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Understanding Contingent Capital

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UNDERSTANDING CONTINGENT CAPITAL *

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【ABSTRACT】

Contingent capital (CC) is a bond that automatically converts into common stock when equity capital is impaired. This paper analyzes the determinants of the interest rate at which CC is issued and discusses the impacts of CC issuance on other financial markets. The paper shows that Japanese banks are likely to offer high interest rates to CC investors, reflecting the economic and balance-sheet conditions of individual banks in Japan. The paper suggests that in order to draw much advantage from CC, regulators should avoid placing excess restrictions on the design of CC. By doing so, regulators can encourage banks to look for the ways to lower the interest rate of CC, some of which are illustrated in the paper. A minimum set of regulations, however, must be imposed on the design and issuing conditions of CC; otherwise, CC may disrupt the functioning of financial markets. In addition, the likelihood of bank failure is not necessarily reduced by replacing subordinated bonds with CC. Furthermore, the optimal combination of CC and subordinated bonds is extremely sensitive to economic conditions, such as the expected growth rate. All these issues are relevant when considering whether or not to allow banks to issue CC.

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【Non-Technical Summary】

- Contingent capital (CC) is a bond that automatically converts into common stock when equity capital is impaired. Due to its usefulness as a means of solving undercapitalization of banks and restoring the soundness of their operations quickly, the Basel Committee on Banking Supervision is considering the introduction of CC into its regulatory framework from the micro-prudential point of view.

- CC has attracted much attention from the macro-prudential perspective as well. For instance, consider the CC such that when the financial sector suffers massive losses as a whole, all the banks must convert their CC into common stock simultaneously. This type of CC is clearly useful to recover the capital adequacy and thus the stability of financial systems when the financial sector suffers from undercapitalization as a whole.

- Despite its obvious usefulness for maintaining resiliency of the financial sector, much about CC remains unexplained. Opponents of the introduction of CC argue that the interest rate of CC may be too high to encourage banks to issue it, or that banks may be reluctant to issue CC, since they are worried about the possible dilution of earnings per share. Advocates of CC, on the other hand, emphasize that it may provide banks with an inexpensive means of restoring capital adequacy, if issued under favorable economic conditions.

- The main purpose of this paper is to discuss the determinants of interest rates at which CC is issued and to investigate how the CC market is connected to other financial markets. A theoretical model is presented in which banks are engaged in fund-raising activity by means of deposits, subordinated bonds, and common stock as well as CC and use the collected funds to make loans or buy other financial assets. The model is found quite useful to produce various numerical examples and thereby to clarify many of the complex properties of CC.

- Many economic conditions are relevant to the determination of the interest rate of CC. For instance, the CC interest rate rises, as the tail risk grows and the investors become more risk averse. It is remarkable that the lower the expected growth rate, the higher

the CC interest rate. This is interesting because a fall in the expected growth rate results in a decline in interest rates of many financial instruments. Note also that the interest rate of CC is affected by the balance sheet of the issuing bank. For instance, the CC interest rate rises, as the amount of subordinated bonds issued increases and that of common stock issued decreases.

・The model can be used to show how the design of CC affects the interest rate of CC. For instance, a reduction in the conversion price, which determines the amount of common stock assigned to CC investors, squeezes the share of existing stockholders and thus results in a decline in the CC interest rate. Another example is that the CC interest rate can be reduced by changing the priority between the liabilities of the bank so that the CC is senior to subordinated bonds.

・Recently, the Lloyds Banking Group (in the United Kingdom) and Rabobank (in the Netherlands) have issued CC. These are important events, since very few CC or CC-like securities have actually been issued. The interest rate at which Rabobank issued its CC (6.875%) is particularly important, since it provides a reference rate for the banks that are planning to issue CC in the near future. It may be reasonably conjectured that Japanese banks must offer higher interest rates to CC investors than Rabobank did. This is an immediate consequence of the characteristics obtaining in Japan, where the growth rate is very low and banks prefer to issue subordinated bonds instead of common stock.

・The interest rates of CC may become prohibitively high when the economic environment surrounding the issuing banks is poor. At the same time, however, the analysis shows that the interest rate can be lowered by modifying the design of CC in an appropriate way. An important implication derived from these observations is that regulators should avoid placing excess restrictions on the design of CC. By doing so, they can encourage banks to issue CC and draw much advantage from CC.

・The issuance of CC may have an impact on other financial markets. Unless it is large, the issuance of CC is likely to be followed by a decline in the stock price of the issuing bank. A remarkable result here is that exactly the same effects of CC issuance on the stock price obtain, irrespective of the fund-raising method adopted by the bank, that is, common stock, subordinated bonds, or CC. This has a very important implication for the following reason. Even if it has no experience of issuing CC, the bank can infer developments in its stock price by issuing CC, based on the information obtained by issuing common stock or subordinated bonds in the near past. It is also remarkable that the issuance of CC has little impact on the interest rate of subordinated bonds, unless a large amount is issued.

・The issuance of CC may lead to destabilization of the CC market. For instance, consider the CC whose conversion price is set at the stock price that prevails in the market at the time of conversion. This type of CC may destabilize the CC market. An immediate implication is that the conversion price must be determined at the time of issuing CC. Another destabilizing factor is the possibility of multiple equilibria in the CC interest rate. One way to avoid this inconvenience is to announce the interest rate together with the other information, such as the amount of issue, simultaneously at the time of issuance.

・There is a counterargument against the use of a capital ratio as a conversion trigger, which says that conversion would be delayed, since the capital ratio is calculated only infrequently. In this regard, the stock price has a high potential to act as a conversion trigger, since anyone can capture it frequently. Due attention should be paid, however, to the use of the stock price as a conversion trigger, since there is the risk of stock price manipulation. Extensive investigation is required to determine the most desirable conversion triggers for CC.

・The model shows that the likelihood of bank failure is not necessarily reduced by replacing existing subordinated bonds with CC. The interest rate of CC is higher than that of subordinated bonds. Thus, the amount of interest payment increases along with the replacement of subordinated bonds with CC. Then bank profits are squeezed; and capital accumulation is delayed. It should be also noted that the optimal combination of CC with subordinated bonds is extremely sensitive to economic conditions, such as the expected rate of growth. This high sensitivity makes it difficult to find the optimal quantity of CC.

・As a final remark, it is pointed out that private banks manage their business, without taking care of any externalities, such as the stability of financial systems. This is an important observation, since it raises another serious problem, that is, the divergence between social welfare and private interests. If it contributes to improving social welfare, the issuance of CC should be promoted. It may be desirable to provide some preferential treatment for the issuance of CC. One way to promote the issuance of CC is to allow CC to be included in the calculations of regulatory capital even before it is converted into common stock.

1. Introduction

Contingent capital (CC) is a bond that automatically converts into common stock when equity capital is impaired (Flannery [2005]). Due to its usefulness as a means of solving undercapitalization of banks and restoring the soundness of their operations quickly, the Basel Committee on Banking Supervision (BCBS) is discussing the incorporation of CC into its regulatory framework.[1]

In addition to this micro-prudential perspective, CC is expected to play an important role as a macro-prudential tool. Massive losses in the financial sector are likely to destabilize financial systems, which often leads to financial crises. In order to encounter these crises, we can consider CC such that when the financial sector suffers massive losses as a whole, all the banks must convert their CC into common stock. Clearly, this type of CC, which converts into common stock when the financial sector suffers from undercapitalization as a whole, is useful for restoring capital adequacy and thus a stable financial system.[2]

Despite its obvious usefulness for strengthening the capital bases of banks and thus the stability of financial systems, much about CC remains unexplained. Opponents of the introduction of CC argue that the interest rate of CC may be too high to encourage banks to issue it, or that banks may be reluctant to issue CC since they are worried about the possible dilution of earnings per share. Advocates of CC, on the other hand, emphasize that it may provide banks with an "inexpensive" means of restoring capital adequacy if issued under favorable economic conditions.

The main purpose of this paper is to discuss the determinants of the interest rate

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[1] See Basel Committee on Banking Supervision (2009). The BCBS is discussing whether or not to incorporate CC into its regulatory framework from two perspectives: *gone concern* (or *at the point of non-viability*) and *going concern*. A gone-concern CC is converted into common stock when a bank fails or when public funds are injected into the bank. In contrast, a going-concern CC is converted into common stock when a prescribed event occurs, assuming that the bank continues to exist. This paper focuses on a going-concern CC.

[2] Squam Lake Working Group on Financial Regulation (2009) explains the usefulness of CC from the perspective of maintaining the stability of financial systems.

at which CC is issued and to investigate how the CC market is connected to other financial markets. No comprehensive expositions have yet been given about the complex properties of CC. One reason is that few banks have issued CC in practice. Another reason is its complex nature as a financial instrument, that is, its mixed characteristics of bond and common stock.[3] This paper presents a simple theoretical model where banks are engaged in fund-raising activity by means of deposits, subordinated bonds, and common stock as well as CC and use these collected funds to make loans or buy other financial assets. The model is found useful to produce various numerical examples, which allow us to discuss the determinants of the CC interest rate and to explore the relationship between CC and other financial markets. This paper aims to investigate the characteristics of CC qualitatively, not to make quantitative projections of CC interest rates in the future.

The remainder of this paper is constructed as follows. Section 2 presents a simple theoretical model, which is used to determine the interest rate of CC. Section 3 produces various numerical examples to demonstrate how the CC interest rate is affected by the parameters of the model. Section 4 examines the impacts of issuing CC on other financial markets and discusses some related issues that are important in considering whether or not to allow banks to issue CC. Section 5 concludes the paper.

2. Pricing of Financial Instruments Based on State Prices

(1) What Is a State Price?

In this paper, the pricing of financial instruments is based on *state prices*. A state price is the price of payoff in a specific *state* that will occur in the future. Below, let $\overline{S}$ denote

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[3] While convertible bonds are financial instruments that have both bond and equity characteristics, they differ significantly in nature from CC. For example, in the case of convertible bonds, the conversion rights are held by investors, but CC is automatically converted into common stock when specific conditions are satisfied. For this reason, while the interest rates of convertible bonds are lower than those of ordinary corporate bonds, the same relationship does not hold for CC.

the number of states; v_i the payoff obtained in *state* i (for $i = 1, \cdots, \bar{S}$) by holding a certain financial instrument; and ψ_i the associated state price. Then the price of the instrument, p, is given by

$$p = \sum_{i=1}^{\bar{S}} \psi_i v_i \,. \qquad (2.1)$$

This paper derives state prices from a consumer's utility function.[4] The following function of constant relative risk aversion is used in particular:

$$U(Y) = \frac{Y^{1-\gamma}}{1-\gamma}, \qquad (2.2)$$

where Y denotes consumption; γ (≥ 0) the degree of relative risk aversion.

If an investor gives up ¥ 1 of current consumption, he/she suffers a marginal decrease in utility in the current period. The investor, however, can use this money to purchase $1/p$ units of a financial instrument at the price of p. In the next period, he/she can use the payoff from this instrument and enjoys a marginal increase in utility. If his/her choice is optimal, the investor can neither increase nor decrease his/her lifetime utility by engaging in further transactions. This implies

$$U'(Y_0) = \frac{1}{p} \sum_{i=1}^{\bar{S}} \rho \pi_i U'(Y_{1,i}) v_i \,, \qquad (2.3)$$

where U' denotes the first derivative of U; ρ the discount factor, that is, $1/(1 + \textit{rate of time preference})$; π_i the probability that *state* i occurs; Y_0 consumption in the current period; and $Y_{1,i}$ consumption in *state* i in the next period.[5]

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[4] There are several methods to obtain state prices: *absolute pricing* and *relative pricing*. The method of *relative pricing* derives the prices of financial instruments, taking as given the stochastic process of the stock price. This paper uses the method of absolute pricing, which allows the issuance of CC to change the process of the stock price.

