-stat = 0.45), 0.84% (t-stat = 0.85) and 0.62% (t-stat = 1.24). These findings suggest that

the misvaluation as we hypothesize does play an important role in the relation between cash holdings and returns.

To reinforce the above findings we estimate the following Fama and MacBeth (1973) regression

$$Ret_{i,t+1} = a + b_1 CH\_hi_{i,t} + b_2 CH\_lo_{i,t} + b_3 RM\_hi_{i,t} + b_4 RM\_lo_{i,t}$$
$$+ b_5 CH\_hi_{i,t} \times RM\_hi_{i,t} + b_6 CH\_lo_{i,t} \times RM\_lo_{i,t} + b_7 Ln(Size) + b_8 B/M_{i,t} + \epsilon_{i,t}, \quad (5)$$

where *CH_hi* (*CH_lo*) is a dummy variable that equals one if the firmís cash holdings is at the top (bottom) tercile and zero otherwise. *RM_hi* (*RM_lo*) is a dummy variable that equals one if the firm belongs to the top (bottom) tercile of relative misvaluation and zero otherwise. Panel D reports the estimation results. Model 1 in the first row partially includes the cash-holdings dummies and controls. The slope b_1, which is the difference between average future stock return on high cash holders and that on medium cash holders, is 0.192 (t-stat = 1.92). The slope b_2, which is the difference between average return on low cash holders and that on medium cash holders, is ñ0.123 (t-stat = ñ2.42). These are consistent with the earlier findings that high cash holders outperform low cash holders.

Model 2 in the second row partially includes the relative-valuation dummies and controls. The slope b_3, which is the difference between average return on relative undervalued firms and that on firms with medium valuation, is 0.190 (t-stat = 4.31). The slope b_4, which is the difference between average return on relatively overvalued holders and that on firms with medium valuation, is ñ0.547 (t-stat = ñ7.53). Stocks that our relative-valuation measure identifies as relatively undervalued have higher future returns while those that our relative-valuation measure identifies as relatively overvalued have lower returns. Model 3 in the final row reports the full model with the cash-holdings dummies, the relative-valuation dummies, and the

interaction terms as well as the standard controls. Controlling for the relative-valuation dummies and the interactions, the slopes b_1 and b_2 become 0.109 (t-stat = 0.90) and ñ0.045 (t-stat = ñ0.77), respectively. Consistent with portfolio analysis, when relative misvaluation is accounted for high cash holders no longer outperform low cash holders.

7. Limits to Arbitrage and the Relation between Cash Holdings and Future Abnormal Stock Returns

This Section examines the role of limits to arbitrage in the relation between cash holdings and future abnormal stock returns. Panel A of Table 6 presents summary statistics of limits to arbitrage and its constituents. Panel B shows that cash holdings are positively correlated with limits to arbitrage, which suggests that undervalued cash-holdings firms are not necessarily easy to long. Panel C reports the portfolios independently sorted by limits-to-arbitrage terciles and cash-holdings deciles.[15]

Low cash-holdings firms hold 1% of the total assets in cash no matter limits to arbitrage are low, medium or high. When limits to arbitrage are low, the average characteristic-adjusted return, the five-factor alpha, and the macroeconomic-factor alpha are 0.02% (t-stat = 0.21), 0.05% (t-stat = 0.95) and 0.09% (t-stat = 1.45), respectively. When limits to arbitrage are medium, the adjusted return and alphas are ñ0.24% (t-stat = ñ1.76), ñ0.19% (t-stat = ñ1.63) and ñ0.37% (t-stat = ñ3.58). When limits to arbitrage are high, the adjusted return and alphas are ñ0.30% (t-stat = ñ2.33), 0.01% (t-stat = 0.03) and ñ0.68% (t-stat = ñ4.81). The abnormal returns on low cash holders are

[15] In this sample which requires data on limits to arbitrage the average number of firms per cash-holdings decile decreases to 231. The magnitudes and statistical significance of the spreads in cash-holdings and abnormal returns between high and low cash holders as well as the slope of return on cash holdings are similar to those reported in Tables 1 and 2.

insignificantly when limits to arbitrage are low but become largely more negative when limits to arbitrage become more severe.

High cash-holdings firms hold around 47% of the total assets in cash across the three levels of limits to arbitrage. When limits to arbitrage are low, the adjusted return and alphas are 0.18% (t-stat = 1.46), 0.23% (t-stat = 1.58) and 0.22% (t-stat = 1.93), respectively. When limits to arbitrage are medium, the adjusted return and alphas are 0.09% (t-stat = 0.77), 0.42% (t-stat = 3.53) and 0.26% (t-stat = 2.47). When limits to arbitrage are high, the adjusted return and alphas are 0.91% (t-stat = 2.84), 1.85% (t-stat = 2.62) and 0.85% (t-stat = 2.60). The positive abnormal returns on high cash holders are weak when limits to arbitrage are low but become stronger when limits to arbitrage become more severe.

When limits to arbitrage are low, the difference in abnormal returns between high and low cash holders are 0.16% (t-stat = 1.13), 0.18% (t-stat = 1.99) and 0.13% (t-stat = 1.19). When limits to arbitrage are medium, the difference in abnormal returns between high and low cash holders are 0.33% (t-stat = 1.69), 0.61% (t-stat = 3.52) and 0.53% (t-stat = 3.12). When limits to arbitrage are high, the difference in abnormal returns between high and low cash holders are 1.21% (t-stat = 3.01), 1.84% (t-stat = 2.65) and 1.53% (t-stat = 3.92). It follows that the dispersions across high and low limits to arbitrage in the differences in abnormal returns between high and low cash holders are 1.05% (t-stat = 2.66), 1.68% (t-stat = 2.07), and 1.40% (t-stat = 3.36). These findings suggest that limits to arbitrage hence misvaluation is important in the relation between cash holdings and returns.

To reinforce the above findings Panel D reports the estimated slope b_1 of Equation (2) across limits-to-arbitrage subsamples. The slope b_1 is 0.403 (t-stat = 1.00) when limits to arbitrage are low and is 0.452 (t-stat = 1.43) when limits to arbitrage are medium. The slope increases to 1.530

(t-stat = 3.24) when limits to arbitrage are high. The difference in the slope between high and low limits to arbitrage is 1.027 (t-stat = 2.01). To summarize, both portfolio analysis and regression test suggest that the positive relation between cash holdings and returns is stronger when limits to arbitrage are more severe.

8. Conclusions

We hypothesize that investors overreact to the salient agency problem pertaining to high cash holdings but underreact to the implicit real-illiquidity concern associated with low cash holdings. Consistently, we find that the future average abnormal stock returns on high cash-holding firms are significantly positive while the abnormal returns on low cash-holding firms are largely negative hence there is a positive relation between cash holdings and returns. The abnormal returns on high cash-holdings firms respond to leverage or the degree of agency problem as the argument of overreaction to agency conflict suggests while the abnormal returns on low cash-holdings firms respond to profitability or the degree of liquidity as the argument of underreaction to real-liquidity concern expects. Cash holdings seems to be a proxy for relative misvaluation in a way suggesting that high (low) cash-holdings firms are relatively undervalued (overvalued) in general. The relation disappears when relative valuation is controlled for or when limits to arbitrage are weak.

References

Ali, Ashiq, Lee-Seok Hwang, and Mark A. Trombley, 2003. Arbitrage risk and the book-to-market anomaly. Journal of Financial Economics 69, 355-373.

Ang, Andrew, Robert J. Hodrick, Yuhang Xing, and Xiaoyan Zhang, 2006. The cross-section of volatility and expected returns. Journal of Finance 61, 259-299.

Ang, Andrew, Robert J. Hodrick, Yuhang Xing, and Xiaoyan Zhang, 2009. High idiosyncratic volatility and low returns: international and further U.S. evidence. Journal of Financial Economics 91, 1-23.

