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The Design of Stratified Contingent Bank Liability Structure to Release Risk Incentive Effects

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Abstract: This paper proposes a new type of bank liability structure with stratified contingent capital based on the suggestions of Basel III and TLAC Term Sheet. It try to solve the problem that the total loss absorbing capacity of global systemically important banks is insufficient and the single contingent capital-CoCos will bring extra risk to the bank in recent years. Compared with single contingent capital, the bail-in mechanism of stratified contingent capital is more complex and its risk effects will be more uncertain. Therefore, this paper studies how to design the parameters setting of stratified contingent liability structure to release the incentive effect of original shareholders' risk taking. Firstly, it analyzed the basic setting of bank capital structure and bail-in mechanism. And then, it calculated the value of CoCos, TLAC bonds, and original shareholders' equity by replicating payoffs using sets of exotic options. Finally, it calculated the elasticity of the original shareholders' equity value to the volatility of asset value. The elasticity is used to analyze the incentive effect of original shareholders' risk taking. The numerical analysis shows that risk incentive effect is more sensitive to the parameters setting of CoCos. In any case, conversion rate has a more important impact than the trigger threshold. In particular, the effect of risk taking can be eliminated by setting the parameters properly.

Keywords: Contingent Capital, Debt Structure, Risk Incentive

1. Introduction

When banks enter financial distress, they have to rely on government assistance because they are unable to raise new capital in the market. After the 2008 financial crisis, the main opinion of regulatory authorities and relevant scholars is to use new financial derivatives to enhance the loss absorption capacity of banks. Basel III proposed to issue contingent capital to strengthen the supervision of banks' systemic risk [1]. Such contingent capital usually exists in the form of contingent convertible bonds (Cocos). CoCos can automatically convert into equity at the point of non-vialibity. In 2015, the Financial Stability Board (FSB) proposed to issue another kind of contingent capital, called TLAC bonds to raise the requirements of the total loss absorbing capacity of global systemically important banks (G-SIBs) in TLAC Term Sheet. G-SIBs can be restructured by converting TLAC bonds into equity in the stage of resolution before bankrupt [2]. Considering the trigger point of CoCos and TLAC bonds are different, there is stratified contingent capital in bank capital structure.

Stratified contingent capital can enhance the banks' loss absorption capacity effectively. But at the same time, the complexity of such new bank liability structure also raises other problems, that is, whether it can play the role in anticipation, and whether there will be unexpected risks. Most of the related researches are concerned about the risk effects of single contingent capital－CoCos because of TLAC bonds come later and its loss-absorbing mechanism is similar to CoCos. Mahmoud and Perotti show that CoCos is superior to subordinated debt that may be bailed in upon default, as it actively discourages ex ante risk [3]. Calomiris and Herring propose CoCos can provide strong incentives for effective risk governance by regulated banks, and help limit regulatory forbearance [4]. Barucci and Viva consider that contingent capital reduces the spread of straight debt and is effective in reducing the asset substitution incentive [5]. Fiordelisi et al find evidence that equity conversion CoCos can reduce several measures of downside risk [6]. But other researches, like Berg and Christoph 、 Mahmoud and Ayowande, Chan and Wijnbergen analyze that CoCos can improve the incentive effect of bank original shareholder's risk taking by converting into equity [7-9]. Gai et al show that bail-in tools such as CoCos can increase in the risk premium for unsecured bonds [10]. To solve this problem, some scholars propose to think more about the contract design of contingent capital. Koziol and Lawrenz show that a conversion price that induces some wealth transfer from equity holders to CoCo bond holders could help to mitigate risk-shifting incentives already present in the current capital structure of banks [11]. Sundaresan and Wang propose to choose a suitable conversion price with market-based trigger may solve the situation where no unique or multiple equilibrium exists [12]. Pennacchi, Hilscher and Raviv, Himmelberg and Tsyplakov all consider a higher convertion ratio can reduce original shareholder' risk taking by more equity dilution [13-15].

