Equity financing constraints and corporate capital structure: a model

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Abstract

Purpose – The "supply-side e ect" brought about by the imper ection o the capital market has increasingly been concerned. The purpose o this paper is to study how will the uncertainty o equity financing brought about by the equity financing regulations in emerging capital market a ect company's capital structure decisions.

Design/methodology/approach – This paper establishes a theoretical model and tries to introduce equity financing uncertainty into the company's capital structure decision-making. The paper uses mathematical derivation method to get some basic conclusions. Next, in order to characterize the quantitative impact o specific actor on capital structure, numerical solution methods are used.

Findings – The model shows that firm's value would decrease with the uncertainty o equity financing, because o the relationship between firm's uture cash and their financing policies. The numerical solution o the model suggests that the uncertainty o equity financing is one o the important actors a ecting the choice o optimal capital structure, the greater the uncertainty is, the lower optimal capital structure is.

Originality/value – The research o this paper has certain academic value or urther understanding o the issues.

Keywords Capital structure, Corporate financing, Equity financing pre erence, Equity financing uncertainty

Paper type Research paper

1. Introduction

The modern corporate financing theory originated rom the achievement o Modigliani and Miller (1958). Under their strict assumptions, MM reached the conclusion that corporate capital structure was unrelated to corporate value by exploiting the thought o no-arbitrage. Scholars o corporate finance therea ter continuously loosened the assumed preconditions o MM theorem, explored the realistic influencing actors o corporate financing and capital structure and put orward several theoretical hypotheses and a lot o empirical results. However, i we divide the variation o company's capital structure into three levels, namely between-industry variation, within-industry variation and within-firm variation, no matter rom which level it is judged, current empirical model has an extremely limited ability to interpret capital structure (Graham and Leary, 2011).

Barclay and Smith (1999) had pointed out that the important thing in the studies o capital structure was to develop more realistic hypotheses, work out more power ul empirical tests and find important actors that could drive corporate financing decision-making and capital structure. Titman (2002) reviews the assumptions o MM theory and classifies MM assumptions into two types:

(1) assumptions o exogenous cash flow, embracing assumptions o tax, bankruptcy cost, in ormation completeness and complete contract; and

(2) assumptions o market per ection.

Titman points out that the previous theoretical and empirical studies on corporate financing and capital structure mainly ocused on loosening the assumptions o cash flow exogenesis in MM hypotheses and ignored the assumptions o market per ection. But in reality, financial market is imper ect and has various rictions or constraints. This leads to the estrangement between academic circles and practitioners in the cognition o financing decision-making and capital structure. The ormer spends plenty o energy on cash flow assumptions, whereas the latter pays more attention to the imper ection o market. For this reason, Titman appeals to the studies on corporate financing and capital structure or more ocus on the imper ection o capital market and calls this imper ection brought about by the eatures o capital suppliers the "supply-side e ect". With respect to the uture direction o studies on capital structure, Graham and Leary (2011) points out again that the attention paid to the "supply-side e ect" is too little and appeals or enhancement in this regard in uture studies.

The first theoretical hypothesis ocusing on the "supply-side e ect" was "market timing hypothesis". In the wake o the asset pricing field's doubt about the "e ficiency market hypothesis", researchers started to pay attention to the impact o ine ficient market on corporate investment/financing decision-making and capital structure. Stein (1996) studies the investment/financing behaviors o company in the case o ine ficient market and rational enterprise managers. His model indicates that in an ine ficient market, the manager o the company can exploit the ine ficiency o market to reasonably arrange financing to obtain benefit. Baker and Wurgler (2002) ormally put orward the market timing hypothesis or the first time: along with the price changes in stock market, there is the best financing timing or financing opportunity window or the company, and most companies should make additional issuance in the overall rise stage o stock market or the period when their own stock price is rising high. The market timing hypothesis o enterprise financing is empirically supported in the Western capital market. In recent years, some domestic studies have also ocused on the e ect o market timing actor on enterprise's financing behavior and capital structure and find that market timing does play a significant role in equity financing o company (Liu *et al.*, 2005, 2006; Liu and Li, 2005; Wang *et al.*, 2005).

Since the market timing is one kind o mani estation o the "supply-side e ect" o stock market, the debt market also shows the "supply-side e ect". Murfin (2012) points out that banks write tighter contracts than their peers a ter su ering payment de aults to their own loan port olios, even when de aulting borrowers are in di erent industries and geographic regions rom the current borrower, it will also be implicated by such a supply-side e ect; borrowers who are most dependent on the relationship aspect o the bank market are also most prone to receive stricter contracts rom a ected lenders.

The study on the "supply-side e ect" is in the stage o preliminary development, and a uni orm ramework has yet to orm. Besides, these expansions are based on the situation o developed capital market. Myers (2003) had pointed out that a majority o capital structure theories were constructed based on the US listed companies, but due to di erent conditions o capital market, all theories had their own applicable assumptions, so established theories and interpretations did not necessarily apply to emerging capital market, or which, as a matter o act, the condition o capital supply lags ar behind that o the Western mature capital market on various aspects, such as the variety o financing instruments, government regulation environment, etc. The "supply-side e ect" is more prominent in the emerging capital market.