Archarya, Viral, Sergei A. Davydenko, and Ilya A. Strebulaev, 2012. Cash holdings and credit risk. Review of Financial Studies 25, 3572-3609.

Ball, Ray, S.P. Kothari, and Jay Shanken, 1995. Problems in measuring portfolio performance: an application to contrarian investment strategies. Journal of Financial Economics 38, 79-107.

Barberis, Nicholas, Andrei Shleifer, and Robert Vishy, 1998. A model of investor sentiment. Journal of Financial Economics 49, 307-343.

Bates, Thomas W., Kathleen M. Kahle, and RenÈ M. Stulz, 2009. Why do U.S. firms hold so much more cash than they used to? Journal of Finance 65, 1985-2021.

Bhardwaj, Ravinder K., and Leroy D. Brooks, 1992. The January anomaly: effects of low share price, transaction costs and bid-asked bias. Journal of Finance 47, 553-575.

Bhushan, Ravi, 1994. An informational efficiency perspective on the post-earnings announcement drift. Journal of Accounting and Economics 18, 45-66.

Bradshaw, Mark T., Scott A. Richardson, and Richard G. Sloan, 2006. The relation between corporate financing activities, analystsí forecasts and stock returns. Journal of Accounting and Economics 42, 53-85.

Bolton, Patrick, Hui Chen Hui, and Neng Wang, 2011. A unified theory of Tobinís q, corporate investment, financing, and risk management. Journal of Finance 66, 1545-1578.

Bolton, Patrick, Hui Chen, Neng Wang, 2013. Market timing, investment, and risk management. Journal of Financial Economics 109, 40-62.

Campbell, John Y., Jens Hilscher, and Jan Szilagyi, 2008. In search of distress risk. Journal of Finance 63, 2899-2939.

Chan., Louis K.C., Jason Karceski, and Josef Lakonishok, 1998. The risk and returns from factors. Journal of Financial and Quantitative Analysis 33, 159-188.

Chen, Nai-Fu, Richard Roll, and Stephen A. Ross, 1986. Economic forces and the stock market. Journal of Business 59, 383-403.

Cooper, Michael J., Huseyin Gulen, and Michael J. Schill, 2008. Asset growth and the cross-section of stock returns. Journal of Finance 63, 1609-1651.

Cooper, Ilan, and Richard Priestley, 2011. Real investment and risk dynamics Journal of Financial Economics 101, 182-205.

Daniel, Kent, Mark Grinblatt, Sheridan Titman, and Russ Wermers, 1997, Measuring mutual fund performance with characteristic-based benchmarks, *Journal of Finance* 52, 1035ñ1058.

Daniel, Kent, and Sheridan Titman, 1997. Evidence on the characteristics of cross-sectional variation in stock returns. Journal of Finance 52, 1-33.

Daniel, Kent, and Sheridan Titman, 2006. Market reactions to tangible and intangible information. Journal of Finance 61, 1605ñ1643.

Daniel, Kent, Sheridan Titman, and K.C. John Wei, 2001. Explaining the cross-section of stock returns in Japan: factors or characteristics? Journal of Finance 56, 743-766.

De Long, J. Bradford, Andrei Shleifer, Lawrence H. Summers, and Robert J. Waldmann, 1990. Noise trader risk in financial markets. Journal of Political Economy 98, 703-738.

Dichev, Ilia D., 1998. Is the risk of bankruptcy a systematic risk? Journal of Finance 53 1131-1147.

Duan, Ying, Gang Hu, and R. David McLean, 2010. Costly arbitrage and idiosyncratic risk: evidence from short sellers. Journal of Financial Intermediation 19, 564-579.

Duchin, Ran, 2010. Cash holdings and corporate diversification. Journal of Finance 65, 955-992.

Fama, Eugene F., and Kenneth R. French, 1992. The cross-section of expected stock returns. Journal of Finance 47, 427-465.

Fama, Eugene F., and Kenneth R. French, 1993. Common risk factors in the returns and bonds. Journal of Financial Economics 33, 3-56.

Fama, Eugene F., and Kenneth R. French, 1997. Industry costs of equity. Journal of Financial Economics 43, 153-193.

Fama, Eugene F., and Kenneth R. French, 2006. Profitability, investment and average returns. Journal of Financial Economics 82, 491-518.

Fama, Eugene F., and Kenneth R. French, 2015. A five-factor asset pricing model. Journal of Financial Economics 116, 1-22.

Fama, Eugene F., and James D. MacBeth, 1973. Risk, return and equilibrium: empirical tests. Journal of Political Economy 81, 607-636.

FrÈsard, Laurent, 2010. Financial strength and product market behavior: the real effects of corporate cash holdings. Journal of Finance 65, 1097-1122.

Fu, Fangjian, 2009. Idiosyncratic risk and the cross-section of expected stock return. Journal of Financial Economics 91, 24-37.

Harford, Jarrad, 1999, Corporate cash reserves and acquisitions, Journal of Finance 54, 1969-1997.

Harford, Jarrad, Sattar Mansi, and William Maxwell, 2008, Corporate governance and firm cash holdings in the US, Journal of Financial Economics 87, 535-555.

Harford, Jarrad, Sandy Klasa, and William F. Maxwell, 2014. Refinancing risk and cash holdings. Journal of Finance 69, 975-1012.

Hirshleifer, David, Kewei Hou, Siew Hong Teoh, and Yinglei Zhang, 2004. Do investors overvalue firms with bloated balance sheets? Journal of Accounting and Economics 38, 297-331.

Jegadeesh, Narasimhan, and Sheridan Titman, 1993. Return to buying winners and selling losers: implications for stock market efficiency. Journal of Finance 48, 65-91.

Jegadeesh, Narasimhan, and Sheridan Titman, 2001. Profitability of momentum strategies: an evaluation of alternative explanations. Journal of Finance 56, 699-720.

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

Jensen, Michael C., and William H. Meckling, 1976. Theory of the firm: managerial behavior, agency costs and ownership structure. Journal of Financial Economics 3, 305-360.

Klasa, Sandy, William F. Maxwell, and Hern□n Ortiz-Molina, 2009. The strategic use of corporate cash holdings in collective bargaining with labor unions. Journal of Financial Economics 92, 421-442.

Lakonishok, Josef, Andrei Shleifer, and Robert W. Vishny, 1994, Contrarian investment, extrapolation, and risk, Journal of Finance 49, 1541-1578.

Lam, F.Y. Eric. C., and K.C. John Wei, 2011. Limits-to-arbitrage, investment frictions, and the asset growth anomaly. Journal of Financial Economics 102, 127-149.

Lehmann, Bruce N., and David M., Modest, 1988. The empirical foundations of the arbitrage pricing theory. Journal of Financial Economics 21, 213-154.

Lipson, Marc L., Sandra Mortal, and Michael J. Schill, 2011. On the scope and drivers of the asset growth effect. Journal of Financial and Quantitative Analysis 46, 1651-1682.

Liu, Jun, and Francis A. Longstaff, 2004. Losing money on arbitrage: optimal dynamic portfolio choice in markets with arbitrage opportunities. Review of Financial Studies 17, 611-641.

Liu, Yixin, and David C. Mauer, 2011. Corporate cash holdings and CEO compensation incentives. Journal of Financial Economics 102, 183-198.

Liu, Xiaolei Laura, and Lu Zhang, 2009. Momentum profits, factor pricing, and macroeconomic risk. Review of Financial Studies 21, 2417-2448.

Mashruwala, Christina, Shivaram Rajgopal, and Terry Shevlin, 2006. Why is the accrual anomaly not arbitraged away? The role of idiosyncratic risk and transaction costs. Journal of Accounting and Economics 42, 3-33.