In this paper, we analyze bank original shareholder' risk taking incentive effort of introducing stratified contingent capital into bank liability structure. Considering that the regulatory authorities may require banks to adjust their capital structure at the end of each audit cycle, this paper establishes a single period dynamic continuous time model. In each cycle, three risk events including conversion of CoCos， convertion of TLAC bonds or bankruptcy liquidation may be triggered. The occurrence of these risk events will affect the final value of depositors, bondholders and original shareholders. This paper develop the model of Hilscher and Raviv to derive closed-form solutions for the values of every stakeholder by decomposing capital structure components into sets of exotic options [14]. Furthermore, we calculate the elasticity of shareholders' equity value to the volatility of bank asset value to measure the incentive effect of original shareholder's risk taking. Based on these calculations, we analyze the impact of important parameters in CoCos and TLAC bonds contracts on the incentive effect of original shareholder's risk taking within a certain range.

2. Model Setup

2.1. Bank Capital Structure

This paper consider a bank capital structure consists of four parts: zero-coupon deposit with face value D and market value V_t^D, CoCos with face value B^C and market value V_t^C, TLAC bonds with face value B^L and market value V_t^L, and residual equity face value E and market value V_t^E. B is the whole face value of all contingent capital, where $B^C=\delta B$, $0<\delta<1$. All the claims mature at time T, unless there is a risk event before T. Our analysis allows the bank's asset value V_t to follow Geometric Brownian motion, we assume

$$dV_t = \mu V_t dt + \sigma V_t dW_t^P \tag{1}$$

where μ is the drift rate, σ is the volatility, and W_t^P is a Wiener process.

2.2. Conversion of CoCos

CoCos is converted into equity at any time before T when the asset value V_t drops below the point of non-vialibity $H_C=(1+\varphi^C)(D+B)$, where $\varphi^C(\varphi^C>0)$ is the minimum regulatory requirement of non-vialibity. After conversion, the CoCos holders receive a share $\alpha(0\le\alpha\le1)$ of the equity and the original shareholders receive the remaining $(1-\alpha)$. The time of CoCos conversion is defined as

$$\tau_C = \inf\left\{t > 0 \middle| V_t \le H_C\right\} \tag{2}$$

2.3. Conversion of TLAC Bonds

After the conversion of CoCos, TLAC bonds is converted into equity at any time before T when the asset value continuously drops below the trigger threshold of resolution $H_L=(1+\varphi^L)(D+B^L)$, where $\varphi^L(0<\varphi^L<(D+B)/(D+B^L)-1)$ measures the distance between the resolution threshold and the book value of whole residual debt. After conversion, the TLAC Bond holders receive a share $\beta(0\le\beta\le1)$ of the equity. The CoCos holders receive a share $\alpha(1-\beta)$ of the equity. The original shareholders receive the remaining $(1-\alpha)(1-\beta)$. The time of TLAC Bonds conversion is defined as

$$\tau_L = \inf\left\{t > 0 \middle| V_t \le H_L\right\} \tag{3}$$

2.4. Bankrupt

After the conversion of all contingent capital, the regulator will force liquidation in the event of insolvency. Following Merton (1974), we assume the bankrupt threshold H_D is equal to the book value of deposit D. The time of bankrupt is defined as

$$\tau_D = \inf\left\{t > 0 \middle| V_t \le H_D\right\} \tag{4}$$

After bankrupt, the deposit holders receive preferential payment $(1-\lambda)D$, where λ is bankruptcy cost.