[5] This paper does not take the inflation rate into account (in other words, it assumes a zero inflation rate), although it is not difficult to do so.

The price of the financial instrument is derived from equation (2.3) with the help of equation (2.2). Note that equation (2.3) can be transformed into

$$p = \sum_{i=1}^{\bar{S}} \rho \pi_i \left(\frac{Y_{1,i}}{Y_0} \right)^{-\gamma} v_i \ . \tag{2.4}$$

The state prices are obtained by comparing equation (2.1) with (2.4). That is,

$$\psi_i = \rho \pi_i \left(\frac{Y_{1,i}}{Y_0} \right)^{-\gamma} \qquad \text{for } i = 1, \cdots, \bar{S} \ . \tag{2.5}$$

It is easy to understand why the consumer utility function is essential to the pricing of financial instruments. Suppose $\gamma = 0$. The consumer is said to be *risk neutral* in this case. Equation (2.5) is reduced to $\psi_i = \rho \pi_i$. This implies that the price of a financial instrument is given by the discounted present value of a series of expected payoffs that accrue from holding this instrument. Suppose $\gamma > 0$, alternatively. The consumer is said to be *risk averse*. The situation is a little bit complicated in this case. If $Y_{1,i} < Y_0$, we have $(Y_{1,i} / Y_0)^{-\gamma} > 1$ and thus $\psi_i > \rho \pi_i$ from equation (2.5). If $Y_{1,i} > Y_0$, on the other hand, we have $(Y_{1,i} / Y_0)^{-\gamma} < 1$ and thus $\psi_i < \rho \pi_i$. These relationships imply that the value of ¥1 obtained in a recession is evaluated higher than that of ¥1 obtained in a boom.

This paper defines *states* in terms of growth rates (Chart 1). Let ϕ_i denote the (gross) growth rate in *state* i. With this notation, the state prices are expressed as

$$\psi_i = \rho \pi_i \phi_i^{-\gamma} \qquad \text{for } i = 1, \cdots, \bar{S} \ . \tag{2.6}$$

Without loss of generality, it is assumed that $\phi_i > \phi_j$ for $i < j$. Therefore, the growth rate is highest in *state* 1, while lowest in *state* $\bar{S}$.

The following example shows how to use these state prices to obtain the interest rate of deposits. Due to deposit insurance, deposits can be considered *safe assets*, albeit with certain limits. Therefore, the following relationship must hold:

$$\sum_{i=1}^{\bar{S}} \psi_i r_d = 1, \tag{2.7}$$

where r_d denotes the interest rate of deposits. The deposit interest rate can be obtained immediately from this equation.

$$r_d = \frac{1}{\sum_{i=1}^{\bar{S}} \psi_i}. \tag{2.8}$$

(2) The Basic Design of Contingent Capital

The design of CC is unlimited. The BCBS is discussing what kind of CC to be incorporated in its regulatory framework. In general, the interest rate of CC and the impacts of issuing CC on other financial markets depend heavily on the design of the CC. Actually, no useful information can be obtained about CC, without specifying its working mechanism in detail. This paper defines the basic design of CC as follows:

<u>The Basic Design of Contingent Capital</u>

- ◇ The failure trigger: one of states (growth rates) $S_b+1,\cdots,\bar{S}$ occurs.
- ◇ The conversion trigger: one of states (growth rates) $S_c+1,\cdots,S_b$ occurs.
- ◇ The conversion price: the stock price at the time of issuance of CC.
- ◇ The priority: the CC is subordinated to subordinated bonds; subordinated bonds are subordinated to deposits.

In the basic design of CC, S_b is referred to as the *critical state for failure*, while the associated growth rate is as the *critical growth rate for failure*. A bank fails in states $S_b+1,\cdots,\bar{S}$, but not in states $1,\cdots,S_b$. In reality, there are various views as to the conditions under which a bank is considered to have failed. The detailed discussion on this point is postponed later in this section.

Next, in the basic design of CC, S_c is referred to as the *critical state for conversion*, while the associated growth rate is as the *critical growth rate for conversion*. The CC is converted into common stock in states $S_c+1,\cdots,S_b$, but not in states $1,\cdots,S_c$. It is also assumed that no conversion occurs if the bank fails, which implies $S_c \le S_b$. In the basic design of CC, there is a one-by-one relationship between state and growth rates. Therefore, it can be said that this CC uses a growth rate as a conversion trigger. This trigger is replaced by a Tier 1 ratio trigger later in this section.

In the basic design, a *conversion price* is set equal to the stock price, p_x, prevailing in the market at the time of issuance of CC. Assume that all the CC held by a bank is converted into common stock at the time of conversion. If the total amount of CC issued is ¥c, the number of common stock assigned to the CC investor is c/p_x. Let m denote the number of common stock held by existing stockholders and λ represent the share of residual claims distributed to them. Then the following relationship holds.

$$\lambda = \frac{m}{m + \frac{c}{p_x}} = \frac{p_x m}{p_x m + c}. \tag{2.9}$$

That is, the share of existing stockholders is determined by the ratio of the payments made by CC investors to the market value of common stock held by the existing stockholders at the time of issuing CC.

Finally, before conversion, CC is subordinated to subordinated bonds and is senior to common stock. Once converted into common stock, the CC is ranked equal to existing common stock. That is, after conversion, CC is neither subordinated nor is senior to common stock. As a matter of course, it is assumed that subordinated bonds are subordinated to deposits.

(3) Pricing of Financial Instruments

In the model, a bank accepts various liabilities to fund its assets (Chart 2). For the sake of simplicity, it is assumed that the bank operates for three periods (periods 0, 1, and 2). In period 0, the bank accepts deposits, issues subordinated bonds, and increases capital by issuing new common stock at the market price as well as issuing CC. In period 1, the capital ratio is calculated to see whether the bank has failed or not. If the bank has not failed, it is checked whether the CC is converted into common stock or not. The bank is always liquidated at the end of period 2.

Next, regarding the assets of the bank, they are assumed to grow according to the same probability distribution of the growth rate as defined above (i.e., ϕ_i for $i = 1, \cdots, \overline{S}$). If the bank fails in period 1, it is liquidated immediately. Otherwise, the bank survives into period 2. The assets of the bank continue to grow again according to the same probability distribution as defined above. Note that the bank makes no payments in period 1, while all the payments are made in period 2 at the end of the model.

a. Evaluating Financial Instruments in Period 2

Below, the growth rates in periods 1 and 2 are denoted by ϕ_i and ϕ_j, respectively. Let $v_f(i, j)$ denote the value of the financial instrument, f, in period 2 (Chart 3). In period 2, the values of assets (a), deposits (d), subordinated bonds (s), CC (c), and common stock (x) are calculated as follows:

(i) $i \le S_c$

$$v_a(i, j) = \phi_i \phi_j a,$$

$$v_d(i, j) = \min\{r_d^2 d, v_a(i, j)\},$$

$$v_s(i, j) = \min\{r_s^2 s, v_a(i, j) - v_d(i, j)\},$$

$$v_c(i, j) = \min\{r_c^2 c, v_a(i, j) - v_d(i, j) - v_s(i, j)\},$$

$$v_x(i, j) = v_a(i, j) - v_d(i, j) - v_s(i, j) - v_c(i, j). \tag{2.10}$$

(ii) $S_c < i \le S_b$

$$v_a(i, j) = \phi_i \phi_j a,$$

$$v_d(i, j) = \min\{r_d^2 d, v_a(i, j)\},$$

$$v_s(i, j) = \min\{r_s^2 s, v_a(i, j) - v_d(i, j)\},$$

$$v_c(i, j) = (1 - \lambda)\{v_a(i, j) - v_d(i, j) - v_s(i, j)\},$$

$$v_x(i, j) = \lambda\{v_a(i, j) - v_d(i, j) - v_s(i, j)\}. \tag{2.11}$$

In the equations above, the interest rate of CC is denoted by r_c, while that of subordinated bonds is denoted by r_s. In the case of bank failure, the residual value is distributed among CC investors and existing stockholders. As defined earlier, the parameter λ is used as a share of residual value distributed to the latter group.

b. Evaluating Financial Instruments in Period 1

The growth rate in period 1 is ϕ_i. Denote the value of f in period 1 by $v_f(i)$. Then the values of assets, deposits, subordinated bonds, CC, and common stock in period 1 are expressed as follows:

(i) $i \le S_b$

$$v_f(i) = \sum_{j=1}^{\bar{S}} \psi_j v_f(i, j) \qquad \text{for} \quad f = a, d, s, c, x . \tag{2.12}$$

(ii) $S_b < i \le \bar{S}$

$$v_a(i) = \phi_i a ,$$

$$v_d(i) = \min\{r_d d, v_a(i)\},$$

$$v_s(i) = \min\{r_s s, v_a(i) - v_d(i)\},$$

$$v_c(i) = \min\{r_c c, v_a(i) - v_d(i) - v_s(i)\},$$

$$v_x(i) = v_a(i) - v_d(i) - v_s(i) - v_c(i) . \tag{2.13}$$

In case (ii), the bank fails in period 1.[6]

c. Evaluating Financial Instruments in Period 0

Denote the value of f in period 0 by v_f. Then the values of assets, deposits, subordinated bonds, CC, and common stock in period 0 are expressed as follows:

$$v_f = \sum_{i=1}^{\bar{S}} \psi_i v_f(i) \qquad \text{for} \quad f = a, d, s, c, x . \tag{2.14}$$

d. Determining Equilibrium Prices and Interest Rates

In the above, the values of financial instruments are calculated, taking a, r_s, and r_c as given. However, these are also endogenous variables to be determined. Their equilibrium values are obtained so that the values of financial instruments coincide

[6] The fear of failure may drive banks into *fire sales*. By taking into consideration the additional losses associated with fire sales, the model becomes more realistic. It is not difficult to incorporate this type of deterioration of asset values into the model. This paper, however, assumes away these costs to keep the model as simple as possible.

with their actual prices. That is,

$$v_s = s, \tag{2.15}$$

$$v_c = c, \tag{2.16}$$

$$v_x = p_x m, \tag{2.17}$$

where p_x is the stock price of the bank in period 0; m is the number of common stock. The model assumes that x shares of common stock are issued in period 0 in addition to n shares issued before period 0. The total number of shares after the capital increase is denoted by $m \equiv n + x$.

The bank must satisfy the following budget constraint:

$$a = e + d + s + c + p_x x, \tag{2.18}$$

where e is the sum of the total capital paid in and the earnings retained before period 0. Note that the value of a is not determined, unless the stock price, p_x, is given. On the other hand, the value of the common stock, p_x, is not determined, unless the value of a is given. These two values are determined simultaneously in equilibrium.

The four unknowns, a, r_s, r_c, and p_x, are determined so that the last four equations hold. The obtained equilibrium values are denoted by a^*, r_s^*, r_c^*, and p_x^*, respectively. It is clear from the derivation process that all the four depend on S_b, and that r_c^* depends on S_c additionally. If necessary, they are denoted explicitly by $a^*(S_b)$, $r_s^*(S_b)$, $r_c^*(S_b, S_c)$, and $p_x^*(S_b)$.

