

Stock Liquidity and Firm Investment

—Evidence from Chinese Listed Companies*

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Abstract

From the perspective of market microstructure, this paper investigates the relationship between stock liquidity, firm investment and capital allocation efficiency. This paper finds that firm investment is positively related to stock liquidity. Moreover, financial constraint, firm growth and risk affect the relationship between firm investment and stock liquidity. In addition, stock liquidity can help firm better utilize investment opportunities, indicated by higher investment and Tobin's Q sensitivities. We also show that firms with good liquidity can lower the investment and Tobin's Q sensitivities when there are no good investment opportunities. The findings of this paper indicate that stock liquidity have positive effect on firm investment. Therefore, to strengthen the effectiveness of stock liquidity, the Chinese government should continue to reform ownership structure and corporate governance, strengthen information disclosure and stepped up its crackdown against inside trading.

Keywords

stock liquidity, firm investment, investment efficiency, market microstructure

1. Introduction

Corporate Investment bears close relation to financial and capital allocation, and is of great significance to the company's production and operations, as well as its capital flow and profits in the future. It is fundamental to the growth of units in micro economy, and exerts powerful influence on macro economy. Thus, it is of important theoretical value and practical significance to study corporate investment. In Tobin's Q theory (1969), investment behavior depends on the investment opportunity represented by Tobin Q solely, while scholars suggest setting less rigorous hypothesis (Note 1) conditions to obtain more practical explanations, owing to the unsatisfying empirical performance, information asymmetry (Myers & Majluf, 1984) and agency costs (Jensen, 1986) in particular. Behavioral finance attaches more importance to the influence of invalid capital market on investment and financial, with the assumption that investor's sentiments could affect corporate investment (Barker et al., 2003). According to the further research by Munoz (2013), there is a positive correlation between stock liquidity and corporate investments (fixed assets, total assets and inventory investment), which tends to be more significant for firm with higher financial constraint and better investment opportunities.

Currently, studies relating to corporate investment mainly focus on macro characteristics such as monetary policy and government intervention, or micro factors such as financial constraint, agency cost,

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etc. With neoclassical investment model as its framework, and dynamic panel data model as its tool, Fangping Peng and Shaoping Wang (2007) tested empirically the effectiveness of interest rate policy from a micro perspective. They found that monetary policies could exert influence on capital cost and finally on company's investment behavior by adjusting interest rate and the yield to maturity of national debt. Besides, with Chinese listed manufacturing companies from 2004 to 2011 as analysis sample, Guangming Gong and Si Meng (2012) found that tight monetary policy constrained corporate investment, while loose monetary policy could promote it. The tighter the constraint was, the greater the influence of monetary policy had on corporate investment. Additionally, Zhongming Cheng et al. (2008) and Haiyan Zhong et al. (2010) assume that, owing to local government's social objective of promoting economic growth and lowering unemployment rate, and the local functionaries' appeal for promotion, listed companies under their control are forced to attain those social and political goals. For instance, local companies are demanded to participate in the construction of infrastructure i.e., energy, communications, etc. They also shoulder the responsibility of conducting merger or acquisition of state-owned companies through financial channel, for the purpose of eliminating poverty, financial deficit and unemployment rate locally. Accordingly, local companies are deflected from the goal of benefit maximization, which leads to overinvestment. To sum up, all the empirical evidence above shows that there is a positive correlation between government intervention and the overinvestment of local state-owned enterprises.

For the information asymmetry and adverse selection between company management and outside shareholders and creditor, the external financial cost exceeds its internal capital, which leads to insufficient capital and investment constraint in the company. Academically, investment-cash flow sensitivity is employed to measure investment constraint (1988). Wei Feng (1999), Feng Wei and Xing Liu (2004) studied Chinese listed companies, and found that the sensitivity was higher in companies under tighter investment constraint. These companies had to compromise the investment opportunity whose NPV is greater than zero for underinvestment (2009). According to Jensen (1986), if the manager focuses on expansion of scale, the company's cash flow may be directed to projects with NPV less than zero, which exhibits a correlation between investment and the change of cash flow. Jingeng He and Jiahua Ding's (2001) finding showed that the investment-cash flow sensitivity of listed company was determined by agency cost. Yujun Lian and Jian Cheng (2007) also found that companies under less financial constraint had the tendency to overinvestment, and agency cost determined investment-cash flow sensitivity; while companies under tighter financial constraint tend to under invest, and its investment-cash flow sensitivity was mainly caused by information asymmetry.

So far, there are seldom studies concerning corporate investment from market microstructure's perspective. On April 29th 2005, share-split reform was implemented, which signifies the full circulation of A-share market, and the restructuring of dualistic ownership structure. Besides, due considerations were given to the common benefit of corporate governance, stock price and liquidity by major shareholders and its agents. With this in mind, the paper investigate the internal relationship among stock liquidity, scale of corporate investment and investment efficiency using Chinese listed non-financial companies from 1998 to 2011.

The contribution and innovation of the paper embodies in the following facets. Firstly, the paper investigates stock liquidity's influence on investment scale and capital efficiency of listed companies from the perspective of market microstructure, and further studies the function of financial constraint and risks of operations. Secondly, the paper demonstrates liquidity's function in corporate governance from the perspective of investment level and investment efficiency. Additionally, various methods are

employed to measure liquidity and corporate investment, with SSE 180 index for robust analysis. The paper will generate valuable suggestion for elevating capital efficiency from the perspective of market microstructure. Lastly, studying company's financial behavior from the perspective of market microstructure can push forward cross-disciplinary research.

The rest part of the paper is organized as follows: chapter 2 for research hypothesis and econometric model; chapter 3 for description of variables and data; chapter 4 for the result of empirical research; chapter 5 for the influence of SSE 180 index adjustment on stock liquidity and corporate investment; chapter 6 for robust analysis; and the last part for summary.

2. Research Hypothesis and Econometric Model

2.1 Stock Liquidity and the Scale of Corporate Investment

According to the existing researches, stock liquidity often exerts its influence on the scale of corporate investment through the following five channels, the first one being mispricing mechanism. Miller (1977) assumes that, in a market teemed with heterogeneous beliefs, optimistic investors (with high expected yield) make high valuation on stocks, while pessimistic investors would quit the stock market owing to short sale constraint. In fact, the stock price reflects the higher valuation of optimistic investors. When the company conducts financial for investment opportunity, the heterogeneous beliefs in investors can expand demand in the market and promote the issuing of stocks. For this reason, the scales of corporate financial and investment have a positive correlation with heterogeneous beliefs of investors.

Besides, the previous research also shows that the more the heterogeneous belief distinctions are, the larger the stock trade volume would be (Hong & Stein, 2007). Baker and Stein (2004) assume that liquidity can be elevated in a market under short sale constraint, only if irrational traders tend to be optimistic. Therefore, liquidity also is the indication of the investors' sensitivity. Combine with Miller's (1997) theory; it is safe to conclude that liquidity is in positive correlation with corporate investment. Still, the conclusion above is drawn through the reflection of heterogeneous beliefs by trade volume and liquidity.

From the researches above, heterogeneous beliefs exerts its influence on corporate investment through the channel of bond. Polk and Sapienza (2009) once studied the catering theory, which means company management could adjust corporate investment to cater for investors' sentiments. On account of information asymmetry, investors could only evaluate the company through its investment behavior. In case that the company rejects the projects that investors deem as profitable, they would sell of their stock, which might arouse more pressure on company management. Min Pan and Dixing Zhu (2011) found that the influence of investor sentiment on corporate investment through financial and catering channel tend to be more powerful in the upturn period, compared with the downturn period.

The second factor is capital cost. Amihud and Mendelson (1986) assume that investors might take liquidity cost into consideration before investing, so that stocks with less liquidity have a higher trade cost, and are expected for a higher rate of return. They conducted empirical research on bid-ask spread, and noticed that it is in positive correlation with the rate of return expected. Likewise, Amihud (2002), Pastor and Stambaugh (2003) measured liquidity through different ways and found that liquidity was in negative correlation with the rate of return expected. As a matter of fact, expected return rate of financial assets is equivalent to the discount rate of projects (Ross et al., 2009). Thus, higher stock liquidity would lower the discount rate and expand company's investment opportunity set.

The third factor is the cost of equity issuing. When issuing stock, the company has to pay offering fee (for underwriting and publicity in investment bank). Bulter et al. (2005) found that stock liquidity was in negative correlation with offering cost, because underwriters were confronted with decreasing inventory cost, searching cost and trade cost when liquidity was improved. Naikang Gu and Hui Chen (2010) studied supplement offerings and allotment in A-share market between July 2000 and April 2005, and found that the higher the liquidity was, the lower the cost for supplement offering and allotment would be.

The fourth factor is feedback mechanism in trade. Khanna and Sonti (2004) consider that informed trading can change the stock price and the indication of stock price. The behavior of informed traders can help with the improvement of decision-making efficiency, as well as the performance and financial constraint in the company. Higher liquidity can promote the trade with informed traders (Kyle & Vila, 1991) and strengthen the feedback effect.