3. Pricing

3.1. Valuation of the Original Shareholders

There are four cases of the payoff to the original shareholders at time T: 1) No risk event occurs before T, and the original shareholders will hold the whole equity; 2) The asset value drops below the point of non-vialibity but stay above the resolution threshold before T. In this case, the original shareholders will hold a share $(1-\alpha)$ of the equity; 3) The asset value drops below the resolution threshold but stay above the bankrupt threshold before T. In this case, the original shareholders will hold a share $(1-\alpha)(1-\beta)$ of the equity; 4) The asset value drops below the bankrupt threshold before T, and the original shareholders' equity value is 0. The payoff to the original shareholders can be summarized as:

$$E_T = \begin{cases} V_T - D - B, & \tau_C > T \\ (1-\alpha)\left(V^T - D - B^L\right), & \tau_C \le T < \tau_L \\ (1-\alpha)(1-\beta)\left(V^T - D\right), & \tau_L \le T < \tau_D \\ 0, & \tau_D \le T \end{cases} \tag{5}$$

The risk-neutral value of the original shareholders can be expressed as:

$$\begin{aligned} V_0^E &= E^Q\left[e^{-rT}\left((V_T - D - B)1_{\{\tau_C > T\}} + (1-\alpha)\left(V_T - D - B^L\right)1_{\{\tau_C \le T < \tau_L\}} + (1-\alpha)(1-\beta)(V_T - D)1_{\{\tau_L \le T < \tau_D\}}\right)\right] \\ &= E^Q\left[e^{-rT}\left((V_T - D - B)1_{\{\tau_C > T\}} + (1-\alpha)\left(\max\left[V_T - D - B^L, 0\right]1_{\{\tau_C \le T\}} - \max\left[V_T - D - B^L, 0\right]1_{\{\tau_L \le T\}}\right)\right.\right. \\ &\quad \left.\left. + (1-\alpha)(1-\beta)\left(\max\left[V_T - D, 0\right]1_{\{\tau_L \le T\}} - \max\left[V_T - D, 0\right]1_{\{\tau_D \le T\}}\right)\right)\right] \end{aligned} \tag{6}$$

where r is the risk-free rate, $E^Q[\bullet]$ denotes the expectation under the risk-neutral measure Q.

Equation (6) can be rewritten as:

$$\begin{aligned} V_0^E &= C_{do}\left(H_C, D + B^L + B^C, T\right) + (1-\alpha)\left(C_{di}\left(H_C, D + B^L, T\right) - C_{di}\left(H_L, D + B^L, T\right)\right) \\ &\quad + (1-\alpha)(1-\beta)\left(C_{di}\left(H_L, D, T\right) - C_{di}\left(H_D, D, T\right)\right) \end{aligned} \tag{7}$$

where $C_{do}(H, K, T)$ is the value of a down-and-out call option with barrier threshold H, strike price $K(K \le H)$ and term T. $C_{di}(H, K, T)$ is the value of a down-and-in call option with barrier threshold H, strike price $K(K \le H)$ and term T. The analytic solution of $C_{do}(H, K, T)$ and $C_{di}(H, K, T)$ can be referred to Zhang [16].

3.2. Valuation of the CoCos Holders

There are four cases of the payoff to the CoCos holders at time T: 1) No risk event occurs before T, and the payoff to the CoCos holders is B^C; 2) The asset value drops below the point of non-vialibity but stay above the resolution threshold before T. In this case, the CoCos holders will hold a share α of the equity; 3) The asset value drops below the the resolution threshold but stay above the bankrupt threshold before T. In this case, the CoCos holders will hold a share $\alpha(1-\beta)$ of the equity; 4) The asset value drops below the bankrupt threshold before T, and the CoCos holders' equity value is 0. The payoff to the CoCos holders can be summarized as:

$$V_T^C = \begin{cases} B^C, & \tau_C > T \\ \alpha\left(V_T - D - B^L\right), & \tau_C \le T < \tau_L \\ \alpha(1-\beta)(V_T - D), & \tau_L \le T < \tau_D \\ 0, & \tau_D \le T \end{cases} \tag{8}$$

