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Capped borrower credit risk and insurer hedging during the COVID-19 outbreak

Shi Chen\textsuperscript{a}, Yang Yang\textsuperscript{a}, Jyh-Horng Lin\textsuperscript{b,⁎}

\textsuperscript{a}School of Economics, Southwestern University of Finance and Economics, Chengdu 611130, China
\textsuperscript{b}Department of International Business, Tamkang University, New Taipei City, Taiwan

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ABSTRACT

In this paper, we apply the risk-neutral valuation methodology to evaluate a life insurer's equity. We model the features capped by the explicit treatment of the borrowing firm's credit risk, the optimal guaranteed rate-setting, and the coronavirus disease (COVID-19) outbreak. The results show that the severe effect of the COVID-19 epidemic on the borrowing firm harms its insurance business but that stringent capital regulation helps. The severe impact of COVID-19 on both the borrowing firm and the insurer hedging harm policyholder protection, thereby adversely affecting insurance stability.

1. Introduction

The year 2020 has seen a fundamental market driver in financial volatility: the global coronavirus disease (COVID-19) outbreak (Daniels Trading, 2020). Due to this pandemic, asset-liability matching management will likely receive renewed focus from insurers and regulators (Scanlan and Delappe, 2020). Insurance Europe (2014) indicates that insurers usually manage financial volatility by hedging transactions. Moreover, the Board of Governors of the Federal Reserve System (2020) states that the regulators encourage financial institutions to work constructively with borrowing firms affected by the COVID-19 outbreak. These reports form the basis of our modelling in this paper.

The purpose of this paper is to develop a capped down-and-out call option model to evaluate the insurer's equity. The features of the model include the capped credit risk from the borrowing firm, the premature risk structure captured by the barrier call, the imperfect competition reflected by the optimal guaranteed rate determination, and the COVID-19 outbreak expressed by the structural break in volatility. We complement the literature of the asset-liability matching management by taking into account the explicit treatment of the borrowing firm's capped credit risk to evaluate the equity of the insurer. We suggest that the capped down-and-out call option model is intimately relevant to the optimal guaranteed rate-setting strategy, policyholder protection, insurer hedging, and the COVID-19 outbreak.

2. Framework model

In this paper, the down-and-out call option approach (Grosen and Jørgensen, 2002) is applied to a life insurer-borrowing firm...
situation because the recent COVID-19 outbreak likely causes a premature risk. We make all financial decisions during a single period horizon \( t \in [0, 1] \). The borrowing firm funds risky assets \( A_b \) at \( t = 0 \) with only the insurer’s risky assets \( A_a \) and its equity \( E_b \). The insurer underwrites investment \( A_a \) with life insurance policies \( L_a \) and its capital \( E_a \). The demands for both the risky assets are perfect-elastic at the constant rates \( R_b \) and \( R_a \) respectively; however, the policy market is imperfectly competitive, where the insurer is the guaranteed rate-setter (see Polborn, 1998). The respective balance sheets of the borrowing firm and the insurer at \( t = 0 \) are given by:

\[
A_b = A_a + E_b \tag{1}
\]
\[
A_a = L_a + E_a = (1 - \alpha)A_a + \alpha A_a \tag{2}
\]

where \((1 - \alpha)\) is the insurer leverage and \( \alpha \) is capital regulation. Both the balance sheets are linked by \( A_a \) where the borrowing-firm liabilities equals the insurer’s assets.

The market value of the borrowing firm’s assets varies with the stochastic process:

\[
dR_b = \mu_b R_b dt + (\sigma_b + \delta_b \sigma_b^2 / 2)R_b d\xi_b,
\]

where

\[
\xi_b = (1 + R_b)A_b,
\]

\[
\mu_b = \text{the instantaneous expected rate of return on } A_b,
\]

\[
\sigma_b + (1 - \beta)\delta_b \sigma_b^2 / 2 = \text{the instantaneous standard deviation of the return, which considers the degree of seriousness of the outbreak } \theta_b \text{ with } 0 < \theta_b < 1.
\]

\( \xi_a \) is a Wiener process, and \( \xi_a = (1 - \alpha)A_a \) where \( \xi_a \) is the strike price, where \( R \) is the guaranteed rate. The first term is the guaranteed payoff to policyholders, and the second term is the hedging payment to the insurer, where \( (R_a - R) > 0 \) is an opportunity cost of hedging.