The last factor is the market for corporate control. Stein (1988) deems that information asymmetry may lure CEOs into sacrificing long-term investment for a better short-term performance. On account of the late return and high risk of long-term investment, the stock price might be underestimated and more pressure are caused on company management. Likewise, Poter (1992) states that liquidity facilitates short-term trade by lowering the trade cost. With much focus on short-term benefit, company management may cut long-term investment like R&D to keep short-term profit, which causes the lack of long-term investment.

As to the empirical evidences, Munoz (2013) analyzed the quarterly data of listed companies in Latin America (Argentina, Brazil, Chili and Mexico) between 1990 and 2010, measuring stock liquidity by turnover rate, and found that liquidity was in positive correlation with corporate investment (fixed asset, total asset, and inventory investment). The relation tends to me more palpable in companies under financial constraint and growth-type companies. Fang et al. (2013) carried out empirical analysis using minimum tick size change in American market and found that liquidity could lower innovation through the function of takeover pressure and short-term investors. With this in mind, the paper comes up with the first competitive hypothesis:

Hypothesis 1a: stock liquidity is in positive correlation with the scale of corporate investment.

Hypothesis 1b: stock liquidity is in negative correlation with the scale of corporate investment.

According to the theory of Fazzari et al. (1988) and Munoz (2013), the following panel data model is employed to test the first hypothesis:

$$INV_{it} = \alpha_0 + \alpha_1 LIQ_{it-1} + \alpha_2 Q_{it-1} + \alpha_3 CFO_{it-1} + \mathbf{X}_{it-1} \lambda + \mathbf{W}_{it} \gamma + \varepsilon_{it} \quad (1)$$

In this model, INV_{it} stands for the investment level of company i in the year t (after the adjustment of total asset at the end of last year). LIQ_{it-1} represents the liquidity of company i in the year $t-1$. Q_{it-1} and CFO_{it-1} respectably stand for the Tobin Q of company i in the year $t-1$ and the cash flow after the adjustment of total asset. \mathbf{X}_{it-1} includes scale, liabilities, revenue, cash, corporate age and other variables relating to the company. \mathbf{W}_{it} refers to the industry and year dummies. Torelieve the endogeneity, all the explanatory variables are lagged for one year.

2.2 Stock Liquidity and the Corporate Investment Efficiency

In Tobin's (1969) theory, the marginal value of Q is the indication of real investment level in perfect capital market. Tobin Q provides a measure for investors to evaluate the investment opportunity, in which process the sensitivity between capital investment and Tobin Q is increased. However, owing to information asymmetry and the striking distinction between internal and external financial cost,

financial constraint often leads to underinvestment (Myers & Majluf, 1984). Still, agency problem pushes the managers into extension of corporate scale, which may cause overinvestment (Jensen, 1986). Besides, inefficient capital market, defected corporate bond market and the discrimination from bank credit give rise to financial constraint. Yujun Lian and Zhi Su (2009) raised that investment level of listed companies was constrained to 20-30% lower than the optimum situation, with the average investment efficiency being 72%. Plus government intervention and internal control, Chineselisted companies are under the common situation of overinvestment (Cheng et al., 2008; Zhong et al., 2010). The question is, whether stock liquidity has a certain impact on investment efficiency of listed companies?

Firstly, based on the previous analysis, companies can take advantage of the mispricing mechanism to finance by issuing stock with lower cost. Here, the feedback of informed investors can offset the impact of financial constraint, thus the investment opportunity set is expanded owing to less capital cost. From this aspect, stock liquidity, indeed, alleviates financial constraint and underinvestment of the company, elevating investment efficiency.

Secondly, the supervision mechanism of major shareholders matters. It is Maug's (1998) theory that the blockholders can elevate the stock price. If blockholders could purchase additional shares at the lower price that do not reflects the benefits of supervision, they could gain profit from the original and additional shares. The more the liquidity is, the more the possibility for major shareholders to gain profit. Consequently, they will conduct supervision positively, so the agency cost of managers is lowered and the efficiency of operations improved.

The third aspect is the incentive contract of CEO. In the theoretical model of Holmstrom and Tirole (1993), the marginal value of personal information increased with the increased stock liquidity, which makes uninformed investors pay extra fee to gain the information and the same edge as informed investors. Thus, the characteristics of the company find expression in its stock price, which indicates the company's basic situation and managers' behavior. As a result, CEO can gain more profit from it and earn much more return from the stock. Dongwei Su and Jiakai Xiong (2013) measured CEO's payment-stock price sensitivity through the sensitivity Delta value of stocks and options hold by CEO. They found that from the year 2005 to 2011, the correlation between stock liquidity and the sensitivity tend to be the shape of a vertical letter "U". A reasonable and effective payment contract can strengthen the partnership of shared interests and risks between managers and shareholders, elevate the moral of company management, and lower agency cost. According to Lv Changjiang and Zhang Haiping (2011), the encouraging mechanism of stock options can tackle with problems such as overinvestment and underinvestment, thus raising the investment efficiency.

The fourth facet is stock price informativeness. According to Kyle and Vila (1991), rising liquidity can minimize the impact on stock price when investors sell or buy stocks. Informed blockholders can buy a bulk of stocks with much lower price from noise traders and gain profit, then major shareholders are willing to gather more information. That's how liquidity works on increasing information in stock price. When stock price is associated with information effectively, it can indicate the situation of the company, and cope with information asymmetry and financial constraint (Durnev et al., 2011). The supervision (Yang, 2010) from outside investors alike can be strengthened. Additionally, stock price with effective information can help with management's decision making in terms of market demand, prediction of the industry, thus improving investment decision and increasing profit of shareholders (Chen et al., 2007).

The last mechanism is the exit threats of block holders. According to the findings of Adamati, Pfleiderer (2009) and Edmans (2009), stock option encouragement and CEO's detrimental opportunism

may make informed traders sell off their stock, leading to slump in stock price and CEO's remuneration. Here, liquidity encourages informed traders to gather information and conduct trades, arousing more violent fluctuation in stock price and CEO's remuneration. That is to say, with higher liquidity, CEO shall not resort to opportunism to prevent negative impacts.

However, liquidity might trim investment efficiency as well. According to Goldsterin and Guembel (2008), liquidity may lower the capital efficiency when feedback effect of stock price is valued by company management. Uninformed traders cut stock price by selling off to mislead the management. If the management accounts it for the impact of negative information and withdraws its investment, investors can benefit a lot from this behavior. The higher the liquidity is, the more profit investors can gain, and the more distorted the investment would be. With all these considered, the second competitive hypothesis is raised.

Hypothesis 2a: stock liquidity can raise the investment efficiency.

Hypothesis 2b: stock liquidity lowers the investment efficiency.

According to the theory of Bushman (2011) and the non-linear relation between investment and investment opportunity, the following panel data model is set to test the second hypothesis.

$$INV_{it} = \beta_0 + \beta_1 LIQ_{it-1} + \beta_2 Q_{it-1} + \beta_3 LIQ_{it-1} * Q_{it-1} + \beta_4 NEG_{it} * LIQ_{it-1} * Q_{it-1} + \beta_5 CFO_{it-1} + \mathbf{X}_{it-1}\lambda + \mathbf{W}_{it}\gamma + \varepsilon_{it} \quad (2)$$

In this model, NEG_{it} stands for dummy variable of the lowering investment opportunity. When the investment opportunity Q_{it} of this year is less than the value Q_{it-1} of last year, NEG_{it} 's value should be 1, or it should be 0. β_3 measures liquidity's impact on capital investment and the sensitivity of investment opportunity. β_4 measures liquidity's extra sensitivity to capital investment and the decreasing investment opportunity.

3. Variables and Data

3.1 Corporate Investment

In a general sense, corporate investment covers the wide range of fixed assets, intangible assets, merger and acquisition, R&D, advertising spending, etc. On account of the discontinuity of merger and acquisition and the difficulty in gathering its data, the corporate investment discussed in this paper is narrowed down to fixed assets, intangible assets and other long-term investment. It is calculated by the difference between the item "the cash on fixed assets, intangible assets and other assets" and "net cash flow withdrawn from fixed assets, intangible assets and other long-term assets" in cash flow statement. The standardized value $INVI_{it}$ is generated after divided by the total assets of last year, for the purpose of eliminating the impact of the difference in corporate scale. This method is adopted by Qingquan Xin (2007), Yujun Lian, Zhi Su (2009) and Jiwei Yang (2010) to measure corporate investment.

Besides, according to the method raised by Pan Tong and Zhengfei Lu (2005), the corporate investment in the paper is measured by the annual variation of fixed assets, building projects and project material. It is also divided by the total assets of last year to generate a standardized index $INV2_{it}$ for robust analysis.

3.2 Stock Liquidity

Stock liquidity denotes the capability of market to trade assets at a reasonable price, manifested in 4 facets including width index (the difference between transaction price and middle price), depth index

(amount of stocks traded at the offering quotation), market resiliency (the recovery speed from unbalanced agency), and transaction immediacy (time spent to draw a successful transaction). It can be measured by spread, turnover rate and indicator of price’s impact. With difficulty in gathering data and computing cost, the paper adopts the following 6 methods to measure liquidity.