The risk-neutral value of the CoCos holders can be expressed as:

$$\begin{aligned} V_0^C &= E^Q\left[e^{-rT}\left(B^C 1_{\{\tau_C > T\}} + \alpha\left(V_T - D - B^L\right)1_{\{\tau_C \le T < \tau_L\}} + \alpha(1-\beta)(V_T - D)1_{\{\tau_L \le T < \tau_D\}}\right)\right] \\ &= E^Q\left[e^{-rT}\left(B^C 1_{\{\tau_C > T\}} + \alpha\left(\max\left[V_T - D - B^L, 0\right]1_{\{\tau_C \le T\}} - \max\left[V_T - D - B^L, 0\right]1_{\{\tau_L \le T\}}\right)\right.\right. \\ &\quad \left.\left. + \alpha(1-\beta)\left(\max\left[V_T - D, 0\right]1_{\{\tau_L \le T\}} - \max\left[V_T - D, 0\right]1_{\{\tau_D \le T\}}\right)\right)\right] \end{aligned} \tag{9}$$

Equation (9) can be rewritten as:

$$\begin{aligned} V_0^C = B^C D_{do}\left(H_C, T\right) + \alpha\Big(C_{di}\left(H_C, D + B^L, T\right) \\ - C_{di}\left(H_L, D + B^L, T\right)\Big) \\ + \alpha(1-\beta)\Big(C_{di}\left(H_L, D, T\right) \\ - C_{di}\left(H_D, D, T\right)\Big) \end{aligned} \tag{10}$$

where $D_{do}(H, T)$ is the value of European down-and-out digital barrier option with barrier threshold H, term T and payoff 1. The analytic solution of $D_{do}(H, T)$ can be referred to Zhang [16].

3.3. Valuation of the TLAC Bonds Holders

There are three cases of the payoff to the TLAC bonds holders at time T: 1) No risk event occurs or the asset value drops below the point of non-vialibity but stay above the resolution threshold before T, and the payoff to the TLAC bonds holders is B^L; 2) The asset value drops below the the resolution threshold but stay above the bankrupt threshold before T. In this case, the TLAC bonds holders will hold a share β of the equity; 3) The asset value drops below the bankrupt threshold before T, and the TLAC bonds holders' equity value is 0. The payoff to the TLAC bonds holders can be summarized as:

$$V_T^L = \begin{cases} B^L, & \tau_L > T \\ \beta(V_T - D), & \tau_L \le T < \tau_D \\ 0, & \tau_D < T \end{cases} \tag{11}$$

The risk-neutral value of the TLAC bonds holders can be expressed as:

$$\begin{aligned} V_0^L &= E^Q\left[e^{-rT}\left(B^L 1_{\{\tau_L > T\}} + \beta(V_T - D)1_{\{\tau_L \le T < \tau_D\}}\right)\right] \\ &= E^Q\left[e^{-rT}\left(B^L 1_{\{\tau_L > T\}} + \beta\left(\max\left[V_T - D, 0\right]1_{\{\tau_L \le T\}} - \max\left[V_T - D, 0\right]1_{\{\tau_D \le T\}}\right)\right)\right] \end{aligned} \tag{12}$$

Equation (12) can be rewritten as:

$$V_0^L = B^L D_{do}\left(H_L, T\right) + \beta\left(C_{di}\left(H_L, D, T\right) - C_{di}\left(H_D, D, T\right)\right) \tag{13}$$

3.4. Valuation of the Deposit Holders

There are two cases of the payoff to the deposit holders at time T: 1) The asset value stays above the bankrupt threshold before T, and the payoff to the deposit holders is D; 2) The asset value drops below the bankrupt threshold before T, and the payoff to the deposit holders is $(1-\lambda)D$. The payoff to the deposit holders can be summarized as:

$$V_T^D = \begin{cases} D, & \tau_D > T \\ (1-\lambda)D, & \tau_D \le T \end{cases} \tag{14}$$

The risk-neutral value of the deposit holders can be expressed as:

$$V_0^D = E^Q\left[e^{-rT} D 1_{\{\tau_D > T\}} + e^{-r\tau_D}(1-\gamma) D 1_{\{\tau_D \le T\}}\right] \tag{15}$$

Equation (15) can be rewritten as:

$$V_0^D = D D_{do}\left(H_D, T\right) + (1-\gamma) D D_{di}\left(H_D, T\right) \tag{16}$$

where $D_{di}(H, T)$ is the value of American down-and-in digital barrier option with barrier threshold H, term T and payoff 1. The analytic solution of $D_{di}(H, T)$ can be referred to Zhang [16].