The first term on the right-hand side of Eq. (4) is the long down-and-out call on \( R \) with the strike price \( C \). The second term is the short down-and-out call paying the policyholders a fraction \( \delta \) of the positive difference between \((1 - \alpha)R \) and \( C \). These two terms are specified as follows:

\[
DOC(R, C) = SC(R, C) - DIC(R, C) \tag{5}
\]

where

\[
SC(R, C) = \frac{R \ln(C) - Ce^{-R} \ln(d_1) - \delta e^{-R} \ln(d_2)}{(1 - \beta)\delta \sigma_b^2 / 2}
\]

\[
d_1 = \frac{1}{\delta_b + (1 - \beta)\delta_b \sigma_b^2 / 2}
\]

\[
d_2 = d_1 - \frac{1}{\delta_b + (1 - \beta)\delta_b \sigma_b^2 / 2}
\]

\[
DIC(R, C) = \frac{R \ln(C) - Ce^{-R} \ln(d_1) - \delta e^{-R} \ln(d_2)}{(1 - \beta)\delta \sigma_b^2 / 2}
\]

\[
d_1 = \frac{1}{\delta_b + (1 - \beta)\delta_b \sigma_b^2 / 2}
\]

\[
d_2 = d_1 - \frac{1}{\delta_b + (1 - \beta)\delta_b \sigma_b^2 / 2}
\]

\[
H = vC, \quad 0 < v < 1, \quad \eta = (R_a - R)/[\delta_b + (1 - \beta)\delta_b \sigma_b^2 / 2] + (1/2)
\]

\( N(\cdot) \) is the cumulative density function of the standard normal distribution.

In Eq. (5), the first term is the standard call pricing value. The second term is the value using the down-and-in call pricing approach, where the barrier ratio \( v = H/C \) is the barrier value of the insurer assets in which creditors cannot force dissolution. \( R \) is the risk-free rate. Next, the second term in Eq. (4) is given by:

\[
DOC((1 - \alpha)R, C) = SC((1 - \alpha)R, C) - DIC((1 - \alpha)R, C) \tag{6}
\]

where the expression of \( SC((1 - \alpha)R, C) \) and \( DIC((1 - \alpha)R, C) \) follows a similar argument as in the case of Eq. (5), except that the

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1 It is recognized that the effect of the COVID-19 outbreak should be both on the borrowing firm’s expected return and volatility of the assets. For simplicity, we ignore the effect of the COVID-19 outbreak on the expected return by normalizing this effect to one.
term $R$ in Eq. (5) is replaced by $(1 - \alpha)R$.  

Now, we apply Dermine and Lajeri (2001) to rewrite Eq. (4) as follows:

$$\Delta_i (R_{bh}, R, C) = DOC (R_{bh}, R, C) - \delta DOC ((1 - \alpha)R_{bh}, (1 - \alpha)R, C)$$

(7)

where

$$DOC (R_{bh}, R, C) = SC (R_{bh}, R, C) - DIC (R_{bh}, R, C)$$

$$SC (R_{bh}, R, C) = R_b N(x_3) - C e^{-\gamma R} N(x_3) - R_b N(x_3) + \mu e^{-\gamma R} N(x_3)$$

$$x_3 = \frac{1}{\sigma^2 + \sigma^2 / 2} \left( \ln R_b + \mu + \sigma^2 / 2 \right)$$

$$x_4 = x_3 - (\sigma^2 + \sigma^2 / 2)$$

$$DIC (R_{bh}, R, C) = R_b \left( \frac{H}{R_b} \right)^{\gamma} N(x_3) - C e^{-\gamma R} \left( \frac{H}{R_b} \right)^{\gamma} N(x_3)$$

$$- R_b \left( \frac{H}{R_b} \right)^{\gamma} N(x_3) + \mu e^{-\gamma R} \left( \frac{H}{R_b} \right)^{\gamma} N(x_3)$$

$$x_5 = \frac{1}{\sigma^2 + \sigma^2 / 2} \left( \ln R_b + \mu + \sigma^2 / 2 \right)$$

$$x_6 = x_5 - (\sigma^2 + \sigma^2 / 2)$$

$$x_7 = \frac{1}{\sigma^2 + \sigma^2 / 2} \left( \ln R_b + \mu + \sigma^2 / 2 \right)$$

$$x_8 = x_7 - (\sigma^2 + \sigma^2 / 2)$$

$$DOC ((1 - \alpha)R_{bh}, (1 - \alpha)R, C)$$

follows a similar argument as in the case of $DOC (R_{bh}, R, C)$, except that the terms $R_b$ and $R$ in $DOC (R_{bh}, R, C)$ are replaced by $(1 - \alpha)R_{bh}$ and $(1 - \alpha)R$.