In the development process o China's stock market over the past more than 20 years, strict regulations on initial public o ering and refinancing are still ollowed today, giving rise to the relatively high uncertainty o corporate equity financing. Equity financing regulation is reflected in two aspects. First, stock issuance regulation: under the standard o "high unity o development, normalization and market bearing capacity" in the stock market o China, the government implements comparatively rigorous regulation on securities issuance: a company needs to satis y financial thresholds (net return on equity, cash dividend distribution, etc.) first o all or the purpose o issuing securities; next, a listed company complying with issuance access conditions is also subject to administrative regulations on issuance pricing, issuance timing, issuance tempo, issuance scale, and so on. For example, the regulatory authority will suspend stock issuance in the period o stock market downturn or due to a special need and loosen the regulation on issuance tempo when the stock market goes up.

Second, the government, based on the needs or macro-control, industrial development and stock market stability, limits and even suspends normal supply o financial products. Even though an enterprise meets the conditions or stock issuance, it is not or sure that it can obtain equity capital when needing equity financing. For instance, the China Securities Regulatory Commission (CSRC) will limit the listing and refinancing o real estate enterprises to coincide with the national regulatory policies o real estate. During ull-circulation share re orm, the CSRC had once shut the door to stock issuance. Since November 2012, IPO had been discontinued again.

From a macroscopic view, the regulation and limitation on stock issuance are help ul or acilitating the sustainable steady development o emerging securities market (Zhu and Cheng, 2005) and improving the e ectiveness o macroeconomic regulation and control. But or enterprises, under the situation o increasingly fierce product market competition, regulation and limitation bring about great uncertainty or corporate equity financing, and it is di ficult or a company to determine whether it can smoothly raise capital through stock market in the uture. This uncertainty o uture equity financing is obviously an important content o the "supply-side e ect". (There is generally no such an e ect in the developed capital market. For example, there is "rapid refinancing system" in many developed capital markets.)

How will the uncertainty brought about by the regulation and limitation on financing in stock market a ect the equity financing behavior and capital structure o company? Wang *et al.* (2011) find rom the study with the data o China's listed companies that the changes o refinancing regulatory policies or listed companies significantly a ect the optimal capital structure o listed companies, but on account o the di ficulty o variables design, their study does not point out the specific directions

o the a ect o refinancing regulation on capital structure. For instance, by loosening or tightening the refinancing policy, will the optimal capital structure o company become higher or lower? Furthermore, what is the influence mechanism behind it? Studies on this aspect have yet to be seen so ar[1].

The innovation o the paper is that by establishing a mathematical model, it depicts the "supply-side e ect" o equity financing (reflected as the probability o equity financing in the uture) on company brought about by equity financing regulation and its a ect on capital structure decision-making in the operating process o company. It is ound through the model that the uncertainty o external equity financing o company will result in value loss o company's shareholders, which increases along with the magnification o uncertainty; additionally, the uncertainty o financing in stock market will also a ect the choice o optimal capital structure o company, and the greater the uncertainty is, the lower optimal capital structure is. The model o the paper is help ul or understanding the influence o external equity financing environment on company's capital structure.

The structure o the paper is arranged as ollows: in Section 2, we establish a mathematical model o financing regulation in stock market and corporate optimal investment/financing decision-making; in Section 3, the influence o several main variables o the model on the choice o optimal capital structure o company is depicted with the method o numerical analysis; Section 4 is the conclusion o the paper.

2. Model

2.1 Basic assumptions

We assume the operation objective o company is the value maximization o all shareholders, and the cash flow o company is related to investment. Most models studying capital structure assume the uture cash flow o company is exogenous and unrelated to financing decision-making (Modigliani and Miller, 1958; Hackbarth *et al.*, 2006; Strebulaev, 2007), implicitly assume the company can raise unds in capital market or investment opportunity with NPV > 0 at any time with no riction. However, in act, when capital market is imper ect and there are constraints on corporate financing, the available unds o company will inevitably a ect the investment ability o company and thereby the cash flow o company.

Make the investment o company in stage t I_t; this investment produces profits in stage $t + 1$; suppose the payo on investment is $a_{t+1}f(I_t)$, among which f is increasing unction and satisfies the principle o diminishing marginal returns. That is to say, $f(0) = 0$, $f' > 0$, and $f'' < 0$; a_{t+1} is a random variable, which means the uncertainty actor a ecting the return on investment at the level o macro-economy or company. In stage t, a_t is given in ormation.

Suppose the liabilities o company in stage t are D_t, and the interest rate o liabilities is r_D; τ represents the tax rate o company; then the payo on equity investment o company in stage $t + 1$ predicted in stage t, π_{t+1}, can be shown as:

$$\pi_{t+1} = (a_{t+1}f(I_t) - I_t - D_t r_D)(1 - \tau) \tag{1}$$

Define $\delta_t = -e_t$; δ_t re ers to the dividend given by the company to shareholders in stage t (when $\delta_t < 0$, it means that the company has made external equity financing, which can be understood as negative dividend). According to the dividend discount model, the objective o company at present moment ($t = 1$) can be shown as:

$$\max V = \mathbb{E}_1\left[\sum_{t=1}^{T} \frac{\delta_t}{(1+r_E)^{t-1}}\right] \tag{2}$$

$\mathbb{E}$ re ers to the expectation operator or dividend, r_E represents the cost o equity use o company, and $r_E > r_D$. Here, we do not consider the e ect o behaviors like management confidence on the financial issues o company.