3.2.1 Bid-Ask Spread (ROLL)

In Roll’s (1984) hypothesis, the real value of stock is subjected to random walking, so that the stock price $p_{it,d}$ on day d is equivalent to the real value adding or minus half of the effective spread. With all this considered, the spread can be measured by the sequence of stock price variation $S_{it} = 2\sqrt{-\text{cov}(\Delta p_{it,d}, \Delta p_{it,d-1})}$. In this formula, S_{it} stands for spread and $\Delta p_{it,d}$ for stock price variation. The formula cannot be applied to the situation when the value of variables is greater than zero, so that a revised ROLL is defined in the paper.

$$ROLL_{it} = \begin{cases} 2\sqrt{-\text{cov}(\Delta p_{it,d}, \Delta p_{it,d-1})}, & \text{if } \text{cov}(\Delta p_{it,d}, \Delta p_{it,d-1}) < 0 \\ 0, & \text{if } \text{cov}(\Delta p_{it,d}, \Delta p_{it,d-1}) \geq 0 \end{cases} \tag{3}$$

3.2.2 Bid-Ask Spread (HL)

Corwin and Schultz (2012) have found another method to measure spread, which is based on two facts: firstly, the maximum or minimum price is subjected to selling or sale respectively, thus their ratio can reflect fluctuation of stocks and the spread; secondly, the fluctuation indicated from the ratio is in proportion to the return interval, but spread variables remain the same. Therefore, the spread can be measured by the ratio of maximum and minimum price in one or two days:

$$S_{it} = \frac{2(e^{\alpha_{it}} - 1)}{1 + e^{\alpha_{it}}} \tag{4}$$

$$\alpha_{it} = \frac{\sqrt{2\beta_{it}} - \sqrt{\beta_{it}}}{3 - 2\sqrt{2}} - \sqrt{\frac{\gamma_{it}}{3 - 2\sqrt{2}}}, \beta_{it} = E \left\{ \sum_{j=0}^1 \left[\ln \left(\frac{H_{it,d+j}^o}{L_{it,d+j}^o} \right) \right]^2 \right\}, \gamma_{it} = \left[\ln \left(\frac{H_{it,d,d+1}^o}{L_{it,d,d+1}^o} \right) \right]^2 \tag{5}$$

$H_{it,d}^o$ and $L_{it,d}^o$ stand for the maximum and minimum price of stock i on day d of the year t respectively. $H_{it,d,d+1}^o$ and $L_{it,d,d+1}^o$ refer to the maximum and minimum price of stock i on day d and $d+1$ of the year t respectively. The larger the spread is, the less the liquidity will be.

3.2.3 Daily Average Turnover Rate (TOVER)

$$TOVER_{it} = \frac{1}{D_{it}} \sum_{d=1}^{D_{it}} \left(\frac{VOL_{itd}}{LNS_{itd}} \right) \tag{6}$$

VOL_{itd} refers to the trade volume of stock i on day d of the year t . LNS_{itd} stands for the amount of stock i in circulation on day d of the year t . D_{it} is the total trading days of year t .

3.2.4 Illiquidity Index (ILLIQ)

$$ILLIQ_{it} = \frac{1}{D_{it}} \sum_{d=1}^{D_{it}} \left(\frac{|r_{itd}|}{V_{itd}} \right) \times 100 \tag{7}$$

In this formula, r_{itd} and V_{itd} stand for the return rate and transaction volume of reinvestment in stock i on day d of the year t respectively, without consideration of dividend. D refers to total trading days, and $|r_{itd}|/V_{itd}$ is the change in price as the volume increases by one million. Its annual average multiply 100 is the illiquidity index. The larger *ILLIQ* index is, the great the impact of trade volume on stock price would be, which shows less liquidity, and vice versa. The index is raised by Amihud (2002), and has found wide application.

3.2.5 Liquidity Ratio (*LR*)

$$LR_{it} = \frac{1}{D_{it}} \sum_{d=1}^{D_{it}} \left(\frac{V_{itd}}{|r_{itd}|} \right) \times 10^{-9} \quad (8)$$

$V_{itd}/|r_{itd}|$ shows the transaction amount which could alter the price by 1%, whose average divided by 10^9 is liquidity index. The larger *LR* is, the less the impact on stock price would be, which shows higher liquidity.

3.2.6 Return Reversal (*GAM*)

According to the theory of Pastor and Stambaug (2003), stocks with less liquidity may overshoot against order flow to a certain trade volume, thus leading to return reversal. They suggest measuring liquidity by return reversal. By substituting of stock i 's trade data in year t in the following regression equation:

$$r_{i,t,d+1}^e = \theta_{i,t} + \phi_{i,t} r_{i,t,d} + \gamma_{i,t} \cdot \text{sign}(r_{i,t,d}^e) \cdot v_{i,t,d} + \varepsilon_{i,t,d+1} \quad (9)$$

r_{itd} and V_{itd} stand for the return rate and transaction volume of reinvestment in stock i on day d of the year t respectively, without consideration of dividend. r_{mitd} refers to the weighted return rate, and

$r_{i,t,d}^e = r_{i,t,d} - r_{m,t,d}$ is abnormal return rate. When x is 0, the value of $\text{Sign}(x)$ also is 0; its value is 1 (-1) when x is greater (smaller) than zero. The larger return reversal index $GAM=|\gamma_{it}|$ is, the more return reversal would be, and the less liquidity is.

3.3 Financial Constraint

Financial constraint refers to the restriction on corporate investment owing to imperfect capital market and the difference between external and internal financial cost. Scholars remain divided in the measurement of financial constraint. In previous studies, prior criteria i.e., dividend payout ratio, firm size, bond rating, leverage ratio (Lian & Cheng, 2007; Almeida et al., 2004; Gilchrist & Himmelber, 1995) and others, were employed to measure financial constraint. To ensure robustness, the paper adopts firm size, dividend payout ratio and interest coverage ratio as the measurement of financial constraint. According to Almeida (2004)'s method, the *SIZE* value is divided into 3 groups each year with the 33rd and 66th percentiles as dividing points, and *DSIZE* value is 3 for samples after the 66th percentile; 1 for samples before the 33rd percentile and 2 for samples in the second group. Likewise, variables *DCASHDIV* and *DTIER* are defined by dividend payout ratio and interest coverage ratio respectively.

3.3.1 Firm Size (*SIZE*)

Companies of smaller scale are in operation for a shorter period with less records of operations and credit, thus they are confronted with much more information asymmetry. Compared with the larger scale of companies, especially those in new industry with much more intangible assets, their collateral for loan is of less value, and it costs much in financial constraint (Almeida et al., 2004; Gilchrist &

Himmlberg, 1995). This criterion is employed by Almeida (2004), Munoz (2013), Lian and Jian (2007).

3.3.2 Dividend Payout Ratio (*CASHDIV*)

Dividend payout is a sliding item of the company with lower adjustment cost apart from other profit distribution items, so that paying out large amount of dividend is against the goal of maximum profit for a company with higher external financial cost and excellent investment opportunity. This index is used by Fazzari (1988), Almeida (2011) and Wei Feng (2004).

3.3.3 Interest Cover Ration (*TIER*)

This index is capable of measuring both solvency and profitability. The higher the index is, the more investment capital the company is holding, and the less financial constraint there is. Contrarily, a lower index indicates the need of external financial, thus leading to financial constraint. Feng Wei, Xing Liu (2004) and Jiwei Yang (2010) both adopt the index to measure financial constraint.

3.4 Operating Risk

The paper adopts two methods to measure business risk, that is, the standard deviation of ROA (*STDROA*) from the year $t-2$ to year t , and the annual fluctuation variance of stock return (*SIGMA*). The paper defines variables of business risk as *DSTDROA* and *DSIGMA* in the same way as financial constrain.

3.5 Investment Opportunity (*Q*)

Generally speaking, investment opportunity of the company is in positive correlation with the size of company. Tobin Q is used as the criterion to measure investment opportunity, and non-circulating market value is represented by non-circulating equity multiplying net assets per share. On account of the ineffective capital market, the paper uses the annual growth rate of revenue (*SGROW*) for robust analysis with reference to Qingquan Xin (2007)'s method.

3.6 Cash Flow (*CFO*)

Fazzari (1988) holds that, in imperfect capital market, the difference between external and internal financial cost leads to financial constraint and the reliance on internal cash flow. The paper adopts the standardized net cash flow *CFO* in operations as the criterion.

3.7 Other control (X_{it})

- 1) *SIZE*: natural logarithm of ending total assets;
- 2) *LEV*: the ratio of ending total liability to ending total assets;
- 3) *SALES*: the ratio of sales revenue to ending total assets;
- 4) *CASH*: the ratio of monetary fund to ending total assets;
- 5) *AGE*: listed years of the company.

