Digital Technologies, Investor Sentiment, Limits to Arbitrage and Value of Firm Cash Holdings in China's A Stock Market is Good

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Cash is a firm's most liquid asset and this asset can add firm value by mitigating firm financial constraints, reducing debt default risk and opportunity costs. But the positive and negative asset pricing effect of cash holdings are related to digital technologies, sustainable performance and investors' sentiment and limits to arbitrage. The paper finds the digital technologies and sustainable performance, both are negatively associated with the value of cash holding. The current study also scrutinized that firm's cash holding value appears to be positive in China's A stock market, and this asset pricing effect is more significant in periods when investor sentiment is high and in firms confronting high level of limits to arbitrage. This research provides evidences on the asset pricing effect of firm cash holdings and on how inefficient capital market affects this asset pricing effect. The findings of this research are useful for firms) improving cash management and have implications for supervising department to improve stock market efficiency.

Keywords: *Limits to Arbitrage; Investor Sentiment; Sustainable Performance; Digital Technologies; Value of Firm Cash Holdings; Asset Pricing Effect.*

Introduction

In the framework of perfect capital market, firms can finance all valuable projects and it is unnecessary for firms to hold cash and tradable security. Consequently, there would be no discount or premium for firm liquidity management. However, the real capital market is imperfect and there are market frictions, such as information asymmetry, agency costs, irrational investors, and firm cash holdings can potentially destroy or improve firm value. Extant researches have investigated how adverse selection problems，moral hazard problems and related risk changes affect value of firm cash holdings.

Several motives have been identified in finance literature to explain corporate cash holding levels. On such critical motive is agency motive which articulates positive association between agency issues and corporate cash holdings. This is the reason organizations with more agency conflicts hold more cash. In the light of said motive, previous literature argues that socially responsible organizations likely to have more agency related conflicts as these firms want to satisfy stakeholders at all level which eventually leads to high level of corporate cash holdings (Harper & Sun, 2020; Chen *et al.,* 2023). On the other hand, financial technology is also a well-recognized concept in financial literature and it has reshaped the financial landscape, hence promotes various policy prescriptions. Thereby, a good understanding regarding the influence of financial technology on cash holding is extremely essential for policy appraisals (Fujiki, 2020, Amihud & Mendelson,1986). First, cash reserve can provide precautionary benefits by reducing under investment and by relieving financial constraints when there are financial constraints and debt crisis costs. Myers & Majluf (1984) show that safety marginal formed by cash holdings can help firms to conquer the adverse shocks to firm investment opportunities and cash flow caused by the high external financing costs. When the information asymmetry problems can improve the possibility of bypassing profitable investment opportunities, financial flexibility is more valuable. Consistent with this expectation, Opler et al. (1999) believe that it is more difficult for firms with low debt ratings to finance in the capital market, and the ratio of cash to non-cash assets is high in these firms, which can be seen as a financial cushion. Almeida et al. (2004) find that the sensitivity of cash-to-cash flow is more significant as the gap between external financing cost and internal financing cost is increasing. Bates et al. (2009) find that the value of cash holdings in firms with high level of cash flow volatility and in firms with high level of R&D expenditures is high, because demand for external financing is more significant in these firms. In markets with frictions, firms with financial constraints must bear under investment losses and cash holding can reduce these losses caused by financial constraints and improve firm value as a result.

Second, the negative value effect of firm cash holding is more significant in firms with serious agency problems because agency costs are high in these firms. Jensen (1986) believes that managers have incentives to expand firm investment to obtain more control right benefits. Myers & Rajan (1998) believe that it is easier for managers to transfer cash from minority shareholders because cash is more liquid and anonymous. Harford et al. (2008) find that firms with more cash holdings are more likely to enforce over investment and entrenched managers are inclined to accumulate liquid assets and expend these assets quickly. In firms controlled by managers and controlling shareholders, cash is more likely to be tools for controllers to make self-benefit, So, cash holdings maybe damage firm value.

Third, in perfect capital market, systematic risks related to cash holdings can damage firm value. Palazzo (2012) believes that firms with high level of systematic have high expected return and it is reasonable for these firms to hold more cash to averse costly external financing when future cash flow decreases. Simutin (2010) believes that there are more growth options in firms with more cash holdings. These firms are riskier because there are fewer assets in place in these firms and expected return of these firms should be high. The above two researches all indicate the positive relationship between level of firm cash holdings and expected stock returns. Contrarily, Ortiz-Molina & Phillips (2014) believe that risk of firms with high level of cash holdings is low because more cash reserves provide firms with more liquidity. So, expected returns of firms with high level of cash holdings should be low and this implies that the relationship between level of cash holdings and expected stock return is negative.

We can see that:(1) the extant researches investigate the value of firm cash holdings at the risk-return framework and agency framework and there is no consensus; (2) all these researches have the potential hypothesis that investors and firm managers are all rational and these researches do not consider how market frictions, such as irrational investors and limits to arbitrage affect the value of firm cash holdings. In developed capital market, institutional investors dominate the capital market, and they are always viewed as rational and sophisticated investors. The Chinese capital market is an emerging capital market, which is dominated by individual investors. At the end of year 2021, the total number of investors in China's A share is 247,150,884 and the number of individual investors is 247, 000, 000, this implies that personal investors dominant this market (He *et al.,* 2021; Wirsbinna & Grega, 2021; Alruwaili *et al.,* 2023; Burca *et al.,* 2022). Compared with institutional investors, personal investors are more likely to be extremely pessimistic or optimistic, which may lead to undervaluation or overvaluation of securities. What's more, there are many limits to arbitrage in Chinese capital market, such as, the daily trading price limits, short selling constraints, and so on. Under this special background, this paper investigates the value of firm cash holdings and how investor sentiment and limits to arbitrage affect these assets pricing effect. This research can enrich researches on the value of firm cash holdings under imperfect capital market and are helpful for improving capital market efficiency.

Literature Reviews

Under the framework of agency theory, extant researches believe that cash can mitigate financial constraints, reduce debt default costs, improve agency costs and affect firm risk, and have investigated the value of firm cash holdings.

First, agency problems can reduce the value of firm cash holding, and effective corporate governance can improve the value of firm cash holding. The interest conflicts between owners and managers can induce agency problems (Jensen & Meckling, 2019; Shibli *et al.,* 2021). The free cash flow agency problems and effectiveness of corporate governance affect the value of firm cash holdings. Zhang & Zhou (2022) believes that the level of auditing risk implied by auditing fee affect investors' positive or negative expectation on the value of firm cash holdings and this expectation can change excess stock returns. This research also proves that abnormal high auditing fee can reduce the value of firm cash holdings and this effect is more significant in firms confronting high level of financial constraints. Meng et al. (2020) prove that top managers' promotion incentives in state-owned enterprises can reduce value of excess cash holdings and cash in these enterprises is more of an agency problem. Product market competition and investor protection laws are two kinds of effective investor protection mechanisms, both of which can mitigate the negative effect of firm cash holding on firm value. The mechanism researches imply that managers with promotion incentives are more likely to make inefficient M&A and to make empire building using firm's cash holdings. Meng et al. (2020) prove that short selling can improve the level of firm cash holdings and the marginal value of firm cash holdings increases. This effect is more significant in firms with high agency costs. The mechanism tests show that short selling improve the value of firm cash holdings through curbing firms' over-investment. Jing et al. (2018) prove that accounting conservatism improves firm value and product market competition can mitigate this effect. Chowdhury et al. (2021) prove that concentrated ownership in Chinese enterprises strengthen block-holders' turning incentives and reduce the value of firm cash holding, this effect is more significant in state-owned enterprises. Zhang & Zhou (2022) prove that political connections improve the level of firm cash holdings but reduce the value of firm cash holdings. But the political connections can improve the value of firm cash holdings in the conditions with perfect external corporate governance. Zhang & Zhou (2022) prove that auditors' industry specialization positively affects the value of firm cash holdings and this effect is more significant in family businesses and in firms with low level of internal control quality. Chowdhury et al. (2021) prove that top managers' entrenched behaviors detriment value of firm cash holdings. Chowdhury et al. (2021) prove that pay gap among top managers in state-owned enterprises improves the level of firm cash holdings and reduces the value of firm cash holdings and these effects are opposite in family businesses. The mechanism tests show that pay gap in state-owned enterprises reduces dividend payout ratio and deteriorates over investment problems. Dittmar & Mahrt-Smith (2007) find that value of cash holding is low in firms with weak corporate governance mechanisms. Drobetz et al.