2.2 Financing constraints in financial market

The constraint o bank loan on company is considered in the first place. The repayment o capital with interest o bank loan is a hard constraint on company, but in the event o bankruptcy and liquidation, the company only bears limited responsibilities or the bank loan. There ore, the bank always makes certain limitation on the debt ratio o company. With re erence to Baker *et al.* (2003), we assume the company will ace the limit o the highest debt ratio ($\bar{L}$) set by the bank while using bank loan, namely:

$$\frac{D_t}{D_t + E_t} \leq \bar{L} \tag{3}$$

Next, the financing constraint in stock market con ronting the company is considered. This makes it uncertain or the company to obtain equity financing in stage t. Let whether the company can obtain equity financing hinge on an independent and identically distributed random state variable b_t, which complies with (0-1) distribution; the value o b_t is 1 with a probability p (indicating the company can obtain equity financing in stock market) and 0 with probability $1 - p$ (indicating the company cannot obtain equity financing in stock market, i.e. $\delta_t \geq 0$); then the constraint can be shown as:

$$\delta_t \geq 0, \ \ if\ b_t = 0 \tag{4}$$

The financing constraint most immediately a ects the company's available capital and investment. In the model herein, the available capital o company can be shown as $E_t + D_t$. An intuitive constraint on investment is that the investment o company in current period cannot exceed current available capital, namely:

$$I_t \leq E_t + D_t \tag{5}$$

Formulas (3) through (5) are the financing constraints on company during its normal operation (i.e. in case o $E_t > 0$). When the net assets o company are negative (i.e. in case o $E_t \leq 0$), the impact o financing constraints on company will be greater. Under such a circumstance, the company actually sinks into financial distress and is on the verge o bankruptcy. Thus, it is hard to raise capital and make investment, let alone dividend policy. Under such a condition, the constraints on company can be shown as:

$$\delta_t = 0, \ \ D_t = 0, \ \ I_t = 0, \ \ if\ E_t < 0 \tag{6}$$

Under the objective and the constraints mentioned above, we are unable to solve the model by directly using Lagrange multiplier method, because due to the existence o random variables, all the variables may not be necessarily derivable everywhere.

To solve the model, we need to analyze it on the basis o the distribution o a_t.

2.3 A static model

A static model is first considered: at the time when $t = 1$, the company makes an investment decision I_1 and financing decisions D_1 and E_1. At the time $t = 2$, the company is liquidated. The simple schematic diagram is shown in Figure 1.

At the time $t = 2$, i the net assets o company is negative (i.e. $a_2 f(I_1) - I_1 - D_1 r_D + E_1 < 0$), the shareholder payo will be 0 (the limited liability nature o company limited by shares). Besides, i the profit o company is negative (i.e. $a_2 f(I_1) - I_1 - D_1 r_D < 0$), the government cannot levy the tax. Then, the shareholder objective o company can be shown as:

$$\begin{aligned} \max V = -E_1 &+ \int_{a_2^{**}}^{a_2^*} \frac{E_1 + a_2 f(I_1) - I_1 - D_1 r_D}{1 + r_E} \, dG(a_2) \\ &+ \int_{a_2^*}^{\infty} \frac{E_1 + [a_2 f(I_1) - I_1 - D_1 r_D](1 - \tau)}{1 + r_E} \, dG(a_2) \end{aligned} \tag{7}$$

$$\text{Subject to}: \quad I_1 \leq E_1 + D_1 \quad \frac{D_1}{D_1}$$

In other words, because at the time $t = 2$ the company aces liquidation, it will avoid using equity as ar as possible and exploit liabilities to the upper limit to the greatest extent during financing at the time $t = 1$ (this is consistent with the capital structure theory o MM (1963) when only tax is taken into consideration). Under such a condition, equity financing constraint does not work in the static model.

2.4 A three-stage dynamic model

On the basis o the static model, we can consider a three-stage dynamic model to study how the company comprehensively selects its optimal capital structure in combination with its current investment demand and uture development in a dynamic process.

The same with the two-stage static model, at the time when $t = 1$, the company makes an investment decision I_1 and financing decisions D_1 and E_1

Based on the optimal investment and financing demands o company at $t = 2$, we can analyze the investment behavior and shareholder income o company at this moment. Here, we need to discuss them under the ollowing cases.

Case 1. I $E_1 + [a_2 f(I_1) - I_1 - D_1 r_D](1 - \tau) \geq E_2^*$, it means the shareholder payo generated by the investment o company in stage 1 can meet the optimal equity demand o company at the time $t = 2$. In such a case, whether equity financing can be realized in capital market has no a ect on corporate investment. As a result, the unds o company at the time $t = 2$ can satis y the optimal investment amount I_2^*, so the investment amount o company at $t = 2$ is I_2^*, and the equity is E_2^*. It can be known rom the conclusion in Section 2.3 that because the company is liquidated at the time $t = 3$, the company will reserve no more equity a ter its investment demand is satisfied; thus the dividend o company at $t = 2$ is $E_1 + [a_2 f(I_1) - I_1 - D_1 r_D](1 - \tau) - E_2^*$. At the same time, the present value to $t = 2$ o the equity payo at $t = 3$ is $V_2\left(I_2^*, E_2^*, D_2^*\right) + E_2^*$, where unction $V_2()$ represents the value unction o shareholder income generated by corporate investment, ollowing the result o ormula (8).