McLean, R. David 2010. Idiosyncratic risk, long-term reversal, and momentum. Journal of Financial and Quantitative Analysis 45, 883-906.

Newey, Whitney K., and Kenneth D. West, 1987. A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. Econometrica 55, 703-708.

Novy-Marx, Robert, 2013. The other side of value: the gross profitability premium. Journal of Financial Economics 108, 1-28.

Ohlson, James A., 1980. Financial ratios and the probabilistic prediction of bankruptcy. Journal of Accounting Research 18, 109-131.

Oritz-Molina, Hern□n, and Gordon M. Phillips, 2014, Real asset illiquidity and the cost of capital, Journal of Finance and Quantitative Analysis 48, 1-32.

Palazzo, Berardino, 2012. Cash holdings, risk, and expected returns. Journal of Financial Economics 104, 162-185.

Pinkowitz, Lee, and Rohan Williamson, 2001. Bank power and cash holdings: evidence from Japan. Review of Financial Studies 14, 1059-1082.

Pontiff, Jeffrey, 1996. Costly arbitrage: evidence from closed-end funds. Quarterly Journal of Economics 111, 1135-1152.

Pontiff, Jeffrey, 2006. Costly arbitrage and the myth of idiosyncratic risk. Journal of Accounting and Economics 42, 35-52.

Shleifer, Andrei, and Robert W. Vishny, 1997. The limits of arbitrage. Journal of Finance 52, 35-55.

Shumway, Tyler, 1997. The delisting bias in CRSP data, Journal of Finance 52, 327-340.

Shumway, Tyler, and Vincent A. Warther, 1999. The delisting bias in CRSPís Nasdaq data and its implications for the size effect. Journal of Finance 54, 2361-2379.

Simutin, Mikhail, 2010. Excess cash and stock returns. Financial Management 39, 1197-1222.

Sloan, Richard G., 1996. Do stock prices fully reflect information in accruals and cash flows about future earnings. Accounting Review 3, 289-315.

Song, Kyojik (Roy), and Youngjoo Lee, 2012. Long-term effects of a financial crisis: evidence from cash holdings of East Asian firms. Journal of Financial and Quantitative Analysis 47, 617-641.

Stambaugh, Robert F., Jianfeng Yu, and Yu Yuan, 2012. The short of it: investor sentiment and anomalies. Journal of Financial Economics 104, 288-302.

Stambaugh, Robert F., Jianfeng Yu, and Yu Yuan, 2015. Arbitrage asymmetry and the idiosyncratic volatility puzzle. Journal of Finance, forthcoming.

Stoll, Hans R., 2000. Friction. Journal of Finance 55, 1479-1514.

Titman, Sheridan, K.C. John Wei, and Feixue Xie, 2004. Capital investments and stock returns. Journal of Financial and Quantitative Analysis 39, 677-700.

Wang, Huijun, and Jianfeng Yu, 2013. Dissecting the profitability premium. American Finance Association 2013 San Diego Meetings Paper.

Wurgler, Jeffrey, and Ekaterina Zhuravskaya, 2002. Does arbitrage flatten demand curves for stocks? Journal of Business 75, 583-608.

Appendix 1
Variable definitions

CH: Cash holdings or cash-to-assets ratio, calculated as cash and short-term investments (item CHE) scaled by total assets (item AT) at the end of the fiscal year. Data source: Compustat Annual.

D/*A*: Leverage or debt-to-asset ratio, calculated as long-term debt (item DLTT) scaled by total assets at the end of a fiscal year. Data source: Compustat Annual.

ROA: Return on assets or earnings profitability, calculated as operating income before extraordinary items (item IB) over a fiscal year scaled by beginning total assets. Data source: Compustat Annual.

TAG: Growth in book value of total assets, calculated as the change in total assets (item AT) over a fiscal year scaled by beginning total assets. Data source: Compustat Annual.

Acc: Accounting accruals, calculated as the change in non-cash assets (item AT less item CHE) less the change in non-debt liabilities (item LT less item DLTT less item DLC) over a fiscal year scaled by beginning total assets. Data source: Compustat Annual.

NOA: Net operating assets, calculated as the change in operating assets and operating liabilities over a fiscal year scaled by beginning total assets. Operating assets is total assets minus cash and short-term investments (item CHE). Operating liabilities is total assets less current liabilities (item DLC), long-term debt (item DLTT), minority interests (item MIB), preferred stocks (item PSTK), and common equity (item CEQ). Data source: Compustat Annual.

I/A: Investment-to-assets ratio, calculated as the change in inventories (item INVT) and gross property, plant, and equipment (item PPEGT) over a fiscal year scaled by beginning total assets. Data source: Compustat Annual.

XF: Net cash flow from external financing, calculated as the sum of ΔE and ΔD. ΔE is net cash flow from equity financing, measured as the cash proceeds from sales of common and preferred stocks (COMPUSTAT item SCSTKC plus item SPSTKC) less the cash payments for purchases of common and preferred stocks (item PRSTKCC plus PRSTKPC) less cash payments for dividends (item CDVC) over a fiscal year scaled by beginning total assets. ΔD is net cash flow from debt financing, measured as the cash proceeds from issuance of long-term debt (Compustat item DLTIS) less the cash payments for long-term debt reductions (item DLTR) plus changes in current debt (item DLCCH, set to zero if missing) over a fiscal year scaled by beginning total assets.[16] Data source: Compustat Annual.

[16] Setting a missing value in item DLCCH to zero provides us with a much larger sample.

NSI: Net share issuance, calculated as the natural logarithm of the ratio of split-adjusted shares (item CSHO multiplied by item ADJEX_C) outstanding at the end of a fiscal year to that at the beginning of the year. Data source: Compustat Annual.

O: Bankruptcy risk score suggested by Ohlson (1980), which is calculated as

ñ4.07◊*Ln*(*A*) + 6.03◊(*L*/*A*) ñ 1.43◊(*CA* ñ *CL*)/*TA* + 0.0757◊*CL*/*CA* ñ 2.37◊*NI*/*TA* + 0.285◊*Loss* ñ 1.72◊*NegBook* ñ 0.521◊ *NI* ñ 1.83◊*Op*/*TL*,

where *Ln*(*A*) is the natural logarithm of total assets, *L* is liabilities *CA* is current assets (item ACT), and *CL* is current liabilities (item LCT) at the end of a fiscal year. *NI* is net income (item NI) for the lagged fiscal year. *Loss* is equal to one if net income for both a fiscal year and the lagged fiscal year is negative and zero otherwise. *NegBook* is equal to one if *L* is greater than *A* and zero otherwise. *NI* is the change in net income between a fiscal year and the lagged fiscal year scaled by the sum of the absolute values of the net income for the two years. *Op*, funds from operations, is defined as that in *FSCORE*. Data source: Compustat.

GP: Gross profitability, calculated as the gross profit (item GP) over a fiscal year scaled by beginning total assets. Data source: Compustat Annual.

Size: Market capitalization, calculated as the closing stock price multiplied by the number of shares outstanding at the end of June of calendar year *t*+1. Data source: CRSP.

B/M: Book-to-market equity ratio, calculated as the book value of equity divided by the market capitalization at the end of fiscal year *t*. Book equity is total assets minus liabilities (item LT), plus balance sheet deferred taxes (item TXDB) and investment tax credits (item ITCI), minus preferred stock liquidation value (item PSTKL) if available, or redemption value (item PSTKRV) if available, or carrying value (item PSTK) if available. Data source: Compustat Annual and CRSP.

PRet: Prior six-month cumulative stock return at the end of May, calculated by compounding the five monthly raw stock returns since the end of previous December. Data source: CRSP.

IVol: Idiosyncratic stock return volatility, measured as the standard deviation of the residual values from the following time-series market model:

$$R_{i,t} = b_{i0} + b_{i1}R_{M,t} + e_{i,t},$$

where R_i is the monthly stock return and R_M is the monthly return on S&P 500 index. The model is estimated with 36 months of return ending in June and requires a full 36-month history. Data source: CRSP.