(2010) point out that the value of cash holdings is low in firms with high level of information asymmetry. Firm diversification can reduce the value of cash holdings by deteriorating agency problems because diversification is closely with empire building and cross department subsidies. Pinkowitz et al. (2006) prove that firm regulation environment can affect value of firm cash holdings significantly, and this effect is asymmetry. Specifically, there is valuation premium in countries with well investor protection regulations, and there is valuation discount in countries with bad investor protection regulations. Chowdhury et al. (2021) proves that paying attention to stakeholders' benefits can improve the supervision from stakeholders and this can improve the value of firm cash holdings consequently.

Second, the precautionary benefits of cash holdings are more significant in firms confronting high level of financial constraints and in firms with high level of debt default risks. The information asymmetry between mangers and shareholders can induce financial constraints (Myers & Majluf, 1984; Paraschiv *et al.,* 2021; Shafi *et al.,* 2022; Kovaite *et al.,* 2022) and which can improve the value of firm cash holdings. Denis and Sibilkov (2010) find that value of cash holdings is higher in firms confronting financial constraints than that in firms without financial constraints and this effect is more significant in firms with more profitable investment opportunities. Harford et al., (2014) investigate whether cash reserve can alleviate under investments problems induced by risk of external financing and the evidences prove that value of cash holdings in firms with more current liabilities is higher. Haushalter et al. (2007) view cash as the means of defending against being taken over and cash can protect firm' market positions. Denis and Sibilkov (2010) prove that financial market development reduces firm cash holdings and improve the value of firm cash holdings and this effect is more significant in private firms. The mechanism tests show that financial development reduces cash-cash flow sensitivity, curbs over investment and alleviates agency problems. Wang et al. (2021) prove that tight monetary policy can improve value of cash holdings in China's A stock market significantly. Harford et al. (2008) prove that environment uncertainty can improve value of firm cash holdings by strengthening financial constraints. When there is costly external financing, cash is especially important in firms with many investment opportunities that need continual cash expenditure, such as R&D expenditures (He & Wintoki, 2016; Jermsittiparsert, 2021). He & Wintoki (2016) indicates that high-tech enterprises and R&D intensity enterprises hold more cash than that in manufacturing enterprises and this can explain the increase of firm cash holdings. Denis & Sibilkov (2010) prove that cash is more important in financial constraints firms because these firms can use cash to invest in profitable projects that may be bypassed because of costly external financing. Acharya et al. (2012) believe that asset structure, especially cash ratio, is dependent on firm's leverage, and firms with high level of default risk can precaution cash shortage by holding more cash and improving firm liquidity.

Third, the value of firm cash holdings increases when there are more investment opportunities in the macro environment because cash holding can decrease opportunity costs. Firms have strong incentive to hold cash when they have more business trading opportunities or have more investment opportunities, or that must bear high cost when reducing dividend or falling into cash shortages, or these firms have high level of cash flow volatility (Almeida *et al.,* 2004; Marin-Garcia *et al.,* 2022; Niaz, 2021; Kowalski, 2022). Yang et al. (2019) prove that level of firm cash holdings positively affects firm value and increase sale growth. The value of cash holdings is higher when firms hold cash for the purpose of precaution and trading (Denis & Sibilkov, 2010; Harford *et al.,* 2014; Hussain *et al.,* 2022; Nguyen & Ngo 2022, Yousaf *et al.,* 2021; Kuczewska & Tomaszewski, 2022). Xiao et al. (2020) prove that level of firm cash holdings positively affects the accumulative abnormal returns in the window periods with the shock of COVID-19, and this research provides direct evidences on the precautionary value of firm cash holdings. Harford et al., 2014 prove that the positive value of cash holding is more significant in firms confronting weak industry competition and this effect increases when financial constraints that competitors confronting increases. Jiang et al. (2015) prove that political shock can improve the value of cash holdings but this effect is weak in state-owned enterprises and is more prevalent in private firms.

Based on the literature review above, we can see that:(1) the extant researches mainly investigate how agency costs, financial constraints and environmental factors affect the value of cash holdings and (2) rational mangers and investors are the underlying hypotheses of all these researches. In reality, investors are always not fully rational. As the biggest emerging stock market in the world, individual investors dominant China's A stock market and individual investors are always affected by market sentiment when making investment decisions. What's more, trading price limits regulation, short selling constraints and other limits to arbitrage factors may reduce the price discovery efficiency. These imply that market sentiment and limits to arbitrage in China's A stock market may affect the pricing of firm cash holdings. So, this paper investigates the asset pricing effect of firm cash holding and how market sentiment and limits to arbitrage affect this asset pricing effect.

Fourth, the value of firm cash holdings decreases when there are more problems regarding environmental behaviours of firm and firms are equipped with digital technology. According to Jiraporn & Chintrakarn (2013), in socially responsible firms, managers appear to be more entrenched which implies that firms experience more agency issues. According to Cheung (2016), socially responsible organizations are able to hold more cash and they mainly focus on maximizing stakeholder's value in contrast with shareholder's value which eventually leads to more agency conflicts. Moreover, Cheung (2016) proclaims that firms when do not perform well in environmental area, they likely to hold less cash because they are not supposing to exhibit socially responsible behavior, hence indicating less agency conflicts between managers and shareholders. This means that organizations with bad environmental performance emphasize more on shareholders' value instead of stakeholders which eventually leads to low cash level. Having said argument, we propose that irresponsible environmental behavior is negatively correlated with firm's

cash holdings. Similarly, the negative association of digital technologies with cash holdings explains that digital platforms are effective to restrict cash holdings. Also, due to the flexibility of such technologies economic agents naturally utilize these technologies to gain benefits and also shrink the cash holdings (Cera *et al.*, 2022; Onah *et al.*, 2021; Matuszewska-Pierzynka, 2021, Lozano-Almansa *et al.*, 2023; Qinqin *et al.*, 2023; Sarwar *et al.*, 2020).

Theory Analysis and Hypotheses

Value of Firm Cash Holding in China's A Stock Market

On the one hand, cash holdings have a positive effect on firm value by mitigating financial constraints and reducing default risk. According to the classical financial literature, the value of firm cash holding is closely related to the asymmetry between managers and the capital market (Myers & Majluf, 1984; Ojogiwa, 2021). First, cash holdings can improve firm value by mitigating under-investment caused by financial constraints. Market frictions caused by information asymmetry can hinder firms from financing funds for profitable projects investment. The cost of external financing is higher than the cost of internal finance and rational managers have incentives to increase cash holdings to provide capital for profitable growth opportunities at low costs (Hartani *et al.*, 2021; Myers & Majluf, 1984). Cash and tradable securities can increase firm value in case of these assets can mitigate under-investment caused by mispricing. Consistent with this viewpoint, Faulkender & Wang (2006) find that value of cash holdings in financial constraints firms is higher than that in non-financial constraints firms. Denis & Sibilkov (2010) confirm that the value of cash holding increases with the extent of financial constraints and this implies that costly external financing improves the value of cash holdings. Similarly, Karpuz et al. (2020) prove that mandatory enforcement of IFAS brings shocks to information asymmetry between outside investors and firms and this reduces the value of firm cash holdings. Kim et al. (2022) prove that terrorist attacks strengthen financial constraints of firms nearby and improve the value of cash holdings consequently. Second, cash holdings can reduce financial distress costs incurred when operating cash flows cannot cover mandatory payment obligations.

On the other hand, firm cash holding may have a negative effect on firm cash holdings because of the costs of free cash flow. Agency conflicts between managers and stockholders can also detriment the value of firm cash holdings (Dat *et al.*, 2022; Jensen & Meckling, 2019). Firm cash holdings can improve firm over-investment and destroy firm value (Jensen, 1986). Dittmar & Mahrt-Smith (2007) point out that there are agency costs of cash holdings. Specifically, they find that enforcement of anti-takeover laws destroys the value of cash holdings. Pinkowitz et al (2006) find that the economic consequences of cash holdings are affected by the quality of corporate governance (such as corruption index, anti-director index). Kalcheva & Lins (2007) prove that the value of non-USA listed firms' cash and tradable securities can be significantly detriment when investor protection is weak and manager tunneling problems are serious in the motherland of these firms. Sun et al. (2012) find that current assets may destroy the value

of firms which locating in countries with weak investor protection laws and serious managerial tunneling problems. Louis et al. (2012) find that accounting conservatism can mitigate agency costs in cash assets.

