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Project financing decision model based on triangular fuzzy AHP

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Abstract. Unban infrastructure investment and international trading cooperation are the most commonly used yet effective strategies of China to stimulate its domestic consumption and economic growth in the post-crisis period. However, high indebtedness of the private sector, especially the state-owned enterprises (SOEs), is undermining the financial soundness, hindering the capability of sustained growth, while posing systemic risk to the economy. Thus, it is important for the private sector to deleverage appropriately in the near future. In this paper, we focus on a particular mechanism of deleveraging, namely the aggregate impact of the stock market. We document that (1) the overall stock market condition affects individual firm's leverage significantly; (2) more precisely, four aggregate market indicators, i.e., index return, ratio of equity financing over GDP, turnover rate, and volatility, negatively correlated with firm's leverage, both book and market; (3) the market impact is stronger for SOEs.

Key words. Deleveraging, Dynamic capital structure, Financing constraints, China.

1. Introduction

The global financial crisis swept China with excessive reduction of demand for its exports. Delayed impacts of contractionary policies in responding to economic overheat that the Chinese government employed during the pre-crisis period worsen the domestic economy after crisis. Inventory backlogs and financial distress have been common problems for domestic firms especially for the state-owned enterprises (SOEs). In this context, the Chinese government had attempted to revive the economy and the private sector through 'the expansion of domestic demand' and 'the Belt and Road Initiative'. The increased capital spending and loose monetary policy used by the Chinese government do have simulative effects to some extent, however, stimulation by increasing the leverage level is seriously instable and the indebtedness for private sector are still high[1].Reviving the economy while deleveraging for both public and private sector now is a great issue of concern. In recent years, the Chinese

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government has been trying to develop its stock market in order to deleverage the private sector via inducing the equity financing activities. However, it remains an empirical question of whether the deleveraging effects exist in China. This paper tries to give an affirmative answer on this issue.

Over the last two decades, China's incredible economic growth has brought attention from the world, however, its equity market is still considered unable to serve as a well-functioning financial system[2].The objective of this paper is to empirically investigate the impacts of the aggregate stock market on individual firm's leverage dynamics.

In practice, equity market timing appears to be an important theory that address real corporate financing activities, and firms' financing decision may depend on the supply side of capital as well, such as the impacts of macroeconomic conditions and the ease of access to debt funding. Under the market timing theory, firms tend to issue equity instead of debt when stock price is overvalued, and repurchase equity when stock price is undervalued[3], so the rebalancing behavior of firms' leverage depends on stock price and market value. The supply side financial factors(macroeconomic conditions, monetary policy, debt market), by comparison, influence financing decision by introducing external limitations and constraints. Graham and Harvey[4]find that the majority of corporate executives surveyed believed that financial liquidity and credit rating are the core issues that to be considered when they determine the capital structure, which are constraints from the supply side.

Market timing theory and the supply side effects have developed substantial literature in the field of capital structure. Empirical researches have examined existence of the two aforementioned influence styles, most results show that both styles can affect firms' financing decision (see[5], [6] and [7] for market timing theory and[8], [9], [10] for supply side effects). However, existing literatures on market timing theory are mainly focusing on firms' leverage rebalancing behavior related to the changes of stock price and market value, without considering the aggregate stock market influence on capital structure of firms. It is also surprising that studies in supply side impacts on financing decision concentrate on macroeconomic conditions and bank loan supply, while little attention has been paid to the impact of the stock market as a supply side factor on firms' financing decision.

In this paper, we focus on Chinese stock market and provide a systematic empirical analysis on the effect of the overall stock market condition on individual firm's leverage and their validity with three steps. Step 1:we analyze the impacts of stock market in determining the Chinese listed firms' financing decision by watching four kinds of aggregate market information as indicators namely: index return, ratio of equity financing over GDP, turnover rate, and volatility, so that the existence of the deleveraging effect of Chinese stock market can be investigated; Step 2:by calculating and comparing the capital structure adjustment speed towards target leverage under the influence of aggregate market information mentioned in step 1, we can find out what kind of market information that is most influential in changing firms' leverage; Step 3: after splitting our sample into state-owned firms (SOEs) and non-state firms and re-estimating the adjustment speed for each category, we find that SOEs exhibit a stronger sense of equity financing preference.

The rest of the paper is as follows. We review the related theories and literatures and discuss the features of Chinese stock market in Section 2. Section 3 discusses the dynamic partial adjustment capital structure models we used in this study. Section 4 describes the data for the empirical analysis and the specifications of variables. Section 5 provides the empirical analysis including evaluation of the effect of firms' ownership. Section 6 presents a series of robustness tests. Conclusions are in Section 7.

2. Literature review and discussion

First, we summarize the previous research related to market timing and supply side factor effects on financing decision in Section 2.1. In Section 2.2, we discuss some unique features of Chinese stock market and choose the aggregate market indicators upon which we investigate the deleveraging effect of the market. Finally, we analyze the deleveraging effects in state-owned firms (SOEs) and non-state firms in Section 2.3.

2.1. Previous research

The static tradeoff theory focuses on the tradeoff between the cost and benefit of debt, which also implies the existence of target leverage. The dynamic tradeoff theory develops studies on capital structure through building multi-stage dynamic models with the impacts of supply side factors are introduced. Korajczyk and Levy[11] find that economy-wide factors and firm-specific components have impacts on the target leverage, and reactions of firms to economic fluctuations are depending on the strictness of external financing constraints. Target leverage is counter-cyclical for the relatively unconstrained firms, but pro-cyclical for the relatively constrained firms. Leary[12] investigates the effect on firms' financial structures from changes in bank funding constraints, who also notes that following an expansion (contraction) in the availability of bank loans, leverage ratios of bank-dependent firms significantly increase (decrease) relative to firms with bond market access.