Price: Share price, measured as the closing stock price (the average of bid and ask prices if the closing price is not available) at the end of June. Data source: CRSP.

DVol: Dollar trading volume, defined as the time-series average of monthly share trading volume multiplied by the monthly closing price over the past one year ending in June. Data source: CRSP.

Appendix 2

Construction of portfolios tracking macroeconomic factors

The macroeconomic factors in Chen, Roll, and Ross (1986) are as follows. The growth rate of industrial production *MP* is the leaded logarithm of the gross rate of change in the industrial production index. Unexpected inflation *UI* and the change in expected inflation *DEI* is estimated from the total seasonally-adjusted consumer price index. The term premium *UTS* is the yield spread between the 10-year and the one-year Treasury bonds. The default premium *URP* is the yield spread between Moodyís Baa and Aaa bonds.[17]

As the factors *MP*, *UI*, and *DEI* are not traded assets, we follow Chan, Karceski, and Lakonishok (1998) and Cooper and Priestley (2011) to use pure tracking portfolios to mimick all the factors for consistency. The basis assets for tracking consist of equal-weighted book-to-market decile portfolios, equal-weighted size decile portfolios, 10 equal-weighted momentum decile portfolios, and equal-weighted cash-holdings decile portfolios. As in Lehmann and Modest (1988) and Cooper and Priestley (2011), we first project the monthly returns in excess of the risk-free rate on each of the 40 basis on the five factors. Specifically we perform 40 time-series regressions to estimate a 40◊5 matrix B of the slopes on the five factors. Let V be the 40◊40 covariance matrix of error terms for these regressions, which are restricted to be orthogonal. The portfolio weights to track the five factors is the 5◊40 matrix $w = (B'V^{-1}B)^{-1}B'V^{-1}$ and the returns on the tracking portfolios are wR', where R is a T◊40 matrix with each column containing the time-series returns on a basis in the sample period. The product wR' gives a 5◊T matrix, in which each row represents the returns on a tracking portfolio for a factor in the sample period. The tracking portfolio constructed this way for a factor has a sensitivity of one with respect to that factor and zero with respect to the others.

[17] We obtain the data used in Liu and Zhang (2009) from Laura Liu. We thank Laura for providing the updated series.

Table 1. Summary statistics, correlations, and the relation between cash holdings and future stock returns

Panel A reports the time-series averages of descriptive statistics of cash-to-assets ratio or cash holdings (*CH*) at the end of fiscal year *t*. Stdev is the standard deviation. 10%, 25%, 75%, and 90% refer to the 10th, 25th, 75th, and 90th percentiles, respectively. Panel B reports the time-series averages of the cross-sectional correlations between *CH* and *Size* or *B/M*. *Size* is the market value of equity at the end of June of calendar year *t*+1. *B/M* is the book-to-market equity ratio using Fama and French (1993) book value at the end of fiscal year *t*. Panel C reports time-series averages of firm characteristics at portfolio formation and monthly equal-weighted portfolio returns in % from July of year *t*+1 to June of year *t*+2 on deciles sorted and rebalanced annually at the end of June of year *t*+1 by *CH*. *N* is the number of firms. CH_m is the median cash holdings. *aRet* is the characteristic-adjusted return, which is the stock returns minus the returns on a five-by-five benchmark portfolio matched to a stock by *Size* and *B/M*. α_{FF} is the Fama and French (2015) five-factor alpha, which is the estimated intercept of the following time series regressions

$$Ret_{p,t} - R_{ft} = \alpha_{p,FF} + \beta_{p,MKT}MKT_t + \beta_{p,SMB}SMB_t + \beta_{p,HML}HML_t + \beta_{p,RMW}RMW_t + \beta_{p,CMA}CMA_t + \epsilon_{p,t},$$

where Ret_p is the monthly return on a cash-holdings portfolio while R_f is the risk-free rate, *MKT* is the market factor, *SMB* is the size factor, *HML* is the value factor, *RMW* is the profitability factor, and the *CMA* is the investment factor. [10ñ1] is the difference in CH_m, *aRet*, or α_{FF} between the high (10) and low (1) *CH* deciles. The *t*-statistics (t-stat) are based on Newey and West (1986) standard error. Panel E reports the deciles sorted by NYSE *CH* breakpoints and value-weighted returns. Panel D reports the estimated slope coefficients (Coeff) of the following Fama and MacBeth (1973) cross-sectional regression

$$Ret_{i,t+1} = \sum_{j=1}^{49} a_j IndDV_{i,j} + b_1 CH_{i,t} + b_2 Ln(Size) + b_3 B/M_{i,t} + \epsilon_{i,t},$$

where Ret_i is the raw monthly stock return on firm *i* in % from July of year *t*+1 to June of year *t*+2, *IndDV* is the set of Fama and French (1997) 49 industry dummies each of with equals one if firm *i* belongs to industry *j* and zero otherwise, and *Ln*(*Size*) is the natural logarithm of *Size*.

Panel A. Summary statistics of cash holdings

Mean	Stdev	10%	25%	Median	75%	90%
0.15	0.17	0.01	0.03	0.08	0.22	0.41

Panel B. Sample correlations with cash holdings

Size	*B/M*
ñ0.04	**ñ0.16**

Panel C. Decile portfolios sorted by cash holdings

	N	CH_m	*aRet*	t-stat	α_{FF}	t-stat
1 (low)	342	0.01	ñ0.20	(ñ2.68)	ñ0.07	(ñ0.70)
2	342	0.02	ñ0.14	(ñ2.48)	ñ0.10	(ñ1.13)
3	342	0.03	ñ0.12	(ñ1.98)	ñ0.09	(ñ0.94)
4	342	0.05	ñ0.11	(ñ2.05)	ñ0.07	(ñ0.74)
5	342	0.07	ñ0.01	(ñ0.12)	0.02	(0.24)
6	342	0.10	0.01	(0.23)	0.13	(1.56)
7	342	0.15	0.11	(2.88)	0.32	(2.94)
8	342	0.22	0.14	(2.74)	0.41	(3.53)
9	342	0.32	0.17	(1.91)	0.53	(4.19)
10 (high)	342	0.54	0.26	(2.16)	0.71	(4.37)
[10ñ1]		0.53	0.46	(2.60)	0.78	(4.37)

Panel D. Slopes of returns against cash holdings and controls

	Industry dummies	*CH* (b_1)	*Ln*(*Size*) (b_2)	*B/M* (b_3)
Coeff	No	0.611	ñ0.102	0.252
t-stat		(2.04)	(ñ2.41)	(4.39)
Coeff	Yes	0.354	ñ0.106	0.250
t-stat		(1.79)	(ñ2.73)	(5.53)

Table 2. Macroeconomic risks and the relation between cash holdings and future stock returns

Panel A reports the average monthly return in % on five traded portfolios tracking the Chan, Roll, and Ross (1986) macroeconomic risk factors. Ret_{MP} is the return on the portfolio that tracks the growth rate of industrial production (*MP*). Ret_{UI} is the return on the portfolio that tracks the unexpected inflation (*UI*). Ret_{UTS} is the return on the portfolio that tracks the term premium (*UTS*). Ret_{DEI} is the return on the portfolio that tracks the change in expected inflation (*DEI*). Ret_{URP} is the return on the portfolio that tracks the default premium (*URP*). Panel B reports the estimated parameters of the following time series regressions

$$Ret_{p,t} - R_{ft} = \alpha_{p,CRR} + \beta_{p,MP}Ret_{MP,t} + \beta_{p,UI}Ret_{UI,t} + \beta_{p,UTS}Ret_{UTS,t} + \beta_{p,DEI}Ret_{DEI,t} + \beta_{p,URP}Ret_{URP,t} + \epsilon_{p,t},$$

where Ret_p is the characteristics-adjusted monthly return on a cash-holdings portfolio while R_f is the risk-free rate. Intercepts that are significant at the 5% level are in bold.