In Eq. (7), $DOC (R_{bh}, R, C)$ is a call on $R_b$ at a strike price $C$, net of a call on $R_b$ at a strike price $R$. The last two terms are the loss of the value from the cap. Besides, this term needs further deduction of the cost of a down-and-in call on $R_b$ at a strike price $C$, net of a down-and-in call on $R_b$ at a strike price $R$. In the second term in Eq. (7), the same pattern as previously applies.

3. Solutions and comparative statics

The mode determines the optimal guaranteed rate, where $\partial \Lambda_\alpha / \partial R = 0$ with $\partial^2 \Lambda / \partial R^2 < 0$. We investigate some comparative statistics of interest, including the effects of the borrowing firm influenced by the COVID-19 outbreak $\theta_b$, the insurer affected by the COVID-19 outbreak $\theta_a$, the insurer’s hedging $\beta$, and the insurer’s leverage $(1 - \alpha)$. Implicit differentiation of the first-order condition for $i = (\theta_b, \theta_a, \beta$ and $\alpha$) yields:

$$\frac{\partial R}{\partial \theta} = -\frac{\partial^2 \Lambda_\alpha / \partial \theta / \partial R^2}$$

(8)

Moreover, we model the insurer’s liability when considering the capped credit risk from the borrowing firm. The debt is valued as follows:

$$\Theta (R_{bh}, C) = C e^{-\gamma R} - [PUT (R_{bh}, C) - DIC (R_{bh}, C)] + \delta DOC ((1 - \alpha)R_{bh}, C)$$

(9)

where

$$PUT (R_{bh}, C) = C e^{-\gamma R} N(-\alpha) - R_b N(-\alpha)$$

and the expression of $DIC (R_{bh}, C)$ and $DOC ((1 - \alpha)R_{bh}, C)$ follows a similar argument as in the cases of Eqs. (5) and (6). In Eq. (9), the first term is a long position on a risk-free guaranteed payment, the second term is the price of the equity holders’ put to default, and the third term is a long call option on the borrowing firm’s underlying assets with the strike price $C$.

We further investigate the effects of $i = (\theta_b, \theta_a, \beta$ and $\alpha$) on policyholder protection. These mathematical results are:

$$\frac{d \Theta}{d i} = \frac{\partial \Theta}{\partial R} \frac{\partial R}{\partial i} + \frac{\partial \Theta}{\partial R} \frac{\partial R}{\partial i}$$

(10)

where the first term is the direct effect, and the second term is the indirect effect. In the following section, we assess the comparative impacts by assuming some parameter values for the numerical analysis.

4. Numerical analysis

Before proceeding with the numerical analysis, unless otherwise indicated, the parameter values are assumed as follows:

(i) Persson and Aase (1997) find that the loading rates for term insurance contracts are 0.81% for a 20-year-old policyholder, 1.73% for a 30-year-old one, 3.72% for a 40-year-old one, and 6.30% for a 50-year-old one. The average loading rate is 3.14%. From the

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2 These details are available from the authors on request.
viewpoint of the market mechanism, the guaranteed price of the life insurance policies should equal 3.14%. Following the argument, we assume that the policy supply function is a locus expressed as $R(\%) = (2.00, 256), (2.25, 285), (2.50, 307), (2.75, 323), (3.00, 334), (3.25, 341), (3.50, 345), (3.75, 347),$ and $(4.00, 348)$. The upward-sloping feature is due to Polborn (1998).

(ii) The security-market interest rate is approximately 4.00%, as reported by Insurance Europe and Oliver Wyman (2013). Thus, we assume $R_f = 4.50\%$. Rudden (2019) reports that the rate of return on life insurers’ invested assets in the United States is 7.07% in 2000, 5.70% in 2008, 4.81% in 2015, and 4.72% in 2018. Thus, we assume $R_f = 5.00\%$. Moreover, the rate of investment returns of the borrowing firm is arbitrary. We assume $R_b = 6.00\%$ for the numerical analysis.