Empirical studies using Chinese data confirms that supply side factors do influence firms' financing decisions in China. Su and Zeng[13]use macro-economic cycle, credit default risk, credit capacity and market return as proxies of macroeconomic factors. They find that macroeconomic conditions are important factors affecting the capital structure of the firms in China. Following Wu et al.[14], the authors examine the credit policy impact on capital structure and the adjustment speed, their results shows that statutory reserve has the most significant effect. Studies including [4], [8], [14], all support that supply side factors such as macroeconomic conditions and bank loan supply would influence firms' external financing activities.

Studies of actual financing decisions show that firms tend to issue equity instead of debt when market value is high, relative to book and past value, and to repurchase equity when their market values are low, this practice is refer to 'equity market timing' [15]. The 'external finance weighted-average' market-to-book ratio (the Ratio) is used by Baker and Wurgler[15] as an independent variable to estimate firms' eq-

uity market timing behavior. The result shows that leverage is strongly negatively related to the Ratio, so the market timing effect on capital structure is critical and persistent. Huang and Ritter[16]document publicly traded U.S. firms from 1963 – 2001, and find that firms tend to issue equity when the cost of equity is relatively low and repurchase equity when the cost is relatively high. Kayhan and Titman's empirical study[17] supports that market timing practice does exist when firms issue stock, but denied that the effect is persistent on capital structure. Hu and Zhuo[18] examined the applicability of market timing theory in China using data of Chinese listed firms, the results show that market timing behavior exists among Chinese list firms and the influence is significant and persistent.

Existing literature examining the effect of supply side factors and market timing on capital structure adjustment has laid a solid foundation for further research, however, little is known about how Chinese stock market can act as an external equity fund provider to influence firms' financing decision from the aggregate perspective. An important motivation of our paper is to consider Chinese stock market as a specific supply side factor, and to identify how the stock market can affect individual firms' capital structure adjustment, so the existence of deleveraging effect of China's stock market can be verified.

2.2. Features of Chinese stock market and aggregate indicators of market condition

In daily trading, information is released from the stock market such as stock price, trading volumes and volatility, while investors make investment decisions by using these information. Management would consider the aggregate stock market factors such as trends, fluctuation and ease of access to equity market, then choose to raise fund by equity or debt financing. A target leverage could also be determined with consideration of these factors. The speed with which a firm adjusts toward its target leverage reflects the sensitivity of the firm's leverage to the corresponding market indicator. We can compare the effectiveness of deleveraging effects with the consideration of different market indicators by measuring the adjustment speed.

There are two major stock exchanges in China: the Shanghai Stock Exchange, established on December 19, 1990, and the Shenzhen Stock Exchange, established on April 3, 1991. Comparing with the stock exchanges in developed countries, the stock exchanges in China are much younger and immature with a lot of government intervention. Based on existing studies with considering the characteristics of Chinese stock market, we choose the index return and its volatility, liquidity, and the ratio of equity financing amount over GDP as proxy variables (indicators) of the stock market features for the following reasons:

First, according to market timing theory, firms have motivation to choose market opportunities that are favourable for them. Studies of stock returns following corporate finance decisions show that firms issue equity when the cost of equity is relatively low and repurchase equity when the cost is relatively high([19], [20]).In the specific case of China, government intervention is more frequently than that in stock markets of developed countries, so the government's influence is very critical to stocks movements. Also, the number of investors in China is huge, which makes

the herding behavior in Chinese stock market extremely serious. Therefore, we use the index return as proxy of market timing and cost of equity financing. Firms are expected to raise equity when the cost is relative low (or when index return is relatively high).

Second, management would consider 'capacity' and 'cost' when making financing decisions [14].The ratio of equity financing amount over GDP has been used as a proxy of stock market's 'capacity' in some Chinese literatures ([14], [21])as it reflects the ease of access to the equity market. In China, IPO and equity refinancing are regulated and verified by the regulatory arm – China Securities Regulatory Commission (CSRC)[1], who sets up the qualification of equity market entry. As a result, firms are expected to raise equity funding when it is relatively easier for entering the market (or when the ratio of equity financing over GDP is relatively high).

Third, index volatility represents market risk. Risk aversion theory suggests that investors are more sensitive to loss relative to earning[22]. On the other hand, risk premium theory argues that risks and benefits are positively correlated as investors demand higher returns to compensate for the higher risk they bear. Relationship between market return and volatility is not clear. In case of Chinese stock market, it has many retail investors with a significant proportion of them are irrational, who makes the stock market volatility much more severely. For the purpose of avoiding risks, firms are expected to choose equity financing when the market risk is relatively low.

Fourth, market liquidity is an indicator of the market depth. An equity market with higher liquidity is capable to absorb enough trading volume, in which context the capital allocation function would be more efficient. Butler et al. [23] noted that the stock market liquidity reflects firms' cost of equity financing, and firms with higher liquidity would have relatively lower equity financing cost. Chinese stock market has been verified to have good liquidity Following Butler et al.[23], we use turnover rate as the proxy of market liquidity.