Case 2. I $E_1 + [a_2 f(I_1) - I_1 - D_1 r_D](1 - \tau) < 0$, it means the company su ers a serious loss and becomes insolvent at the time t = 2. In such a case, no matter whether uture investment can bring positive net present value, current negative net assets are a kind o "burden". At the moment, the optimal decision o company is bankruptcy and reorganization[2]. The incomes o shareholders brought by the company when $t = 2$ and $t = 3$ are both zero.

Case 3. I $0 \leq E_1 + [a_2 f(I_1) - I_1 - D_1 r_D](1 - \tau) < E_2^*$, it means although the company is not insolvent at the time t = 2, its equity cannot meet its optimal equity demand. In such a case, whether equity financing can be realized in market appears to be crucial. I b = 1, namely that the company can realize equity financing in capital market, meaning the company does not have the problem o insu ficient equity financing, the available unds o company can still satis y the optimal investment amount I_2^* at the time $t = 2$; there ore the investment amount o company is I_2^*, and the equity is E_2^* at $t = 2$. It can also be known rom the a oresaid conclusion that because the company is liquidated at the time $t = 3$, the company will reserve no more equity a ter its investment demand is satisfied; thus the dividend o company at $t = 2$ is $E_1 + [a_2 f(I_1) - I_1 - D_1 r_D](1 - \tau) - E_2^*$, and at the same time, the present value to $t = 2$ o the equity payo at $t = 3$ is $V_2\left(I_2^*, E_2^*, D_2^*\right) + E_2^*$. But i b = 0, namely that the company cannot realize equity financing in capital market, the company will be con ronted with the problem o insu ficient equity. It can be known rom the optimality o I_2^*, D_2^* and E_2^* that the equity investment o company can only be in a "suboptimum" state, represented by superscript "**"; then, the equity investment amount o company $E_2^{**} \leq E_1 + [a_2 f(I_1) - I_1 - D_1 r_D](1 - \tau)$, the dividend o company at $t = 2$ is $E_1 + [a_2 f(I_1) - I_1 - D_1 r_D](1 - \tau) - E_2^{**}$, and meanwhile, the present value to $t = 2$ o the equity payo at $t = 3$ is $V_2\left(I_2^{**}, D_2^{**}, E_2^{**}\right) + E_2^{**}$, where I_2^{**} and D_2^{**} represent suboptimum total investment level and debt level, respectively.

By combining the three cases above and noticing the probability that the company cannot raise money in capital market is 1-p, we use V_2^* and V_2^{**} to represent

$V_2\left(I_2^*, E_2^*, D_2^*\right)$ and $V_2\left(I_2^{**}, D_2^{**}, E_2^{**}\right)$, respectively; then, the shareholder objective unction o company at the time $t = 1$ can be shown as:

$$\begin{aligned} \max V_1 = & \frac{E_1 - (I_1 + D_1 r_D)(1-\tau)}{1+r_E}\left(1 - G\left(a_2^*\right)\right) \\ & + \int_{a_2^*}^{\infty} \frac{V_2^* + (1-\tau)a_2 f(I_1)}{1+r_E}\, dG(a_2) \\ & - (1-p)\int_{a_2^*}^{a_2^{**}} \frac{V_2^* - V_2^{**}}{1+r_E}\, dG(a_2) - E_1 \end{aligned} \tag{9}$$

$$\text{Subject to}: I_1 \le E_1 + D_1; \quad \frac{D_1}{D_1 + E_1} \le \bar{L};$$

$$E_2^{**} \le E_1 + [a_2 f(I_1) - I_1 - D_1 r_D](1-\tau) \quad a_2^* = \frac{I_1 + D_1 r_D - E_1/(1-\tau)}{f(I_1)};$$

$$a_2^{**} = \frac{I_1 + D_1 r_D + \left(E_2^* - E_1\right)/(1-\tau)}{f(I_1)}$$

It is worth noting that under the constraint condition $E_2^{**} \le E_1 + [a_2 f(I_1) - I_1 - D_1 r_D](1-\tau)$, any a_2 has a E_2^{**} corresponding to it, so E_2^{**} is the unction o $a_2 . I_1, D_1$ and E_1 that make the value o ormula (9) maximum are the optimal investment and financing decisions at the time $t = 1$. In ormula (9), V_2^{**} shows the shareholder value o company is in the suboptimum state, whereas V_2^* shows this value is in the optimal state. It can be known rom the analysis o case 3 that $V_2^{**} < V_2^*$; in addition, because $a_2^* < a_2^{**}$:

$$\int_{a_2^*}^{a_2^{**}} \frac{V_2^* - V_2^{**}}{1+r_E}\, dG(a_2) \ge 0.$$

Thus, we obtain the ollowing proposition:

$_1, D_1$ and E_1 in ormula (9), we can write the Lagrangian equation o ormula (9) and constraint condition and solve the first-order optimal condition. Since it is di icult to work out the analytical solution o ormula (9), we will resort to the method o numerical solution in the next section.

3. Numerical analysis

In the dynamic model, although we give the determining equation o optimal investment and financing decisions, as well as the solving method, it is very hard to obtain the

explicit solution o model in view o its complexity. In order to observe the result o model in a more intuitive way, we can give the specific unction orm o $f(I)$ and the specific distribution orm o a, and then the optimal L and I_1 with the method o numerical solution.