(iii) We follow Briys and de Varenne (1994) and assume $\alpha = 0.10$ and $\delta = 0.85$. $E_B$ is assumed to be 35, which makes the borrower’s capital-to-asset ratio fall between 9.50% and 12.30%, which is consistent with 11.70% in 2018 of the United States.\(^3\) (iv) Brockman and Turtle (2003) report that the average implied barrier is 0.69, with a corresponding standard deviation of 0.23. Thus, we assume $\nu = 0.60$. Brockman and Turtle (2003) find that asset volatilities display a wide variation from less than 5% to a maximum of over 340% in the corporate security valuation. The mean asset volatility is 0.29. The volatility range is from 0.1 to 0.5 in the study of Briys and de Varenne (1994). For simplicity, we consider $\sigma_a = \sigma_b = 0.20$.

(iv) A part of asset volatility demonstrates the structural break effect in our model. Defining the structural break ratio is arbitrary. Thus, we assume $0.20 \leq \theta_a \leq 0.80$ and $0.20 \leq \theta_b \leq 0.80$.

(v) Adams (1996) finds that the median leverage value of life insurers is approximately 0.89. Thus, we assume that leverage $(1 - \alpha)$ falls into the range of $0.02 \leq \alpha \leq 0.14$.

(vi) According to the report of the International Association of Insurance Supervisors (2018), U.S. life insurers use hedges has substantially increased; for example, the notional amount of the derivative holdings represented about 30% of assets in 2010, rising to about 50% in 2017. Thus, we assume $0 \leq \beta \leq 0.60$ for the numerical analysis.

Table 1 demonstrates that the optimal guaranteed rate is negatively related to the severe effect of the COVID-19 outbreak on the borrowing firm. The decreased optimal guaranteed rate (and thus the increased optimal insurer interest margin) results in reducing the life insurance policies, as reduced investment returns are an integral part of the policies themselves in the asset-liability matching management. Our result indicates that the capped down-and-out call option model can be used to explain the COVID-19 impact to a great extent.

Table 2 shows that hedging enhances the policies at an increased guaranteed rate when hedging is low, whereas it decreases the policies at a reduced guaranteed rate. The former supports Daniels Trading (2020). The ambiguous effect suggests that the insurer would have to evaluate its risk management capability and then decide its risk absorption.

In Table 3, we show that capital regulation enhances the life insurance business at an increased guaranteed rate. The insurer makes use of its pricing (guaranteed rate-setting) strategy to attract policyholders. The result implies an important role played by the pricing strategy in the life insurance market. However, the financial authorities usually tend to adapt to prevent a financial crisis by capital regulation.

Table 4 shows that an increase in the credit risk of the borrowing firm decreases the policyholder protection, thereby adversely affecting insurance stability. The positive direct effect demonstrates increased policyholder protection. But the negative indirect impact shows the decreased policyholder protection significantly at a reduced optimal guaranteed rate. Mao and Zhang (2020) argue that life insurance is a new business opportunity in the COVID-19 outbreak. Alternatively, we say that the business costs to policyholders are high when the asset-liability matching management focuses on managing capped credit risk and conducting guaranteed rate-setting strategies.

Table 5 shows that the insurer’s hedging operation harms its policyholder protection when explicitly considering the credit risk of its borrowing firm. In the model, the direct effect is very significant and results in decreasing the policyholder protection. An increase in hedging reduces the funds for the insurer’s investment. The reduced investment returns harm policyholder protection. Our results are consistent with Daniels Trading (2020), as the hedging is costly.

Table 6 suggests that capital regulation enhances (harms) policyholder protection when capital regulation is loose (stringent). Insurer capital enhances policyholder protection, but costs the insurer. Capital regulation harms policyholders and benefits the insurer. According to the Board of Governors of the Federal Reserve System (2020), during the COVID-19 outbreak period, the Board is supporting financial organizations that choose to use their capital and liquidity buffers to lend (i.e., invest) and undertake other supportive actions safely. Stringent capital regulation during the COVID-19 outbreak supports our argument.