From the derivation process of v_a, v_d, v_s, v_c, and v_x, the following relationship must hold:

$$v_a = v_d + v_s + v_c + v_x. \tag{2.19}$$

This equation plays an important role when the interrelationships among the markets of CC, subordinated bonds, and common stock are discussed in the later sections.

It should be remarked that the relationship, $v_d = d$, does not necessarily hold. The reason is that when the value of deposit (the principal and interest) exceeds the asset value of a bank ($r_d^2 d > \phi_i \phi_j a$), the difference is covered by deposit insurance. This means $v_d < d$. Below, v_d is referred to as the *deposit burden on the bank,* while $d - v_d$ is as the *burden for deposit insurance*.

(4) Minimum Capital Requirements

Banks must comply with the minimum capital requirements. Unless mentioned otherwise, CC is not counted as regulatory capital before conversion. First, the Tier 1 capital ratio must exceed the minimum capital requirement denoted by δ_1 in period 1. The conditions depend on whether CC is converted into common stock or not:

$$\delta_1 \le \frac{\phi_i a^*(S_b) - r_d d - r_s^*(S_b)s - r_c^*(S_b, S_c)c}{\phi_i a^*(S_b)} \quad \text{for } i = 1, \cdots, S_c, \qquad (2.20)$$

$$\delta_1 \le \frac{\phi_i a^*(S_b) - r_d d - r_s^*(S_b)s}{\phi_i a^*(S_b)} \quad \text{for } i = S_c + 1, \cdots, S_b. \qquad (2.21)$$

Similarly, the capital ratio including Tier 2 capital must exceed the minimum capital requirement denoted by δ_2. The conditions depend on whether CC is converted into common stock or not:

$$\delta_2 \le \frac{\phi_i a^*(S_b) - r_d d - r_c^*(S_b, S_c)c}{\phi_i a^*(S_b)} \quad \text{for } i = 1, \cdots, S_c, \qquad (2.22)$$

$$\delta_2 \le \frac{\phi_i a^*(S_b) - r_d d}{\phi_i a^*(S_b)} \quad \text{for } i = S_c + 1, \cdots, S_b. \qquad (2.23)$$

Furthermore, the capital ratios in period 0 must satisfy the same minimum capital requirements. That is,

$$\delta_1 \le \frac{a^*(S_b) - d - s - c}{a^*(S_b)}, \qquad (2.24)$$

$$\delta_2 \le \frac{a^*(S_b) - d - c}{a^*(S_b)}. \qquad (2.25)$$

(5) Transformation from a State Trigger to a Capital-Ratio Trigger

In the basic design of CC, the conversion trigger is defined in terms of states. Here, this state-based conversion trigger is transformed into a conversion trigger based on the capital ratio.

Contingent Capital with a Capital- Ratio Trigger

◇ The failure trigger: the debts exceed assets.

◇ The conversion trigger: the Tier 1 capital ratio falls below δ_1.

◇ The conversion price: the stock price at the time of issuance of CC.

◇ The priority: the CC is subordinated to subordinated bonds; subordinated bonds are subordinated to deposits.

The critical point for conversion, S_c, and the critical point for failure, S_b, can be associated with the Tier 1 ratio in the following way. First, a bank is considered to have failed when its debts exceed its assets. Therefore, the following inequalities must hold:

$$0 \le \frac{\phi_i a^*(S_b) - r_d d - r_s^*(S_b)s - r_c^*(S_b, S_c)c}{\phi_i a^*(S_b)} \quad \text{for} \quad i = 1, \cdots, S_b,$$

$$0 > \frac{\phi_i a^*(S_b) - r_d d - r_s^*(S_b)s - r_c^*(S_b, S_c)c}{\phi_i a^*(S_b)} \quad \text{for} \quad i = S_b + 1, \cdots, \bar{S}. \qquad (2.26)$$

Next, the CC is converted into common stock when the Tier 1 capital ratio falls below the minimum capital requirement δ_1. Therefore, the following inequalities must hold:

$$\delta_1 \le \frac{\phi_i a^*(S_b) - r_d d - r_s^*(S_b)s - r_c^*(S_b, S_c)c}{\phi_i a^*(S_b)} \quad \text{for} \quad i = 1, \cdots, S_c,$$

$$\delta_1 > \frac{\phi_i a^*(S_b) - r_d d - r_s^*(S_b)s - r_c^*(S_b, S_c)c}{\phi_i a^*(S_b)} \quad \text{for} \quad i = S_c + 1, \cdots, S_b. \qquad (2.27)$$

A number of combinations of S_b and S_c may satisfy all these conditions; or, on the contrary, no such combinations may exist. In the next section, the properties of the equilibrium price/interest rates thus obtained are examined extensively.

3. THE DETERMINANTS OF THE INTEREST RATES OF CONTINGENT CAPITAL

This section uses the theoretical model introduced in the previous section to discuss how the economic environment and the design of CC affect the level of CC interest rates.[7] Additionally, the CC issued by the Lloyds Banking Group (in the United Kingdom) and Rabobank (in the Netherlands) are examined, and their interest rates are evaluated.

(1) The Effects of Conversion Timing on Contingent Capital Interest Rates

Chart 5 (1) compares the interest rates of CC with those of subordinated bonds and deposits, while Chart 5 (2) shows the stock price level. In both charts, the horizontal axis denotes the amount of CC issued. Unless otherwise specified, all the amounts referred to in this paper are normalized by the amount of deposits, that is, $d=1$. These charts show many properties of the CC interest rate as follows.

As the CC issuance increases, the CC interest rate shows a zigzag pattern. Two bumps are observed in Chart 5 (1), when the issuance of CC amounts to 0.06 and 0.17. These bumps are created by the changes in the critical point for conversion. Unless the critical point for conversion changes, the CC interest rate declines along with an increase in CC issuance. At the same time, however, the issuance of CC increases the leverage ratio, which in turn raises the critical growth rate for conversion (or lowers S_c). This increases the likelihood of CC conversion. To make up for the potential loss associated with this inconvenience, the CC interest rate must jump up.[8]

When the critical growth rate rises, the CC interest rate does not necessarily rise simultaneously. When the growth rate is high, CC is the same as bonds, whose interest rate is fixed. In contrast, when the growth rate is low, it is the same as common stock, from which only residual profits are obtained. In other words, CC inherits only

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[7] The model in this paper can deal with a wide variety of probability distributions. Chart 4 presents the standard assumption regarding the probability distribution of the growth rate, where the expected rate of growth is 2%. This distribution is characterized by the realization of an extremely high growth rate (a bubble economy) and an extremely low growth rate (bursting of the bubble). In the standard case, other parameters are set as follows: $\rho=0.998$, $\gamma=0.6$, $e=0.075$, $n=1$, $d=1$, $c=0.05$, $x=0.05$, $s=0.05$, $\delta_1=0.04$, $\delta_2=0.08$, and $\overline{S}=11$. The numerical examples in this paper were obtained by changing these parameters.

[8] In Chart 5 (1), $S_c=9$, $S_c=8$, and $S_c=7$ when the amount of CC falls in the range of 0.01 to 0.06, 0.06 to 0.16, and 0.17 to 0.20, respectively.

disadvantages from bonds and common stock. Therefore, the CC interest rate has to be high enough to compensate for these disadvantages. Consider the CC that converts into common stock in spite of the growth rate being very high (or S_c being small). This CC is almost the same as common stock; thus, its interest rate can be lowered. Alternatively, consider the CC that is not converted despite the growth rate being very low (or S_c being large). This CC is almost the same as subordinated bonds; thus, its interest rate can be lowered again.[9] To sum up, the relationship between the critical growth rate for conversion (or S_c) and the CC interest rate is typically depicted as an inverted U-shaped curve.

The critical growth rate for failure (S_b) affects the relationship between the critical growth rate for conversion (S_c) and the CC interest rate. Chart 6 shows these relationships for a number of different critical points for failure. As explained above, the CC interest rate profile is depicted as an inverted U-shaped curve with $S_b = 7$. With S_b greater than 7, investors prefer the CC that is closer to bonds (i.e., high S_c), which earn fixed revenues even under poor economic conditions. Therefore, the CC interest rate is a decreasing function of S_c. In contrast, with S_b smaller than 7, investors prefer the CC that is closer to common stock (i.e., low S_c). This implies that the CC interest rate is an increasing function of S_c. Since S_b is usually large, it is likely that the relationship between the critical growth rate for conversion and the CC interest rate is drawn as a downward-sloping curve.

The most interesting result shown in Chart 5 is the existence of multiple equilibria. In the chart, there are two equilibrium interest rates when CC issuance is 0.06. Suppose that the CC interest rate is raised by a certain number of percentage points from the lower equilibrium rate. This suppresses the profits of the bank; and thus its capital ratio declines. This implies that the CC is converted into common stock at a higher growth rate (i.e., the critical growth rate for conversion goes up). This is unfavorable to CC investors, since the likelihood is reduced that CC has priority over common stock. To make up for this potential loss, the CC interest rate must be raised. Multiple equilibria exist if this increase in the CC interest rate coincides with the initial

[9] If $S_b = S_c$, the interest rate of subordinated bonds coincides with that of CC.

increase.[10] Conversely, there may be some cases where no equilibrium exists.

Note that the interest rate of subordinated bonds forms a floor for the CC interest rate. There are several reasons for this. First, CC is subordinated to subordinated bonds in its basic design.[11] Therefore, its interest rate must be higher than that of subordinated bonds. Furthermore, the CC is forced to convert into common stock under adverse conditions, where the stock price declines along with the slowdown of economic growth. The CC interest rate should be raised additionally to compensate for these disadvantages.

(2) Environmental Conditions Affecting the Interest Rate of Contingent Capital

The CC interest rate is affected by various environmental conditions. Here, a variety of numerical examples are produced by changing the parameter values in the model and show how the CC interest rate changes according to the environmental conditions.

a. Expected Growth Rates

The CC interest rate is affected by expected growth rates. In Chart 7, the two expected growth rates of 2% and 0% are assumed. Significant differences are observed in the CC interest rate as well as in the prices/interest rates of other financial instruments. As the expected growth rate declines, downside pressure is put on interest rates in general. Actually, the interest rates of deposits and subordinated bonds both decline. In contrast, the CC interest rate climbs. This reflects a drop in the stock price of the bank, which is caused by a decline in the expected growth rate. The interest rate of CC, which has the same characteristics as common stock, must be sufficiently high to compensate for the potential losses due to the drops in the stock price of the bank.

[10] The accrued interest on CC is included in the calculation of profits and losses in period 1. This is key to the existence of multiple equilibria. Multiple equilibria disappear, if the model is altered so that the capital ratio is calculated without taking the accrued interest into consideration.