3.8 Industry and Year Fixed Effect (K_{it})

The paper set up 20 years and industry dummy variables based on type M of comprehensive industry, according to the classification established by CSRC.

3.9 Data

The paper selects Chinese nonfinancial listed companies from 1998 to 2011, gathering data relating to stock trade and corporate finance from CSMAR database developed by GTA Company of Shenzhen. All the extreme values of variables within 1% are winsorized. The definition of variables and data are shown in Table 1 as follows.

The average and median of corporate investment *INVI* (*INV2*) are 0.069 (0.044) and 0.042 (0.014), and its standard deviation is 0.085 (0.122), which shows the striking distinction among different companies. The average and standard deviation of *ILLIQ* are 0.305 and 0.395, exhibiting different liquidity of

stocks.

Table 1. Variable Definitions and Descriptive Data (1998-2011)

Variable	Definition	Sample	Average	Standard Deviation	Median	Minimum	Maximum
<i>INVI</i>	Capital Investment 1	15705	0.069	0.085	0.042	-0.067	0.439
<i>INV2</i>	Capital Investment 2	16905	0.044	0.122	0.014	-0.256	0.644
<i>ROLL</i>	Roll (1984) Spread	19224	0.011	0.005	0.010	0.001	0.030
<i>HL</i>	Corwin (2012) Spread	19196	0.046	0.013	0.044	0.023	0.083
<i>TOVER</i>	Daily Turnover Rate	19354	2.738	2.546	2.013	0.293	16.07
<i>ILLIQ</i>	Illiquidity Rate	19355	0.305	0.395	0.158	0.005	2.286
<i>LR</i>	Liquidity Rate	19366	2.291	3.526	1.094	0.103	26.10
<i>GAM</i>	Return Reversal Index	19196	0.102	0.158	0.042	0	0.951
<i>Q</i>	Tobin Q	19465	1.683	1.026	1.360	0.812	7.459
<i>SGROW</i>	Sales Growth	17966	0.234	0.638	0.143	-0.840	4.571
<i>CFO</i>	Net Cash Flow/Total Assets	19685	0.044	0.083	0.043	-0.216	0.279
<i>SIZE</i>	Ln (Total Assets in the end)	19687	21.28	1.203	21.14	10.84	28.28
<i>LEV</i>	Total Liability/Total Assets	19687	0.496	0.290	0.477	0.055	2.253
<i>SALES</i>	Revenue/Total Assets	19635	0.632	0.467	0.517	0.033	2.571
<i>CASH</i>	Cash holding/Total Assets	19687	0.178	0.148	0.136	0.003	0.723
<i>AGE</i>	Listed Years	19690	7.599	4.743	7	1	19
<i>TIER</i>	Interest cover ratio	15764	9.577	14.61	4.276	-4.782	56.98
<i>CASHDIV</i>	Dividend payout	19679	0.088	0.149	0.030	0	3.997
<i>STDROA</i>	Standard Deviation of <i>ROA</i> from year <i>t-2</i> to year <i>t</i>	15564	0.036	0.049	0.018	0	0.352
<i>SIGMA</i>	Standard Deviation of Return	18266	0.032	0.015	0.029	0.015	0.124

4. Empirical Evidence

4.1 Univariate Analysis

Figure 1-6 show the relation between capital investment and 6 liquidity indexes. The observed values of samples are equally divided into 5 groups, then the *INVI* average of each group is calculated and exhibited in figures. As is shown in Figure 4, capital investment *INVI* drops as *ILLIQ* rises. That is to say, liquidity is in positive correlation with corporate investment.

The result of univariate analysis is shown in Figure 2. Samples are divided into 2 groups by the median of liquidity. Then, *INVI* average, median and variance of each group are calculated. *INVI* average (median) of the group with *ILLIQ* larger than the median reads 0.058 (0.032), while the result of the other group reads 0.079 (0.052) with a significance level of 1%. The results remain nearly the same when tested by other indexes.

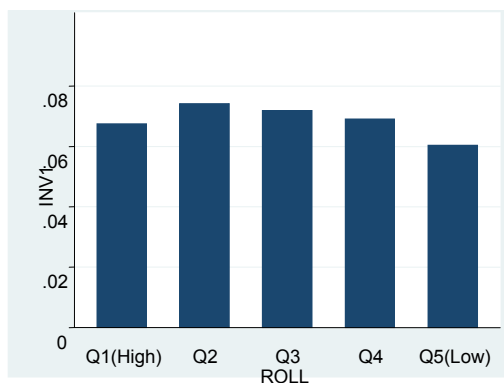


Figure 1. *INVI* and *ROLL*

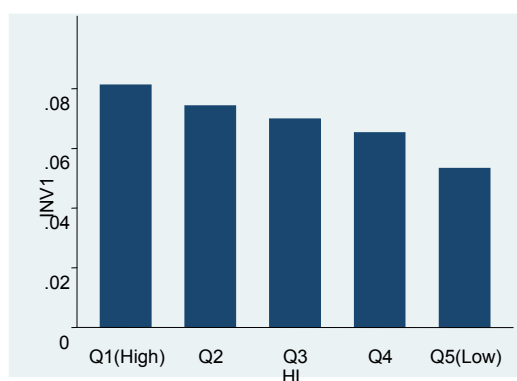


Figure 2. *INVI* and *HL*

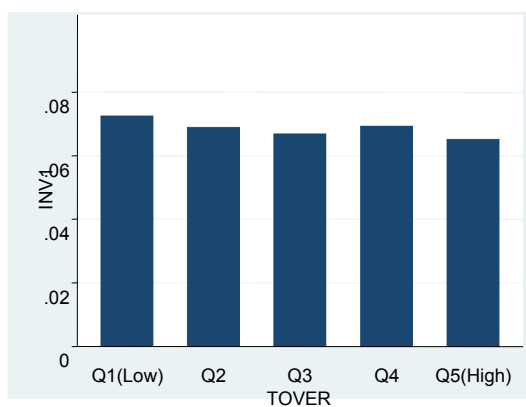


Figure 3. *INVI* and *TOVER*

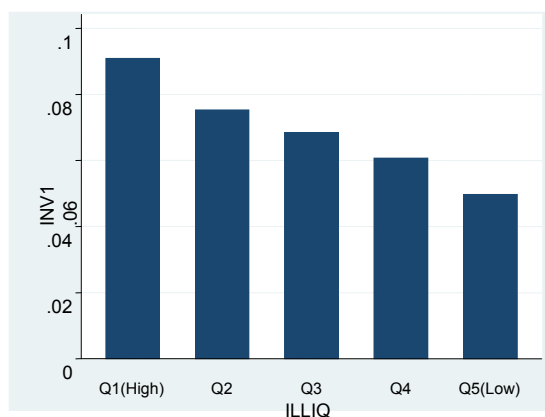


Figure 4. *INVI* and *ILLIQ*

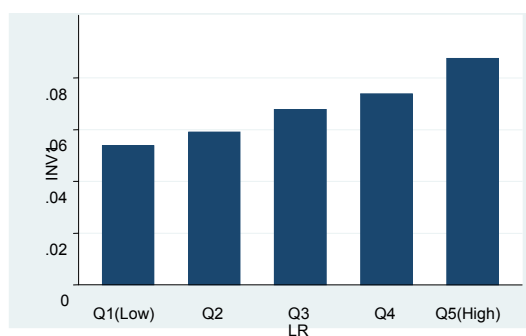


Figure 5. *INVI* and *LR*

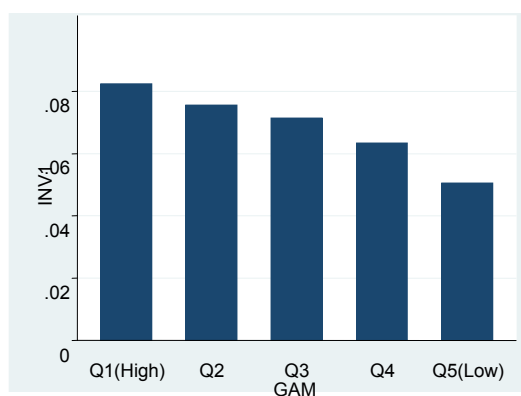


Figure 6. *INVI* and *GAM*

Table 2. Univariate Analysis of Liquidity and *INVI*

	Less than median			Great than Median			Change in averages	Change in medians
	Average	Median	Standard Deviation	Average	Median	Standard Deviation		
<i>ROLL</i>	0.070	0.043	0.086	0.067	0.041	0.083	2.168**	1.856*
<i>HL</i>	0.075	0.049	0.086	0.062	0.035	0.083	9.973***	14.342***
<i>TOVE</i>	0.069	0.043	0.082	0.069	0.040	0.088	-0.050	2.987***

<i>R</i>								
<i>ILLIQ</i>	0.079	0.052	0.089	0.058	0.032	0.079	15.614***	20.238***
<i>LR</i>	0.057	0.032	0.079	0.080	0.053	0.089	-16.747***	-21.218***
<i>GAM</i>	0.077	0.050	0.087	0.060	0.034	0.082	12.000***	15.669***

Note: *** indicates the significance level of 1%;

** indicates the significance level of 5%;

* indicates the significance level of 10%;

The comparison of averages is conducted by T test, and the median comparison is tested by Wilconox.