Under China's special background, the positive effect of cash holding on value should be stronger than the negative effect of cash holdings on value. First, in China's developing capital market, many enterprises confront financial constraints, high level of cost and difficulty in financing, both of which are the main factors preventing firms from development. Many facts, such as the special monetary policies, regulated interest rates, unbalance of financial development, internal agency problems and information asymmetry, are the causes of financial constraints (Streimikiene, 2023; Yodchai *et al.*, 2022; Wu & Huang, 2017). Second, the cash agency problems may be weak in both state-owned enterprises and private firms. The key driver of a firm over-investment is conflict of interest between shareholders and managers. Managers incline to retain cash flows in firms and invest in negative NPV projects, through which managers can make self-benefits. Agency costs related to over-investment are the basic driver that reduces firm value. Richardson (2006) find that over-investment mainly exists in firms with high level of cash flows. Many researchers believe that the main driver of over investment in China is government interventions, instead of interest conflict between shareholders and managers. What's more, the Chinese government has enforced many actions to improve firm investment efficiency in China, such as administrative accountability, state-owned capital operating budgeting regulation, special auditing regulation and Economic Value Added (EVA) Evaluation system. The enforcement of all these regulations can curb over-investment in state-owned enterprises. On the other hand, a family firm with highly concentrated ownership is also one of the most popular and important ownership structures in China. Controlling shareholders or members of the family are always managers of these firms, and the interest conflict between shareholders and managers is very weak. This implies that the problem of over-investment that can bring managers control benefits is not very serious. Based on the analysis above, we believe that the problems of over-investment associated with cash holdings are not very serious in China, and the negative value effect of cash holdings maybe not very serious (Atkociuniene & Siudikiene, 2021; Rodrigues-Ferreira *et al.*, 2023).

We believe that the benefits of cash holdings in alleviating financial constraints, and reducing default risks are more evident, and these benefits are more than the costs associated with cash holdings. The value of cash holding in China is positive. So, we introduce the first hypothesis.

H1: The level of firm cash holdings can positively affect firm value in China's A stock market.

How Does Investor Sentiment Affect the Value of Firm Cash Holding in China's A Stock Market

Investor sentiment has always been viewed as potential driver of stock price change. De Long et al. (1990) depict the effect of sentiment in financial market and show that sentiment factors can drive asset prices to deviate from their

fundamental value. Under this theatrical framework, many researches provide evidences of the asset pricing effect of sentiment. For example, Baker & Wurgler (2007) investigate the effect of sentiment on the price of assets that are difficult to make an evaluation and difficult to arbitrage. The results show that expected returns of distressed stocks and growth stocks are lower following the period with high investor sentiment. Stambaugh et al. (2012) investigate how sentiment affects the cross section of stock returns and find that asset pricing anomaly is more significant following periods of high investor sentiment. Garcia (2021) proves that the effect of sentiment on stock price in(is) more prevalent in recession periods than that in expansion periods. Da et al. (2015) reveal the predictive ability of sentiment on return reversal effect. Investor sentiment can be defined as beliefs on risks and returns that cannot be explained by realization. But De Long et al. (1990) point out that sentimental investors' random trading behaviors make asset price unpredictable and bring hinders to arbitrage activities, all of these affect stock return continuously. Brown and Cliff (2005) find that future stock returns will be lower(higher) if investor sentiment drives price higher(lower) than its fundamental value, because mean reversion is one of the common phenomena in society and nature. The empirical researches on the U.S and other developed stock markets prove the findings above (Bathia & Bredin, 2016; Shahzad *et al.*, 2022; Tiberius *et al.*, 2021). Wang et al. (2021) use CPI proxies for investor sentiment and prove that future stock returns are negatively related to the level of investor sentiment worldwide and this effect lasts a short time in developed capital market and lasts a long time in developing capital market.

Pessimistic investor sentiment can increase the level of investors' aversion and are more like to give more weight to the positive effect of cash holdings on alleviating financial constraints and reducing debt default risks. So, the demand for stocks with high level of cash holdings increases and the prices of these stocks increase. Investor sentiment is a hot topic in financial research (Park & Sohn, 2013), but it can explain investors' decision making(decision-making) process (Parveen *et al.*, 2020), portfolios construction behaviors, risk sources (Cagli *et al.*, 2020), risk preference (Qadan *et al.*, 2019) and risk premium (Qadan & Aharon, 2019). Fang et al. (2021) prove that optimistic investor sentiment is positively related to stock returns in the current month and pessimistic investor sentiment induces a negative effect. The effect of both kinds of sentiment on stock returns reversed in the future periods. Investor sentiment can change investors' risk attitude in the stock market. In periods when investor sentiment is declining, investors become more risk aversion and this would lead investors to transfer more of their risky assets to safety assets. Such as, in low investor sentiment periods, investors choose to buy safety assets instead of speculative assets or choose to leave the stock market. Investment not only affects individual investors' trading behaviors but also affect institutional investors' trading behaviors (Devault *et al.*, 2019). In low investor sentiment periods, investors choose to transfer equity funds to fixed return funds (Da *et al.*, 2015), because debt funds are safer than equity funds, debt funds attract more investors in periods with low investor sentiment and price of debt funds increase, price of equity funds decrease.

In periods when investor sentiment is low, investors are more risk averse and these kinds of risk attitude affect the cash holdings-expected stock returns relationship in two ways. First, risk-averse investors prefer low-risk firms in which the level of cash holding is high and dislike high-risk firms in which the level of cash holdings is low. Second, risk-averse investors demand high level of risk premium given the level of risk, this can reduce the valuation of securities and improve the costs of external financing. This implies that the effect of cash holding at alleviating firm financial constraints is more prevalent. In summary, in periods when investor sentiment is low, a high level of cash holdings caters for risk-averse investors' low-risk preference and the positive effect of cash holdings in alleviating firm financial constraints is more significant. So, the positive relationship between the level of cash holdings and expected stock returns is more significant in periods when investor sentiment is low. Based on the analysis above we introduce the second hypothesis.

Hypothesis 2: In periods when investor sentiment is low, the positive relationship between cash holding and expected stock returns is more significant.

How Limits to Arbitrage Affect the Value of Firm Cash Holding in China's A Share Market

According to the efficient capital market theory, the potential profitable opportunities of the mispriced stocks can attract rational investors' arbitrage trading activities which can eliminate mispricing. In an imperfect capital market, mispricing is caused by irrational investors' trading activities and in the case when limits to arbitrage hinder the effectiveness of arbitrage activities, this mispricing would be persistent (Barberis & Thaler, 2003). Arbitragers are only willing to arbitrage on profitable opportunities that can bring them abnormal high returns. Too high arbitrage cost makes the asset pricing anomaly unprofitable (Novy-Marx & Velikov, 2016), short selling constraints make the overvaluation persistent by hindering arbitrages from enforcing arbitrage activities on bad information implied in the overvaluated assets (Miller, 1977) and arbitrage risks hinder arbitrage activities (Pontiff, 2006). De Long et al. (1990) point out that unpredictable noise traders' trading activities can deviate stock price from fundamental value, and this can improve arbitrage risks. Shleifer & Vishny (1997) believe that arbitrage activities also confront financial constraints problems which can propel arbitragers liquidate their arbitraging conditions. Individual investors dominate the emerging capital markets (Voronkova & Bohl, 2005) and are more likely to be affected by irrational factors which can limit arbitrage activities. Specifically, risks related to high transaction costs, opacity, low level of investor protection (Carrieri *et al.*, 2013), more corruptions (Switzer & Tahaoglu, 2015) and weak outsider shareholders rights, are common. And all these risks can hinder sophisticated investors' arbitrage activities. As a result, limits to arbitrage maybe unable to eliminate mispricing induced by investor sentiment. He et al. (2021) proves that limits to arbitrage are one of the most important factors driving asset pricing anomaly in China's A stock market and investor sentiment-driven asset pricing anomaly is more significant in firms with high level of limits to arbitrage.

Based on the analysis above, this paper believes that market frictions, such as individual investors' dominance, unsophisticated institutional investors, imperfect regulations, weak investor protection, low information opacity, trading price limits regulations and short selling constraints, all these factors imply that arbitrage risk and arbitrage cost are high in China's A stock market. Consequently, mispricing of stocks with high level of arbitrage cost and arbitrage risks are especially difficult to be eliminated in this market and investor sentiment-driven mispricing in these stocks would be more significant. We introduce the third hypothesis below.

Hypothesis 3: The positive asset pricing effect of cash holding is more significant in firms with high level of limits to arbitrage.

Research Design

Variables Definition

Dependent Variables

$RET_{i,t}$ is monthly raw stock return of stock i in month $t+1$, equals monthly return of stock i in month $t+1$.

$ER_{i,t}$ is monthly excess return of stock i in month $t+1$, equals $RET_{i,t}$ minus risk free return in month $t+1$.