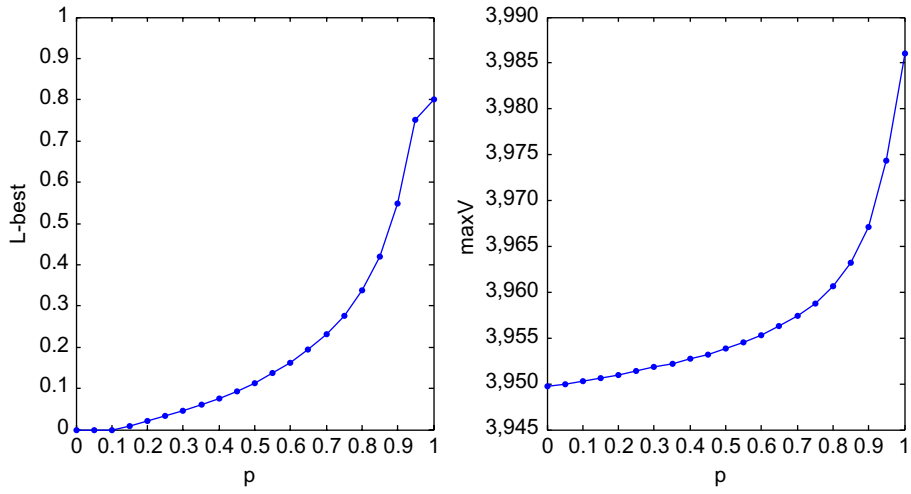
We might make $f(I) = 20\sqrt{I}$; then $f(I)$ satisfies assumptions $f(0) = 0$, $f' > 0$, and $f'' < 0$[3].

The poorest condition o corporate investment is $af(I) = 0$, so we might assume that the random distribution a o the return on investment in the uture is geometrical normal distribution. In addition, because a_1 is a known variable at the time when $t = 1$, or simplicity, we might suppose $a_1 = 1$. $a_{t+1} = a_t * \tilde{\eta}_{t+1}$, where ln $\tilde{\eta}_{t+1}$ complies with the normal distribution o $N(\mu_{t+1}, \sigma^2_{t+1})$, in which μ_{t+1} represents the expected growth rate o the return on investment rom stage t to stage $t + 1$ and σ^2_{t+1} measures the risk in uture economy.

3.1 Equity financing probability and company's capital structure

We first o all pay attention to the e ect o probability p that the company can obtain external equity financing at the time when $t = 2$ on the optimal capital structure. Make parameters $\bar{L} = 80\%$, $\tau = 25\%$, $r_E = 10\%$, $r_D = 5\%$, $\mu_2 = \mu_3 = 1$, and $\sigma_2 = \sigma_3 = 0.3$[4], substitute them into the original equation, and solve the equation; then we obtain the changes o optimal capital structure along with p, shown as in Figure 3.

In the le t subgraph o Figure 3, we can find that with the given parameters, when p approaches to zero, the optimal capital structure o company is also zero, and as p increases, the numerical value o optimal capital structure increases accordingly. When $p = 1$, the optimal capital structure o company is at the point $\bar{L} = 80\%$.



Notes: Parameters: $f(I) = 20\sqrt{I}$, $r_E = 10\%$, $r_D = 5\%$, $\bar{L} = 80\%$, $t = 25\%$, $\mu_2 = \mu_3 = 1$, $\sigma_2 = \sigma_3 = 0.3$

Figure 3.
Equity financing probability vs optimal capital structure and shareholder value

The result o this numerical solution indicates that the larger the financing constraint in stock market (in the model, reflected by the smaller probability p that the company can obtain external equity financing at $t = 2$) is, the lower the optimal capital structure based on enterprise value maximization is.

The right subgraph o Figure 3 intuitively shows us the e ect o probability p that the company can obtain external equity financing at $t = 2$ on the current shareholder value o company. It can be observed rom the subgraph that along with the increase o p, shareholder value increases as well. To be more intuitive, the smaller the uncertainty o corporate financing in stock market in the next stage is, the larger the shareholder value is. This result is consistent with the conclusion o Proposition 2.

3.2 Debt ratio limit, equity financing probability and optimal capital structure

Based on the results above, we can also investigate the impact o bank's limit to the highest debt ratio o company on the optimal capital structure o company and then the e ect o the combined change o highest debt ratio limit and p on corporate capital structure, which helps us know the marginal e ect o p on capital structure in di erent cases.

To make it comparable with the results o Figure 3, we still set parameters as ollows: $\tau = 25\%$, $r_E = 10\%$, $r_D = 5\%$, $\mu_2 = \mu_3 = 1$ and $\sigma_2 = \sigma_3 = 0.3$. Table I and Figure 4 give the optimal debt ratios o company in case o di erent values o p in the range o $\bar{L}$ rom 65 percent to 90 percent.

In Table I, with other parameters given, we provide the optimal shareholder values o company corresponding to assigned p and $\bar{L}$. It can be seen in the table that the shareholder value o company tends to rise in the direction o "south-east". That is to say, the shareholder value o company rises gradually with the increase o p. On the other side, along with the increase o $\bar{L}$, the shareholder value o company also rises, indicating that $\bar{L}$ is also one o the actors influencing the shareholder value o company.