4.2 Stock Liquidity and Capital Investment: Multivariate Regression Analysis

Figure 3 shows the result of panel data regression (1) from 1998 to 2011. Column (i) to column (vi) measure liquidity respectively by different methods i.e., *ROLL*, *HL*, *TOVER*, *ILLIQ*, *LR* and *GAM*. The explained variable is capital investment *INVI* (Note 2).

As is shown in Table 3, when liquidity is measured by *TOVER* and *LR*, their coefficients should be greater than zero with a significance level of 1% (referring to column iii and v), which signifies the fact that the size of company grows as liquidity increases. When daily average turnover rate increases by one standard variation, corporate investment increases by 0.51%. Compared with the *INVI* average of 6.9%, the impact of turnover rate tends to be more powerful. When *HL*, *ILLIQ* and *GAM* are employed, their coefficients should be less than zero with a significance level of 1%. That is to say, hypothesis 1a holds true, and liquidity is positively correlate with corporate investment.

As to the impact of company-level variables on corporate investment, the coefficient of Tobin Q is greater than zero with a significance level of 1%, which means that investment scale expands with investment opportunity, a conclusion similar to that of Xin Qingquan (2007). Coefficient of *CFO* is greater than zero with a significance level of 1%, which means capital investment increases with more internal capital, a conclusion similar to that of Fazzari (1988). Coefficient of *SIZE* is greater than zero with a significance level of 1%, showing that capital investment increases with corporate scale. Besides, coefficients of *LEV* and *AGE* are less than zero with a significance level of 1%, indicating that companies with high financial leverage and older age have less capital investment. The conclusion is compatible with that of Xin Qingquan (2007).

Table 3. Liquidity and *INVI*: Multivariate Regression Analysis

	(i) <i>ROLL</i>	(ii) <i>HL</i>	(iii) <i>TOVER</i>	(iv) <i>ILLIQ</i>	(v) <i>LR</i> ^②	(vi) <i>GAM</i>
Liquidity _{it-1}	0.0780 (0.146)	-0.462*** (0.107)	0.002*** (0.000)	-0.014*** (0.003)	0.001*** (0.000)	-0.025*** (0.005)
<i>Q</i> _{it-1}	0.008*** (0.001)	0.008*** (0.001)	0.008*** (0.001)	0.007*** (0.001)	0.003*** (0.001)	0.007*** (0.001)
<i>CFO</i> _{it-1}	0.143*** (0.011)	0.141*** (0.011)	0.145*** (0.011)	0.143*** (0.011)	0.151*** (0.011)	0.143*** (0.011)
<i>SIZE</i> _{it-1}	0.008*** (0.001)	0.008*** (0.001)	0.009*** (0.001)	0.006*** (0.001)		0.007*** (0.001)
<i>LEV</i> _{it-1}	-0.025*** (0.003)	-0.024*** (0.003)	-0.026*** (0.003)	-0.022*** (0.003)	-0.024*** (0.003)	-0.023*** (0.003)
<i>SALES</i> _{it-1}	0.001 (0.002)	0 (0.002)	0.001 (0.002)	0.001 (0.002)	0.003 (0.002)	0.001 (0.002)

<i>CASH</i> _{it-1}	0.013 (0.008)	0.012 (0.008)	0.0050 (0.008)	0.011 (0.008)	0.009 (0.008)	0.012 (0.008)
<i>AGE</i> _{it-1}	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)
Constant	-0.100*** (0.023)	-0.070*** (0.024)	-0.127*** (0.023)	-0.057** (0.024)	0.073*** (0.008)	-0.074*** (0.023)
N	15304	15278	15404	15405	15416	15278
R ²	0.172	0.174	0.173	0.174	0.166	0.174
F	40.79	40.86	41.82	41.71	44.07	41.13

Note: All the models include year and industry fixed effects; values in the brackets are standard variations of robust analysis;

*** indicates the significance level of 1%;

** indicates the significance level of 5%;

* indicates the significance level of 10%.

4.3 The Mediating Effects of Financial Constraints, Growth Opportunities, Operating Risks

According to conclusions in previous chapters, liquidity is in positive correlation with corporate investment. Therefore, it is natural to analyze that heterogeneity of liquidity in different companies.

In imperfect capital market, investment is constrained by the difference between external and internal financial cost. With higher liquidity, the company can finance with lower cost by mispricing. Feedback from informed traders alike, helps relieve financial constrain, which makes it possible for companied under constraint to finance and increase investment. Ample internal capital and low financial cost lead to little demand for capital in companies without constraint, which are less sensitive to liquidity.

Growth phase is capable of adjusting liquidity as well. According to Zhang (2007), growth-type companies with more investment opportunity are better at seizing a fine opportunity to invest. Contrarily, value-type companies with less investment opportunity tend to make more steady moves. A reasonable explanation is that value-type companies are less likely to cut capital investment when loaded with unproductive capital in unfavorable situation, considering the irreversibility of investment. Under favorable economic environment, growth-type companies are prone to increase investment, while value-type ones can put unproductive capital in use, thus lessening its demand for investment expansion. Therefore, growth-type companies can make better use of liquidity for increasing investment. According to Munoz (2013), liquidity is of positive correlation with corporate investment (fixed assets, total assets and inventory investment), which is more palpable in companies under financial constraint.

As to the findings of Khanna and Sonti (2004), informed traders help adding information indicated in stock price, thus improving financial constraint and decision-making efficiency. Subrahmanyam and Tittman (2001) hold that feedback mechanism's impact is stronger under a less favorable company-shareholder relationship or much operating uncertainties, for the positive information reflected from stock price promotes shareholders' confidence in stock and the trade. It benefits operating efficiency and corporate value as well. With all this considered, the paper predicts that liquidity's impact is more palpable in growth-type companies under financial constraint and higher operating risks.

According to Feng Wei, Xing Liu (2004) and Jiwei Yang (2010), interest cover ratio (*DTIER*) is employed to measure financial (Note 3), and its relation with liquidity is also reflected by the

correlation term in regression equation (1). Possible results are shown in Table 4, where column (i) to column (vi) adopt 6 different indexes i.e., *ROLL*, *HL*, *TOVER*, *ILLIQ*, *LR* and *GAM*, to measure liquidity respectively. It is clear that in the results measured by index *ROLL*, *HL*, *ILLIQ* and *GAM*, their coefficients are less than zero with a significance level of 1%. The correlation term is positive with a significance level of 1%, indicating a tighter financial constraint (and a lower *DTIER*), so that liquidity can exert more impact on corporate investment. With *TOVER* as the criterion, its coefficient is negative with a significance level of 5%, while the coefficient of *TOVER* and *DTIER*'s correlation term is positive. That being the case, turnover rate shows a negative correlation with corporate investment, and the company will suffer tighter constraint, which means liquidity might hinder investment, a phenomenon against the paper's conclusion. By liquidity index, *LR* shows positive value with a significance level of 5%, and the correlation term of *LR* and *TIER* has a coefficient of 0 insignificantly. Thus, financial constraint is not subjected to *LR*. Generally speaking, the result in Table 4 exhibits that financial constraint can adjust the relation between liquidity and corporate investment.

Table 4. Liquidity, *TIER* and *INVI*

	(i) <i>ROLL</i>	(ii) <i>HL</i>	(iii) <i>TOVER</i>	(iv) <i>ILLIQ</i>	(v) <i>LR</i>	(vi) <i>GAM</i>
Liquidity _{it-1}	-1.272*** (0.212)	-0.755*** (0.112)	-0.002** (0.001)	-0.046*** (0.004)	0.002** (0.001)	-0.093*** (0.007)
Liquidity _{it-1} * <i>DTIER</i>	0.647** (0.079)	0.182*** (0.022)	0.001*** (0.000)	0.017*** (0.002)	0 (0.000)	0.038*** (0.004)
<i>Q</i> _{it-1}	0.007*** (0.001)	0.006*** (0.001)	0.008*** (0.001)	0.006*** (0.001)	0.003*** (0.001)	0.007*** (0.001)
<i>CFO</i> _{it-1}	0.133*** (0.011)	0.129*** (0.010)	0.141*** (0.011)	0.137*** (0.011)	0.152*** (0.011)	0.139*** (0.011)
<i>SIZE</i> _{it-1}	0.008*** (0.001)	0.007*** (0.001)	0.009*** (0.001)	0.006*** (0.001)		0.007*** (0.001)
<i>LEV</i> _{it-1}	-0.019*** (0.003)	-0.017*** (0.003)	-0.022*** (0.003)	-0.016*** (0.003)	-0.025*** (0.003)	-0.019*** (0.003)
<i>SALES</i> _{it-1}	-0.001 (0.002)	-0.001 (0.002)	0.001 (0.002)	-0.001 (0.002)	0.003 (0.002)	-0.001 (0.002)
<i>CASH</i> _{it-1}	0.001 (0.008)	-0.001 (0.008)	-0.005 (0.008)	0.007 (0.008)	0.010 (0.008)	0.008 (0.008)
<i>AGE</i> _{it-1}	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)
Constant	-0.093*** (0.023)	-0.063*** (0.023)	-0.114*** (0.023)	-0.062*** (0.023)	0.071*** (0.008)	-0.081*** (0.023)
N	15304	15278	15404	15405	15416	15278
R ²	0.177	0.179	0.175	0.180	0.166	0.179
F	40.14	40.38	41.30	43.20	41.98	43.30

Note: All the models include year and industry fixed effects;

*** indicates the significance level of 1%;

** indicates the significance level of 5%;

* indicates the significance level of 10%.