$IDR_{i,t}$ is monthly industry mean return adjusted return of stock i in month $t+1$, equals $RET_{i,t}$ minus monthly industry mean return in month $t+1$.

$AR_{i,t}$ is abnormal return of stock i in month $t+1$, equals $ER_{i,t}$ minus Fama et al., (1993) three factors model predicted risk return of stock i in month $t+1$, the prediction model is equation (1).

$$ER_{i,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + \varepsilon_{i,t} \quad (1)$$

Equation (2) is used to calculated $AR_{i,t}$.

$$AR_{i,t} = ER_{i,t} - (\hat{\alpha}_i + \hat{\beta}_i MKT_t + \hat{s}_i SMB_t + \hat{h}_i HML_t) \quad (2)$$

Independent Variables

Level of firm i's cash holdings $CASH_{i,t}$, equals firm i's ratio of amount of monetary asset divided by total asset at the end of fiscal year t.

Controlled Variables

$PB_{i,t-1}$ is market to book value of equity at the end of month t, equals stock price and the end of month t is divided by book value per share at the beginning of the year that t belongs to.

$Size_{i,t-1}$ is firms scale, equals log of tradable market value of stock i at the end of month t.

$RE_{i,t-1}$ is profitability of firm i, equals net revenue divided by total revenue in year t.

$RET_{i,t}$ is monthly raw stock return of stock i in month t.

$INV_{i,t}$ is capital expenditure of firm i in year t, equals "outflow of investment" divided by total asset at the beginning of year t.

$INV_{i,t}$ is leverage of firm i at the end of year t, equals 'total liability' divided by 'total asset'.

Proxies for Market Sentiment

S_t^C proxies for low investor sentiment in month t, if tradable market value weighted individual stock returns of China's A stock market in month t less than 0 then S_t^C equals 1, otherwise 0.

S_t^R proxies for continuously low investor sentiment in month t, if tradable market value weighted individual stock returns of China's A share in month t and month t-1 are both less than 0, then market less than 0 then S_t^R equals 1, otherwise 0.

Measures of Limits to Arbitrage

According to Shleifer and Vishny (1997), the problems of mispricing are more serious in firms with high level of limits to arbitrage. We use three variables proxy for limits to arbitrage.

$TRANSP_{i,t}$ proxies for firm transparency, measured by stock price syncraticity which can be calculated following the two steps below. First, we estimate Fama et al., (1993) three factors model (3) using daily trading data in months t-1 and t-2 and calculate Adjusted R square ($R_{i,t}^2$) of this regression.

$$R_{i,t} = \alpha_{i,t} + \beta_{i,t} * R_{m,t} + s_{i,t} * SMB_{m,t} + w_{i,t} * HML_{m,t} + e_{i,t} \quad (3)$$

Second, we calculate $TRANSP_{i,t}$ using model (4).

$$TRANSP_{i,t} = \log(\frac{R_{i,t}^2}{1 - R_{i,t}^2}) \quad (4)$$

The main reason for high stock price synchronicity is that firm specific information can be incorporated into stock price. Morck et al. (2000) argue that low level of synchronicity indicates more specified firm information incorporated into stock price. West (1988) argue that low synchronicity is driven by non-fundamental information and irrational behavior caused by this information. However, Wang et al. (2021) find that stock price synchronicity increases with firm information transparency in China's A stock market. This indicates that stocks with low synchronicity are related to more noise trading and high level of arbitrage risk of these stock.

$PLM_{i,t}$ is number of stock prices reach price limits, equals time of stock i's daily returns reach price limits in the periods from month $t-2$ to month t. Kim & Rhee (1997) prove that trading price limits regulations hinder stock price reaches equilibrium price. $TURN_{i,t}$ is ratio of stock turnover, which equals mean of daily turnover of stock i in the periods from month $t-2$ to month t. The model

constructed by Amihud & Mendelson (1986) indicates that stock turnover can be a proxy for stock liquidity. But in China's A stock market, Zhang and Liu (2006) argue that stock turnover cannot proxy for stock liquidity but can proxy for investors' heterogeneous beliefs because short selling constraints and heterogeneous beliefs are common in China's A stock market. So, we think that arbitrage risk is high in stocks with high turnover rate which indicates a high level of heterogeneous beliefs.

$DUVOL_{i,t}$ is trading volume of stock i in month t, which equals mean of daily trading volume of stock i in the periods from month t-2 to month t. According to Bhushan (1994), trading volume can be used to inversely measure price pressure and time required to complete one market order. Admati & Pfleiderer (1988) argue that trading cost is low when trading volume is high. So, we believe that stocks with low trading volume are more difficult to be arbitraged.

Design of Regression Model

$$RET_{i,t+1} = \beta_0 + \beta_1 * CASH_{i,t} + \beta_2 * AMH_{i,t} + \beta_3 * TURN_{i,t} + \beta_4 * RET_{i,t} + \beta_5 * PR_{i,t} + \beta_6 * SIZE_{i,t} + \beta_7 * I_{i,t} + \beta_8 * Lev_{i,t} + \varepsilon_{i,t}$$ (5)

According to Fama & MacBeth (1973) regression method, we first conduct regressions month by month, and then we calculate time series mean and t statistics of each estimated coefficients. In the regression model above, the dependent variable $RET_{i,t+1}$ represents $RET_{i,t}$, $ER_{i,t}$, $IDR_{i,t}$ and $AR_{i,t}$, respectively.

Sample

Based on data attainable principle and sample maximizing principle, this paper uses listed firms in China's A stock market during the periods from 1999 to 2020 as sample. The financial data obtained from CSMAR listed firms research database provider, daily and month stock trading data and three factors' data are from RESSET financial research database. We delete observations with missing values and exclude financial sector firms including the banking and security industry. We also winsonrize the whole sample. After the treatments above, we match financial data at the beginning of the years with monthly stock returns data and we obtain 383661 observations.

Empirical Results and Analysis

Descriptive Statistics

Table 1 presents the summary statistics of the main variables. We can see that the mean and median of $RET_{i,t}$ are 1.308 % and 0.020 %, respectively, the difference between third quartile and median is lower than the difference between first quartile and median, and the skewness of $RET_{i,t}$ is 1.215. All these evidences indicates that monthly stock returns in China's A stock market are positively distributed and more than half returns are lower than mean return. Means of $ER_{i,t}$, $IDR_{i,t}$ and $AR_{i,t}$ are all lower than the corresponding medians of these variables and skewnesses of these variables are all positive, all these evidences indicate that monthly excess stock returns and monthly abnormal stock returns are all positively skewed.

Mean and median of $CASH_{i,t-1}$ are 0.189 and 0.148, respectively, the difference between third quartile and median is lower than the difference between first quartile and median, and the skewness is 1.514. All these evidences indicate that level of cash holdings in China's A stock market is relatively high and it is positively skewed.

Mean and median of $PB_{i,t-1}$ are 5.014 and 3.080, respectively, the difference between third quartile and median lower than the difference between first quartile and median, and the skewness and kurtosis of this variable are both high. All these evidences indicate that the price divided by book value of equity in China's A stock market is positively skewed.

Mean and median of $SIZE_{i,t-1}$ are 22.095 and 22.102, respectively, the difference between third quartile and median is 0.304 and the difference between first quartile and median is 0.704, and both skewness and kurtosis of this variable are positive. All these evidences indicate that listed firms scale in China's A stock market is positively skewed.

Median of variables $RE_{i,t-1}$, $INV_{i,t-1}$ and $LEV_{i,t-1}$ are all lower than corresponding means of these variables, the difference between third quartile and median of these variables is all lower than the corresponding differences between first quartile and median of these variables. These evidences indicate that profitability, capital expenditure and leverage of listed firms in China's A stock market are all positively skewed.