[11] For a similar reason, the interest rate of subordinated bonds is always higher than that of deposits.

b. Uncertainty about the Economic Outlook

The CC interest rate is affected by uncertainty about the economic outlook. Chart 8 shows what happens to the equilibrium interest rates of financial instruments when the probability distribution of future growth rates is flattened. The flattening of the growth rate distribution implies the enlargement of tail risk or an increase in the probability that the growth rate becomes extremely high or low. As tail risk increases, the CC interest rate goes up. This is because an increase in tail risk raises the interest rate of subordinated bonds, which marks the floor of the CC interest rate, since CC is subordinated to subordinated bonds in the basic design of CC. On the other hand, an increase in tail risk has only limited impacts on stock prices. Therefore, the CC interest rate increases, mainly reflecting the rise in the interest rate of subordinated bonds.

c. Risk Aversion among Investors

The CC interest rate is also affected by investors' attitudes toward risk. Chart 9 shows that the CC interest rate increases, as investors become more risk averse. In general, as investors become cautious about risk-taking, the prices of financial instruments decline; and the interest rates go up. In fact, the chart shows a decline in the stock price and an increase in the interest rate of subordinated bonds. Reflecting these characteristics of common stock and subordinated bonds, the CC interest rate must be raised.

d. The Amount of Subordinated Bonds Issued

The CC interest rate is also affected by the amount of subordinated bonds and common stock issued. Chart 10 (1), where the horizontal axis represents the amount of subordinated bonds issued, compares the CC interest rate with the interest rates of subordinated bonds and deposits, while Chart 10 (2) shows the stock price level. As the amount of subordinated bonds increases, the CC interest rate rises in steps, due to the rises in the critical growth rate for conversion. An increase in the amount of subordinated bonds leads to an increase in assets and enlarges the leverage ratio. Thus, the minimum capital requirement is breached with a slight decline in the growth rate. This means that the critical growth rate for conversion becomes higher. This in turn implies an increase in the probability that CC investors lose their priority over existing stockholders. The CC interest rate must go up in order to compensate for this disadvantage.

e. The Amount of Common Stock Issued

The CC interest rate depends on the amount of common stock issued. Chart 11 shows the impacts of issuing additional common stock on various financial markets. The horizontal axis represents the amount of newly issued common stock, which is normalized by the amount of existing common stock. The chart shows that the CC interest rate is lowered, as an additional issue of common stock increases. Initially, the CC interest rate decreases in steps. This is due to the declines in the critical growth rate for conversion, which results from the issuance of common stock enhancing the capital adequacy of the bank. When common stock is increased beyond a certain amount, the CC interest rate starts declining smoothly. This is because the credit risk of the bank is reduced as a result of the increase in equity capital.

(3) The Design of Contingent Capital and Its Effects on Interest Rates

The CC interest rate is affected by the design of CC as well as environmental conditions, which cannot be manipulated by the issuing bank.

a. A Conversion Price

The CC interest rate depends on the share of existing stockholders, or a conversion price, and is controllable to a certain extent by adjusting these parameter values. As shown below, a reduction of the conversion price (here, to 80% of the stock price at the time of issuance) squeezes the share of existing stockholders and thus enables the CC interest rate to be lowered (Chart 12).

$$\lambda = \frac{m}{m + \frac{c}{0.8 p_x}} = \frac{0.8 p_x m}{0.8 p_x m + c}. \tag{3.1}$$

Contingent Capital with a Low Conversion Price

- ◇ The failure trigger: the same as the CC with a capital-ratio conversion trigger.
- ◇ The conversion trigger: the same as the CC with a capital-ratio conversion trigger.
- ◇ The conversion price: 80% of the stock price at the time of issuance of CC.
- ◇ The priority: the same as the CC with a capital-ratio conversion trigger.

This is nothing but a zero-sum game, however. If the share of CC investors is increased, that of existing stockholders is decreased by the same amount. If the impairment of equity capital is attributable to existing shareholders who failed to monitor bank managers, it is easily justified to reduce the share of existing stockholders and thereby to lower the CC interest rate. As such, the CC interest rate may depend on the possibility that existing stockholders are convinced of their responsibility as a monitor of the issuing bank.

b. Priority

The CC interest rate is altered by changing the priority between CC and subordinated bonds.

Contingent Capital Senior to Subordinated Bonds

- ◇ The failure trigger: the same as the CC with a capital-ratio conversion trigger.
- ◇ The conversion trigger: the same as the CC with a capital-ratio conversion trigger.
- ◇ The conversion price: the same as the CC with a capital-ratio conversion trigger.
- ◇ The priority: subordinated bonds are subordinated to CC; CC is subordinated to deposits.

Chart 13 shows the effects of changing priority between CC and subordinated bonds. Suppose that CC is issued in a large amount. In this case, the CC interest rate declines, when the priority is changed so that CC is senior to subordinated bonds. The size of the decline is limited, however, for the following reason. Since CC is a bond before conversion, an increase in CC boosts the leverage ratio and enables a small decline in the growth rate to cause a significant drop in the capital ratio. This raises the probability that CC is converted into common stock, that is, the most subordinated class of securities. The CC interest rate must be kept high to compensate for this disadvantage. Furthermore, if CC is issued in a small amount, the CC interest rate is almost untouched by the priority change. When massive losses occur as a result of a failure, both CC and subordinated bonds are used to absorb them, irrespective of the priority change. Therefore, the priority has little impact on the CC interest rate. Chart 13 (2) shows the CC interest rate obtained under the assumption of a zero growth economy. The CC interest rate remains almost intact, despite the priority change. This supports the conclusion above that a priority change has only a limited impact on the CC interest rate.

(4) Examples: The Lloyds Banking Group and Rabobank

There are two opposing arguments, regarding how high the CC interest rate will be when it is actually issued in the future. Optimists argue that CC can be used as a means of raising capital "inexpensively" if issued during an economic upturn. In contrast, pessimists argue strongly that the interest rate of CC will be too high for private banks to have any incentive to issue it. Recently, the Lloyds Banking Group and Rabobank have issued CC or a CC-like security. These are among the very few examples of CC issued. Here, the CC interest rates offered by the two financial institutions are examined, based on the discussions presented above.

a. The Lloyds Banking Group

In November 2009, the Lloyds Banking Group announced that it would issue CC called Enhanced Capital Notes (ECNs) in exchange for the existing hybrid products (Chart 14). The ECNs convert into common stock when the core Tier 1 ratio falls below 5%. The conversion price was predetermined, based on the actual share price observed prior to the date of issuance. The ECNs have the same priority as lower Tier 2 capital, and are included in the calculation of lower Tier 2 capital. They have maturity of 10-15 years. A premium of 1.5-2.5% was put on the coupon rate of the securities to be exchanged. The Lloyds Banking Group raised the subscription limit to prepare for a possible oversubscription, but found much stronger demand on the date of issuance.

The following facts must be taken into consideration in evaluating the CC premium (1.5-2.5%) offered by the Lloyds Banking Group. At the time of issuance, the Lloyds Banking Group was "nationalized" in part and was suspended from redeeming bonds and making any interest payments. Under these circumstances, the exchange of hybrid products for CC offered significant advantages: they paid higher interest and, once converted into common stock, could be sold and cashed in. Since the Lloyds Banking Group issued the CC under these exceptional circumstances, it is not clear how useful the above-mentioned interest rate premiums are for banks that plan to issue CC as a completely new security in the future.

b. Rabobank

Rabobank issued a CC called the Senior Contingent Note (SCN) in March 2010. This CC was issued as a completely new security and thus subject to less noise in its price formation than the CC issued by the Lloyds Banking Group (Chart 14). The SCN is designed as follows: when the capital ratio falls below 7% before maturity, the principal and the unpaid interest are both reduced to 25% and redeemed to the investors in cash. Although it appears at first glance to differ greatly from a CC product, the SCN is a variant of the CC explained thus far. It is virtually the same security as the CC with the basic design when the stock price has declined 75% by the time of conversion.

The SCN is senior to subordinated bonds, but excluded from the calculation of equity capital, since it is not covered by the Basel Capital Accord. Its maturity is 10 years. Rabobank issued the CC at a coupon rate of 6.875% and received twice as many bids as planned. This shows that banks can issue CC at a reasonable interest rate even in the course of financial instability. Rabobank attributes its success to its high capital adequacy ratio and earnings strength.

c. Evaluating the SCN with the Help of Numerical Examples

Rabobank's SCN will serve as a benchmark, when other banks plan to issue CC in the future. The interest rates of various types of CC under a wide variety of economic conditions can be inferred with the help of the numerical examples presented above and the coupon rate of the SCN. For instance, one of the numerical examples shows that the priority between CC and subordinated bonds has very little impact on the CC interest rate. Therefore, the fact that the SCN is a senior bond does not really explain why Rabobank could issue it at a low coupon rate.

Below, it is discussed how Rabobank could lower the issuing interest rate of SCNs further. First, note that the conversion trigger was set at a very high level. In the case of the SCNs, the conversion trigger is defined in terms of the *equity capital ratio*, which corresponds to the core Tier 1 ratio of an ordinary bank. Rabobank set this trigger at 7%, which is quite high. According to one of the numerical examples, the CC interest rate is reduced by lowering the capital-ratio conversion trigger.

Second, it should be noted that Rabobank issued the SCNs under circumstances in which the economy was unstable, and the expected growth rate was low. According to one of the numerical examples, the CC interest rate is likely to be high in an economy where the expected growth rate is low. Therefore, it is expected that if Rabobank issued the CC in an economic upturn, the interest rate would be lower. This supports the optimists' view that CC can be used as a means of raising equity capital "inexpensively" during a business upswing.

Third, in the case of the SCNs, both the principal and unpaid interest are discounted significantly to 25%, if the conversion trigger is activated. This is the same situation *ex post* as the one in which a conversion price is set at a significantly higher level than the stock price at the time of conversion. According to one of the numerical examples, the CC interest rate is lowered by setting a low conversion price. Therefore, Rabobank could lower the interest rate by changing the discount rate to a more modest number, say, 50%.

Based on the numerical examples in this section, the CC interest rate tends to be high and weakens the incentive to issue CC in countries under the following economic conditions: the expected growth rate is low; the tail risk is large; investors are strongly risk averse; the amount of outstanding subordinated bonds is large; and the outstanding value of common stock is small.[12] Even in these countries, however, the CC interest rate can be lowered by taking a variety of measures. Bearing in mind the differences in financial and economic conditions between countries, regulators should avoid placing excessive restrictions on the design of CC so that they can encourage a large number of banks to issue CC and derive as many benefits from them as possible.

4. Other Issues

There are many important issues that regulators should consider before determining whether or not to allow banks to issue CC. In this section, the following issues are discussed: (1) how the issuance of CC affects other financial markets; (2) whether or not the issuance of CC destabilizes the financial markets; (3) how the CC interest rate is calculated when the stock price is used as a conversion trigger; and (4) how the issuance of CC affects the probability of bank failure.