The results in Table I are shown in Figure 4 in a more comprehensive and intuitive manner. It can be observed rom the figure that as $\bar{L}$ decreases (namely that the bank

	L-bar					
P	65 (%)	70 (%)	75 (%)	80 (%)	85 (%)	90 (%)
0.0	0.00	0.00	0.00	0.00	23.46	47.89
0.1	0.00	0.00	0.00	0.00	24.95	49.12
0.2	0.00	0.00	0.00	2.09	26.75	50.45
0.3	0.00	0.00	0.00	4.58	28.78	52.06
0.4	0.00	0.00	0.00	7.60	31.24	53.91
0.5	0.00	0.00	0.00	11.37	34.30	56.20
0.6	0.00	0.00	0.00	16.26	38.19	59.12
0.7	0.00	0.00	2.55	23.07	43.55	63.04
0.8	0.00	0.00	15.74	33.69	51.79	68.92
0.9	21.43	31.38	42.59	54.84	66.75	79.72
1.0	65.00	70.00	75.00	80.00	85.00	90.00

Table I.
Impact o debt ratio limit and equity financing probability on optimal capital structure

Notes: Parameters are set as ollows: $f(I) = 20\sqrt{I}$, $r_E = 10\%$, $r_D = 5\%$, $\tau = 25\%$, $\mu_2 = \mu_3 = 1$ and $\sigma_2 = \sigma_3 = 0.3$; L-bar represents the limit o highest debt ratio, and p represents the probability o equity financing in market in the next stage; results in the table are the optimal debt ratios corresponding to L-bar and p

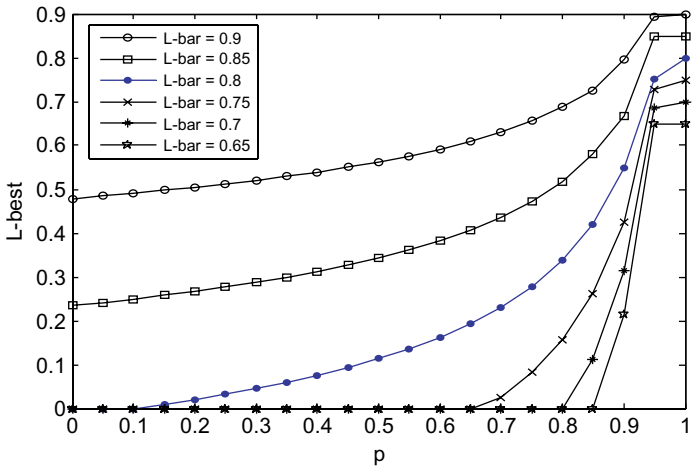


Figure 4.
E ect o debt ratio limit and equity financing probability on optimal capital structure o company

tightens the limit to the debt ratio o company), the line representing the optimal shareholder value o company gradually declines, showing the financing riction brought about by debt ratio limit rom the bank will also reduce the shareholder value o company. Besides, with every given $\bar{L}$, along with the increase o p, the shareholder value o company gradually rises, which is coincident again with the conclusion o Proposition 2.

Additionally, through observing the shapes o all curves, we can find that when $\bar{L}$ is relatively high, the curve is relatively gentle, whereas when $\bar{L}$ is lower, the curve is steeper. This result indicates that along with the increase o $\bar{L}$, the sensitivity o the optimal shareholder value o company to p decreases; similarly, along with the increase o p, the sensitivity o the optimal shareholder value o company to $\bar{L}$ also decreases.

3.3 Growth opportunity, equity financing probability and optimal capital structure

In the model herein, random variable $\tilde{a}_2$ is an important variable. Its characteristics may be an important actor influencing the optimal capital structure. In our assumption about $\tilde{a}$, μ_{t+1}, as an important characteristic variable o $\tilde{a}$, represents the expected growth rate o the return on investment rom stage t to stage $t+1$, so it is necessary to investigate the combined change o μ_{t+1} and p (representing uture growth) on the optimal decision-making o company.

Similarly, to make it comparable with the results above, we still set parameters as ollows: $\tau = 25\%$, $r_E = 10\%$, $r_D = 5\%$, $\bar{L} = 80\%$ and $\sigma_2 = \sigma_3 = 0.3$. Table II gives the optimal capital structures o company in case o di erent values o p in the range o μ gradually increasing rom 0.5 to 1.2.

It can be seen in Table II that in each column, as p increases, the optimal capital structure rises, which coincides with the conclusion o Section 3.1 again; in each row, as μ increases, the optimal capital structure shows a trend o decline – this result is consistent with the theoretical study o Myers (1977). According to Myers, when the uture growth opportunity is higher, the company has more real options; i the company adopts debt financing in such case, it means that the company may give up these options, because such investment trans ers wealth rom shareholders to the creditor.

p	μ 0.5 (%)	0.6 (%)	0.7 (%)	0.8 (%)	0.9 (%)	1.0 (%)	1.1 (%)	1.2 (%)
0.0	70.54	62.45	51.69	37.82	20.20	0.00	0.00	0.00
0.1	71.70	63.73	53.15	39.38	21.89	0.00	0.00	0.00
0.2	73.05	65.15	54.71	41.15	23.87	2.09	0.00	0.00
0.3	74.00	66.79	56.63	43.23	26.13	4.58	0.00	0.00
0.4	76.28	68.78	58.81	45.73	28.89	7.60	0.00	0.00
0.5	77.15	70.99	61.52	48.76	32.29	11.37	0.00	0.00
0.6	80.00	73.87	64.96	52.67	36.66	16.26	0.00	0.00
0.7	80.00	77.03	69.47	57.99	42.69	23.07	0.00	0.00
0.8	80.00	80.00	75.36	66.00	51.98	33.69	10.38	0.00
0.9	80.00	80.00	80.00	76.88	69.31	54.84	35.24	10.15
1.0	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00