The paper measures growth (note 4) by *BM*, referring to the method of *DTIER*. Samples are ranked by *BM*, then equally organized into 3 groups. The *DBM* value of samples over 66 percentile is 3; those under 33 percentile is 1; and the value of the second group is 2. The correlation term is also added to regression equation (1). Table 5 shows the result by prediction. The results of *ROLL*, *HL*, *ILLIQ* and *GAM* show that their coefficients and the correlation term are positive with a significance level of 1%, indicating the possibility of investment expansion in growth-type companies with rising liquidity, which is with the conclusion of Munoz (2013). Besides, the coefficients of *TOVER* and *LR* is not that significant, but those of correlation terms are significantly positive. It can be inferred that liquidity may reduce investment of companies growing better, which is against the expectation of the paper. In summary, results in Table5 exhibit that the influence of liquidity on investment is heterogeneous in different growth-type companies.

Table 5. Liquidity, Growth and Corporate Investment *INVI*

	(i) <i>ROLL</i>	(ii) <i>HL</i>	(iii) <i>TOVER</i>	(iv) <i>ILLIQ</i>	(v) <i>LR</i>	(vi) <i>GAM</i>
Liquidity _{it-1}	-0.486** (0.238)	-0.626*** (0.119)	0 (0.001)	-0.025*** (0.004)	-0.001 (0.001)	-0.029*** (0.010)
Liquidity _{it-1}	0.288*** (0.093)	0.104*** (0.027)	0.001** (0.000)	0.006*** (0.002)	0.001*** (0.000)	0.002 (0.004)
* <i>DBM</i>						
<i>Q</i> _{it-1}	0.008** (0.001)	0.009*** (0.001)	0.009*** (0.001)	0.007*** (0.001)	0.004*** (0.001)	0.007*** (0.001)
<i>CFO</i> _{it-1}	0.144** (0.011)	0.143*** (0.011)	0.146*** (0.011)	0.144*** (0.011)	0.152*** (0.011)	0.143*** (0.011)
<i>SIZE</i> _{it-1}	0.007*** (0.001)	0.006*** (0.001)	0.008*** (0.001)	0.005*** (0.001)		0.007*** (0.001)
<i>LEV</i> _{it-1}	-0.026*** (0.003)	-0.026*** (0.003)	-0.026*** (0.003)	-0.021*** (0.003)	-0.026*** (0.003)	-0.023*** (0.003)
<i>SALES</i> _{it-1}	0.001 (0.002)	0 (0.002)	0.001 (0.002)	0 (0.002)	0.003 (0.002)	0.001 (0.002)
<i>CASH</i> _{it-1}	0.013 (0.008)	0.012 (0.008)	0.005 (0.008)	0.011 (0.008)	0.010 (0.008)	0.012 (0.008)
<i>AGE</i> _{it-1}	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)
Constant	-0.085*** (0.024)	-0.051** (0.025)	-0.112*** (0.024)	-0.048** (0.024)	0.070*** (0.008)	-0.073*** (0.023)
N	15304	15278	15404	15405	15416	15278
R ²	0.173	0.175	0.173	0.174	0.167	0.174
F	40.53	40.98	41.44	41.92	41.71	40.32

Note: All the models include year and industry fixed effects; values in the brackets are standard variations of robust analysis;

*** indicates the significance level of 1%;

** indicates the significance level of 1%;

* indicates the significance level of 10%.

Operating risks (Note 5) are measured by *ROA*'s standard deviation (*STDROA*) from year $t-2$ to year t , and the correlation term is added in regression equation (1) as well to measure its function. As is shown in Table 4, when liquidity is measured by *ROLL*, *HL*, *ILLIQ* and *GAM*, their correlation terms are positive at the 1% significance. Thus, liquidity's influence on investment is more powerful as operating risks grow. The coefficients of *TOVER* and *LR* are positive with a significance level of 1%, while the correlation term of *TOVER* and *DSTDROA* is negative with a significance level of 1%, so that liquidity's impact is lessened when uncertainties increase. This conclusion is contradictory to the paper's prediction. Generally speaking, results in Table 6 shows that liquidity's impact on investment is more powerful in companies under higher operating risks.

Table 6. Liquidity, Operating Risks and Corporate Investment *INVI*

	(i) <i>ROLL</i>	(ii) <i>HL</i>	(iii) <i>TOVER</i>	(iv) <i>ILLIQ</i>	(v) <i>LR</i>	(vi) <i>GAM</i>
Liquidity _{it-1}	0.688*** (0.209)	-0.260** (0.118)	0.004*** (0.001)	0.001 (0.005)	0.001*** (0.000)	-0.008 (0.009)
Liquidity _{it-1} *	-0.307*** (0.075)	-0.086*** (0.020)	-0.001*** (0.000)	-0.007*** (0.002)	0 (0.000)	-0.007** (0.004)
<i>DSTDROA</i>						
<i>Q</i> _{it-1}	0.008*** (0.001)	0.008*** (0.001)	0.009*** (0.001)	0.007*** (0.001)	0.003*** (0.001)	0.007*** (0.001)
<i>CFO</i> _{it-1}	0.142*** (0.011)	0.140*** (0.011)	0.145*** (0.011)	0.143*** (0.011)	0.151*** (0.011)	0.143*** (0.011)
<i>SIZE</i> _{it-1}	0.008*** (0.001)	0.007*** (0.001)	0.009*** (0.001)	0.006*** (0.001)		0.007*** (0.001)
<i>LEV</i> _{it-1}	-0.025*** (0.003)	-0.023*** (0.003)	-0.025*** (0.003)	-0.020*** (0.003)	-0.024*** (0.003)	-0.022*** (0.003)
<i>SALES</i> _{it-1}	0.001 (0.002)	0 (0.002)	0.001 (0.002)	0 (0.002)	0.003 (0.002)	0 (0.002)
<i>CASH</i> _{it-1}	0.013 (0.008)	0.012 (0.008)	0.005 (0.008)	0.010 (0.008)	0.009 (0.008)	0.012 (0.008)
<i>AGE</i> _{it-1}	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)
Constant	-0.091*** (0.023)	-0.061** (0.024)	-0.118*** (0.023)	-0.052** (0.024)	0.071*** (0.008)	-0.072*** (0.023)
N	15304	15278	15404	15405	15416	15278
R ²	0.173	0.175	0.174	0.175	0.166	0.174
F	40.66	40.64	41.29	41.51	41.91	40.55

Note: All the models include year and industry fixed effects;

*** indicates the significance level of 1%;

** indicates the significance level of 5%;

* indicates the significance level of 10%.

4.4 Stock Liquidity and Investment Efficiency

Table 7 shows the results of panel data regression (2), where column (i) to column (vi) adopt different methods i.e., *ROLL*, *HL*, *TOVER*, *ILLIQ*, *LR* and *GAM*, to measure liquidity. The explained variable here is *INVI*.

As is shown in Table 7, coefficient of investment opportunity Q is positive with a significance level of 1%, signifying that corporate scale expands when investment opportunity increases. All the correlation terms between Q and are negative $ROLL$, HL , $TOVER$ and $ILLIQ$ are negative, indicating that liquidity can safeguard the return from investment opportunity by facilitating financial and lowering cost, and leading to capital investment. The coefficient of $Liquidity*Q*NEG$ is positive at 1% significance, showing that liquidity can lessen the sensitivity between capital investment and decreasing investment opportunity. In companies with higher liquidity, the sensitivity between capital investment and investment opportunity is lower. When $TOVER$ and LR is employed to measure liquidity, the coefficient of $LR*Q$ is significantly negative, while those of $TOVER*Q*NEG$ and $LR*Q*NEG$ are positive at 1% significance. Thus, both $TOVER$ and LR reduce capital efficiency, which is against the paper's expectation.