(1) The Impacts of Contingent Capital Issuance on Other Financial Markets

Just as the CC interest rate is affected by the market conditions of other financial instruments, the issuance of CC has impacts on the prices and interest rates of other financial instruments. Chart 5 above shows the impacts of CC issuance on the interest rates of subordinated bonds and the stock price of the bank issuing CC.

a. The Impacts of Contingent Capital Issuance on the Subordinated Bond Market

First, it is considered how CC issuance affects the interest rate of subordinated bonds. The issuance of CC, unless extremely large, has only a limited impact on the interest rate of subordinated bonds. Since CC is subordinated to subordinated bonds, the issuance of CC is beneficial to subordinated bond holders and thus lowers the interest rate of subordinated bonds. In fact, when CC is issued beyond a certain amount, the

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[12] Given the Japanese economic conditions and the balance sheets of the Japanese banks, characterized by a low growth rate, the large amount of subordinated bonds issued, and the small amount of common stock issued, the CC interest rate is expected to be significantly higher in Japan than in the United States and the United Kingdom, and even in emerging countries.

interest rate of subordinated bonds starts to decline. The interest rate of subordinated bonds, however, does not decline until the amount of CC outstanding is large enough for subordinated bonds investors to save the default cost of the issuing bank. The reason is that since subordinated bonds are subordinated to deposits, the benefits gained from CC issuance are mostly absorbed by deposits.

b. The Impacts of Contingent Capital Issuance on the Stock Market

In order to consider the impacts of issuing CC on the stock price, it is essential to understand Tobin's Q and the deposit burden on the bank. The *asset value of the bank*, v_a, is the discounted value of the future bank assets, which include both the principal and interest. This value does not necessarily coincide with the *acquisition price of the bank assets*, a. Tobin's Q is given by the ratio of these two values. That is,

$$q \equiv \frac{v_a}{a}. \tag{4.1}$$

It is obvious from the derivation process that v_a is proportional to a. Consequently, Tobin's Q does not depend on a.

As seen in Chart 5 (2) above, the relationship between the amount of CC issuance and the stock price is depicted as a smile curve. The smile curve is observed only if Tobin's Q is larger than unity (otherwise, the stock price declines monotonically along with an increase in CC issuance). If Tobin's Q is greater than unity, a unit increase in bank assets will raise its asset value by one or more. Meanwhile, an equilibrium interest rate of CC is determined so that the unit value of CC is equal to one. Therefore, the net value of issuing CC is positive in this case. If the amount of CC issuance is small (the bank assets are small) and the deposit ratio is high enough, the burden for deposit insurance is positive, while the deposit burden on the bank is smaller than d $(=1)$. As CC issuance increases (the bank assets increase), the burden for deposit insurance declines, while the deposit burden on the bank increases. If all of the net increase in the asset value is absorbed by the deposit insurance, the value of common stock does not increase. Moreover, it is often observed that the deposit burden on the bank increases, and thus the stock price declines. This is likely to occur when the amount of CC issuance is small. However, if CC is issued in a large amount, the increments in the asset value of the bank will eventually be directed to the stock value, which increases the stock price of the issuing bank.

c. Mathematical Analysis

The following analysis takes as given Tobin's Q (q), the deposit burden on the bank ($v_d(a)$), e, d, s, c, x, and m. In this case, the following two equations are sufficient to solve for a and p_x:

$$a = e + d + s + c + p_x x, \qquad \text{(4.2) [previously referred to as (2.18)]}$$

$$q \cdot a = v_d(a) + s + c + p_x(n + x). \qquad \text{(4.3) [transformed from (2.19)]}$$

Note that neither the interest rate of subordinated bonds, r_s, nor the CC interest rate, r_c, is directly involved in the determination of a and p_x. Once the values of a and p_x are given, the values of r_s and r_c are determined so that the equilibrium conditions (2.15)–(2.17) are satisfied simultaneously.

To see the impacts of issuing CC on the stock price, a comparative static analysis is conducted as follows. Equations (4.2) and (4.3) are totally differentiated and organized as follows. Note that n, e, and d are taken as given and are not included in the differential equations.

$$\begin{pmatrix} da \\ dp_x \end{pmatrix} = \frac{1}{\Delta} \begin{pmatrix} m & -x \\ q - v_d'(a) & -1 \end{pmatrix} \begin{pmatrix} 1 & 1 & p_x \\ 1 & 1 & p_x \end{pmatrix} \begin{pmatrix} dc \\ ds \\ dx \end{pmatrix},$$

$$\Delta \equiv m - (q - v_d'(a))x, \qquad (4.4)$$

from which the impact of CC issuance on the stock price can be calculated as follows:

$$\frac{\partial p_x}{\partial c} = \frac{(q-1) - v_d'(a)}{\Delta}. \qquad (4.5)$$

The sign of the determinant, Δ, is likely to be positive, since the number of newly issued shares, x, is far smaller than the total number of shares, m. Therefore, the impact of CC issuance on the stock price is determined by the sign of the numerator.

Two points are relevant to the determination of the sign of the numerator. The first point is whether or not Tobin's Q is greater than unity. As discussed in Appendix A, Tobin's Q depends on various conditions, such as the location and shape of the probability distribution of the future growth rate. The second is whether or not the burden for deposit insurance is positive. The latter condition can be rephrased as whether or not the bank assets, a, are relatively small. As discussed in Appendix B, when a is small enough, $v_d'(a)$ takes a positive value; when a is large enough, $v_d'(a)$ is zero. Note that Tobin's Q and the deposit burden on the bank depend on S_b, which defines under what conditions a bank fails. Its value, however, is assumed to be intact in the following discussion.

Suppose that Tobin's Q is smaller than unity. Then equation (4.5) always takes a negative value, that is, the CC issuance puts downward pressures on the stock price. Suppose alternatively that Tobin's Q is greater than unity. As discussed earlier, when the value of a is small, $v_d'(a)$ takes a positive value. If this value is sufficiently large, equation (4.5) takes a negative value, that is, the CC issuance lowers the stock price. When the value of a is sufficiently large, however, the value of $v_d'(a)$ is zero. In this case, the sign of equation (4.5) is positive; in other words, the CC issuance boosts the stock price of the issuing bank.

The most notable result concerning equation (4.4) is that the issuance of subordinated bonds and common stock has the same impacts on the stock price as that of CC, quantitatively as well as qualitatively, unless the possibility of bank failure changes as a result of CC issuance.[13] This can be seen in the second matrix on the right-hand side of the top of equation (4.4). The first column of this matrix is used to calculate the effects of CC issuance. Note that the second column of this matrix is identical to the first. This suggests that the issuance of subordinated bonds has the

[13] This conclusion depends heavily on the assumption that the issuance of CC has no impact on the likelihood of bank failure. In general, however, the probability of bank failure declines if CC is converted into common stock. Note that CC is issued literally in order to change the probability of bank failure. The model in this paper assumes that the bank is liquidated in period 2 without exception and incorporates no mechanism by which the issuance of CC affects the costs associated with its future failure. However, it is not difficult to incorporate these costs.

same impacts on the stock price as does the CC issuance. Next, the third column is p_x times as large as the first. This demonstrates that the impact of issuing one unit of common stock is p_x times the impact of issuing ¥1 of CC. Note, however, that this represents the impact of issuing ¥ p_x of common stock. Therefore, the impact of issuing ¥1 of common stock is equal to that of issuing ¥1 of CC.

The relationship between the amount of CC issuance and the stock price is complicated, and thus the theoretical argument above does not help us project precisely how CC issuance affects the stock price in practice. It is possible to say qualitatively that the stock price tends to decline as a result of CC issuance, when economic growth is slow. It is almost impossible, however, to predict quantitatively to what extent the growth rate should be low precisely so that CC issuance leads to a reduction in the stock price. Unfortunately, the limited experiences of CC issuance do not leave us any rules of thumb to solve this problem in a realistic way.

Nonetheless, the same theoretical model gives us a practical method of forecasting the effects of CC issuance on the stock price. The impacts of CC issuance on the stock price can be projected closely if the bank has an experience of issuing common stock or subordinated bonds in the near past. Remember that issuing subordinated bonds has exactly the same impacts on the stock price as issuing CC, and that issuing new common shares at the market price also has the same effects on the stock price as issuing CC. Therefore, if the stock price declined as a result of the issuance of subordinated bonds or common stock, the stock price is expected to decline when CC is issued.

(2) The Possibility of Contingent Capital Issuance Destabilizing Financial Markets

The issuance of CC may destabilize other financial markets, not just affecting price formation in those markets. This section addresses two issues regarding such market instability: destabilizing conversion-price designs and multiple-equilibrium CC interest rates.

a. Contingent Capital with a Conversion Price at the Stock Price upon Conversion

It is sometimes argued that a conversion price should be set at the same level as the stock price prevailing in the market at the time of conversion. The conversion of CC will occur when the economy is depressed and the stock price is exposed to strong downward pressures. At the time of issuance, however, it is hardly predictable how much the stock price will decline by the time of conversion. Therefore, it seems "fair" to set a conversion price at the stock price prevailing in the market at the time of conversion. The following analysis shows that it is naïve to think of this type of conversion price as "fair" in any sense. What is worse is that it may destabilize the stock market.

First, it is shown that the idea of using a stock price at the time of conversion as a conversion price has nothing to do with the notion of "fairness." Let $p_x^1(i)$ and $p_c^1(i)$ denote the prices of common stock and CC that prevail in state i in period 1 (i.e., at the time of conversion), respectively. If a conversion price is set at the stock price at the time of conversion, the share of existing stockholders, $\lambda'(i)$, is given by

$$\lambda'(i) \equiv \frac{m}{m + \dfrac{p_c^1(i) \cdot c}{p_x^1(i)}} = \frac{p_x^1(i) \cdot m}{p_x^1(i) \cdot m + p_c^1(i) \cdot c}. \tag{4.6}$$

Choose the value of $\bar{\lambda}$ arbitrarily and use it to calculate the total values of common stock and CC in period 1.

$$p_x^1(i) \cdot m = \bar{\lambda} \sum_{j=1}^{\bar{S}} \psi_j (v_a(i,j) - v_d(i,j) - v_s(i,j)),$$

$$p_c^1(i) \cdot c = (1 - \bar{\lambda}) \sum_{j=1}^{\bar{S}} \psi_j (v_a(i,j) - v_d(i,j) - v_s(i,j))$$

$$\text{for } i = S_c + 1, \cdots, S_b. \tag{4.7}$$

The substitution of equation (4.7) into (4.6) shows that $\lambda'(i)$ is always equal to $\bar{\lambda}$. Remember that the latter value is chosen arbitrarily. Therefore, $\lambda'(i)$ has no relevance to the concept of "fairness."

This result is nearly trivial, although it appears counterintuitive at first glance.

According to equation (4.7), the stock price in period 1 is determined once the share of existing stockholders is given. That is, the stock price is not exogenous, but determined endogenously by the share of existing stockholders. Unless the share of existing stockholders is determined exogenously from the viewpoint of fairness, the stock price has no relevance to the concept of fairness. This implication cannot be obtained from the approach to derive the CC interest rate, taking as given the stochastic process of the stock price of the bank issuing CC.

Next, it is also shown that the idea of using the stock price at the time of conversion as a conversion price produces another problem of introducing a new source of uncertainty. As is evident from the above discussion, the assumption that the share of existing stockholders is determined by the market price of the stock at the time of conversion provides investors with insufficient information. Investors must predict at what level the share of existing stockholder will be in the future and what the associated stock price will be. As a matter of course, a premium to compensate for this uncertainty over a conversion price is added to the CC interest rate. Furthermore, the probability distribution concerning the share of existing stockholders may not be assumed at all. Therefore, investors may require from the issuing bank a very high premium for the uncertainty. This suggests that in order to suppress the CC interest rate, the share of existing stockholders or the conversion price should be determined by the time of issuance.

b. The Possibility of Multiple Equilibria Destabilizing the Contingent Capital Market

Multiple equilibria pose a further problem by increasing uncertainty in the CC market. The numerical example given in Chart 5 explains the point clearly. Suppose that the issue of CC amounts to 0.06. With the CC interest rate set at 9%, the CC is converted into common stock in state 9. In contrast, with the interest rate set at 8%, the CC is converted into common stock in state 8. Consider the case where an issuing bank provides investors with only the information on the amount issued, but leaves the interest rate determined in market equilibrium. In this case, the interest rate is determined purely by chance, depending on the consensus among investors. Any consensus, however, is difficult to reach quickly. Therefore, CC investors are faced with a confusing market until they can reach a consensus.