2.3. Ownership and deleveraging

Ownership could determine a firm's financing preference. China's model of the state-dominated financial system suggests that many SOEs can keep their earnings and have access to cheaper financing, which helps them to hold more sufficient cashflow than non-state firms. Many of SOEs are operating in monopoly industries that can bring enormous profit for them. They are able to get loans from state-owned banks with lower cost, while banks are scrambling for providing loans to them as well. Although some SOEs are incurring huge loss due to backwardness in technology and management, they usually have a large capacity of tangible assets and government subsidy, which are favourable for applying bank loan as well. Thus, most of the SOEs

[1] Private placement equity and SEO are the most-common used methods of equity refinancing for Chinese listed firms. CSRC issued related regulations on the refinancing time intervals, the profitability of company, the purpose of raising funds, the issue size limit as well as the structure of corporate governance and other factors to set up the refinancing market entry qualification, who is also responsible for verifying IPO applications.

prefer debt financing and bear high leverage. In comparison, non-state firms are often plagued by financial constraint. When the macro-economy is weak, commercial banks often enhance risk prevention by tightening credit supply or increasing interest rates, causes the financing difficulty phenomenon being particularly prominent for the non-state firms.

In recently years, China had put great efforts in developing its stock market and had taken a series of policies for stimulating equity financing, so the indebtedness of the private sector can be reduced, especially for the SOEs that are typically considered as with 'hypertension'. However, we argue that non-state firms are the first beneficiaries of stock market development and the stimulation policies taken by the Chinese government, because they are more sensitive to those improvements such as difficulty loosening of equity market entry and financing cost reducing, or we can expect that deleveraging effect is more significant to non-state firms than SOEs.

3. The model

Flannery and Rangan[25] use a general partial-adjustment model of firm leverage to test whether there is indeed a leverage target and if so, what is the speed with which a firm moves toward its target. In their model, the target leverage is set as a function of firm characteristics. In this paper, we make adjustments on Flannery and Rangan's model by specifying the target leverage as the function of stock market variables and prior period firm characteristic variables. The model is as follows:

$$LEV^*_{i,t} = \beta X_{i,t-1} + \lambda Market_t\,, \tag{1}$$

in Eq. (1), we model the target debt level of firm i in period t ($LEV^*_{i,t}$) as a function of a set of lagged firm characteristic variables ($X_{i,t-1}$) and stock market variables in period t($Market_t$).

After identifying the firm's target leverage in Eq.(1), we measure how quickly the firm adjusts its leverage back toward the target leverage from a position that deviated from it. According to the existing literature ([6], [9]), we use the standard partial adjustment model as follows:

$$LEV_{i,t} - LEV_{i,t-1} = \delta i, t(LEV^* i, t - LEV_{i,t-1})\,, \tag{2}$$

$LEV_{i,t} - LEV_{i,t-1}$ represents the actual adjustment of firm i's leverage[2], which is determined by the difference between its target leverage at time t ($LEV^*_{i,t}$) and its actual leverage at time t - 1 ($LEV_{i,t-1}$). $\delta_{i,t}$ represents the proportion of leverage deviation away from firm i's target leverage. $\delta = 1$ indicates that firm i fully adjusts for any deviation away from its target leverage, the firm's actual leverage after adjustment is the same as its target leverage; $\delta < 1$ indicates that only partial adjustment is performed.

Then, substituting Eq. (1) into Eq. (2) and rearranging yields the following

[2] Here we use book leverage ratio. The description is given in Table 1.

dynamic partial adjustment model:

$$LEV_{i,t} = (1 - \delta_{i,t})LEV_{i,t-1} + \beta\delta_{i,t}X_{i,t-1} + \lambda\delta_{i,t}Market_t + \mu_i + \varepsilon_{i,t}\,, \qquad (3)$$

where μ_i and $\varepsilon_{i,t}$ are firm fix effect and the error term respectively.

Additionally, we employ a dummy variable (SOE) to represent firms' ownership. We have:

$$LEV^*i,t = \beta X_{i,t-1} + \lambda 0 Market_t + \varphi SOE_{i,t}Market_t + \theta SOE_{i,t}\,. \qquad (4)$$

SOE takes the value of 1 if the sample is SOEs and the value of 0, if otherwise. $SOE_{i,t}Market_t$ are the interaction terms between SOEs and stock market influence. φ denotes the difference of leverage adjustments between SOEs to non-state firms with the influence of stock market.

Similar to Eq.(2), we revise Eq.(4) as follows:

$$\begin{aligned} LEV_{i,t} =& (1 - \delta_{i,t})LEV_{i,t-1} + \beta\delta_{i,t}X_{i,t-1} + \lambda_0 Market_t \\ &+ \varphi SOE_{i,t}Markett + \theta SOE_{i,t} + \mu i + \varepsilon_{i,t}\,. \end{aligned} \qquad (5)$$

As SOE stands for firms' ownership, we can measure the leverage adjustment under the market influence for the non-state firms with λ_0, and with $\lambda_0 + \varphi$ for the SOEs.