Table 7. Liquidity and Investment Efficiency

	(i) <i>ROLL</i>	(ii) <i>HL</i>	(iii) <i>TOVER</i>	(iv) <i>ILLIQ</i>	(v) <i>LR</i>	(vi) <i>GAM</i>
Q_{it-1}	0.006*** (0.001)	0.015*** (0.003)	0.005*** (0.001)	0.005*** (0.001)	0.006*** (0.001)	0.006*** (0.001)
Liquidity _{it-1}	-0.268* (0.160)	-0.225** (0.108)	-0.001* (0.001)	-0.022*** (0.003)	0.003*** (0.000)	-0.041*** (0.005)
Liquidity _{it-1} *	-0.172* (0.091)	-0.219*** (0.054)	0 (0.000)	-0.004** (0.001)	-0.002*** (0.000)	-0.011** (0.004)
Q_{it-1}	0.373*** (0.079)	0.105*** (0.019)	0.001*** (0.000)	0.009*** (0.002)	0.001*** (0.000)	0.024*** (0.005)
$Q_{it-1}*NEG$	0.144*** (0.011)	0.142*** (0.011)	0.145*** (0.011)	0.141*** (0.011)	0.149*** (0.011)	0.141*** (0.011)
CFO_{it-1}	0.008*** (0.001)	0.007*** (0.001)	0.008*** (0.001)	0.005*** (0.001)		0.007*** (0.001)
LEV_{it-1}	-0.026*** (0.003)	-0.025*** (0.003)	-0.025*** (0.003)	-0.020*** (0.003)	-0.026*** (0.003)	-0.022*** (0.003)
$SALES_{it-1}$	0 (0.002)	0 (0.002)	0.001 (0.002)	0 (0.002)	0.002 (0.002)	0 (0.002)
$CASH_{it-1}$	0.015* (0.008)	0.014* (0.008)	0.010 (0.008)	0.012 (0.008)	0.013 (0.008)	0.012 (0.008)
AGE_{it-1}	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)
Constant	-0.090*** (0.023)	-0.083*** (0.024)	-0.103*** (0.024)	-0.0370 (0.023)	0.066*** (0.008)	-0.071*** (0.023)
N	15250	15228	15359	15360	15371	15228
R ²	0.176	0.177	0.174	0.180	0.174	0.179
F	40.73	40.53	41.26	41.66	42.80	41.71

Note: All the models include year and industry fixed effect; values in the brackets are standard variations of robust analysis;

*** indicates the significance level of 1%;

** indicates the significance level of 5%;

* indicates the significance level of 10%.

5. Further Analysis Based on the Adjustment of SSE 180 Index

Adjustments of stock index denotes regular or temporary adjustments of component stock owing to its scale and liquidity by management companies, for the purpose of altering its trade state, without affecting shareholders' equity and cash flow in the future. According to previous researches, index adjustment can affect liquidity of component stocks. Hegde and McDermott (2003) employed Pool index 500 from 1993 to 1998 to study sample stocks. They found that added stocks' liquidity is improved because trade cost and information asymmetry are reduced. Becker-Blease and Paul (2006) used Pool index 500 from 1980 to 2000 to study the samples and found that the liquidity of added stocks are significantly increased. Exogenous and liquidity effect of index adjustment make it possible for the research on liquidity and corporate investment.

The paper studies the relation between liquidity and corporate investment using SSE 180 index adjustment issued on July 1st, 2002, which is the alteration of SSE 30. The index is based on 180 sample stocks of authority, wide coverage and high liquidity, and is adjusted twice a year by 10%. Adjustment list is often issued two weeks in advance. The paper studies added stocks in SSE 180 adjustment from 2002 to 2011, when SSE 180 index was adjusted 19 times, with 340 added stocks and another 340 deleted. The paper excludes all the temporary adjustment and sample stocks deleted less than 3 years since the date of adding.

In Table 7 and 8, liquidity change of stocks and relating index description are shown for three years before and after the deleted (Note 6) year. According to Table 8, *INV1* and *INV2* decreased after a period of increasing, with lower average investment after the deleted year at the 5% significance. In the three years after the deleted year, the average of *ROLL*, *HL*, *ILLIQ* and *GAM* are significantly higher than the years before deleted year. Contrarily, *LR* index drops when stocks are deleted.

Table 9 shows the result of regression equation. Explained variables from column (i) to column (viii) are *ROLL*, *HL*, *TOVER*, *ILLIQ*, *LR*, *GAM*, *INV1* and *INV2* respectively. In the three years after the stocks were deleted, *POST* value is 1; while *POST* value is 0 for the years before the stocks were deleted. As is shown in the figure, when *ILLIQ* and *GAM* is used as measurement, the coefficient of *POST* is significantly positive; while it is significantly negative when *LR* is used as measurement. It is clear that stock liquidity dropped significantly after the stock was deleted. Additionally, with regard to index adjustment's influence on capital investment, the coefficient of *POST* is significantly negative (referring to column vii and viii). It is clear that stocks liquidity and capital investment dropped after the stock was deleted.

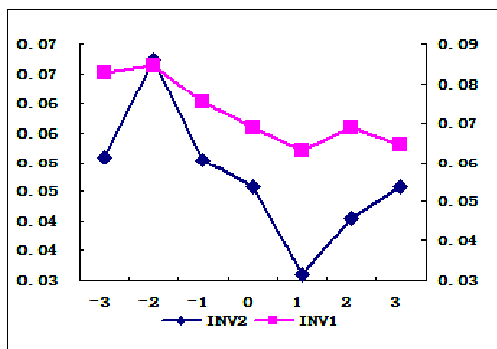


Figure 7. Index Adjustment and Corporate Investment

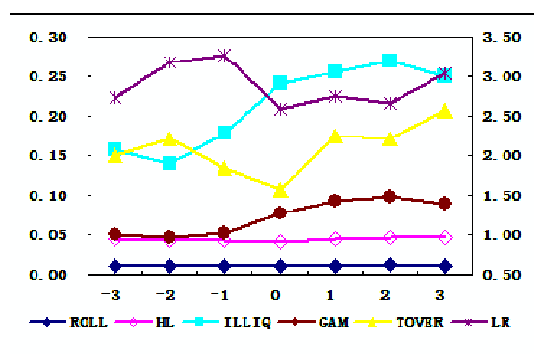


Figure 8. Index Adjustment and Liquidity

Table 8. Descriptions of Index Adjustment, Liquidity and Corporate Investment

year	(i) NV1	(ii) INV2	(iii) ROLL	(iv) HL	(v) TOVER	(vi) ILLIQ	(vii) LR	(viii) GAM
-3	0.083	0.051	0.011	0.044	2.001	0.157	2.730	0.050
-2	0.085	0.067	0.011	0.044	2.208	0.140	3.179	0.046
-1	0.075	0.050	0.011	0.043	1.836	0.178	3.276	0.051
0	0.069	0.046	0.011	0.042	1.566	0.240	2.590	0.077
1	0.063	0.031	0.011	0.044	2.255	0.255	2.744	0.092
2	0.069	0.041	0.012	0.046	2.217	0.269	2.654	0.098
3	0.064	0.046	0.012	0.047	2.574	0.250	3.034	0.089
(-1, -3)	0.080	0.055	0.011	0.043	1.968	0.160	2.973	0.050
(1, 3)	0.066	0.039	0.012	0.046	2.351	0.258	2.803	0.093
Diff	0.014***	0.016**	-0.001*	-0.003***	-0.382***	-0.098***	0.170	-0.044***

Note: 0 stands for the deleted year; -3 to -1 refers to three years previously, and 1 to 3 designates three years after. (-1, -3) is the average of previous years, and (1, 3) of three years after. Diff equals to (-1, -3) minus (1, 3). The significance of difference is tested by T value;

*** indicates the significance level of 1%;

** indicates the significance level of 5%;

* indicates the significance level of 10% respectively.

Table 9. Index Adjustment, Liquidity and Corporate Investment

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
	ROLL	HL	TOVER	ILLIQ	LR	GAM	INV1	INV2
POST	0	0.001	0.317***	0.095***	-0.413**	0.042***	-0.012*	-0.014***
	(0.000)	(0.001)	(0.104)	(0.015)	(0.209)	(0.007)	(0.007)	(0.005)
Q_{it-1}							0.005	0.005
							(0.005)	(0.004)
CFO_{it-1}							0.103**	0.167***
							(0.048)	(0.036)
$SIZE_{it-1}$							0.012***	0.004
							(0.004)	(0.003)
LEV_{it-1}							-0.046**	-0.004
							(0.021)	(0.017)
$SALES_{it-1}$							0.004	0

							(0.008)	(0.006)
$CASH_{it-1}$							0.0370	-0.008
							(0.032)	(0.024)
AGE_{it-1}							-0.007***	-0.006***
							(0.001)	(0.001)
Constant	0.010***	0.048***	2.495***	0.250***	2.065***	0.095***	-0.229**	-0.034
	(0.001)	(0.002)	(0.329)	(0.048)	(0.659)	(0.022)	(0.092)	(0.066)
N	1153	1155	1160	1160	1160	1155	1043	992
R ²	0.0550	0.143	0.104	0.0970	0.0780	0.075	0.130	0.207
F	2.857	8.174	5.742	5.334	4.173	3.967	5.212	8.656

Note: Values in the brackets are standard variations of robust analysis;

*** indicates the significance level of 1%;

** indicates the significance level of 5%;

* indicates the significance level of 10%.