3.5. The Elasticity of the Original Shareholders' Equity Value to the Volatility of Asset Value

The elasticity of the original shareholders' equity value to the volatility of asset value means the change degree of the original shareholders' equity value caused by 1% change in the volatility of asset value. It can be expressed as:

$$e_{E_0} = \frac{\partial V_0^E / V_0^E}{\partial \sigma / \sigma} = \frac{\partial V_0^E}{\partial \sigma}\frac{\sigma}{V_0^E} \tag{17}$$

Combined with Equation (6), Equation (17) can be rewritten as:d

$$\begin{aligned} \frac{\partial V_0^E}{\partial \sigma} &= \frac{\partial C_{do}\left(H_C, D+B^L+B^C, T\right)}{\partial \sigma} + (1-\alpha)\left(\frac{\partial C_{di}\left(H_C, D+B^L, T\right)}{\partial \sigma} - \frac{\partial C_{di}\left(H_L, D+B^L, T\right)}{\partial \sigma}\right) + (1-\alpha)(1-\beta)\left(\frac{\partial C_{di}\left(H_L, D, T\right)}{\partial \sigma} - \frac{\partial C_{di}\left(H_D, D, T\right)}{\partial \sigma}\right) \\ &= v_{cdo}\left(H_C, D+B^L+B^C, T\right) + (1-\alpha)\left(v_{cdi}\left(H_C, D+B^L, T\right) - v_{cdi}\left(H_L, D+B^L, T\right)\right) + (1-\alpha)(1-\beta)\left(v_{cdi}\left(H_L, D, T\right) - v_{cdi}\left(H_D, D, T\right)\right) \end{aligned} \tag{18}$$

where $v_{cdo}(H,K,T)$ is the Vega of a down-and-out call option with barrier threshold H, strike price $K(K \le H)$ and term T.

$v_{cdi}(H,K,T)$ is the Vega of a down-and-in call option with barrier threshold H, strike price $K(K \le H)$ and term T.

$v_{cdi}(H,K,T)$ can be calculated as:

$$\begin{aligned} v_{cdi}\left(H,K,T\right) &= V_0 N'\left(d_1\right)\left((1-\lambda)\sqrt{T} - \frac{\ln\left(V_0/K\right)}{\sigma^2\sqrt{T}}\right) - Ke^{-rT}N'\left(d_1 - \sigma\sqrt{T}\right)\left(-\lambda\sqrt{T} - \frac{\ln\left(V_0/K\right)}{\sigma^2\sqrt{T}}\right) - V_0 N'\left(d_2\right)\left((1-\lambda)\sqrt{T} - \frac{\ln\left(V_0/H\right)}{\sigma^2\sqrt{T}}\right) \\ &+ Ke^{-rT}N'\left(d_2 - \sigma\sqrt{T}\right)\left(-\lambda\sqrt{T} - \frac{\ln\left(V_0/H\right)}{\sigma^2\sqrt{T}}\right) + V_0\left(\left(H/V_0\right)^{2\lambda} N'\left(d_3\right)\left((1-\lambda)\sqrt{T} - \frac{\ln\left(H/V_0\right)}{\sigma^2\sqrt{T}}\right)\right. \\ &+ \left.\left(\frac{2-4\lambda}{\sigma}\right)N\left(d_3\right)\left(H/V_0\right)^{2\lambda}\ln\left(H/V_0\right)\right) - Ke^{-rT}\left(\left(H/V_0\right)^{2\lambda-2} N'\left(d_3\right)\left(-\lambda\sqrt{T} - \frac{\ln\left(H/V_0\right)}{\sigma^2\sqrt{T}}\right)\right. \\ &+ \left.\left(\frac{2-4\lambda}{\sigma}\right)N\left(d_3\right)\left(H/V_0\right)^{2\lambda-2}\ln\left(H/V_0\right)\right) \end{aligned} \tag{19}$$

where

$$\lambda = \frac{r+\sigma^2/2}{\sigma^2}, \quad d_1 = \frac{\ln(V_0/K)}{\sigma\sqrt{T}} + \lambda\sigma\sqrt{T},$$

$$d_2 = \frac{\ln(V_0/H)}{\sigma\sqrt{T}} + \lambda\sigma\sqrt{T}, \quad d_3 = \frac{\ln(H/V_0)}{\sigma\sqrt{T}} + \lambda\sigma\sqrt{T},$$