4. Data, variable definitions and summary statistics

4.1. Data

Our sample contains nonfinancial firms listed in the Chinese A-share market (Shenzhen and Shanghai). The data used in econometric analyses are quarterly observations covering the period from the 1st quarter of 2005 to the 4th quarter of 2014. We took the following procedures to obtain appropriate data: 1. Each sample firm contains data at least for 5 years for the purpose of continuity in watching leverage adjustment; 2.Financial firms and firms with ST(special treatment) or PT(particular transfer) symbol are excluded from the samples; 3. Samples with extreme values, samples with missing value and samples with book-leverage ratio greater than 1 or less than 0 are excluded; 4.The bottom 1% and the top 1% of the observations are deleted to minimize the effect of potential outliers. We end up with the total firm-quarter observation in the dataset of 45, 280 for the variables used in empirical analyses of this paper. The data is taken from GTA's China Stock Market &Accounting Research database (CSMAR) and Wind financial database.

4.2. Variable definitions

Table 1 summarizes and explains the variables we used in the empirical studies.

Table 1. Variable descriptions.

Variable	Symbol	Description
book leverage	LEV	ratio of total book liabilities to total book assets
index return	R	the weighted average return[3] of Shanghai's A-share index and Shenzhen's A share index
ratio of equity financing over GDP	EQUI	ratio of total equity funding volume[4] over GDP
volatility	VT	the weighted average volatility of Shanghai's A-share index and Shenzhen's A share index
liquidity	TURNOVER	ratio of index trading volume to outstanding shares of component stocks
profitability	EBIT	ratio of earnings before interest and taxes to total assets
non-debt tax shield	NDTS	ratio of depreciation to total assets
firm size	LNTA	the natural logarithm of total assets
growth rate	GROWTH	the growth rate of operating income
asset liquidity	LIQ	ratio of liquid assets to total assets
investment opportunities	TOBINQ	market value[5] /(total assets - net intangible assets - goodwills)
Industry characteristics	INDU	reference to 2012 CSRC industry classification standard

4.3. Summary statistics

Table 2 presents summary statistics of main variables used in empirical analysis. We see that the mean ratio of book-leverage ratio for our sample firms is 0.4907, which suggests that the leverage ratio overall are reasonable. However, the minimum value for the book-leverage is only 0.0071 while the maximum is 0.9997, which shows that the leverage ratios for different firms are significantly different. We can also find that the standard deviation for the firm size, growth rate and Tobin's Q value are relatively higher.

[3]Weighted using the trading volume of Shanghai's A-share index and Shenzhen's A share index.

[4]The data of equity funding amount was taken from National Bureau of Statistics of China.

[5]We use the calculation mythology of the "market value A" of CSMAR database, that Market value = common shares traded with RMB × closing price for the corresponding period + B-shares traded with foreign currency listed in China × closing price of B-shares for the corresponding period × spot exchange rate + (total outstanding shares - common shares traded with RMB - B-shares traded with foreign currency listed in China) × ending values of owner's equity / ending values of paid-in capital + ending values of total liabilities.

Table 2. Summary statistics.

Variables	Obs	Mean	Std Dev	Min	Max
LEV	45280	0.4907	0.1939	0.0071	0.9997
EBIT	45280	0.0387	0.0467	-1.0942	0.5028
NDTS	45280	0.0238	0.0161	0.0004	0.0747
LNTA	45280	21.8936	1.2955	17.4987	28.5174
GROWTH	45280	0.1901	0.4267	-0.5670	2.7957
LIQ	45280	0.5346	0.2169	0.0071	1.0000
TOBINQ	45280	1.8412	1.6405	0.2008	9.0746
R	45280	0.0042	0.0905	-0.2123	0.2186
EQUI	45280	0.0190	0.0083	0.0080	0.0327
VT	45280	0.6269	0.3793	0.2523	1.4111
TURNOVER	45280	1.6148	0.7804	0.2887	

5. Empirical analysis

This section presents the results from the dynamic partial adjustment model, followed by a discussion of their implications and the results with the state ownership consideration.

5.1. Leverage adjustment under the influence of stock market

The estimation for Eq.(3) can be achieved using fixed effects model or random effects model. However, Hausman's test result refused the random effects model, so we use the fixed effects model for the estimation. It is noticeable that the stock market variables (index return, ratio of equity financing amount over GDP, volatility and liquidity) are highly correlated[6], which would cause significant multicollinearity if they are included in the regression simultaneously. To address this problem, we put the stock market variables separately into the regression. The regression results are shown on column 2 - 5 of table 3.

This table represents the regression result of Eq.(3). The leverage ratio is computed on a book value basis. We report coefficient estimates in the tables (standard errors are in parenthesis) with *, **, and *** indicating significance at the 10%, 5%, and 1% levels, respectively. We also report the adjusted R-square statistic and number of observations.

The first column of table 3 is the regression result without stock market controls, from where we can see the Chinese listed firms do adjust their capital structure towards the target leverage. Firms close in one year about 43.58% (since the reported coefficient on LEV_{t-1}, which is $1-\delta$, is 56.42%) of the gap between the actual and target leverage ratio. It means that firms narrow the gap of the actual leverage to the target leverage at an average speed of 44%. $\delta < 1$ indicates that only partial

[6] Correlation coefficient: R and Equi: 0.5183; Equi and VT: 0.5554; VT and TURNOVER: 0.8336.

adjustment is performed due to the adjustment cost.