There are a number of methods to avoid multiple equilibria. The first method is to avoid the quantity that is likely to allow for multiple equilibria at the time of issuance. In this case, the interest rate can be determined uniquely in the market equilibrium. The second method is to announce the CC interest rate together with the announcement of the amount of CC issued. This follows an existing market practice and is more practical than the first method. For example, when issuing subordinated bonds, it is a practice for a bank to announce the interest rate. This method presumes that the bank can calculate the equilibrium CC interest rate precisely. If it announces an interest rate lower than the equilibrium rate, the bank cannot achieve its sales target. Conversely, if it announces a higher interest rate, the bank must pay more than is necessary. However, a possible imbalance between the supply and demand in a market is not specific to CC and may arise in other financial markets. Furthermore, the problem of multiple equilibria has no effects on other markets, including the interest rate of subordinated bonds or the stock price. To sum up, it is inferred that the uncertainty due to the multiple equilibria will not entail a high cost, if eliminated by announcing the CC interest rate.

(3) Contingent Capital with a Stock-Price Conversion Trigger

When a bank uses a capital-ratio conversion trigger, the capital ratio should be calculated frequently so that CC is converted into common stock in a timely manner. Otherwise, the level of capital-ratio trigger should be raised to make early conversion possible. In either case, the associated costs seem to be high. The third method is to make use of the stock price as a conversion trigger to replace a capital-ratio trigger. Here, the interest rate is calculated for the CC that is designed in the following way.[14]

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[14] In using the stock price as a conversion trigger, one should fully recognize the associated disadvantages, such as the possible turbulence caused by rumors and stock price manipulation.

<u>Contingent Capital with a Stock-Price Conversion Trigger</u>

◇ The failure trigger: the same as the CC with a capital-ratio conversion trigger.

◇ The conversion trigger: 70% of the stock price at the time of issuance of CC.

◇ The conversion price: 60% of the stock price at the time of issuance of CC.

◇ The priority: the same as the CC with a capital-ratio conversion trigger.

To replace the capital-ratio conversion trigger with a stock-price conversion trigger, the inequalities (2.27) should be replaced with

$$p_x^1(i) \geq 0.7 p_x \quad \text{for} \quad i = 1, \cdots, S_c,$$

$$p_x^1(i) < 0.7 p_x \quad \text{for} \quad i = S_c + 1, \cdots, S_b, \tag{4.8}$$

where $p_x^1(i)$ is the stock price in state i in period 1; p_x is the stock price in period 0 (at the time of CC issuance).

It takes some time for the CC to convert into common stock after the trigger is activated. As such, the stock price is highly likely to have fallen below the trigger level by the time the CC investors are allowed to sell the stock. With this taken into consideration, a conversion price is set at a level lower than the conversion trigger, 70% of the stock price at the time of issuance in the present example. If the conversion price is 60% of the stock price at the time of issuance, the share of existing stockholders can be calculated in the same way as shown in equation (3.1). That is,

$$\lambda = \frac{m}{m + \dfrac{c}{0.6 p_x}} = \frac{0.6 p_x m}{0.6 p_x m + c}. \tag{4.9}$$

Chart 15 shows the relationships between the amount of CC issuance and various interest rates and the stock price. As is the case where the capital-ratio conversion trigger is used, there is the possibility of multiple equilibria. Furthermore, a range of CC issuance that allow for multiple equilibria is quite large. As discussed earlier, multiple equilibria may increase uncertainty in the market. Therefore, it is desirable to take actions to prevent uncertainty from arising by, for example, announcing the interest rate in advance.

(4) The Impacts of Contingent Capital Issuance on the Likelihood of Failure

Here, the impacts of CC issuance on the probability of bank failure are examined. The failure of a bank may destabilize entire financial systems through a number of paths, such as trade relation among banks and a loss of confidence among market participants. The BCBS pay much attention to CC, because the committee believes that CC makes it easier for a bank suffering a capital loss to raise capital quickly and thereby reduce the risk of bank failure, and prevent entire financial systems from destabilizing.

However, the likelihood of bank failure cannot be reduced by simply increasing the amount of CC. Clearly, when the CC converts into common stock, the probability of bank failure will be lowered due to the increased equity capital. The issuance of CC has, however, two drawbacks. First, CC is nothing but a bond before conversion. Therefore, the greater the amount of CC issued, the higher the leverage ratio and the greater the probability of bank failure. Second, the interest rate at which CC is issued is expected to be relatively high. This puts downward pressure on earnings and thereby makes capital accumulation slow. A lower capital ratio makes bank failure more likely.

As described just above, the issuance of CC has two aspects, with regard to bank failure: issuing CC decreases the probability of bank failure just as well as it increases the probability. The probability of bank failure can be minimized by striking a good balance between these two aspects. It is also shown how the optimal amount of CC issuance responds to changes in the economic environment, based on the model presented in Section 2. As an example, we focus on the relationship between the expected growth rate and the optimal amount of CC issuance in particular.

As explained earlier, the issuance of CC raises the leverage ratio of the bank and thus the likelihood of bank failure. This leverage effect is reduced by decreasing the amount of other debts along with the issuance of CC. Specifically, we consider the case where subordinated bonds are replaced by new CC. This setting may serve as a reference point when considering whether regulations should allow for the inclusion of

CC in calculating Tier 2 capital.

There are three cases where a bank fails in the model presented in Section 2:

(1) Failure in period 1;

(2) Failure in period 2, with conversion of CC in period 1;

(3) Failure in period 2, with no conversion of CC in period 1.

Each of the three cases is examined in detail below.

First, in case (3), the bank fails when the following condition is satisfied:

$$r_d^2 d + r_s^2 s + r_c^2 c > \phi_i \phi_j a \,. \tag{4.10}$$

This paper assumes that CC is subordinated to subordinated bonds. Thus, the interest rate of CC is higher than that of subordinated bonds. Therefore, as subordinated bonds are replaced by CC, the left-hand side increases. In contrast, under the assumption here, the amount of assets remains intact by replacing the subordinated bonds with CC, and thus the right-hand side remains constant. Hence, the probability of bank failure increases, as the subordinated bonds are replaced by CC.

Next, in case (2), the bank fails when the following condition is satisfied:

$$r_d^2 d + r_s^2 s > \phi_i \phi_j a \,. \tag{4.11}$$

The left-hand side falls, when subordinated bonds are replaced by CC. As explained earlier, the right-hand side remains constant, since the amount of assets remains intact with subordinated bonds replaced with CC. Therefore, the probability of bank failure decreases, as the subordinated bonds are replaced by CC.

Finally, case (1) has already been discussed with the failure trigger in Section 2. The bank fails when the following condition is satisfied. That is,

$$r_d d + r_s s + r_c c > \phi_i a \,. \tag{4.12}$$

Chart 16 (1) illustrates the relationship between the amount of CC issued and the probability of bank failure.[15] The dotted line, the dashed line, and the thin solid line represent the bank failure probability of cases (1), (2), and (3), respectively. The dashed line for case (2) goes down monotonically, while the thin solid line for case (3) goes up monotonically.[16] Note that equation (4.10) is a restriction that is looser than equation (4.11). Thus, the probability that case (3) occurs is always higher than the likelihood that case (2) occurs. The thick solid line in Chart 16 (1) represents the sum of the three probabilities, that is, the probability of bank failure. The probability of bank failure is lowest when the amount of CC is 3% to 5% of deposits. Therefore, it is not necessarily true that the greater the amount of CC issued, the lower the probability of bank failure.

The optimal amount of CC issuance in order to minimize the probability of bank failure changes along with the expected growth rate. Chart 16 (2) illustrates the relationship between the expected growth rate and the optimal combination of CC and subordinated bonds. Their relationship is not straightforward at all. Moreover, the sensitivity of the optimal combination to the expected growth rate is extremely large. Note that in the numerical example above, the sum of subordinated bonds and CC is given arbitrarily. Hence, a remaining issue is how to choose an optimal sum of subordinated bonds and CC. All these complex issues must be discussed when regulatory authorities consider the optimal combination of CC and subordinated bonds.

5. CONCLUSION

Contingent capital (CC) can automatically recover impaired equity capital in the midst of financial crises, when it is difficult for banks to issue new common stock. Therefore, it has great advantages for enhancing the soundness of banks and increasing the

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[15] In the chart, the sum of subordinated bonds and CC issued is assumed to be 15% of the amount of deposits. The expected rate of growth is assumed to be 0.5%.

[16] In some cases, the dashed line for case (2) rises, while the thin solid line for case (3) declines. This is caused by a decline in the critical growth rate for conversion (it becomes less likely to convert) in period 1.

stability of financial systems. The interest rates at which CC is issued may vary significantly, reflecting the economic environment in each country and the balance-sheet conditions of the banks. Therefore, in order to enable many banks to enjoy the advantages of CC and thereby improve the stability of financial systems in a large number of countries, it is not desirable for regulators to put excessive restrictions on the design of CC.

This does not mean, however, that any CC design should be accepted. For instance, consider the CC such that the stock price prevailing in the market at the time of conversion is used as a conversion price. In this case, when the conversion of CC is expected, the stock market becomes unstable, due to speculative activity among market participants. This suggests that a conversion price of CC should be determined at the time of issuance. In addition, there is a possibility of multiple-equilibrium CC interest rates, and the uncertainty due to multiple equilibria may impair the stability of the market. A way to eliminate the existence of multiple equilibria is to announce the interest rate as well as the issued amount at the time of CC issuance. Regulators should deepen the understanding of these potential destabilizing properties of CC and impose a minimum set of requirements on the design of CC so that the issuance of CC will not become a new destabilizing factor.

Transparency is another important issue for the design of CC. The objective of this paper is to clarify the characteristics of CC, using a model that is the simplest possible. Nonetheless, this paper has just shown the complexity of CC as a financial instrument more explicitly. It should be noted that the complexity of CC is likely to create asymmetric information between the issuing bank and investors. Therefore, when CC is actually issued, its trigger should be as simple and verifiable as possible, so that the conversion of CC is not delayed by the discretion of the issuing bank. In this regard, a stock-price trigger is considered a promising candidate, since it can be captured frequently by both an issuing bank and investors. A caveat is that a stock-price trigger is exposed to another serious risk, that of stock price manipulation.

As a final remark, the following problem is to be addressed. That is, there may be a divergence between social welfare and private interests, regarding the introduction of

CC. As the CC issuance increases, the risk of impairment of equity capital decreases and the probability of destabilization of financial systems declines. Therefore, the issuance of CC is thought to have great social advantages. No private banks, however, take into account externalities, such as the stability of financial systems. This is why private interests deviate from social welfare. If the promotion of CC issuance contributes to improving social welfare, it may be desirable to provide some preferential treatment by, for example, allowing CC to be included in the calculation of regulatory capital even before conversion into common stock.

APPENDIX A. TOBIN'S Q AND THE ASSET VALUE OF A BANK

The asset value of a bank, v_a, is key to the pricing of various financial instruments for fund-raising. Here, its basic properties are discussed from the viewpoint of Tobin's Q.