Table 1

Descriptive Statistics of Main Variables

Variables	Mean	Media	Q1	Q3	Min	Max	Skew	Kurt	Std
$RET_{i,t}$(%)	1.308	0.02	-6.8	7.89	-78.19	197.43	1.215	6.992	13.995
$ER_{i,t}$(%)	1.035	-0.217	-7.073	7.613	-78.284	197.207	1.214	6.986	14.001
$IDR_{i,t}$(%)	-0.055	-0.953	-5.554	4.119	-83.171	195.781	1.787	14.102	10.213
$AR_{i,t}$(%)	-0.019	-0.987	-5.486	4.115	-75.303	203.483	1.803	14.028	10.259
$CASH_{i,t-1}$	0.189	0.149	0.091	0.246	0.001	0.906	1.514	2.474	0.141
$PB_{i,t-1}$	5.014	3.08	2.01	4.84	0.08	13291.84	146.562	27670.82	58.893
$SIZE_{i,t-1}$	22.095	22.102	21.406	22.806	17.808	28.612	0.061	0.545	1.173

Variables	Mean	Media	Q1	Q3	Min	Max	Skew	Kurt	Std
$RE_{i,t-1}$	0.084	0.077	0.028	0.151	-3.166	2.214	-4.036	47.302	0.195
$RET_{i,t-1}$	0.012	0	-0.069	0.078	-0.801	1.974	1.289	7.753	0.142
$INV_{i,t-1}$	0.056	0.041	0.018	0.078	0	0.366	1.513	2.515	0.051
$LEV_{i,t-1}$	0.419	0.415	0.263	0.567	0.007	1	0.159	-0.681	0.198
ENVCON	0.253	0	0.013	0.342	4.212	6.122	0.431	0.125	0.67
DT	0.145	0.21	0.114	0.142	2.302	2.201	0.631	1.256	0.470

Correlation Analysis

Table 2 presents the correlation coefficients between main variables. We can see that the Pearson correlation coefficients between $CASH_{i,t-1}$ and $RET_{i,t}$, $ER_{i,t}$, $IDR_{i,t}$ are 0.002, 0.003 and 0.006, and are significant at 10 %, 5 % and 1 % level, respectively. The Spearman correlation coefficients between $CASH_{i,t-1}$ and $RET_{i,t}$, $ER_{i,t}$, $IDR_{i,t}$, $AR_{i,t}$ are 0.002, 0.003, 0.004 and 0.002, and are significant at 10 %, 10 %, 5 % and 10 % level, respectively. The evidences above indicate that level of listed firms cash holdings are positively related to stock return.

The correlation coefficients of controlling variables $SIZE_{i,t-1}$ and $RE_{i,t-1}$ between each monthly return's variables are all negative. This indicates that firm scale and profitability are negative with expected stock returns. The correlation coefficients of controlling variable $PB_{i,t-1}$ between each monthly returns' variables are all positive. This indicates that future stock returns of firms with high price divided by the book value of equity are relatively low.

Most correlation coefficients of controlling variable $INV_{i,t-1}$ between each monthly stock returns variables are positive. This indicates that future stock returns of firms with high level of capital expenditure are relatively high. The correlation coefficients of controlling variable $RET_{i,t-1}$ between $RET_{i,t}$ and $ER_{i,t}$ are significantly positive, but the correlation coefficients of controlling variable $RET_{i,t-1}$ between $IDR_{i,t}$ and $AR_{i,t}$ are significantly negative. These indicates that monthly stock returns are positively related to the following monthly raw and excess returns and negatively related to the following monthly industry or three factors-adjusted abnormal returns.

Portfolios Analysis

First, we classify the whole sample into ten portfolios sorted by $CASH_{i,t-1}$ month by month and indicate each portfolio by variables from D1 to D10. Second, we calculate tradable market value-weighted mean and arithmetic mean of each portfolio month by month. Third, we calculate time series mean of each portfolio's monthly returns and the return differences between extreme portfolios D1 and D10 during the whole sample period. The results are presented in table 3.

When the returns measured by $RET_{i,t}$, $ER_{i,t}$, $IDR_{i,t}$ and $AR_{i,t}$, the time series mean of tradable market value weighted mean returns of portfolios D1 are 1.179 %, 0.924 %, -0.075 % and -0.136 %, the corresponding mean returns of portfolios D10 are 1.519 %, 1.264 %, 0.058 % and -0.017 %, and the returns differences between portfolios D1 and portfolios D10 are 0.340 %, 0.334 %, 0.133 % and 0.119 %, which are significant at 1 %, 1 %, 10 % and 10 % level, respectively.

When the returns measured by $RET_{i,t}$, $ER_{i,t}$, $IDR_{i,t}$ and $AR_{i,t}$, the time series mean of arithmetic mean returns of portfolios D1 are 1.199 %, 0.945 %, -0.058 % and -0.119 %, the corresponding returns of portfolios D10 are 1.531 %, 1.276 %, 0.061 % and -0.006 %, and the returns differences between portfolios D1 and portfolios D10 are 0.332 %, 0.332 %, 0.119 % and 0.113 %, which are significant at 1 %, 1 %, 10 % and 10 % level, respectively. Evidences above show that returns of portfolios sorted by $CASH_{i,t-1}$ increase with $CASH_{i,t-1}$ on the whole. The portfolios analysis primarily prove that expected returns of firms with high level of cash holdings are higher than that in firms with low level of cash holdings

Table 2

Correlation Coefficients between Main Variables

	$RET_{i,t}$	$ER_{i,t}$	$IDR_{i,t}$	$AR_{i,t}$	$CASH_{i,}$	$PB_{i,t}$	$SIZE_{i,t-1}$	$RE_{i,t-1}$	$RET_{i,t-1}$	$INV_{i,t-1}$	$LEV_{i,t-1}$	$ENVCON_{i,t-1}$	$DG_{i,t-1}$
$RET_{i,t}$	1	0.999***	0.726***	0.688***	0.002*	-0.002*	-0.034***	-0.011***	0.023***	0.008**	0.003*	0.008**	0.023*
$ER_{i,t}$	0.999***	1	0.726***	0.699***	0.003**	-0.002*	-0.036***	-0.011***	0.023***	0.008***	0.004**	0.008***	0.014**
$IDR_{i,t}$	0.625***	0.625***	1	0.904***	0.006***	-0.001	-0.028***	-0.003**	-0.053***	0.003	-0.001	0.003	-0.201
$AR_{i,t}$	0.599***	0.598***	0.848***	1	0.001	0	-0.022***	-0.005***	-0.066***	0.002	-0.001	0.002	-0.111
$CASH_{i,t-1}$	0.002*	0.003*	0.004**	0.002*	1	-0.004**	0.032***	0.204***	-0.001	-0.061***	-0.399***	-0.061***	-0.329***
$PB_{i,t-1}$	-0.062	-0.062***	-0.036***	-0.022***	0.120***	1	0.001	-0.031***	0	-0.014***	0.045***	-0.014***	0.042***
$SIZE_{i,t-1}$	-0.043***	-0.046***	-0.048***	-0.036***	0.038***	0.111***	1	0.173***	0.077***	-0.038***	0.002	-0.038***	0.002
$RE_{i,t-1}$	-0.013***	-0.013***	0.008***	0.011***	0.241***	0.133***	0.173***	1	-0.009***	0.116***	-0.326***	0.116***	-0.126***
$RET_{i,t-1}$	0.009***	0.010***	-0.073***	-0.094***	-0.001	-0.015***	0.068***	-0.012***	1	0.008***	0.003*	0.008***	0.003*
$INV_{i,t-1}$	0.016***	0.016***	0.009***	0.002	-0.021***	-0.022***	0.001	0.167***	0.018***	1	-0.036***	1	-0.046***
$LEV_{i,t-1}$	0.005***	0.005***	-0.001	-0.001	-0.355***	-0.071***	0.016***	-0.474***	0.005***	-0.052***	1	-0.052***	
$ENVCON_{i,t-1}$	0.004***	0.005***	-0.001	-0.001	-0.455***	-0.071***	0.016***	-0.474***	0.005***	-0.041***	-0.052***	1	
$DG_{i,t-1}$	0.015***	0.032***	-0.002	-0.051	-0.152***	-0.082***	0.026***	-0.434***	0.045***	-0.012***	-0.122***	0.412***	1

*Note: *, **, and *** are statistically significant at the 1 %, 5 %, and 10 % levels, respectively.*

Time Series Mean Returns of Portfolios Sorted by *CASH*ᵢ,

Portfolios	TMVWMR (%)				AMR(%)			
	RET_t	ER_t	AR_t	IDR_t	RET_t	ER_t	AR_t	IDR_t
D1	1.179**	0.924	-0.075	-0.136	1.199**	0.945	-0.058	-0.119
D2	1.338**	1.083*	0.019	-0.018	1.356**	1.101*	0.031	-0.004
D3	1.354***	1.099*	-0.027	-0.058	1.374**	1.119*	-0.014	-0.04
D4	1.225**	0.970**	-0.196**	-0.161**	1.235**	0.980**	-0.190*	-0.151**
D5	1.345**	1.09**	-0.071	-0.091	1.358**	1.103**	-0.065	-0.079
D6	1.397**	1.142**	-0.014	-0.042	1.409**	1.155**	-0.008	-0.03
D7	1.367**	1.112**	-0.054	-0.091	1.379**	1.125**	-0.048	-0.078
D8	1.494**	1.240**	0.072	0.079	1.511**	1.256**	0.08	0.094*
D9	1.558**	1.303**	0.087	0.073	1.571**	1.317**	0.092	0.085
D10	1.519**	1.264**	0.058	-0.017	1.531**	1.276**	0.061	-0.006
D10-D1	0.340***	0.334***	0.133*	0.119*	0.332***	0.332***	0.119*	0.113*
T	3.74	3.75	1.74	1.85	3.61	3.61	1.7	1.87

Note: *, **, and *** are statistically significant at the 1 %, 5 %, and 10 % levels, respectively. TMVWMR (%) = Tradable market value weighted mean returns (%) AMR (%) = Arithmetic mean returns (%)

Regression Results

Table 4 presents steps wise regressions results of model (1) with different dependent variables. When the dependent variables are $RET_{i,t}$, $IDR_{i,t}$, $ER_{i,t}$ and $AR_{i,t}$, the estimated coefficient of $CASH_{i,t-1}$ in the first step regression results are 0.729, 0.669, 0.729 and 0.592, and all these four estimates are significant at 5% level. What's more, when the dependent variables are $RET_{i,t}$, $IDR_{i,t}$, $ER_{i,t}$ and $AR_{i,t}$, the increments of adjusted R2 in regression results from step one to step two are 0.28%, 0.51%, 0.28% and 0.08%, respectively.