Table 3. Regression results for estimation of leverage adjustment under stock market influence

	LEV				
R		-0.0049***			
		(0.0017)			
$EQUI$			-0.1801**		
			(0.0913)		
VT				-0.0058**	
				(0.0028)	
$TURNOVER$					-0.0024**
					(0.0011)
LEV_{t-1}	0.5642***	0.5631***	0.5641***	0.5650***	0.5651***
	(0.0132)	(0.0132)	(0.0132)	(0.0132)	(0.0132)
$EBIT_{t-1}$	-0.1921***	-0.1893***	-0.1930***	-0.1901***	-0.1901***
	(0.0252)	(0.0253)	(0.0253)	(0.0253)	(0.0253)
$NDTS_{t-1}$	-0.6472***	-0.6472***	-0.6412***	-0.6484***	-0.6473***
	(0.1441)	(0.1442)	(0.1441)	(0.1442)	(0.1441)
$LNTA_{t-1}$	0.0075***	0.0053**	0.0067***	0.0050**	0.0056***
	(0.0021)	(0.0022)	(0.0022)	(0.0022)	(0.0022)
$GROWTH_{t-1}$	0.0043**	0.0043**	0.0041**	0.0046**	0.0043**
	(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0019)
LIQ_{t-1}	-0.0276**	-0.0291**	-0.0285**	-0.0292**	-0.0295**
	(0.0116)	(0.0116)	(0.0116)	(0.0116)	(0.0117)
$TOBINQ_{t-1}$	-0.0020**	-0.0035***	-0.0022**	-0.0027***	-0.0025***
	(0.0009)	(0.0011)	(0.0009)	(0.0009)	(0.0009)
Obs	45280	45280	45280	45280	45280
Adjusted R2	0.3991	0.3997	0.3993	0.3994	0.3994

The coefficients for the remaining firm characteristics variables do not show surprising trends. Profitability (EBIT) is negative associated with leverage ratio, which means that better profitability brings higher retained earnings, so the demands for debt financing is reduced. Higher non-debt tax shield (NDTS) is associated with lower leverage ratio as firms with higher depreciation expenses are less likely to issue debt for tax shield purposes. Firm size (LNTA) is positive with leverage ratio, means that large firms may have more tangible assets so they could obtain bank loans easier. The coefficient of growth rate (GROWTH) shows that firms with higher growth are able to send favourable signals to the market, so they could obtain bank loans easier. Higher asset liquidity (LIQ) is associated with lower leverage ratio, means that sufficient liquid assets can improve firms' internal funds, so less external financing is needed. Investment opportunities (TOBINQ) is negative to leverage ratio, shows that firms that has better investment opportunities prefer less debt to avoid extra external financing cost. These estimations are unanimous with existing literature [9], [26], [27].

The columns 2-5 of table 3 presents the coefficient estimates from Eq. (3) that

examines the impact of the stock market variables to leverage adjustment. The coefficient of index return is negative and significant at the 1% level, which suggests that index return as a proxy of cost of equity financing would negatively influence financing decision. Firms would use equity financing when index return is high so that the financing cost is lower. The coefficient on the ratio of equity financing over GDP is negative and significant at the 5% level, which suggests that firms prefer to use equity financing when the barrier of entry to the equity market is lower. Volatility is negatively correlated with leverage, which is different to our expectation. This result may be due to: first, equity financing preference of China's listed firms is strong because equity financing cost is significantly lower than debt financing costs, companies prefer to raise fund from the equity market that pay no interest on; second, Herd Behavior magnifies the irrationalness of investors, more investors run into the stock market when it is boom, so shares are overvalued and market volatility is increased. According to the market timing theory, rational managers would issue shares when they are overvalued, leads lower leverage associates with higher volatility. Liquidity is negatively correlated with leverage, suggests that liquidity improves the efficiency of market allocations and induces equity financing. In sum, all evidence strongly suggest that we have identified a deleveraging effect of Chinese stock market that is directly related to the four abovementioned market variables/indicators.

Furthermore, when we measure the influence of stock market on target leverage by only using index return (R), we have the coefficient of LEV_{t-1} that is 0.564, so $\delta_{i,t} = 1 - 0.564 = 0.446$. From Eq.(3), we can obtain the value of λ, which equal to -0.0011 and represents the impact of index return to target leverage[7]. We can find the market variable affecting leverage adjustment most strongly by comparing the absolute value of λ correspondingly. By comparison[8], the absolute value of λ for the ratio of equity financing over GDP is highest, suggests that firms' leverage are most sensitive to the barrier of entry to equity market. It also means that deleveraging by expanding equity financing amount is most effective.

5.2. Considering firms' ownership

In this subsection, we further look at how firms' ownership can affect their leverage adjustment with the influence of stock market factors.

We define a firm as a SOE judging by whether state ownership is at least 33%, because the Chinese corporate law states that 33% of ownership defines the ultimate controlling shareholder. In our sample, there are about 65% of total firm-quarter observations that are associated with the cases, in which the state ownership is 33% or above. These firms are classified as SOEs. Finally, our sample includes 15, 848 non-stated observations and 29, 432 SOEs observations when book leverage values is used. We put the stock market variables separately into the regression of Eq.(5) using fixed effects model, the regression results are shown in table 4.

[7] $\lambda = \frac{\lambda\delta_{i,t}}{\delta_{i,t}} = \frac{-0.0049}{0.446} = -0.0011$

[8] We find the value of λ corresponding to the ratio of equity financing amount over GDP, volatility and liquidity are-0.4122 -0.0133 and -0.0055 respectively by the same way that we calculate λ for index return.