Tobin's Q is independent from a and thus can be calculated separately as follows.

$$q = \omega \sum_{i=1}^{S_b} \phi_i \psi_i + \sum_{i=S_b+1}^{\bar{S}} \phi_i \psi_i \,, \tag{A.1}$$

where

$$\omega \equiv \sum_{i=1}^{\bar{S}} \phi_i \psi_i \,. \tag{A.2}$$

Combining these equations with equation (2.6) shows that Tobin's Q depends on the probability distribution of the growth rate and the shape of the utility function of consumers (i.e., the degree of relative risk aversion).

Chart A1 (1) shows the impacts of the expected growth rate on Tobin's Q. It is intuitive that Tobin's Q rises together with the expected rate of growth.

Suppose that Tobin's Q is smaller than unity. The higher the likelihood of failure (the smaller the value of S_b), the higher the value of Tobin's Q. If Tobin's Q is smaller than unity, the bank gains from reducing its asset size. Actually, it is more desirable for the bank to fail and withdraw from the business promptly than to continue its operation. Suppose alternatively that Tobin's Q is greater than unity. In this case, the lower the likelihood of failure (the greater the value of S_b), the higher the value of Tobin's Q.

Charts A1 (2) and A1 (3) show the relationship between the shape of the probability distribution of the growth rate and Tobin's Q. A high expected growth rate is assumed in the former, while a low rate is in the latter. Here, changes in tail risk are expressed as changes in the shape of the probability distribution. Denote the probability distribution in the standard case by π_i (for $i = 1, \cdots, \bar{S}$). Then the probability distribution with a high degree of tail risk is constituted as follows.

$$\pi'_i = \frac{\pi_i + \alpha}{1 + \alpha \bar{S}} \qquad \text{for } i = 1, \cdots, \bar{S} \,, \tag{A.3}$$

where α takes a positive value. π'_i converges to $1/\bar{S}$ as α goes to infinity.

Regardless of the expected rate of growth, Tobin's Q declines, as the tail risk increases, unless the probability of bank failure is very high. The reason is that as the tail risk increases, a risk-averse consumer gains less and less from investing in the bank.

Chart A1 (4) shows the relationship between Tobin's Q and the degree of risk aversion among consumers. As the degree of risk aversion among consumers increases, Tobin's Q drops. If Tobin's Q is smaller than unity, the bank gains from reducing assets at an early stage. In fact, Tobin's Q increases by liquidating the bank at an early stage (or vice versa).

APPENDIX B. DEPOSIT INSURANCE AND DEPOSIT BURDEN ON A BANK

As discussed above, the deposit burden on a bank, v_d, is not necessarily equal to the nominal amount of deposits, d, due to the existence of deposit insurance. In general, the value of v_d changes together with a. Since v_d affects the stock price of the bank, understanding its variation is key to predict the impacts of CC issuance on financial markets.

Chart A2 (1) illustrates the relationship between the deposit burden on a bank, v_d, and a. There is no proportional relationship between them, as observed between v_a and a. The reason is that v_d depends on the size of d relative to a as well as on the size of a. This paper uses the expression of $v_d(a)$, wherever it is necessary to emphasize the dependency of v_d on a.

Chart A2 (2) shows the value of deposit burden on a bank differentiated by the amount of assets, that is, $v_d'(a)$. In general, when the amount of assets is large enough in relation to the size of deposits, it is not likely that deposits cannot be paid out due to losses. Therefore, when a is sufficiently small, $v_d'(a)$ takes a positive value. When a is sufficiently large, since the bank can always pay out its deposits, the value of $v_d'(a)$ becomes zero.

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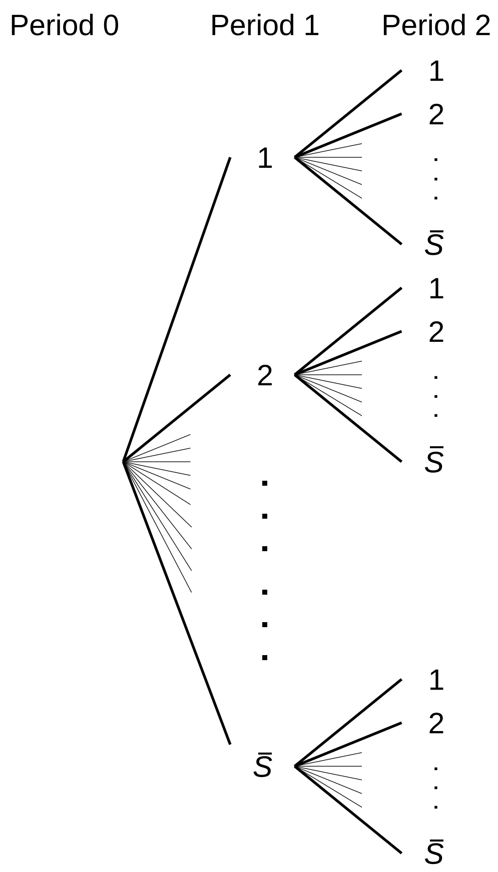
Squam Lake Working Group on Financial Regulation (2009), "An Expedited Resolution Mechanism for Distressed Financial Firms: Regulatory Hybrid Securities," Council on Foreign Relations, Center for Geoeconomic Studies.

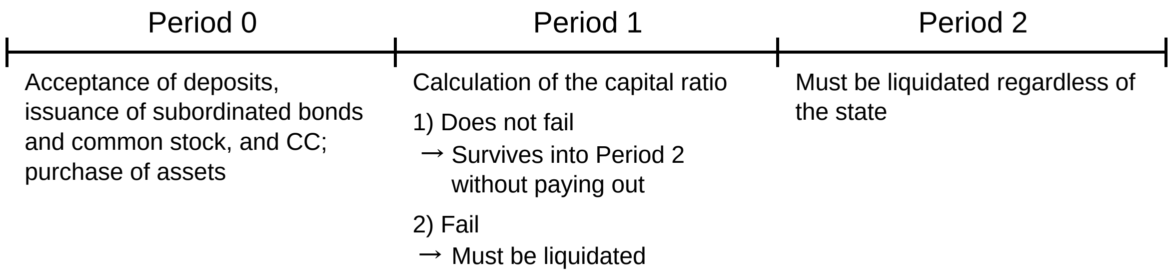
(Chart 1)

Developments of States in the Model

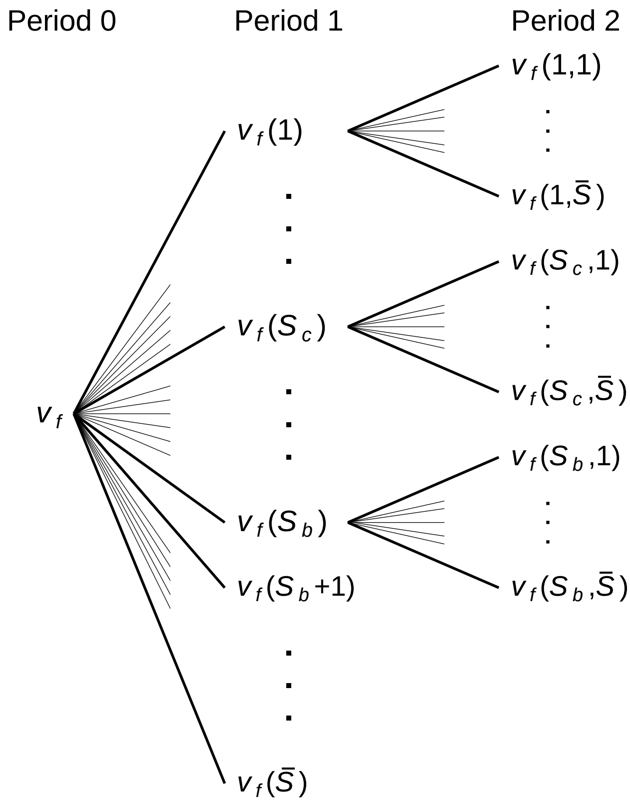


(Chart 2)

Timing of Events

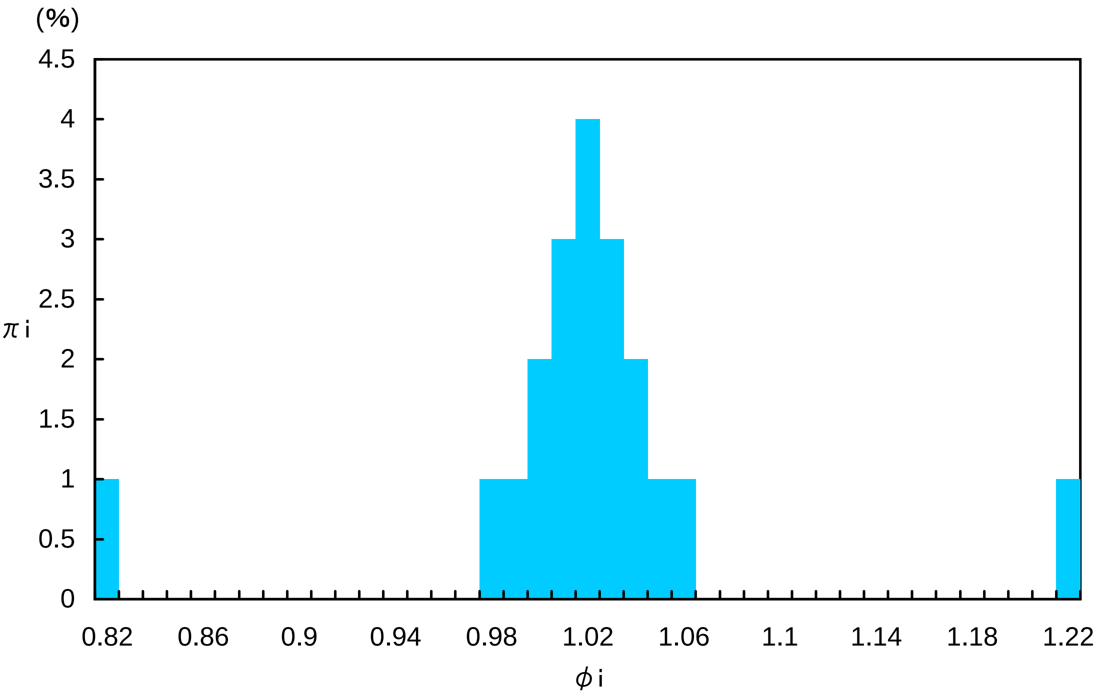


Pricing of Financial Instruments



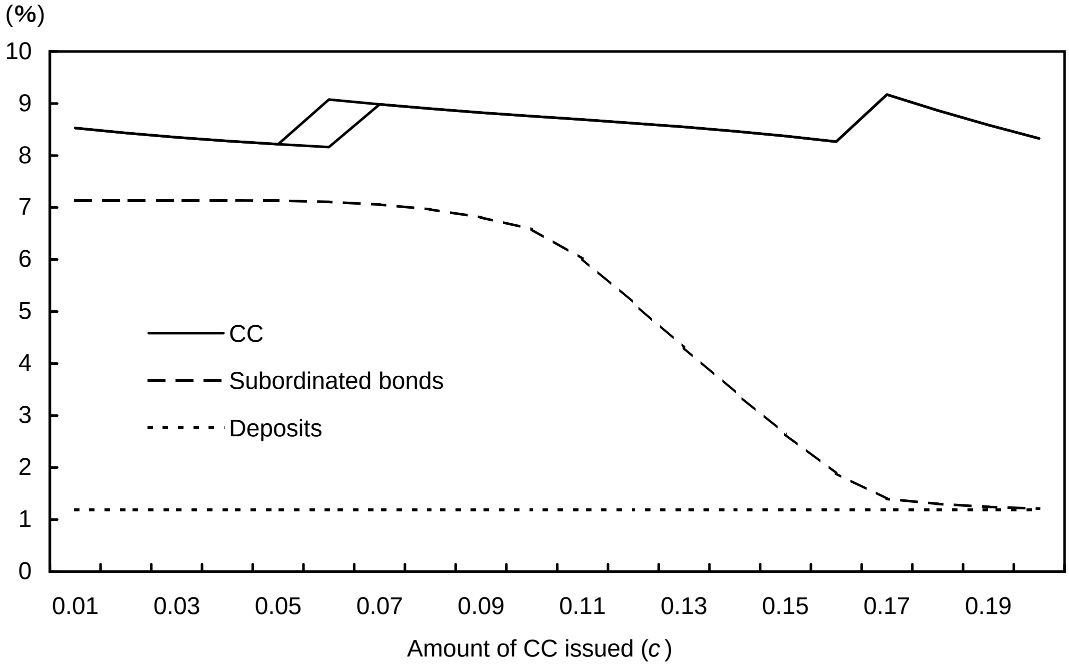
(Chart 4)