$N(x)$ is the distribution function of the standard normal distribution, $N'(x) = \left(1/\sqrt{2\pi}\right)e^{-x^2/2}$.

$v_{cdo}(H,K,T)$ can be calculated as:

$$\begin{aligned} v_{cdo}(H,K,T) &= V_0 N'(d_2)\left((1-\lambda)\sqrt{T} - \frac{\ln(V_0/H)}{\sigma^2\sqrt{T}}\right) - Ke^{-rT}N'\left(d_2 - \sigma\sqrt{T}\right)\left(-\lambda\sqrt{T} - \frac{\ln(V_0/H)}{\sigma^2\sqrt{T}}\right) \\ &- V_0\left((H/V_0)^{2\lambda} N'(d_3)\left((1-\lambda)\sqrt{T} - \frac{\ln(H/V_0)}{\sigma^2\sqrt{T}}\right) + \left(\frac{2-4\lambda}{\sigma}\right) N(d_3)(H/V_0)^{2\lambda}\ln(H/V_0)\right) \\ &+ Ke^{-rT}\left((H/V_0)^{2\lambda-2} N'(d_3)\left(-\lambda\sqrt{T} - \frac{\ln(H/V_0)}{\sigma^2\sqrt{T}}\right) + \left(\frac{2-4\lambda}{\sigma}\right) N(d_3)(H/V_0)^{2\lambda-2}\ln(H/V_0)\right) \end{aligned} \tag{20}$$

4. Numerical Analysis

4.1. Parameters Setting

The basic parameters of bank capital structure are referred to 2019 annual report of China Construction Bank. We assume the initial asset value V_0 is 25.44. The liability structure is composed of deposit with face value D=18.37 and contingent capital with face value B=4.83. We choose T=1 given that major audits are scheduled once a year. The risk-free rate r=1.75% is the one-year deposit rate of China Construction Bank. We choose the following base case values for other parameters: δ=0.5, σ=0.03, α=β=0.5, φ^C=0.04, and φ^L=0. Then we perform sensitivity analysis around these values.

4.2. The Impacts of Conversion Ratio on Risk Incentive Effect

We first consider the impacts of conversion ratio on the incentive effect of original shareholder' risk taking. Figure 1 and Figure 2 show that the elasticity increases as the volatility of bank asset increases and elasticity increases as either conversion ratio α or β decreases. That means a high risk market can inspire original shareholder' risk taking and more equity dilution through conversion can restrain original shareholder' risk taking. Figure 1 and Figure 2 also present that the elasticity is zero when the volatility of bank asset is too low. That's because conversion of either contingent capital is hard to be triggered. In addition, Figure 1 shows that the elasticity could be negative when the setting of conversion ratio is too friendly to bonds holders. It is not conducive to investment decision.

It can be seen from Figure 3 that the impact of α on e_{E0} is bigger than the the impact of β on e_{E0}. The reason is that conversion of CoCos is easier to trigger. There is a zero value curve composed of the points corresponding to the conversion ratio of CoCos and TLAC bonds because of e_{E0} impacted by α ranges from positive to negative. This suggests that the incentive effect of original shareholder' risk taking can be eliminated by proper setting of conversion ratio.