Table 4. Regression results with consideration of firms' ownership

	LEV			
	MARKET_t =R	MARKET_t =EQUI	MARKET_t =VT	MARKET_t =TURNOVER
LEV_{t-1}	0.5617***	0.5631***	0.5633***	0.5633***
	(0.0132)	(0.0131)	(0.0131)	(0.0131)
$EBIT_{t-1}$	-0.1881***	-0.1920***	-0.1882***	-0.1903***
	(0.0253)	(0.0254)	(0.0253)	(0.0254)
$NDTS_{t-1}$	-0.6451***	-0.6433***	-0.6442***	-0.6470***
	(0.1431)	(0.1431)	(0.1444)	(0.1431)
$LNTA_{t-1}$	0.0054**	0.0067***	0.0051**	0.0055**
	(0.0022)	(0.0021)	(0.0023)	(0.0022)
$GROWTH_{t-1}$	0.0042**	0.0041**	0.0045**	0.0042**
	(0.0019)	(0.0019)	(0.0019)	(0.0019)
LIQ_{t-1}	-0.0283**	-0.0280**	-0.0288**	-0.0292**
	(0.0116)	(0.0116)	(0.0116)	(0.0116)
$TOBINQ_{t-1}$	-0.0033***	-0.0022**	-0.0026***	-0.0024***
	(0.0011)	(0.0009)	(0.0009)	(0.0009)
$MARKET_t(\lambda_0)$	-0.0013*	-0.1562**	0.0019	0.0005
	(0.0028)	(0.1651)	(0.0049)	(0.0021)
$SOE_{i,t}$*$MARKET_t(\varphi)$	-0.0087***	-0.3611***	-0.0113**	-0.0044*
	(0.0030)	(0.1972)	(0.0054)	(0.0024)
$SOE_{i,t}$	0.0097	0.0178**	0.0155*	0.0148*
	(0.0081)	(0.0088)	(0.0088)	(0.0089)
$\lambda_0+\varphi$	-0.0101***	-0.5173***	-0.0094**	-0.0039*
	[0.0843]	[0.1128]	[0.0998]	[0.0493]
Obs	45280	45280	45280	45280
Adjusted R^2	0.4016	0.4012	0.4013	0.4013

This table represents the regression result of Eq.(5). The leverage ratio is computed on a book value basis. We report coefficient estimates in the tables (standard errors are in parenthesis) with *, ** , and *** indicating significance at the 10%, 5%, and 1% levels, respectively. We also report the adjusted R-square statistic and number of observations. The numbers inside the square brackets are the Wald test results for the significance of H_o: $\lambda_0 + \varphi = 0$.

From table 4, we can see that the leverage of SOEs are negatively correlated with all of the four market variables we used. For comparison, only index return and ratio of equity financing amount over GDP are significantly negative with the leverage of non-stated observations at 10% and 5% levels respectively. Non-stated firms, which are expected to be more sensitive to lower financing cost and barrier of entry (i.e. increased index return and higher ratio of equity financing amount over

GDP) than SOEs because of the tougher financing difficulties they faced. However, our regression result shows that the influences from the stock markets are much stronger for SOEs than for non-stated observations. The coefficients of the interaction terms (φ) are significant for all of the market indicators we used, which suggests that the impacts of the market indicators on SOEs and non-stated observations are significantly different due to difference in ownership. The evidences show that the equity financing preference of SOEs observations is stronger and deleveraging effect is more significant to SOEs than to non-stated firms.

5.3. Further investigation: ownership and financial constraints

Financial constraints are important factors to be considered when analyzing capital structure, as firms with different financial constraints could have different financing choice while everything else being same. In Section 2.3, we argued that non-stated firms should be more sensitive to aggregate market impacts as they are more financially constrained. However, our empirical analysis in Section 5.2 suggests that aggregate market influences are stronger for SOEs that are considered to face less financial constraints. To further understand the relationship between the aggregate market indicators to firms with different ownership and financial constraints, we classify our sample observations into four groups: SOEs without financial constraints (SOEs/NFC), SOEs with financial constraints (SOEs/FC), non-state firms without financial constraints (NS/NFC), non-state firms with financial constraints (NS/FC).

We follow Fazzari[28] and Korajczyk and Levy[11] by identifying financially constrained observations as with better growth but pay dividend lower than 0.05RMB per share. Also, following Yu[14] and Jiang[21], we identify firms with operating income growth rate higher than industry average as firms with better growth. After the grouping process, we use Eq.(3) for our estimation, the regression results for different groups are shown in table 5.

Table 5. Regression results with consideration of ownership and financial constraints, classified by dividend payout

	LEV					
	R	*EQUI*	*VT*	*TURNOVER*	*Obs*	*Adj.* R^2
SOEs/NFC	-0.0087***	-0.4641***	-0.0132***	-0.0054***	22091	0.4330
	(0.0021)	(0.1140)	(0.0033)	(0.0013)		
SOEs/FC	-0.0116*	-0.1580***	-0.0066*	0.0007	4128	0.3000
	(0.0060)	(0.3590)	(0.0118)	(0.0050)		
NS/NFC	-0.0042	-0.1932**	0.0021	0.0008	11484	0.3443
	(0.0036)	(0.1971)	(0.0062)	(0.0024)		
NS/FC	-0.0099**	-0.4991***	-0.0040	-0.0057	7577	0.4381
	(0.0079)	(0.4563)	(0.0137)	(0.0068)		

This table reports the results from estimating the key variables of Eq. (3) after controlling $X_{i,t-1}$, a vector of the previously highlighted firm characteristics. The observations classified with ownership and financial constraints into four groups: SOEs/NFC: SOEs without financial constraints; SOEs/FC: SOEs with financial constraints; NS/NFC: non-state firms without financial constraints; NS/FC: non-state firms with financial constraints. The leverage ratio is computed on a book value basis. We report coefficient estimates in the tables (standard errors are in parenthesis) with *, **, and *** indicating significance at the 10%, 5%, and 1% levels, respectively. We also report the adjusted R-square statistic and number of observations for different groups.