Panel A. Average risk premiums on macroeconomic risk factors

	Ret_{MP}	Ret_{UI}	Ret_{UTS}	Ret_{DEI}	Ret_{URP}
Average	1.23	ñ0.08	1.11	ñ0.01	ñ0.23
t-stat	(8.07)	(ñ0.94)	(2.71)	(ñ0.52)	(ñ2.18)

Panel B. Time-series regressions of cash-holdings portfolio returns on returns on five tracking portfolios

	β_{MP}	β_{UI}	β_{UTS}	β_{DEI}	β_{URP}	α_{CRR}
1 (low)	ñ0.005	0.313	0.000	ñ1.359	ñ0.325	**ñ0.26**
2	0.049	0.066	0.018	ñ0.835	ñ0.147	**ñ0.26**
3	0.020	0.078	0.019	ñ0.931	ñ0.115	**ñ0.20**
4	0.053	0.039	0.019	ñ0.655	ñ0.120	**ñ0.23**
5	0.037	0.015	0.029	ñ0.486	ñ0.086	**ñ0.11**
6	ñ0.013	ñ0.073	0.012	0.246	ñ0.061	ñ0.01
7	ñ0.013	ñ0.076	0.001	0.363	0.105	**0.15**
8	ñ0.039	ñ0.050	ñ0.002	0.554	0.127	**0.22**
9	ñ0.075	ñ0.115	ñ0.033	1.387	0.203	**0.35**
10 (high)	ñ0.009	ñ0.141	ñ0.045	1.960	0.355	**0.41**
[10ñ1]	ñ0.004	ñ0.454	ñ0.045	3.319	0.680	**0.67**
t-stat	(ñ0.06)	(ñ3.59)	(ñ1.90)	(3.04)	(4.78)	(4.97)

Table 3. The relation between cash holdings and future abnormal stock returns across low and high leverage

Panel A reports time-series averages of firm characteristics at portfolio formation and abnormal stock returns on portfolios first grouped by low leverage (*D*/*A* below median) versus high leverage (*D*/*A* above median) at the end of fiscal year *t* then by deciles of *CH*. [low,1]ñ[high,1] is the difference in the median cash holdings or abnormal returns between low leverage firms with low cash holdings and high leverage firms with low cash holdings. [low,10]ñ[high,10] is the difference in the median cash holdings or abnormal returns between low leverage firms with high cash holdings and high leverage firms with high cash holdings. [lowñhigh] of [10ñ1] is the difference in the [10ñ1] spread of median cash holdings or abnormal returns between low leverage firms and high leverage firms. Panel B reports the estimated slope coefficients of the cross-sectional regression

$$Ret_{i,t} = a + b_1 CH_{i,t} + b_2 Ln(Size) + b_3 B/M_{i,t} + \epsilon_{i,t}$$

for low leverage firms and high leverage firms. [lowñhigh] is the difference in the slope estimate between low leverage firms and high leverage firms.

Panel A. Leverage and decile portfolios sorted by cash holdings

Leverage=low	*N*	CH_m	*aRet*	t-stat	α_{FF}	t-stat	α_{CRR}	t-stat
1 (low *CH*)	171	0.01	ñ0.19	(ñ2.20)	ñ0.05	(ñ0.38)	ñ0.29	(ñ3.73)
2	171	0.04	ñ0.15	(ñ2.80)	0.00	(0.00)	ñ0.18	(ñ3.17)
3	171	0.07	ñ0.02	(ñ0.33)	0.20	(1.92)	0.01	(0.10)
4	171	0.10	0.03	(0.68)	0.28	(2.54)	0.07	(1.13)
5	171	0.14	0.02	(0.43)	0.29	(2.40)	0.09	(1.52)
6	171	0.19	0.15	(2.43)	0.45	(3.77)	0.23	(3.44)
7	171	0.25	0.09	(1.16)	0.49	(3.52)	0.26	(3.03)
8	171	0.33	0.27	(2.59)	0.67	(4.52)	0.47	(4.43)
9	171	0.45	0.32	(1.85)	1.00	(2.87)	0.54	(3.06)
10 (high *CH*)	171	0.63	0.37	(2.51)	0.84	(4.41)	0.49	(3.73)
[10ñ1]		0.62	0.56	(2.87)	0.89	(4.22)	0.78	(4.59)
Leverage=high								
1 (low *CH*)	171	0.01	ñ0.21	(ñ2.48)	ñ0.04	(ñ0.32)	ñ0.26	(ñ3.68)
2	172	0.01	ñ0.13	(ñ2.01)	ñ0.12	(ñ1.28)	ñ0.22	(ñ3.85)
3	171	0.02	ñ0.20	(ñ2.71)	ñ0.19	(ñ1.81)	ñ0.31	(ñ4.66)
4	172	0.03	ñ0.17	(ñ2.42)	ñ0.12	(ñ1.32)	ñ0.25	(ñ3.52)
5	172	0.04	ñ0.10	(ñ1.27)	ñ0.12	(ñ1.12)	ñ0.24	(ñ3.00)
6	171	0.05	ñ0.12	(ñ1.54)	ñ0.17	(ñ1.53)	ñ0.27	(ñ3.68)
7	171	0.07	0.04	(0.47)	0.01	(0.12)	ñ0.13	(ñ1.77)
8	171	0.10	0.06	(1.06)	0.03	(0.32)	ñ0.04	(ñ0.66)
9	171	0.15	0.06	(0.93)	0.12	(1.05)	0.00	(ñ0.05)
10 (high *CH*)	171	0.30	0.06	(0.59)	0.30	(2.47)	0.14	(1.37)
[10ñ1]		0.29	0.27	(1.83)	0.34	(2.68)	0.40	(3.12)
[low,1]ñ[high,1]			0.02	(0.33)	ñ0.01	(ñ0.34)	ñ0.03	(ñ0.35)
[low,10]ñ[high,10]			0.31	(2.73)	0.54	(3.78)	0.35	(2.91)
[lowñhigh] of [10ñ1]			0.29	(2.15)	0.55	(2.95)	0.38	(2.68)

Panel B. The slopes of return against cash holdings and controls across leverage

Leverage		*CH* (b_1)	*Ln*(*Size*) (b_2)	*B*/*M* (b_3)
low	Coeff	0.699	ñ0.137	0.327
	t-stat	(2.45)	(ñ2.79)	(4.55)
high	Coeff	0.411	ñ0.069	0.227
	t-stat	(1.13)	(ñ1.52)	(3.84)
[lowñhigh]	Coeff	0.288	ñ0.068	0.100
	t-stat	(1.60)	(ñ2.87)	(2.37)

Table 4. The relation between cash holdings and future abnormal stock returns across unprofitable and profitable firms

Pane A reports time-series averages of firm characteristics at portfolio formation and abnormal stock returns on portfolios first grouped by non-positive *ROA* (unprofitable) versus positive *ROA* (profitable) in fiscal year *t* then by deciles of *CH*. [*ROA*>0,10]ñ[*ROA*>0,10] is the difference in the median cash holdings or abnormal returns between unprofitable firms with high cash holdings and profitable firms with high cash holdings. [*ROA*>0,1]ñ[*ROA*>0,1] is the difference in the median cash holdings or abnormal returns between unprofitable firms with low cash holdings and profitable firms with low cash holdings. [*ROA*>0ñ*ROA*>0] of [10ñ1] is the difference in the [10ñ1] spread of median cash holdings or abnormal returns between unprofitable firms (*ROA*>0) and profitable firms (*ROA*>0). Panel B reports the estimated slope coefficients of the cross-sectional regression

$$Ret_{i,t} = a + b_1 CH_{i,t} + b_2 Ln(Size) + b_3 B/M_{i,t} + \epsilon_{i,t}$$

for unprofitable firms and profitable firms. [unprofitableñprofitable] is the difference in the slope estimate between unprofitable firms and profitable firms.