In all the regression results, the estimated coefficients of controlling variables $SIZE_{i,t-1}$ and $RET_{i,t-1}$ are all significantly negative, this indicates that firm size and last monthly stock returns both can negatively predict monthly stock returns. Estimated coefficients of variable $PB_{i,t-1}$ are all insignificant negative, this indicates that future returns of stocks with high ratio of price divided by book value of equity is low. Estimated coefficients of variable $RE_{i,t-1}$ are all insignificant positive, this indicates that expected stock returns of high profitable firms are high. Most of the estimated coefficients of variable $INV_{i,t-1}$ and $LEV_{i,t-1}$ are insignificantly positive. This indicates that expected stock returns of firms with high level of capital expenditure and high level of leverage are high.

Step Wise Regression Results of Model (1) when Different Dependent Variables

Dependent variables	$RET_{i, t}$	$RET_{i, t}$	$IDR_{i, t}$	$IDR_{i, t}$	$ER_{i, t}$	$ER_{i, t}$	$AR_{i, t}$	$AR_{i, t}$
Steps	Step1	Step 2	Step1	Step 2	Step1	Step 2	Step1	Step 2
Const	10.322***	10.138***	8.518***	8.333***	10.067***	9.884***	4.978***	4.832***
	-3.1	-3.05	-3.19	-3.11	-3.03	-2.97	-3.71	-3.59
$CASH_{i, t-1}$		0.729**		0.669**		0.729**		0.592**
		-2.27		-2.35		-2.27		-2.01
$PB_{i, t-1}$	-0.007	-0.008	-0.007	-0.009*	-0.007	-0.008	-0.003	-0.004
	(-1.04)	(-1.34)	(-1.39)	(-1.70)	(-1.04)	(-1.34)	(-0.59)	(-0.76)
$SIZE_{i, t-1}$	-0.414***	-0.414***	-0.392***	-0.392***	-0.414***	-0.414***	-0.234***	-0.234***
	(-2.96)	(-2.97)	(-3.19)	(-3.19)	(-2.96)	(-2.97)	(-3.77)	(-3.74)
$RE_{i, t-1}$	0.317	0.236	0.275	0.201	0.317	0.236	0.071	0.018
	-1.34	-1.07	-1.26	-0.98	-1.34	-1.07	-0.29	-0.08
$RET_{i, t-1}$	-5.045***	-5.069***	-5.108***	-5.127***	-5.045***	-5.069***	-6.179***	-6.208***
	(-6.29)	(-6.36)	(-7.08)	(-7.15)	(-6.29)	(-6.36)	(-9.57)	(-9.65)
$INV_{i, t-1}$	0.112	0.307	0.316	0.487	0.112	0.307	-0.207	-0.099
	-0.19	-0.5	-0.59	-0.85	-0.19	-0.5	(-0.39)	(-0.18)
$LEV_{i, t-1}$	-0.004	0.194	0.054	0.231	-0.004	0.194	0.243	0.373**
	(-0.02)	-1.02	-0.3	-1.54	(-0.02)	-0.33	-1.24	-2.33
N	263	263	263	263	263	263	263	263
ADJ_R²	23.99 %	24.27 %	14.92 %	15.43 %	23.99 %	24.27 %	20.83 %	20.91 %

Note: *, **, and *** are statistically significant at the 1 %, 5 %, and 10 % levels, respectively.

The evidences from the regression results above indicate that level of firm cash holdings positively affects expected stock returns after controlling firm size, price-to-book value of equity, firm profitability, momentum factor, and firm capital expenditure. All these evidences prove the hypothesis one.

Robust Test

Table 5 presents the regression results of Fama et al., (1993) three factors' models in each decile portfolio during the whole sample period when excess portfolios returns are measured by tradable market value-weighted average monthly individual excess returns and arithmetic average monthly individual excess returns.

When the monthly portfolios excess returns are measured by tradable market value weighted average monthly stock excess returns, the monthly abnormal returns(alpha) of portfolio D1 to portfolio D10 are 0.246, 0.487 %, 0.466 %, 0.339 %, 0.487 %, 0.520 %, 0.460 %, 0.623 %, 0.669 % and 0.683 %.

When the monthly portfolios excess returns are measured by arithmetic average monthly stock excess returns, the monthly abnormal returns(alpha) of portfolio D1 to portfolio D10 are 0.259 %, 0.496 %, 0.479 %, 0.342 %, 0.494 %, 0.526 %, 0.466 %, 0.632 %, 0.676 % and 0.686 %. The weighted and arithmetic monthly abnormal returns(alpha) of portfolio D10 are 0.683 % and 0.686 %, both of which are significant at 10 % level. In summary, abnormal portfolio returns increase with level of firm cash holdings. What's more, estimated coefficients of MKT_t and SMB_t are all significantly positive and estimated coefficients of and HML_t are all significantly negative, all these evidences are consistent with conclusions of extant researches.

Table 5

Results of Robustness Test

Excess Return	Tradable Market Value Weighted Excess Returns (%)									
Portfs	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Alpha	0.246	0.487	0.466	0.339	0.487	0.52	0.46	0.623	0.669	0.683∗
	-0.5	-1	-0.94	-0.7	-0.99	-1.07	-0.94	-1.28	-1.38	-1.87
MKT_t	60.624∗∗∗	60.963∗∗∗	61.829∗∗∗	61.030∗∗∗	59.198∗∗∗	61.383∗∗∗	59.371∗∗∗	59.312∗∗∗	59.519∗∗∗	58.601∗∗
	-10.03	-10.25	-10.19	-10.27	-9.8	-10.3	-9.95	-9.95	-10.03	-9.63
SMB_t	45.218∗∗∗	34.782∗	37.871∗∗∗	38.439∗∗∗	36.196∗∗	37.052∗∗∗	44.325∗∗∗	40.152∗∗∗	43.102∗∗∗	36.190∗∗
	-3.49	-2.72	-2.91	-3.01	-2.79	-2.9	-3.46	-3.14	-3.38	-2.77
HML_t	-7.379	-15.746	-19.996	-19.222	-26.489∗	-29.921∗	-28.351∗	-36.613∗	-35.313∗∗	-50.989∗∗
	(-0.46)	(-0.99)	(-1.23)	(-1.21)	(-1.63)	(-1.87)	(-1.77)	(-2.29)	(-2.22)	(-3.12)
N	260	260	260	260	260	260	260	260	260	260
F	44.35	44.01	44.77	45.77	42.46	47.18	46.69	46.83	48.22	45.73
Adjrsq	0.3343	0.3325	0.3364	0.3415	0.3244	0.3485	0.3461	0.3468	0.3536	0.3413