6. Robust Analysis

For the purpose of testing the relation between stock liquidity and corporate investment, the robust analysis is conducted from the following 4 aspects:

1) Considering the possibility of reverse causality between liquidity and corporate investment, the paper analyzes using lagged liquidity to eliminate endogenous error. Furthermore, the paper estimates equation. (1) Using panel data model with fixed effect, which contributes to the elimination of endogenous errors by controlling unobservable non-time-varied factors such as culture, management's characteristics and heterogeneity of the company. As is shown in Table 10, coefficients of HL and $ILLIQ$ are significantly negative; those of $ROLL$ and GAM are insignificantly negative; while that of $TOVER$ is significantly positive, indicating the positive correlation between liquidity and corporate investment. Despite of reduced significance, results in Table 10 is consistent with that in Table 3.

Table 10. Stock Liquidity and $INVI$ (FE)

	(i) $ROLL$	(ii) HL	(iii) $TOVER$	(iv) $ILLIQ$	(v) LR	(vi) GAM
Liquidity _{it-1}	-0.0420	-0.185*	0.001*	-0.005**	-0.001***	-0.004
	(0.131)	(0.095)	(0.000)	(0.002)	(0.000)	(0.005)
Q_{it-1}	0.007***	0.007***	0.007***	0.007***	0.010***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
CFO_{it-1}	0.021**	0.022***	0.021**	0.021**	0.022***	0.022***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
$SIZE_{it-1}$	-0.009***	-0.008***	-0.009***	-0.009***		-0.009***
	(0.001)	(0.001)	(0.001)	(0.001)		(0.001)
LEV_{it-1}	-0.038***	-0.037***	-0.038***	-0.037***	-0.037***	-0.037***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
$SALES_{it-1}$	0.012***	0.012***	0.012***	0.012***	0.013***	0.012***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$CASH_{it-1}$	0.113***	0.111***	0.111***	0.113***	0.115***	0.112***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
AGE_{it-1}	0.002	0.002	0.002	0.001	0.001	0.002

	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Constant	0.207*	0.202*	0.200*	0.221**	0.0260	0.208*
	(0.107)	(0.107)	(0.106)	(0.107)	(0.102)	(0.107)
N	15304	15278	15404	15405	15416	15278
R ²	0.072	0.072	0.072	0.073	0.070	0.071
F	25.64	25.46	25.95	26.00	25.61	25.38

Note: All the models include year and industry fixed effects; values in the brackets are standard variations of robust analysis;

*** indicates the significance level of 1%;

** indicates the significance level of 5%;

* indicates the significance level of 10%.

2) To tackle with investment persistence, the paper employs lagging dependent variable as explanatory variable. Owing to inconsistency between OLS and FE, the paper adopts System GMM for estimation, which can successfully cope with problems like investment persistence and endogeneity by use of lagging variable as its instrumental variable. Estimation results are shown in Table 11 below.

As is shown in the Table, the original hypothesis holds true in AR (2)P, indicating no sequence of order two relation in residual sequence. According to Sargan's test, except for column (i), the instrumental variables in other columns are all verified, so that the models for the paper are reasonable. Besides, the coefficient of $INVI_{it-1}$ is significantly positive with the 1% significance, manifesting the continuity of capital investment. In the results of *HL*, *ILLIQ* and *GAM*, their coefficients are negative with the 1% significance; while in the results of *TOVER* and *LR*, the coefficients are significantly positive. Thus, there is a positive correlation between liquidity and capital investment, which is with the conclusion drawn in previous chapters.

Table 11. Stock Liquidity and $INVI$ (Panel Data Model)

	(i) <i>ROLL</i>	(ii) <i>HL</i>	(iii) <i>TOVER</i>	(iv) <i>ILLIQ</i>	(v) <i>LR</i>	(vi) <i>GAM</i>
$INVI_{it-1}$	0.346*** (0.008)	0.354*** (0.008)	0.355*** (0.008)	0.354*** (0.008)	0.346*** (0.009)	0.349*** (0.008)
Liquidity _{it-1}	0.009 (0.091)	-0.190*** (0.069)	0.001* (0.000)	-0.004*** (0.001)	0.001*** (0.000)	-0.007*** (0.002)
Q_{it-1}	0.007*** (0.001)	0.007*** (0.001)	0.007*** (0.001)	0.007*** (0.001)	0.006*** (0.001)	0.008*** (0.001)
CFO_{it-1}	0.021*** (0.005)	0.024*** (0.005)	0.022*** (0.005)	0.025*** (0.005)	0.024*** (0.006)	0.019*** (0.005)
$SIZE_{it-1}$	0.003*** (0.001)	0.003*** (0.001)	0.002* (0.001)	0.00100 (0.001)		0.004*** (0.001)
LEV_{it-1}	-0.033*** (0.002)	-0.032*** (0.002)	-0.030*** (0.002)	-0.030*** (0.002)	-0.029*** (0.002)	-0.030*** (0.002)
$SALES_{it-1}$	0.015*** (0.002)	0.016*** (0.002)	0.016*** (0.002)	0.015*** (0.002)	0.016*** (0.002)	0.016*** (0.002)
$CASH_{it-1}$	0.059*** (0.007)	0.058*** (0.007)	0.055*** (0.007)	0.054*** (0.007)	0.047*** (0.008)	0.055*** (0.007)
AGE_{it-1}	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***

	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.039	-0.020	-0.031	-0.009	0.034**	-0.056**
	(0.026)	(0.025)	(0.026)	(0.025)	(0.014)	(0.025)
N	12763	12767	12770	12770	12780	12767
χ^2	4554.3	4642.37	4939.38	4665.27	2822.71	4615.09
AR(2) P	0.847	0.767	0.709	0.733	0.811	0.847
Sargan P	0.036	0.054	0.131	0.180	0.146	0.115

Note: All the models include year and industry fixed effects; values in the brackets are standard variations of robust analysis;

*** indicates the significance level of 1%;

** indicates the significance level of 5%;

* indicates the significance level of 10%;

AR(2) P is the result of sequence of order two; Sargan P is the test of instrumental variables' rationality.

3) With referring to the method of Tong Pan and Zhengfei Lu (2005), the paper measures corporate investment by the annual change of fixed assets, building projects and project materials, which is standardized as $INV2_{it}$. The paper re-estimates the results in Table4 to Table7, by use of $INV2_{it}$ as its explained variable. As a result, liquidity is indeed in positive correlation with corporate investment, which is stronger in growth-type companies with financial constraint and higher operating risks. The equation of investment efficiency shows that liquidity can strengthen the sensitivity (Note 7) between investment and investment opportunity, while its function could be reversible in case of decreasing investment opportunity.

4) Considering the inefficient capital market, the paper measure investment opportunity by revenue growth rate $SGROW$, with referring to Xin Qingquan's (2007) method, to re-estimate the result in Table4. As a result, a positive correlation is found between liquidity and corporate investment.

7. Conclusion

With Chinese listed non-financial companies from 1998 to 2011 as analyzing sample, the paper studies the relationship among stock liquidity, investment scale and capital efficiency from the perspective of market microstructure. We found that investment scale is positively correlate to liquidity, and corporate characteristics can exerts certain influence. In growth-type companies with financial constraint and higher operating risks, liquidity imposes strong influence on corporate investment. Additionally, companies with higher liquidity are more sensitive to investment opportunity. The results generated from different measurement and the robust analysis by SSE 180 index all exhibit conclusions listed above.

The results of the paper can be applies to policy making from the following two aspects. Firstly, listed companies can cut equity cost and financial constraint by raising liquidity, which can also benefit long-term, more profitable financial, expand investment scale and increase shareholders' profit. Liquidity can tackle with information asymmetry by raising information embedded in stock price and improve CEO's payment-performance sensitivity and investment efficiency. Therefore, listed companies should strive to improve equity and capital structure, as well as corporate governance to safeguard outside shareholders' benefit and stock liquidity. Another implication is that authorities should further implement information disclosure, promote the development of investment and security

analyst agency, and crack down on black-box trade. In so doing, information asymmetry will diminish, and investors' equity, fair trades in the market and market liquidity can be realized.

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Notes

Note 1. There are two flaws in the empirical evidence of Q theory: one is a higher capital adjustment cost under lower R^2 model; the other is the significant implication of cash flow, apart from Tobin Q, which represents investment opportunity.

Note 2. For the reason that the correlation between LR and $SIZE$ is as high as 0.6, $SIZE$ is not controlled in the equation of LR .

Note 3. To avoid the impact of extreme values, the paper has measured financial constraint by different means like $DTIER$, $TIER$, as well as $DCASHDIV$ and $DSIZE$. All the measurement generates similar conclusions.

Note 4. The paper measures corporate growth by DQ defined by Tobin Q , and draws the same conclusion.

Note 5. The paper draws similar conclusion analyzing with $DSIGMA$.

Note 6. The paper also employs added stocks as analyzing samples, and has found that liquidity measured by $ILLIQ$, LR and GAM increases significantly after the added year, compared with the previous three years, while $INV1$ and $INV2$ have not changed much.

Note 7. Some of the results are not reported in the paper. Please inquire the author in case that you are in need of the data.