For observations that are SOEs with no financial constraints, the coefficient on all of the four market indicators are negative and significant at the 1% level. It suggests that the deleveraging effects of Chinese stock market is most significant for this group. For SOEs with financial constraints, the coefficient on the ratio of equity financing over GDP is negative and significant at the 1% level, which suggests that this group is most sensitive to the 'capacity' of stock market. The cost of equity financing (i.e., index return and volatility) do have significant influence on their capital structure but only at the 10% level. For the group consist of non-state observations without financial constraints, only the coefficient on the ratio of equity financing over GDP is negative and significant at the 5% level, while other three market indicators are unable to make any explanatory. Finally, the group consist of non-state observations with financial constraints is most sensitive to the 'capacity' of stock market as well. Index return also have negative influencing power on this group's leverage adjustment, however, for this group, the influence from the cost of equity financing is still weaker than that from the 'capacity' of stock market.

In brief, our regression results exhibit that the deleveraging effects are strongest for SOEs with no financial constraints, which is also stronger for SOEs as a whole than for non-stated observations. The cost of equity financing have significantly negative impacts on leverage adjustments for the observations with financial constraints, however, the influence from the 'capacity' of stock market is more critical.

6. Robustness tests

In this section, we test for the robustness of deleveraging effects of Chinese stock market to alternative measures of leverage ratio and an alternative method of classifying sample firms.

6.1. Alternative measures of leverage ratio

There has been many definitions of 'leverage' varies across capital structure studies. In this subsection, we analyze the robustness of our results with different definitions of leverage ratio. We employ two alternative forms of leverage ratios commonly used and re-estimate the dynamic partial adjustment model. They are market leverage ($MLEV$) and interest bearing leverage ($ILEV$).

The alternative leverage ratios are defined as follows:

$$MLEV_{i,t} = \frac{BD_{i,t}}{MV_{i,t}},$$

$$ILEV_{i,t} = \frac{LD_{i,t} + SD_{i,t} + NP_{i,t} + NCD_{i,t} + BP_{i,t} + OP_{i,t}}{TA_{i,t}}.$$

Where $BD_{i,t}$ is the book value of total debt for firm i at time t, $MV_{i,t}$ denotes market value for firm i at time t. $LD_{i,t}$, $SD_{i,t}$, $NP_{i,t}$, $NCD_{i,t}$,$BP_{i,t}$, $OP_{i,t}$ denotes the book value of long term debt, short term debt, notes payable, non-current debt due in one year, bonds payable and other payables for firm i at time t respectively. $TA_{i,t}$ represents the book value of total assets for firm i at time t.

The results are reported as follows:

Table 6. Regression results with market leverage as the dependent variable

	MLEV				
R		-0.3611***			
		(0.0120)			
EQUI			-1.6221***		
			(0.4980)		
VT				-0.3313***	
				(0.0164)	
TURNOVER					-0.1731***
					(0.0069)
$MLEV_{t-1}$	0.3120***	0.4510***	0.3341***	0.3683***	0.3582***
	(0.0191)	(0.0176)	(0.0192)	(0.0193)	(0.0187)
$EBIT_{t-1}$	-1.0161***	-0.5141***	-1.0652***	-0.8140***	-0.8681***
	(0.1010)	(0.0917)	(0.1002)	(0.0991)	(0.0993)
$NDTS_{t-1}$	-2.3821***	-2.1213***	-1.8130**	-2.3472***	-2.3214***
	(0.7460)	(0.6421)	(0.7101)	(0.7162)	(0.7161)
$LNTA_{t-1}$	0.2802***	0.0753***	0.2081***	0.1253***	0.1310***
	(0.0138)	(0.0116)	(0.0127)	(0.0139)	(0.0129)
$GROWTH_{t-1}$	0.0435***	0.0389***	0.0263***	0.0647***	0.0428***
	(0.0104)	(0.0098)	(0.0098)	(0.0106)	(0.0102)
LIQ_{t-1}	0.1021*	-0.0081	0.0261	0.0152	-0.0356
	(0.0611)	(0.0556)	(0.0606)	(0.0602)	(0.0611)
$TOBINQ_{t-1}$	0.0404***	-0.0603***	0.0213***	0.0036	0.0059*
	(0.0035)	(0.0040)	(0.0032)	(0.0030)	(0.0030)
Obs	45280	45280	45280	45280	45280
Adjusted R^2	0.2811	0.4062	0.3573	0.3271	0.352

This table represents the regression result of Eq.(3). We report coefficient esti-

mates in the tables (standard errors are in parenthesis) with *, ** , and *** indicating significance at the 10%, 5%, and 1% levels, respectively. We also report the adjusted R-square statistic and number of observations.