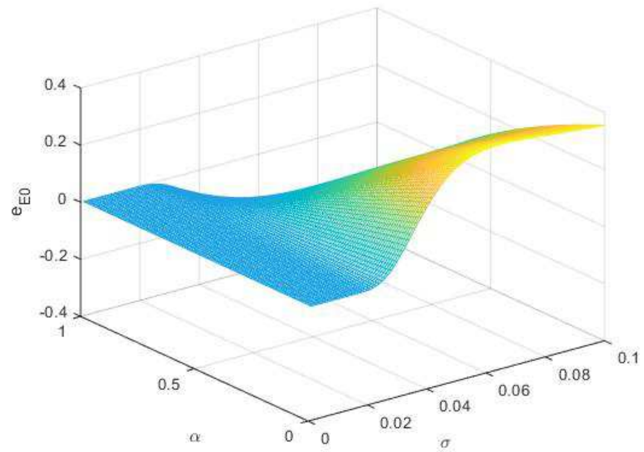

Figure 1. *Impacts of α and σ on e_{E0}.*

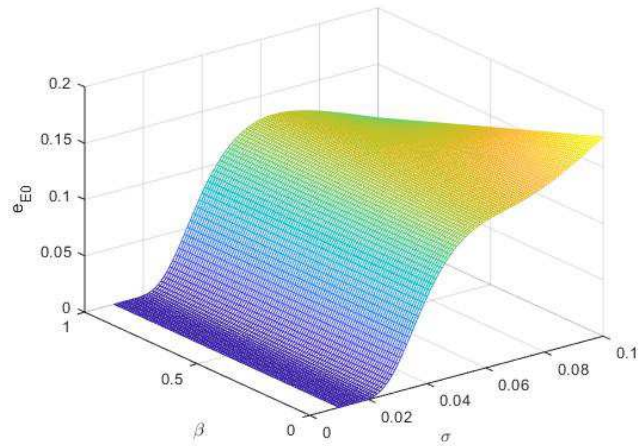

Figure 2. *Impacts of β and σ on e_{E0}.*

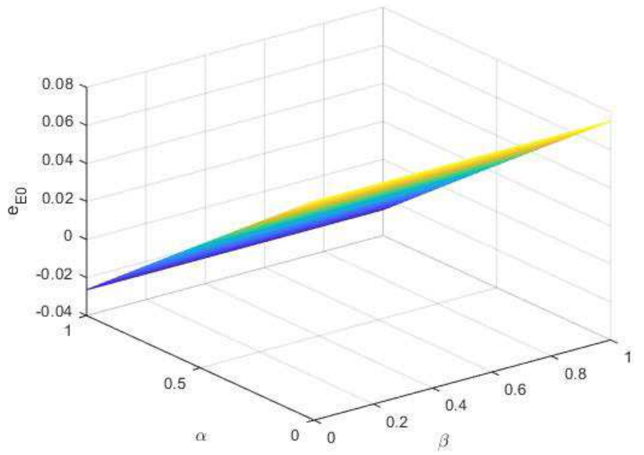

Figure 3. *Impacts of α and β on e_{E0}.*

4.3. The Impacts of Trigger Threshold on Risk Incentive Effects

Then we consider the impacts of trigger threshold on the incentive effect of original shareholder' risk taking. Figure 4 and Figure 5 show that the elasticity increases as the volatility of bank asset increases and the elasticity decreases as either trigger threshold increases when the volatility of bank asset is high. That means the uncertainty caused by early conversion can restrain original shareholder' risk taking. Figure 5 presents that the change of the elasticity is not obvious as the trigger threshold increases when the volatility of bank asset is not too high. That's because conversion of TLAC bonds will only be triggered in a high risk market.

It can be seen from Figure 6 that the trigger threshold of CoCos has a major impact on the incentive effect. By compare Figure 4 and Figure 6, we can see that impact of conversion ratio on the incentive effect is much bigger than the impact of trigger threshold on the incentive effect. This suggests that we should main consider the setting of conversion ratio to control the incentive effect of original shareholder' risk taking.