Panel A. Profitability and decile portfolios sorted by cash holdings

ROA>0 (unprofitable)	*N*	CH_m	*aRet*	t-stat	α_{FF}	t-stat	α_{CRR}	t-stat
1 (low *CH*)	84	0.01	ñ0.46	(ñ2.78)	ñ0.45	(ñ1.60)	ñ0.78	(ñ5.29)
2	84	0.02	ñ0.35	(ñ2.10)	ñ0.21	(ñ0.86)	ñ0.85	(ñ5.80)
3	85	0.04	ñ0.48	(ñ3.23)	ñ0.25	(ñ1.36)	ñ0.72	(ñ5.41)
4	84	0.06	ñ0.18	(ñ1.38)	0.17	(0.94)	ñ0.32	(ñ2.42)
5	84	0.10	ñ0.08	(ñ0.47)	0.34	(1.50)	ñ0.16	(ñ1.12)
6	85	0.14	ñ0.03	(ñ0.16)	0.34	(1.46)	ñ0.22	(ñ1.25)
7	85	0.21	0.00	(0.00)	0.51	(2.32)	0.05	(0.38)
8	84	0.30	0.07	(0.37)	0.49	(2.05)	ñ0.07	(ñ0.35)
9	84	0.44	0.20	(0.67)	1.00	(1.81)	0.27	(0.88)
10 (high *CH*)	84	0.64	0.47	(2.29)	0.84	(3.01)	0.38	(1.78)
[10ñ1]		0.63	0.93	(3.66)	1.19	(4.01)	1.21	(4.93)
ROA>0 (Profitable)								
1 (low *CH*)	257	0.01	ñ0.12	(ñ1.44)	0.10	(0.34)	ñ0.11	(ñ1.56)
2	256	0.02	ñ0.09	(ñ1.23)	ñ0.07	(ñ0.81)	ñ0.17	(ñ2.55)
3	258	0.03	ñ0.07	(ñ1.14)	ñ0.05	(ñ0.66)	ñ0.13	(ñ2.21)
4	257	0.04	ñ0.10	(ñ1.47)	ñ0.13	(ñ1.36)	ñ0.19	(ñ2.71)
5	257	0.06	0.00	(0.07)	ñ0.02	(ñ0.22)	ñ0.10	(ñ1.66)
6	257	0.09	0.12	(2.04)	0.10	(1.68)	0.03	(0.72)
7	257	0.13	0.06	(1.01)	0.10	(1.36)	0.02	(0.40)
8	257	0.18	0.14	(2.47)	0.26	(3.62)	0.15	(2.73)
9	257	0.27	0.11	(2.03)	0.30	(4.18)	0.17	(3.74)
10 (high *CH*)	257	0.44	0.33	(3.05)	0.66	(5.40)	0.43	(5.31)
[10ñ1]		0.44	0.45	(2.84)	0.59	(4.35)	0.53	(4.53)
[*ROA*>0,10]ñ[*ROA*>0,10]			0.14	(1.04)	0.18	(0.94)	ñ0.05	(ñ0.39)
[*ROA*>0,1]ñ[*ROA*>0,1]			ñ0.44	(ñ1.94)	ñ0.55	(ñ1.69)	ñ0.67	(ñ4.18)
[*ROA*>0ñ*ROA*>0] of [10ñ1]			0.58	(2.49)	0.63	(2.28)	0.62	(2.46)

Panel B. The slopes of return against cash holdings and controls across profitability

		CH (b_1)	*Ln*(*Size*) (b_2)	*B*/*M* (b_3)
ROA>0 (unprofitable)	Coeff	1.686	ñ0.324	0.251
	t-stat	(2.74)	(ñ5.43)	(4.18)
ROA>0 (profitable)	Coeff	0.606	ñ0.085	0.238
	t-stat	(1.99)	(ñ2.15)	(3.68)
[unprofitableñprofitable]	Coeff	1.079	ñ0.239	0.013
	t-stat	(1.84)	(ñ4.81)	(0.22)

Table 5. Relative misvaluation and the relation between cash holdings and future abnormal stock returns

Panel A reports descriptive statistics of relative misvaluation (*RM*) and its constituents. The constituents are total asset growth (*TAG*), accounting accruals (*Acc*), net operating assets (*NOA*), the capital-investment-to-assets ratio (*I*/*A*), external financing (*XF*), net share issuance (*NSI*), Ohlsonís (1980) bankruptcy risk score (*O*), gross profitability (*GP*), return on assets (*ROA*), and the book-to-market equity ratio (*B*/*M*) at the end of fiscal year *t* as well as prior six-month stock return ending at the end of May of calendar year *t*+1 (*PRet*). Panel B reports the time-series averages of the cross-sectional correlations between cash holdings (*CH*) and *RM* or its constituents. Panel C reports time-series averages of firm characteristics at portfolio formation and abnormal stock returns on portfolios independently sorted by terciles of *RM* and deciles of *CH*. [high,10]ñ[low,1] is the difference in median cash holdings or abnormal returns between firms with high relative misvaluation (*RM*=high), i.e. relatively undervalued, and high cash holdings and firms with low relative misvaluation (*RM*=low), i.e. relatively overvalued, and low cash holdings. [~high,10]ñ[~low,1] is the difference in median cash holdings or abnormal returns between firms with low to medium relative misvaluation (*RM*=low or medium), i.e. not relatively undervalued, and high cash holdings and firms with medium to high relative misvaluation (*RM*=medium or high), i.e. not relatively overvalued, and low cash holdings. [low,10]ñ[high,1] is the difference in median cash holdings or abnormal returns between firms with low relative misvaluation (*RM*=low), i.e. relatively overvalued, and high cash holdings and firms with high relative misvaluation (*RM*=high), i.e. relatively undervalued, and low cash holdings. Panel D reports the estimated slope coefficients of the following cross-sectional regression

$$Ret_{i,t+1} = a + b_1 CH\_hi_{i,t} + b_2 CH\_lo_{i,t} + b_3 RM\_hi_{i,t} + b_4 RM\_lo_{i,t} + b_5 CH\_hi_{i,t} \times RM\_hi_{i,t} + b_6 CH\_lo_{i,t} \times RM\_lo_{i,t} + b_7 Ln(Size) + b_8 B/M_{i,t} + \epsilon_{i,t},$$

where *CH_hi* (*CH_lo*) is a dummy variable which equals one if the firm is in the top (bottom) tercile of cash holdings and zero otherwise while *RM_hi* (*RM_lo*) is a dummy variable which equals one if the firm is in the top (bottom) tercile of relative misvaluation and zero otherwise.