Excess Return	Arithmetic Average Excess Return (%)									
Portfs	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Alpha	0.259	0.496	0.479	0.342	0.494	0.526	0.466	0.632	0.676	0.686∗
	-0.52	-1.02	-0.96	-0.7	-1	-1.08	-0.95	-1.29	-1.39	-1.88
MKT_t	60.657∗∗∗	60.860∗∗∗	61.710∗∗∗	60.908∗∗∗	59.042∗∗∗	61.386∗∗∗	59.299∗∗∗	59.249∗∗∗	59.450∗∗∗	58.505∗∗∗
	-10	-10.21	-10.15	-10.24	-9.76	-10.28	-9.92	-9.92	-9.99	-9.58
SMB_t	46.559∗∗∗	36.307∗∗	39.225∗∗∗	39.848∗∗∗	37.464∗∗	38.229∗∗	45.540∗∗∗	41.605∗∗∗	44.393∗∗∗	37.712∗∗
	-3.58	-2.84	-3.01	-3.12	-2.88	-2.98	-3.55	-3.24	-3.47	-2.88
HML_t	-7.76	-15.484	-19.892	-18.976	-26.332∗	-29.824∗	-225.36	-36.394∗∗	-35.134∗∗	-50.569∗∗∗
	(-0.48)	(-0.97)	(-1.22)	(-1.19)	(-1.62)	(-1.86)	(-1.76)	(-2.27)	(-2.20)	(-3.09)
N	260	260	260	260	260	260	260	260	260	260
F	44.53	44.08	44.82	45.88	42.46	47.31	46.83	46.96	48.29	45.71
Adjrsq	33.52	33.29	33.67	34.2	32.45	34.91	34.68	34.74	35.39	34.12

*Note: *, **, and *** are statistically significant at the 1 %, 5 %, and 10 % levels, respectively.*

In summary, three factors model regression results in each decile portfolio during the whole show that abnormal portfolios return increase with level of firm cash holdings when the returns are measured both by tradable market value-weighted mean returns or by arithmetic mean returns. These evidences prove that abnormal stock returns of firms with high level of cash holdings if high, which confirm hypothesis one.

Further Researches

Effect of Investor Sentiment on the Value of Firm Cash Holdings

Table 6 presents the regression results of model (1) when the dependent variables are $RET_{i,t}$ and $IDR_{i,t}$ in sub-samples constructed by S_t^C and S_t^R. In periods when investor sentiment is low (S_t^C equals 1), the estimated coefficients of dependent variables $RET_{i,t}$, $ER_{i,t}$, $IDR_{i,t}$, $AR_{i,t}$ and $IDR_{i,t}$ are 0.716, 0.716, 0.883 and 0.818, and significant at 10 %, 10 %, 5 % and 5 % level, respectively. In other periods when S_t^C equals 0, the estimated coefficients of dependent variables $RET_{i,t}$, $ER_{i,t}$, $IDR_{i,t}$, $AR_{i,t}$ and $IDR_{i,t}$ are all insignificantly positive. When investor sentiment is low in month t and $t-1$ (S_t^R equals 1), the estimated coefficients of dependent variables $RET_{i,t}$, $ER_{i,t}$, $IDR_{i,t}$, $AR_{i,t}$ and

$IDR_{i,t}$ are 0.842, 0.842, 0.726 and 0.627, and significant at 5 %, 5 %, 5 % and 10 % level, respectively. In other month(months) when S_t^R equals 0, the estimated coefficients of dependent variables $RET_{i,t}$, $ER_{i,t}$, $IDR_{i,t}$, $AR_{i,t}$ and $IDR_{i,t}$ are all insignificant positive.

Table 6

Regression Results of Model (1) in Sub Samples Constructed by Investor Sentiment

Sub sample periods	$S_t^C = 1$				$S_t^C = 0$				$S_t^R = 1$				$S_t^R = 0$			
Returns	$RET_{i,t}$	$ER_{i,t}$	$IDR_{i,t}$	$AR_{i,t}$	$RET_{i,t}$	$ER_{i,t}$	$IDR_{i,t}$	$AR_{i,t}$	$RET_{i,t}$	$ER_{i,t}$	$IDR_{i,t}$	$AR_{i,t}$	$RET_{i,t}$	$ER_{i,t}$	$IDR_{i,t}$	$AR_{i,t}$
Constant	-16.126***	-16.390***	-8.475**	3.631**	33.568***	33.322***	23.328***	5.917**	19.653***	19.402***	14.846	5.684	-23.49	-23.757	-14.687	1.907
	(-4.08)	(-4.14)	(-2.51)	-2.28	-7.73	-7.68	-6.42	-2.79	-5.27	-5.2	-4.88	-3.52	(-4.35)	(-4.40)	(-3.27)	-0.88
$CASH_{i,t-1}$	0.716*	0.716*	0.883**	0.818**	0.74	0.74	0.478	0.386	0.842**	0.842**	0.726**	0.627*	0.327	0.327	0.467	0.471
	-1.75	-1.75	-2.4	-2.33	-1.52	-1.52	-1.12	-0.84	-2.2	-2.2	-2.13	-1.79	-0.61	-0.61	-1	-0.93
$PB_{i,t-1}$	-0.005	-0.005	-0.004	-0.011	-0.011	-0.011	-0.013	0.003	-0.012	-0.012	-0.008	-0.013	-0.007	-0.007	-0.009	-0.001
	(-0.71)	(-0.71)	(-0.57)	(-1.85)	(-1.13)	(-1.13)	(-1.67)	(-0.31)	(-1.07)	(-0.61)	(-0.89)	(-1.55)	(-0.99)	(-0.99)	(-1.46)	(-0.22)
$SIZE_{i,t-1}$	0.419**	0.419**	0.371**	-0.196**	-1.158***	-1.158***	-1.073***	-0.268**	0.728***	0.728***	0.655***	-0.114	-0.734***	-0.738***	-0.688***	-0.269***
	-2.41	-2.41	-2.4	(-2.75)	(-5.98)	(-5.98)	(-6.39)	(-2.67)	-3	-3	-3.08	(-1.13)	(-4.65)	(-4.65)	(-4.94)	(-3.58)
$RE_{i,t-1}$	0.973***	0.973**	0.804**	0.918***	-0.422	-0.422	-0.338	-0.795**	0.959**	0.959**	0.822**	0.766*	0.031	0.031	0.025	-0.2
	-2.97	-2.97	-2.66	-3.15	(-1.47)	(-1.47)	(-1.24)	(-2.41)	-2.08	-2.08	-1.92	-1.63	-0.13	-0.13	-0.11	(-0.77)
$RET_{i,t-1}$	-2.736**	-2.736**	-2.874***	-4.043***	-7.149***	-7.149***	-7.137***	-8.165***	-3.448**	-3.448**	-3.739**	-5.755***	-5.527***	-5.527***	-5.519***	-6.341***
	(-2.68)	(-2.68)	(-3.19)	(-4.82)	(-6.07)	(-6.07)	(-6.69)	(-8.75)	(-2.08)	(-2.08)	(-2.59)	(-4.58)	(-6.09)	(-6.09)	(-6.70)	(-8.49)
$INV_{i,t-1}$	1.788**	1.788**	1.648**	1.038	-1.015	-1.015	-0.549	-1.127	1.796	1.796	1.565	0.58	-0.114	-0.114	0.182	-0.297
	-2.23	-2.23	-2.29	-1.53	(-1.13)	(-1.13)	(-0.64)	(-1.29)	-1.49	-1.49	-1.47	-0.53	(-0.16)	(-0.16)	-0.27	(-0.45)
$LEV_{i,t-1}$	0.444*	0.444*	0.411**	0.244	-0.029	-0.029	0.07	0.490**	-0.065	-0.065	-0.105	-0.106	0.268	0.268	0.326*	0.513**
	-1.63	-1.63	-1.96	-1.16	(-0.11)	(-0.11)	(-0.33)	-2.06	(-0.23)	(-0.23)	(-0.45)	(-0.42)	-1.16	-1.16	-1.8	-2.66
ADJ_R²(%)	7.634	7.634	3.631	4.461	9.352	9.353	0.048	5.571	7.472	7.472	3.738	4.468	8.845	8.845	4.383	5.212

*Note: *, **, and *** are statistically significant at the 1 %, 5 %, and 10 % levels, respective*

The regression results show that the positive value of cash holding is significant in periods when investor sentiment is high but insignificant in other periods, after controlling the other determinants. So, the positive value of firm cash holdings is mainly driven by pessimistic investor sentiment and hypothesis 2 is confirmed.

Effect of Limits to Arbitrage on the Value of Firm Cash Holdings

In each month, we classify the whole sample into three sub-samples sorted by each limit to arbitrage measure $TRANSP_{i,t}$, $PLM_{i,t}$, $TURN_{i,t}$, $DVOL_{i,t}$, respectively. The three sub-samples are named low, middle and high level of limits to arbitrage.

Table 7 presents differences and t-statistics between month returns of extreme decile portfolios sorted by different limits to arbitrage measures.

In sub-sample with low level of firm transparency, when the return measures are $RET_{i,t}$, $ER_{i,t}$, $AR_{i,t}$ and $IDR_{i,t}$, the return differences between extreme decile portfolios are 0.480, 0.005, 0.003 and 0.003, and these four values are significant at 1 %, 1 %, 5 % and 5 % level, respectively.