5. Conclusion

This paper proposes the capped credit risk to model the insurer’s equity valuation during the COVID-19 outbreak. The results show that the insurer’s business is negatively related to the severe effect of the COVID-19 epidemic on its borrowing firm but positively related to stringent capital regulation. The policyholder protection is negatively associated with the severe impact of the COVID-19 outbreak on the borrowing firm and to the insurer hedging. The model presented here is relatively general and should open at least one further avenue of research. One immediate outgrowth of the model is to introduce a new methodology on how insurers are required to measure counterparty credit risk derivatives’ contracts.

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3 See the World Bank, available at: [https://data.worldbank.org/indicator/FB.BNK.CAPA.ZS](https://data.worldbank.org/indicator/FB.BNK.CAPA.ZS)
Table 1. Responsiveness of the optimal guaranteed rate to $\theta_b$.

| $\theta_b$ | $(R \%)$, $\Lambda_u(\theta_b)$, $R$, C | $(2.50, 307)$ | $(2.75, 323)$ | $(3.00, 334)$ | $(3.25, 341)$ | $(3.50, 345)$ | $(3.75, 347)$ | $(4.00, 348)$ |
|------------|--------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| $0.20 \rightarrow 0.30$ | $\frac{dR}{d\theta_b}$ ($10^{-3}$) | -3.761 | -3.7624 | -3.9008 | -4.5103 | -7.1592 | - | - |
| $0.30 \rightarrow 0.40$ | -3.9663 | -3.9534 | -4.0912 | -4.7205 | -7.4745 | - | - |
| $0.40 \rightarrow 0.50$ | -4.1672 | -4.1463 | -4.2829 | -4.9311 | -7.7887 | - | - |
| $0.50 \rightarrow 0.60$ | -4.3705 | -4.3409 | -4.4756 | -5.1417 | -8.1011 | - | - |
| $0.60 \rightarrow 0.70$ | -4.5758 | -4.5369 | -4.6689 | -5.3520 | -8.4110 | - | - |

Note: The shaded area presents the results evaluated at the optimal guaranteed rate.

Table 2. Responsiveness of the optimal guaranteed rate to $\beta$.

| $\beta$ | $(R \%)$, $\Lambda_u(\beta)$ | $(2.50, 307)$ | $(2.75, 323)$ | $(3.00, 334)$ | $(3.25, 341)$ | $(3.50, 345)$ | $(3.75, 347)$ | $(4.00, 348)$ |
|--------|-----------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| $0.00 \rightarrow 0.10$ | $\frac{dR}{d\beta}$ | -1.1170 | 1.0814 | 1.0783 | 1.1829 | 1.7468 | - | - |
| $0.10 \rightarrow 0.20$ | -0.1420 | 0.2050 | 0.2885 | 0.4377 | 0.8660 | - | - |
| $0.20 \rightarrow 0.30$ | -0.5041 | -0.4010 | -0.2935 | -0.1705 | 0.0190 | - | - |
| $0.30 \rightarrow 0.40$ | -0.8185 | -0.7014 | -0.5892 | -0.4906 | -0.4505 | - | - |
| $0.40 \rightarrow 0.50$ | -0.9703 | -0.8406 | -0.7184 | -0.6190 | -0.6176 | - | - |

Note: As Table 1, except that $\beta$ is various.

Table 3. Responsiveness of the optimal guaranteed rate to $\alpha$.

| $\alpha$ | $(R \%)$, $\Lambda_u(\alpha)$ | $(2.50, 307)$ | $(2.75, 323)$ | $(3.00, 334)$ | $(3.25, 341)$ | $(3.50, 345)$ | $(3.75, 347)$ | $(4.00, 348)$ |
|---------|-----------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| $0.02 \rightarrow 0.04$ | $\frac{dR}{d\alpha}$ | 31.3606 | 27.8495 | 24.3578 | 21.3504 | 21.1696 | - | - |
| $0.04 \rightarrow 0.06$ | 18.3599 | 16.0734 | 13.8684 | 12.0288 | 11.9582 | - | - |
| $0.06 \rightarrow 0.08$ | 13.1555 | 11.4590 | 9.8365 | 8.5074 | 8.4904 | - | - |
| $0.08 \rightarrow 0.10$ | 10.3546 | 8.9903 | 7.7016 | 6.6534 | 6.6602 | - | - |
| $0.10 \rightarrow 0.12$ | 8.6076 | 7.4600 | 6.3811 | 5.5089 | 5.5255 | - | - |

Note: As Table 1, except $\alpha$ is various.