Panel A. Descriptive statistics of relative misvaluation and its constituents

	Mean	Stdev	10%	25%	Median	75%	90%
RM	3.00	0.53	2.34	2.61	2.98	3.37	3.72
TAG	0.17	0.87	ñ0.10	ñ0.01	0.08	0.20	0.44
Acc	ñ0.03	0.10	ñ0.12	ñ0.07	ñ0.03	0.02	0.08
NOA	0.72	0.58	0.39	0.56	0.71	0.83	0.99
I/A	0.11	0.39	ñ0.04	0.02	0.07	0.14	0.26
XF	0.01	0.09	ñ0.07	ñ0.02	0.00	0.03	0.12
NSI	1.12	1.65	0.98	1.00	1.01	1.04	1.21
O	ñ73.84	9.87	ñ83.87	ñ78.87	ñ73.78	ñ68.69	ñ64.12
GP	0.47	0.44	0.14	0.24	0.40	0.61	0.87
ROA	0.03	0.24	ñ0.09	0.00	0.05	0.09	0.15
B/M	0.96	1.24	0.25	0.44	0.75	1.18	1.76
PRet	0.07	0.30	ñ0.27	ñ0.09	0.07	0.23	0.41
	0.07						

Panel B. Sample correlations with cash holdings

RM	*TAG*	*Acc*	*NOA*	*I/A*	*XF*	*NSI*	*O*	*GP*	*ROA*	*B/M*	*PRet*
0.12	**0.05**	**ñ0.06**	**ñ0.40**	**ñ0.08**	**ñ0.04**	**0.02**	**0.14**	**0.10**	**0.05**	**ñ0.15**	**0.00**

Table 5 ñ continued

Panel C. Relative misvaluation and decile portfolios sorted by cash holdings

RM=low	*N*	CH_m	*aRet*	t-stat	α_{FF}	t-stat	α_{CRR}	t-stat
1 (low *CH*)	103	0.01	ñ0.44	(ñ4.45)	ñ0.33	(ñ2.66)	ñ0.45	(ñ5.09)
2	92	0.02	ñ0.43	(ñ5.09)	ñ0.39	(ñ2.99)	ñ0.50	(ñ4.82)
3	86	0.03	ñ0.32	(ñ3.30)	ñ0.29	(ñ2.44)	ñ0.36	(ñ3.56)
4	83	0.04	ñ0.48	(ñ4.93)	ñ0.51	(ñ3.54)	ñ0.58	(ñ5.47)
5	79	0.07	ñ0.30	(ñ3.23)	ñ0.28	(ñ2.08)	ñ0.38	(ñ3.82)
6	73	0.09	ñ0.13	(ñ1.61)	ñ0.08	(ñ0.49)	ñ0.10	(ñ1.10)
7	66	0.14	ñ0.09	(ñ0.92)	0.05	(0.32)	ñ0.02	(ñ0.24)
8	61	0.19	ñ0.06	(ñ0.49)	0.22	(1.39)	0.01	(0.09)
9	58	0.28	ñ0.10	(ñ1.02)	0.18	(0.98)	0.14	(1.11)
10 (high *CH*)	60	0.47	ñ0.06	(ñ0.32)	0.09	(0.38)	0.11	(0.63)
RM=medium								
1 (low *CH*)	75	0.01	0.00	(0.03)	0.18	(1.37)	ñ0.09	(ñ0.92)
2	78	0.02	0.17	(2.24)	0.21	(1.95)	0.07	(1.00)
3	79	0.03	ñ0.02	(ñ0.21)	0.03	(0.32)	ñ0.11	(ñ1.39)
4	77	0.04	0.12	(1.70)	0.20	(1.84)	ñ0.01	(ñ0.16)
5	77	0.07	0.14	(2.12)	0.18	(1.75)	0.03	(0.43)
6	78	0.10	0.11	(1.53)	0.19	(2.13)	0.07	(0.95)
7	81	0.14	0.22	(3.47)	0.31	(2.60)	0.22	(3.16)
8	79	0.19	0.26	(3.34)	0.45	(4.03)	0.33	(4.06)
9	79	0.28	0.32	(2.63)	0.63	(4.27)	0.47	(4.06)
10 (high *CH*)	82	0.46	0.48	(4.53)	0.78	(5.61)	0.63	(4.89)
RM=high								
1 (low *CH*)	52	0.01	0.18	(1.34)	0.27	(1.97)	ñ0.01	(ñ0.06)
2	61	0.02	0.06	(0.68)	0.08	(0.68)	ñ0.12	(ñ1.31)
3	66	0.03	0.17	(2.19)	0.19	(1.87)	0.08	(1.06)
4	71	0.04	0.15	(1.93)	0.18	(1.94)	ñ0.02	(ñ0.31)
5	75	0.07	0.25	(3.10)	0.29	(2.93)	0.13	(1.73)
6	80	0.10	0.21	(3.12)	0.30	(3.53)	0.09	(1.25)
7	84	0.14	0.34	(4.65)	0.47	(5.31)	0.33	(4.56)
8	90	0.20	0.33	(4.90)	0.49	(5.21)	0.25	(3.59)
9	93	0.28	0.31	(3.77)	0.60	(5.63)	0.38	(4.03)
10 (high *CH*)	89	0.45	0.53	(4.16)	0.94	(6.48)	0.67	(5.37)
[high,10]ñ[low,1]			0.98	(5.04)	1.27	(6.26)	1.12	(5.76)
[~high,10]ñ[~low,1]			0.24	(1.45)	0.34	(2.08)	0.49	(3.51)
[low,10]ñ[high,1]			ñ0.24	(ñ0.87)	ñ0.18	(ñ0.64)	0.11	(0.52)

Panel D. The slopes of return against cash holdings dummies, relative misvaluation dummies, and controls

Model		*CH_hi* (b_1)	*CH_lo* (b_2)	*RM_hi* (b_3)	*RM_lo* (b_4)	*CH_hi*◊*RM_hi* (b_5)	*CH_lo*◊*RM_lo* (b_6)	*Ln*(*Size*) (b_7)	*B*/*M* (b_8)
1	Coeff	0.192	ñ0.123					ñ0.128	0.215
	t-stat	(1.92)	(ñ2.42)					(ñ2.92)	(3.55)
2	Coeff			0.190	ñ0.547			ñ0.161	0.111
	t-stat			(4.31)	(ñ7.53)			(ñ3.70)	(1.94)
3	Coeff	0.109	ñ0.045	0.159	ñ0.509	0.029	ñ0.030	ñ0.155	0.128
	t-stat	(0.90)	(ñ0.77)	(3.03)	(ñ5.40)	(0.37)	(ñ0.34)	(ñ3.64)	(2.43)

Table 6. Limits to arbitrage and the relation between cash holdings and future abnormal stock returns

Panel A reports descriptive statistics for the limits to arbitrage (*LTA*) measure and its constituents. The constituents are idiosyncratic volatility (*IVol*), stock price (*Price*), and dollar trading volume (*DVol*) at the end of June of calendar year *t*+1. Panel B reports the time-series averages of the cross-sectional correlations between *CH* and *LTA* or its constituents. Panel C reports time-series averages of firm characteristics at portfolio formation and abnormal stock returns on portfolios independently sorted by terciles of *LTA* and deciles of *CH*. [highñlow] of [10ñ1] is the difference in the [10ñ1] spread of median cash holdings or abnormal returns between firms with high limits to arbitrage (*LTA*=high) and firms with low limits to arbitrage (*LTA*=low). Panel D reports the estimated slope coefficients of the cross-sectional regression

$$Ret_{i,t} = a + b_1 CH_{i,t} + b_2 Ln(Size) + b_3 B/M_{i,t} + \epsilon_{i,t}$$

across firms with low, medium, and high limits to arbitrage. [highñlow] is the difference in the slope estimate between firms with high limits to arbitrage and firms with low limits to arbitrage.