In sub-sample with high level of firm transparency, when the return measures are $RET_{i,t}$, $ER_{i,t}$, $AR_{i,t}$ and $IDR_{i,t}$, the return differences between extreme decile portfolios are all insignificantly positive. These evidences indicate that return differences between extreme decile portfolios are significant in sub-sample with low level of information transparency but insignificant in sub-sample with high level of information transparency.

In sub-sample with high frequency of stock price reaches price limits, when the return measures are $RET_{i,t}$, $ER_{i,t}$, $AR_{i,t}$ and $IDR_{i,t}$, the return differences between extreme decile portfolios are 0.534 %, 0.534 %, 0.286 % and 0.224 % and the former two differences are both significant at 5 % level. In sub-sample with low frequency of stock price reaches price limits, when the return measures are $RET_{i,t}$, $ER_{i,t}$, $AR_{i,t}$ and $IDR_{i,t}$, the return differences between extreme decile portfolios are 0.385 %, 0.004 %, -0.001 % and 0.001 % and the former two differences are both significant at 1 % level. These evidences indicate that stock returns increase with the level of firm cash holdings, especially in firms with high frequency of stock price reaches price limits.

In stocks with high turnover, when the return measures are $RET_{i,t}$, $ER_{i,t}$, $AR_{i,t}$ and $IDR_{i,t}$, the return differences between extreme decile portfolios are 0.311 %, 0.311 %, -0.057% and 0.013, and these four values are all insignificant. In stocks with low turnover, when the return measures are $RET_{i,t}$, $ER_{i,t}$, $AR_{i,t}$ and $IDR_{i,t}$, the return differences between extreme decile portfolios are 0.310 %, 0.003 %, 0.003 % and 0.001 %, and these four values significant at 5 %, 5 %, 5 % and 10 % level, respectively. The evidences above indicate that the positive asset pricing effect of firm cash holdings are mainly magnified in firms with high level of stock turnover and insignificant in firms with low level of stock turnover.

In stocks with high market trading value, when the return measures are $RET_{i,t}$, $ER_{i,t}$, $AR_{i,t}$ and $IDR_{i,t}$, the return differences between extreme decile portfolios are 0.542 %, 0.542 %, 0.309 % and 0.183 %, and the former two values are significant at 5 % level. In stocks with low market trading value, when the return measures are $RET_{i,t}$, $ER_{i,t}$, $AR_{i,t}$ and $IDR_{i,t}$, the return differences between extreme decile portfolios are 0.148 %, 0.001 %, -0.001 % and 0.000 %, and the former two values are significant at 10 % level. In stocks with middle level of market trading value, when the return measures are $RET_{i,t}$, $ER_{i,t}$, $AR_{i,t}$ and

$IDR_{i,t}$, the return differences between extreme decile portfolios are 0.384 %, 0.384 %, 0.163 % and 0.201 %, and are all significant.

In summary, evidences from the analysis of return differences between extreme decile portfolios indicate that the positive asset pricing effect of firm cash holdings is more significant in firms with low level of information transparency, high frequency of stock price reaching price limit, low level of stock turnover and high level of market trading value. These imply that asset pricing effect of cash holdings in China's stock market cannot be explained by measures of limits to arbitrage.

Table 7

Return Differences between Extreme Decile Portfolios Sorted by CASHi, t-1

Limits to arbitrage measures	Sub samples	Return Differences	$RET_{i,t}$	$ER_{i,t}$	$AR_{i,t}$	$IDR_{i,t}$
$TRANSP_{i,t}$	Low	DIF (10-1) (%)	0.480***	0.005***	0.003**	0.003**
		T	2.94	2.94	1.94	2.5
	Middle	DIF (10-1) (%)	0.664***	0.664***	0.461**	0.443**
		T	3.45	3.44	2.87	2.56
	High	DIF (10-1) (%)	0.009	0.009	0.267	0.196
		T	1.13	1.13	1.41	0.57
$PLM_{i,t}$	Low	DIF (10-1) (%)	0.385***	0.004***	-0.001	0.001
		T	2.97	2.97	-1.49	0.7
	Middle	DIF (10-1) (%)	0.411	0.411	0.383**	0.287
		T	1.3	1.29	2.55	1.49
	High	DIF (10-1) (%)	0.534**	0.534**	0.286	0.224
		T	2.56	2.56	0.09	0.28
$TURN_{i,t}$	Low	DIF (10-1) (%)	0.310**	0.003**	0.003**	0.001*
		T	2.76	2.75	2.64	1.85
	Middle	DIF (10-1) (%)	0.066	0.066	-0.168*	-0.106
		T	0.24	0.24	1.77	0.69
	High	DIF (10-1) (%)	0.311	0.311	-0.057	0.013
		T	1.17	1.17	-0.64	0.37
$DVOL_{i,t}$	Low	DIF (10-1) (%)	0.148*	0.001*	-0.001	0
		T	1.86	1.86	-0.08	0.68
	Middle	DIF (10-1) (%)	0.384**	0.384**	0.163	0.201*
		T	2.63	2.63	1.62	1.72
	High	DIF (10-1) (%)	0.542**	0.542**	0.309	0.183
		T	2.39	2.39	0.82	0.93

Note:*, **, and *** are statistical significant at the 1 %, 5 %, and 10 % levels, respectively.

Research Conclusions and Implications

Extant researches investigated the value of firm cash holdings and determinants of this effect from perspectives of precautionary benefits, agency costs and risk change. These researches hypothesize that the capital market is without market frictions and the investors are rational. Different from the extant researches, this paper investigates the value of firm cash holdings and how limits to arbitrage and investor sentiment affect this effect based on the backgrounds of individual investors dominance, serious limits to arbitrage, state-owned enterprises and family firms coexist and concentrated ownership structure. In China's stock market, we believe that the positive asset pricing effect of firm cash holding is stronger than the negative effect, and the net asset pricing effect of cash holding is positive. In periods when investor sentiment is low, pessimistic investors are more risk averse and prefer stocks with high level of firm cash holdings and low risk of liquidity shortage. What's more, an increase of investor risk averse can improve risk premium which can deteriorate

financial constraints firms face. So, value of firm cash holdings is higher in periods when investor sentiment is low than that in other periods. Arbitrage risk and arbitrage costs can hinder arbitragers from eliminating sentiment-driven mispricing. So, the sentiment-driven positive asset pricing effect of firm cash holdings is more significant in firms with high level of limits to arbitrage. After the theory analysis, this paper conducts empirical analysis using correlation coefficients analysis, portfolios analysis and regression analysis method, and forms the following conclusions. First, under China's special background, the value of firm's cash holdings is positive. The evidences from empirical investigation using monthly raw returns, monthly excess returns, monthly industry mean return adjusted returns and monthly abnormal returns as dependent variables all support the above conclusions. There are three potential reasons for this conclusion. Enforcement of administrative accountability, state-owned capital operating budgeting regulation, special auditing regulation and Economic Value Added (EVA) Evaluation system can mitigate free cash flow agency problems in state-owned

enterprise. Free cash flow agency problems itself in family firms are not serious because of the highly concentrated ownership in these firms. The capital market in China is developing and many firms with profitable growth opportunities cannot finance sufficient capital, and this implies that the precautionary benefits of cash holdings are more significant in China. Second, the positive value effect of firm cash holdings is more significant in periods when investor sentiment is low. On the one hand, in periods when investor sentiment is high, the valuation of firms with high level of cash holdings is high because investors are more risk averse and prefer firms with high level of cash holdings and low risk and they are willing to pay more for these stocks. On the other hand, in periods when investor sentiment is low, the precautionary effect of cash holding is more significant because more risk-averse investors demand high level of risk premium which can strengthen the financial constraints. Third, the positive value of firm cash holdings is more significant in firms confronting high level of limits to arbitrage. The sentiment-driven asset pricing effect of cash holdings will be more significant because high level of arbitrage risk and high level of arbitrage costs can hind arbitragers to mitigate the mispricing in capital market.

Based on the conclusions above, we introduce the following implications. First, from the viewpoint of market value management, firms should not only cash demand in the future, but also should consider financing environment and corporate governance quality when making cash holdings decisions. These considerations are helpful for firms to improve the positive value effect of firm's cash holdings. Second, firms should consider investor sentiment when making cash holdings decisions because investor sentiment can not only affect the value of firm cash holdings, but also affect firm financial constraints. Firms should hold more cash in periods when investor sentiment is low and should hold less cash in periods when investor sentiment is high. Third, to improve stock market efficiency and promote stock market stably development, it is urgent to improve firm transparency, loosen regulations on market trading and foster investor education.

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