Table II.
E ect o growth opportunity and equity financing probability on optimal capital structure

Notes: Parameters are set as ollows: $f(I) = 20\sqrt{I}$, $r_E = 10\%$, $r_D = 5\%$, $\tau = 25\%$, $\bar{L} = 80\%$ and $\sigma_2 = \sigma_3 = 0.3$; μ represents the growth o uture corporate income, and p represents the probability o equity financing in market in the next stage; results in the table are the optimal debt ratios corresponding to μ and p

The results in Table II are shown in Figure 5 in a more detailed and intuitive way. The graphical results clearly show us that consistent with the result above, the financing riction in stock market is still an important actor influencing the optimal capital structure o company: with other parameters given, the larger the financing riction in stock market is (reflected by smaller p), the lower the optimal capital structure o company is. Meanwhile, it can be seen rom the positions o all curves that the uture corporate growth also significantly influences the optimal capital structure o company – along with μ increases, the curve o optimal capital structure declines gradually. This result preliminarily demonstrates that in our three-stage dynamic model, when the company makes a decision on current optimal capital structure, the uture corporate growth is one o the important actors that should be considered; specifically, the higher the uture corporate growth is, the lower the current optimal capital structure o company is. It is especially worth noting that

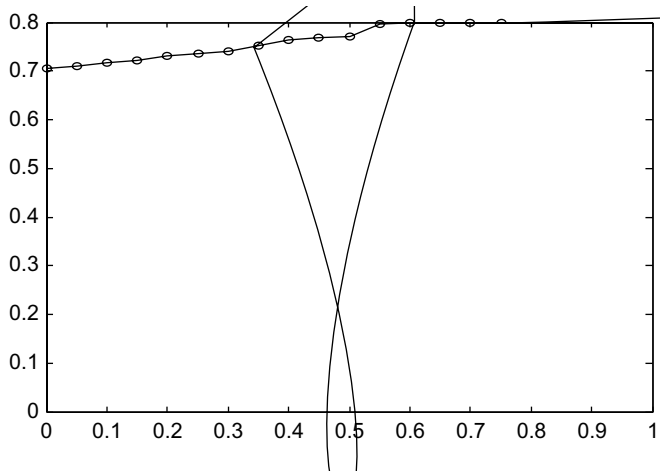


Figure 5.
E ect o growth opportunity and equity financing probability on optimal capital structure

when μ is relatively large and p relatively low, the optimal capital structure o company is in the state o zero capital structure; on the contrary, when μ is relatively small and p relatively high, the optimal capital structure o company is at the highest limit position (in this result, zero capital structure is help ul or interpreting the "financial conservative" behavior while the highest capital structure or "financial radical" behavior).

3.4 Income volatility, equity financing probability and optimal capital structure of

It is observed that in our assumption about $\tilde{a}$, σ_{t+1}^2 represents the fluctuation degree o the return on investment rom stage t to stage $t+1$, there ore it is another important characteristic variable o $\tilde{a}$. As a result, it is necessary to investigate the combined change o σ_{t+1} and p (representing uture income volatility) on the optimal decision-making o company.

Similarly, to make it comparable with the results above, we still set parameters as ollows: $\tau = 25\%, r_E = 10\%, r_D = 5\%, \bar{L} = 80\%$ and $\mu_2 = \mu_3 = 1$. Table III describes the optimal capital structures o company in case o di erent values o p in the range o σ increasing rom 0.1 to 0.5.

It can be seen rom Table III that the optimal capital structure tends to rise along the direction o "le t bottom". To be specific, in every column, as p increases, the optimal capital structure gradually rises, which coincides with the a oresaid conclusion again; in every row, as σ increases, the optimal capital structure shows a trend o decline.

The results in Table III are shown in Figure 6 in a more detailed and intuitive way. The graphical results clearly show that consistent with the result above, the financing riction in stock market is still an important actor influencing the optimal capital structure o company: with other parameters given, the larger the financing riction in stock market is (reflected by smaller p), the lower the optimal capital structure o company is. Meanwhile, it can be seen rom the positions o all curves that the uture income volatility o company also significantly influences the optimal capital structure o company – along with σ increases, the curve o optimal capital structure declines gradually. This result preliminarily demonstrates that in our three-stage dynamic

	σ				
p	0.1 (%)	0.2 (%)	0.3 (%)	0.4 (%)	0.5 (%)
0.0	32.93	15.60	0.00	0.00	0.00
0.1	34.03	17.20	0.00	0.00	0.00
0.2	35.29	19.00	2.09	0.00	0.00
0.3	36.78	21.13	4.58	0.00	0.00
0.4	38.60	23.71	7.60	0.00	0.00
0.5	40.88	26.91	11.37	0.00	0.00
0.6	43.93	31.10	16.26	1.54	0.00
0.7	48.33	36.95	23.07	8.97	0.00
0.8	55.64	46.25	33.69	20.43	6.74
0.9	72.42	65.55	54.84	42.77	30.31
1.0	80.00	80.00	80.00	80.00	80.00

Notes: Parameters are set as ollows: $f(I) = 20\sqrt{I}$, $r_E = 10\%$, $r_D = 5\%$, $\tau = 25\%$, $\bar{L} = 80\%$ and $\mu_2 = \mu_3 = 1$; σ represents the uture income volatility o company, and p represents the probability o equity financing in market in the next stage; results in the table are the optimal debt ratios corresponding to σ and p

Table III.
E ect o income volatility and equity financing probability on optimal capital structure

model, when the company makes a decision on current optimal capital structure, apart rom several important actors mentioned above, the uture income volatility is one o the important actors that should be considered; specifically, the higher the uture income volatility is, the lower the current optimal capital structure o company is. It is worth particularly noting that when σ is relatively high and p relatively low, the optimal capital structure o company is in the state o zero capital structure.