Table 7. Regression results with interest bearing leverage as the dependent variable

			ILEV		
R		-0.0084***			
		(0.0016)			
$EQUI$			-0.4152***		
			(0.0904)		
VT				-0.0011	
				(0.0026)	
$TURNOVER$					-0.0021*
					(0.0011)
$ILEV_{t-1}$	0.5351***	0.5360***	0.5372***	0.5360***	0.5373***
	(0.0123)	(0.0123)	(0.0124)	(0.0123)	(0.0124)
$EBIT_{t-1}$	-0.1302***	-0.1243***	-0.1320***	-0.1291***	-0.1283***
	(0.0244)	(0.0242)	(0.0245)	(0.0244)	(0.0244)
$NDTS_{t-1}$	-0.8712***	-0.8701***	-0.8562***	-0.8712***	-0.8701***
	(0.1371)	(0.1371)	(0.1370)	(0.1371)	(0.1371)
$LNTA_{t-1}$	0.0077***	0.0038*	0.0059***	0.0073***	0.0061***
	(0.0020)	(0.0021)	(0.0020)	(0.0022)	(0.0021)
$GROWTH_{t-1}$	0.0053***	0.0052***	0.0048**	0.0054***	0.0053***
	(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0019)
LIQ_{t-1}	-0.0479***	-0.0505***	-0.0498***	-0.0482***	-0.0495***
	(0.0118)	(0.0119)	(0.0119)	(0.0118)	(0.0119)
$TOBINQ_{t-1}$	-0.0008	-0.0035***	-0.0013	-0.0009	-0.0012
	(0.0008)	(0.0010)	(0.0008)	(0.0009)	(0.0009)
Obs	45280	45280	45280	45280	45280
Adjusted R^2	0.3522	0.354	0.3532	0.3511	0.3522

This table represents the regression result of Eq.(3). We report coefficient estimates in the tables (standard errors are in parenthesis) with *, ** , and *** indicating significance at the 10%, 5%, and 1% levels, respectively. We also report the adjusted R-square statistic and number of observations.

From the robustness test results which are consistent with our previous results we find that, regardless of the leverage ratio definition, the leverage is negative associated with index return, ratio of equity financing amount over GDP, volatility and liquidity. The deleveraging effect of Chinese stock market does exist.

6.2. Alternative method of financial constraints classification

Drobetz and Wanzenried[29] argue large firms should be able to more easily perform leverage adjustment because they have better access to public debt markets. This suggests that we could use firm size to classify financially constrained and unconstrained firms. Follows Yu[14], we group the observations with the natural logarithm of their total assets (i.e. firm size), and define a firm to be financially constrained as its size falls below the 20th percentile of the industry to which it belongs. Industry classification is referenced to 2012 CSRC industry classification standard. After the grouping process, we still use Eq.(3) for our estimation. The results are reported as follows:

Table 8. Regression results with consideration of ownership and financial constraints, classified by firm size

	LEV					
	R	*EQUI*	*VT*	*TURNOVER*	*Obs*	*Adj.* R^2
SOEs/NFC	-0.0098***	-0.4939***	-0.0142***	-0.0057***	24508	0.4130
	(0.0021)	(0.1085)	(0.0032)	(0.0013)		
SOEs/FC	-0.0019*	-0.1306***	0.0141	0.0009	3922	0.2026
	(0.0058)	(0.3443)	(0.0116)	(0.0053)		
NS/NFC	-0.0006	0.1071	-0.0027	-0.0015	10624	0.3073
	(0.0037)	(0.1822)	(0.0066)	(0.0025)		
NS/FC	-0.0013*	-0.3361***	-0.0015	0.0043	6226	0.3051
	(0.0070)	(0.3991)	(0.0120)	(0.0054)		

This table reports the results from estimating the key variables of Eq. (3) after controlling $X_{i,t-1}$, a vector of the previously highlighted firm characteristics. The observations classified with ownership and financial constraints into four groups: SOEs/NFC: SOEs without financial constraints; SOEs/FC: SOEs with financial constraints; NS/NFC: non-state firms without financial constraints; NS/FC: non-state firms with financial constraints. The leverage ratio is computed on a book value basis. We report coefficient estimates in the tables (standard errors are in parenthesis) with *, **, and *** indicating significance at the 10%, 5%, and 1% levels, respectively. We also report the adjusted R-square statistic and number of observations for different groups.

The results of robustness test are consistent with our previous empirical analysis, that the deleveraging effects are strongest for SOEs with no financial constraints, which is also stronger for SOEs as a whole than for non-stated observations. However, there is no significant relationship between the market indicators to leverage adjustment of the group consists of non-stated observations without financial constraints.

7. Conclusion

In the background of China's economic slowdown, stock market development has been considered as an effective strategy by Chinese government to reduce indebtedness for the private sectors. Our paper examined the existence of deleveraging effect of Chinese stock market to the private sector and investigated its validity. The majority of literature about capital structure are focused on impacts on financing decision from macro-economic factors as well as from debt financing channels. Also, studies on applicability of market timing theory in China mainly use changes in stock price or market value as a starting point. Our paper, which consider Chinese stock market as a specific supply side factor, can be a supplementary for existing capital structure studies.

By using quarterly data from the 1st quarter of 2005 to the 4th quarter of 2014 we document that: (1) the deleveraging effect of Chinese stock market does exist; (2) all of the four ways conveying the effect of deleveraging, namely, index return, ratio of equity financing over GDP, turnover rate, and volatility, are negatively correlated with the leverage ratios of the sampled firms; (3) the deleveraging effect is more significant for SOEs;(4) Our results are not sensitive to an alternative measure of leverage ratio or classifying observations by different definitions of financial constraints.

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