Panel A. Descriptive statistics of limits to arbitrage and its constituents

	Mean	Stdev	10%	25%	Median	75%	90%
LTA	2.00	0.67	1.00	1.34	2.00	2.65	2.99
IVol	0.13	0.07	0.06	0.08	0.11	0.16	0.21
Price	20.83	25.68	3.08	6.52	14.78	28.48	44.09
DVol	2.08e8	8.93e8	0.00e8	0.03e8	0.20e8	1.18e8	4.49e8

Panel B. Sample correlations with cash holdings

LTA	*IVol*	*Price*	*DVol*
0.12	**0.16**	**ñ0.03**	0.00

Table 6 ñ continued

Panel C: Limits to arbitrage and decile portfolios sorted by cash holdings

LTA=low	*N*	CH_m	*aRet*	t-stat	α_{FF}	t-stat	α_{CRR}	t-stat
1 (low *CH*)	82	0.01	0.02	(0.21)	0.05	(0.95)	0.09	(1.45)
2	83	0.02	ñ0.03	(ñ0.42)	ñ0.12	(ñ1.48)	ñ0.08	(ñ1.33)
3	81	0.03	0.03	(0.39)	ñ0.03	(ñ0.30)	ñ0.01	(ñ0.23)
4	77	0.04	0.03	(0.45)	ñ0.09	(ñ1.22)	ñ0.07	(ñ1.28)
5	73	0.06	0.10	(1.55)	ñ0.02	(ñ0.23)	ñ0.01	(ñ0.18)
6	71	0.09	0.06	(1.02)	ñ0.01	(ñ0.18)	0.01	(0.24)
7	65	0.13	0.18	(2.82)	0.13	(1.49)	0.11	(1.75)
8	59	0.19	0.11	(1.91)	0.10	(1.09)	0.11	(1.79)
9	53	0.28	0.28	(3.11)	0.49	(4.62)	0.37	(4.40)
10 (high *CH*)	33	0.43	0.18	(1.46)	0.23	(1.58)	0.22	(1.93)
[10ñ1]		0.43	0.16	(1.13)	0.18	(1.99)	0.13	(1.19)
LTA=medium								
1 (low *CH*)	84	0.01	ñ0.24	(ñ1.76)	ñ0.19	(ñ1.63)	ñ0.37	(ñ3.58)
2	89	0.02	ñ0.23	(ñ1.62)	ñ0.26	(ñ2.34)	ñ0.27	(ñ2.93)
3	92	0.03	ñ0.10	(ñ1.25)	ñ0.17	(ñ1.55)	ñ0.20	(ñ2.58)
4	90	0.04	ñ0.11	(ñ1.35)	ñ0.20	(ñ1.76)	ñ0.24	(ñ2.74)
5	94	0.06	ñ0.05	(ñ0.67)	ñ0.08	(ñ0.90)	ñ0.17	(ñ2.26)
6	93	0.09	0.06	(0.98)	0.00	(0.03)	ñ0.03	(ñ0.43)
7	100	0.13	0.13	(2.25)	0.17	(1.58)	0.15	(2.25)
8	102	0.19	0.09	(1.85)	0.22	(2.49)	0.09	(1.89)
9	106	0.28	0.09	(1.12)	0.34	(2.65)	0.24	(2.53)
10 (high *CH*)	104	0.47	0.09	(0.77)	0.42	(3.53)	0.26	(2.47)
[10ñ1]		0.46	0.33	(1.69)	0.61	(3.52)	0.53	(3.12)
LTA=high								
1 (low *CH*)	66	0.01	ñ0.30	(ñ2.33)	0.01	(0.03)	ñ0.68	(ñ4.81)
2	59	0.02	ñ0.10	(ñ0.80)	0.26	(1.25)	ñ0.43	(ñ3.26)
3	58	0.03	ñ0.17	(ñ1.51)	0.22	(1.28)	ñ0.36	(ñ3.01)
4	64	0.04	ñ0.07	(ñ0.67)	0.30	(1.50)	ñ0.36	(ñ2.99)
5	64	0.06	0.08	(0.67)	0.45	(2.42)	ñ0.17	(ñ1.39)
6	67	0.09	0.02	(0.20)	0.39	(2.04)	ñ0.10	(ñ0.91)
7	66	0.13	0.32	(2.97)	0.71	(3.34)	0.17	(1.60)
8	70	0.19	0.33	(2.53)	0.80	(3.96)	0.16	(1.35)
9	72	0.28	0.18	(1.40)	0.61	(3.24)	0.22	(1.79)
10 (high *CH*)	93	0.50	0.91	(2.84)	1.85	(2.62)	0.85	(2.60)
[10ñ1]		0.49	1.21	(3.01)	1.84	(2.65)	1.53	(3.92)
[highñlow] of [10ñ1]			1.05	(2.66)	1.68	(2.07)	1.40	(3.36)

Panel D. The slopes of return against cash holdings and controls across limits to arbitrage

LTA		*CH* (b_1)	*Ln*(*Size*) (b_2)	*B*/*M* (b_3)
low	Coeff	0.403	ñ0.082	0.097
	t-stat	(1.00)	(ñ2.05)	(1.12)
medium	Coeff	0.452	ñ0.053	0.231
	t-stat	(1.43)	(ñ1.36)	(3.70)
high	Coeff	1.530	ñ0.508	0.192
	t-stat	(3.24)	(ñ7.12)	(2.67)
[highñlow]	Coeff	1.027	ñ0.426	0.096
	t-stat	(2.01)	(ñ5.07)	(1.55)

Table 7. Cash holdings and future earnings announcement stock returns

Panel A: Decile portfolios sorted by cash holdings

	$eRet_1$	t-stat	$eRet_2$	t-stat	*aRet*	t-stat
1 (low *CH*)						
2						
3						
4						
5						
6						
7						
8						
9						
10 (high *CH*)						
[10ñ1]						

Panel B: Leverage and decile portfolios sorted by cash holdings

Leverage=low	$eRet_1$	t-stat	$eRet_2$	t-stat	*aRet*	t-stat
1 (low *CH*)						
2						
3						
4						
5						
6						
7						
8						
9						
10 (high *CH*)						
[10ñ1]						
Leverage=high						
1 (low *CH*)						
2						
3						
4						
5						
6						
7						
8						
9						
10 (high *CH*)						
[10ñ1]						
[low,1]ñ[high,1]						
[low,10]ñ[high,10]						
[highñlow] of [10ñ1]						

Panel C: Profitability and decile portfolios sorted by cash holdings

ROA>0 (unprofitable)	$eRet_1$	t-stat	$eRet_2$	t-stat	*aRet*	t-stat
1 (low *CH*)						
2						
3						
4						
5						
6						
7						
8						
9						
10 (high *CH*)						
[10ñ1]						
ROA>0 (Profitable)						
1 (low *CH*)						
2						
3						
4						
5						
6						
7						
8						
9						
10 (high *CH*)						
[10ñ1]						
[*ROA*>0,10]ñ[*ROA*>0,10]						
[*ROA*>0,1]ñ[*ROA*>0,1]						
[*ROA*>0ñ*ROA*>0] of [10ñ1]						

Panel D: Relative misvaluation and decile portfolios sorted by cash holdings

RM=low	$eRet_1$	t-stat	$eRet_2$	t-stat	*aRet*	t-stat
1 (low *CH*)						
2						
3						
4						
5						
6						
7						
8						
9						
10 (high *CH*)						
[10ñ1]						
RM=medium						
1 (low *CH*)						
2						
3						
4						
5						
6						
7						
8						
9						
10 (high *CH*)						
[10ñ1]						
RM=high						
1 (low *CH*)						
2						
3						
4						
5						
6						
7						
8						
9						
10 (high *CH*)						
[10ñ1]						
[high,10]ñ[low,1]						
[~high,10]ñ[~low,1]						
[low,10]ñ[high,1]						

Panel E: Limits to arbitrage and decile portfolios sorted by cash holdings

LTA=low	$eRet_1$	t-stat	$eRet_2$	t-stat	*aRet*	t-stat
1 (low *CH*)						
2						
3						
4						
5						
6						
7						
8						
9						
10 (high *CH*)						
[10ñ1]						
LTA=medium						
1 (low *CH*)						
2						
3						
4						
5						
6						
7						
8						
9						
10 (high *CH*)						
[10ñ1]						
LTA=high						
1 (low *CH*)						
2						
3						
4						
5						
6						
7						
8						
9						
10 (high *CH*)						
[10ñ1]						
[highñlow] of [10ñ1]						