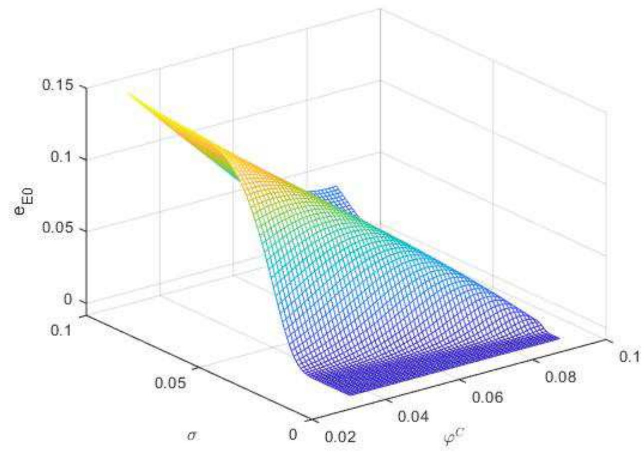

Figure 4. *Impacts of σ and φ^C on e_{E0}.*

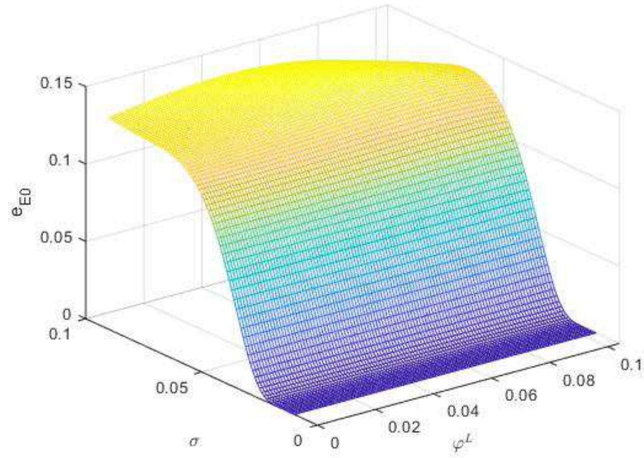

Figure 5. *Impacts of σ and φ^L on e_{E0}.*

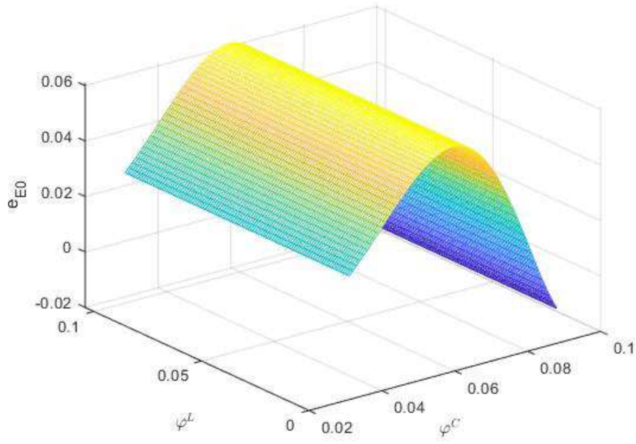

Figure 6. *Impacts of φ^L and φ^C on e_{E0}.*

5. Conclusion

In this paper we analyze the incentive effect of original shareholder' risk taking based on a bank liability structure with stratified contingent capital. We provide closed-form solutions for the values of every stakeholder by decomposing value expressions into sets of exotic options.

The presence of stratified contingent capital can effectively increase the total loss absorbing capacity of the bank. At the same time, its negative risk effects should not be ignored. We demonstrate that CoCos design has a more important impact on risk incentive effect than TLAC bonds. In particular, conversion ratio plays a key role. When the conversion ratio of CoCos is too friendly to bonds holders, it can even restrain risk incentive effect.

The results of numerical analysis show that the risk incentive effect can be released in a bank liability structure with well-designed stratified contingent capital. Losses can be absorbed in stages when the bank enters financial distress. In this case, the risk contagion is effectively reduced and taxpayers' money is protected because there is no need for bail out.

In conclusion, this paper supports the idea of introducing a variety of contingent capital with different triggering events into bank liability structure to reduce banks' risk-taking and improve the total loss absorption capacity. It will provide guidance for effective financial supervision to prevent systemic risk.

Acknowledgements

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