4. Conclusion

Through a model and numerical analysis, the paper discusses the e ect o the equity financing probability on the optimal capital structure o company. The study conclusion demonstrates:

- In the static model, due to the absence o the going-concern pressure o company, the optimal financing always uses liabilities as ar as possible to maintain the optimal capital structure at the upper limit. This is consistent with the conclusion o MM (1963) when only tax is taken into consideration.
- In the dynamic model, the company needs to consider the operation in the next stage. Since the uture cash flow o company is related to its current investment and financing activities, the uncertainty o company's external equity financing will impact the shareholder value. Specifically, the smaller the probability that the company can realize external equity financing in the next stage, the greater the loss o shareholder value will be caused.
- The numerical solution o dynamic model shows that with model parameters set, the probability o financing in stock market has a significant e ect on the optimal capital structure o company: the smaller the probability that the

The study conclusion o this paper can add a new actor or the interpretation o equity financing pre erence o A-share listed companies. Such companies mostly belong to competitive industries in the stage o rapid growth and expansion and need to make continual investment on the premise o steady finance. However, stock issuance regulation increases the uncertainty o corporate financing in stock market. There ore, as to entity companies, the opportunity o equity financing is very precious: by seizing this opportunity, the company is able to reserve equity unds to cope with the possible equity uncertainty in uture, strengthen the ability to compete and the flexibility to grasp development opportunities, including investment in necessary projects or merger and acquisition, and maintain a high credit rating; especially under the circumstances o uncertain business environment, fierce competition and strict financing conditions in stock market, the company can gradually reduce financial leverage and capital cost and increase shareholder value by means o subsequent debt financing. For these reasons, listed companies pre er to equity financing and strive to meet the access conditions o stock issuance and obtain the qualification o stock issuance even through earnings management. Such a behavior cannot be totally attributed to low financing cost, corporate governance, insider control and other corporate actors, but also involves the actor o rational reaction to the equity financing uncertainty brought about by stock market conditions and financing regulations.

The study in this paper also has some enlightenment significance or regulatory authorities. One o the aims o regulatory authorities o capital market by taking strict regulatory measures or equity refinancing o listed companies is to allocate limited capital to better investment projects by means o government intervention, thereby improving the allocation e ficiency o capital. But seen rom actual operation, such a regulatory mode is liable to make company "intentionally hoard" equity capital and thereby reduce the utilization e ficiency o equity capital. As a result, regulatory authorities need to urther think about how to impel listed companies to improve the use e ficiency o equity capital with more e ective measures.

Notes

1. In the academic circle o corporate finance, there are many studies ocusing on the e ect o financing constraints on capital budget, dividend policy, cash reserve and risk management. For example, it is shown by the result o the general model established by Almeida *et al.* (2011) that the greater the uture financing constraints are, the more the company currently tends to invest projects with shorter payback period and lower risk, as well as assets with good investment liquidity and high mortgage value. But the financing constraints mentioned by these studies are generally defined as the condition that current cash flow cannot meet current investment demand, but still implicitly assume the company is able to acquire financing rom external market, despite the high financing cost.
2. The insolvency o company here means the net assets are negative in a purely theoretical sense, that is, all equities o company (including intangible assets, human capital, etc.) are exhausted. In reality, insolvency o company does not necessarily lead to bankruptcy, because the company still has the value o existence, i.e. having net assets, or example, the assessed value o intangible assets o company, and so on.
3. Note: Coe ficient 20 in $f(I) = 20\sqrt{I}$ has no essential meaning, and the purpose o using 20 is merely or the convenience o unitization – making the value o $f(I) - I$ maximum when $I = 100$.

4. Parameters are selected based on the ollowing: it can be ound rom the data on the interest-bearing debt/total capital input o listed companies in 2012, except financial companies and companies titled with ST, the ratio o about 95 percent's companies is lower than 90 percent, and that o 80 percent's companies is lower than 80 percent; there ore the paper selects 80 percent as the highest debt ratio limit o company, but this parameter will be adjusted and compared in the analysis below; considering that the income tax rate o company in orce in China is 25 percent, $\tau = 25\%$; since 2009, the interest rate o short-term bank loans in China fluctuates between 4.86 percent and 6.10 percent, so $r_D = 5\%$ in the paper (besides, the interest rate o corporate bonds is maintained at about 5 percent in recent years); since 2009, the average annual rate o return in Shanghai Composite Index o China is approximately 10 percent, so $r_E = 10\%$; because the paper adopts a three-stage model, it is not easy or parameter a to find a corresponding parameter in the real economy; there ore $\mu_2 = \mu_3 = 1$ and $\sigma_2 = \sigma_3 = 0.3$ or the time being here, and special parameter changes are conducted or these two variables below.

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Further reading

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