Table 4. The effect of $\theta_b$ on the liability of the insurer.

| $\theta_b$ | $(R \%)$, $\Lambda_u(\theta_b)$ | $(2.50, 307)$ | $(2.75, 323)$ | $(3.00, 334)$ | $(3.25, 341)$ | $(3.50, 345)$ | $(3.75, 347)$ | $(4.00, 348)$ |
|------------|---------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| $0.20 \rightarrow 0.30$ | $\frac{d\theta}{d\theta_b}$: total effect | -0.2176 | -0.1390 | -0.0802 | -0.0412 | -0.0257 | - | - |
| $0.30 \rightarrow 0.40$ | -0.2286 | -0.1456 | -0.0836 | -0.0426 | -0.0262 | - | - |
| $0.40 \rightarrow 0.50$ | -0.2398 | -0.1523 | -0.0870 | -0.0439 | -0.0266 | - | - |
| $0.50 \rightarrow 0.60$ | -0.2510 | -0.1589 | -0.0904 | -0.0451 | -0.0269 | - | - |
| $0.60 \rightarrow 0.70$ | -0.2624 | -0.1656 | -0.0937 | -0.0463 | -0.0272 | - | - |

Notes: As Table 1, except that $\theta_b$ is various. The direct effect is positive in sign, and the indirect effect is negative. The negative indirect effect is sufficient to offset the positive direct effect.

CRediT authorship contribution statement

Shi Chen: Software, Validation, Formal analysis, Writing - review & editing, Funding acquisition. Yang Yang: Investigation, Resources, Validation, Data curation, Visualization. Jyh-Horng Lin: Conceptualization, Methodology, Writing - original draft, Supervision, Project administration.

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Table 5
The effect of $\beta$ on the liability of the insurer.

| $\beta$  | $(R\%)$ | $(L)$ | (2.50, 307) | (2.75, 323) | (3.00, 334) | (3.25, 341) | (3.50, 345) | (3.75, 347) | (4.00, 348) |
|---------|---------|-------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
|         | $d\theta/d\beta$: total effect |       |             |             |             |             |             |             |             |
| $0.00\rightarrow0.10$ | - | -1.7777 | -30.6523 | -51.4858 | -64.8899 | -70.6104 | - | |
| $0.10\rightarrow0.20$ | - | -55.1758 | -57.9429 | -60.7275 | -62.9407 | -63.4718 | - | |
| $0.20\rightarrow0.30$ | - | -89.5754 | -76.8147 | -68.5871 | -63.8012 | -61.2645 | - | |
| $0.30\rightarrow0.40$ | - | -106.7875 | -87.1475 | -73.9629 | -65.9810 | -62.0844 | - | |
| $0.40\rightarrow0.50$ | - | -115.2015 | -92.3536 | -76.9140 | -67.5098 | -62.9717 | - | |

Note: As Table 1, except that $\beta$ is various.

Table 6.
The effect of $\alpha$ on the liability of the insurer.

| $\alpha$ | $(R\%)$ | $(L)$ | (2.50, 307) | (2.75, 323) | (3.00, 334) | (3.25, 341) | (3.50, 345) | (3.75, 347) | (4.00, 348) |
|----------|---------|-------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
|          | $d\theta/d\alpha$: total effect |       |             |             |             |             |             |             |             |
| $0.02\rightarrow0.04$ | - | 1980.2222 | 1195.6356 | 649.4356 | 306.6610 | 133.8728 | - | |
| $0.04\rightarrow0.06$ | - | 1138.1832 | 668.7164 | 348.1634 | 150.9663 | 53.9244 | - | |
| $0.06\rightarrow0.08$ | - | 800.4462 | 461.4087 | 231.7045 | 91.4869 | 23.1580 | - | |
| $0.08\rightarrow0.10$ | - | 618.1901 | 350.3012 | 169.5679 | 59.7005 | 6.4499 | - | |
| $0.10\rightarrow0.12$ | - | 504.1155 | 280.9232 | 130.7510 | 39.7005 | -4.2811 | - | |

Notes: As Table 1, except that $\alpha$ is various. The direct effect is negative, whereas the indirect effect is positive. The positive indirect effect is sufficient to offset the negative direct effect when capital regulation is low, and the positive indirect effect is insufficient to offset the negative direct effect when capital regulation is high.

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