Growth Rate Probability Distribution

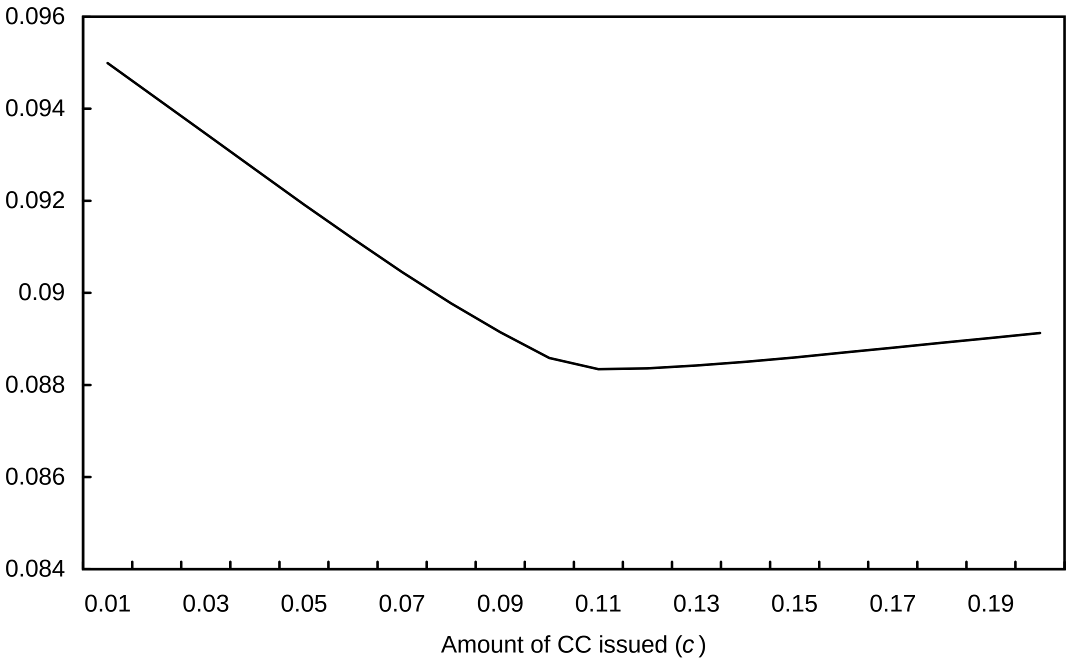


Impacts of CC Issuance on Financial Markets

(1) Interest Rates of CC, Subordinated Bonds, and Deposits



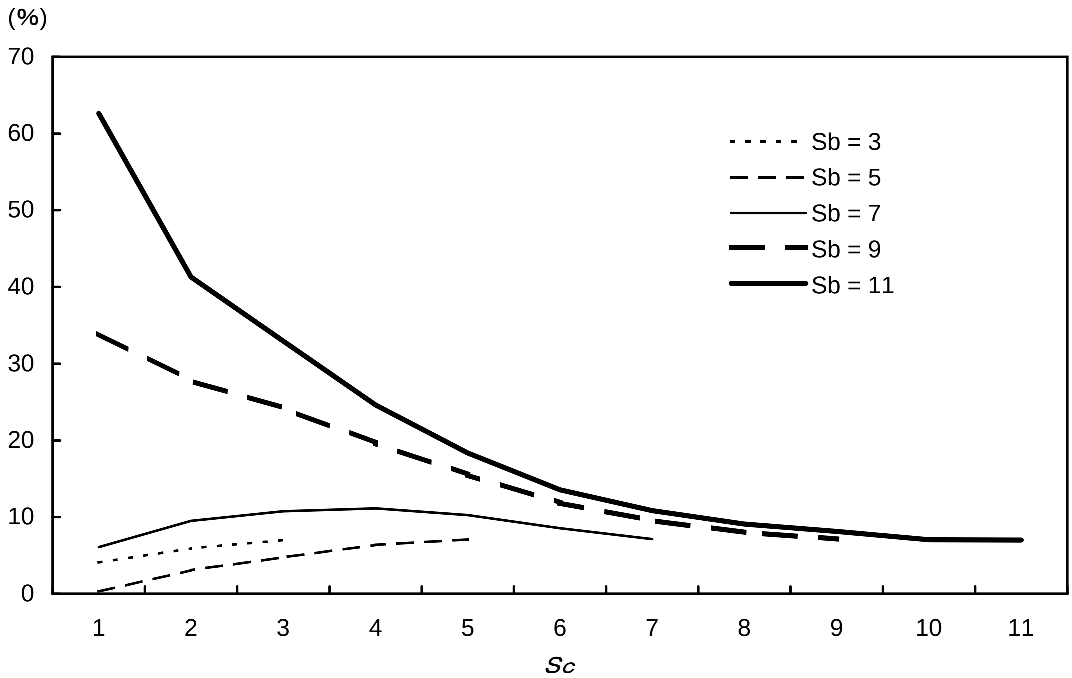
(2) Stock Price



Note: The horizontal axis denotes the amount of CC issued (c) when the amount of deposits is normalized to one.

(Chart 6)

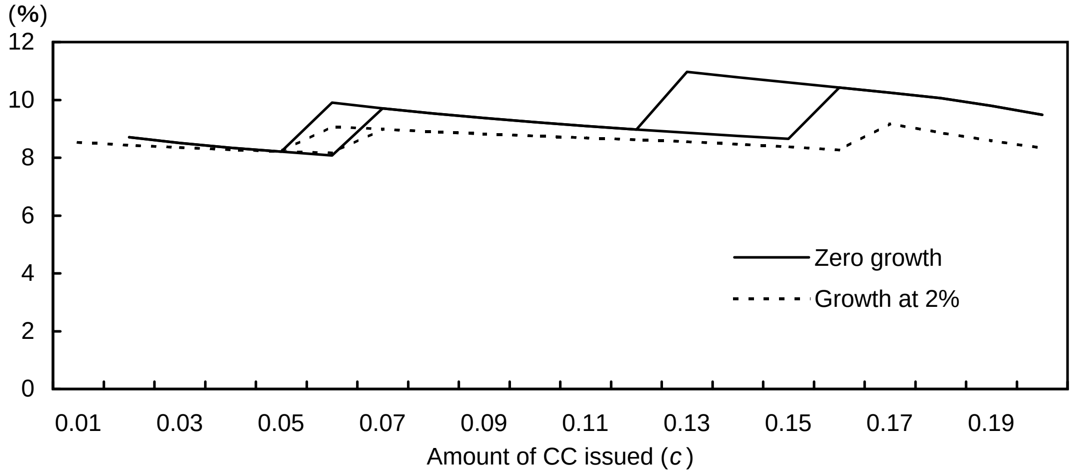
Impacts of Timing of Failure/Conversion on the CC Interest Rates



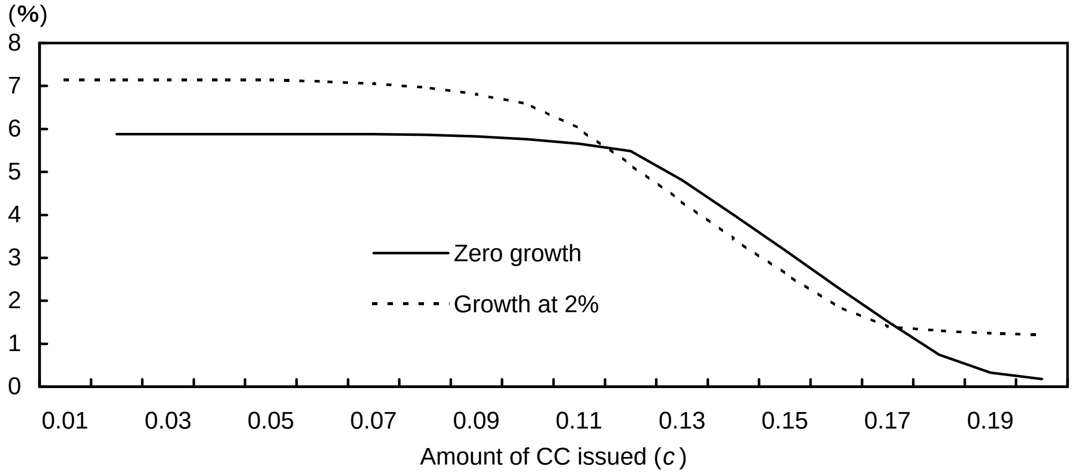
(Chart 7)

Impacts of Expected Growth Rates on Financial Markets

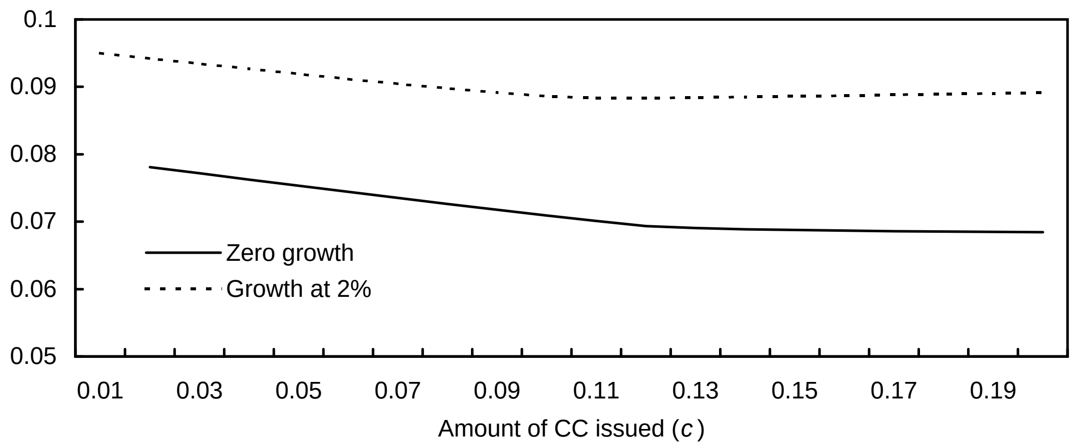
(1) Interest Rate of CC



(2) Interest Rates of Subordinated Bonds



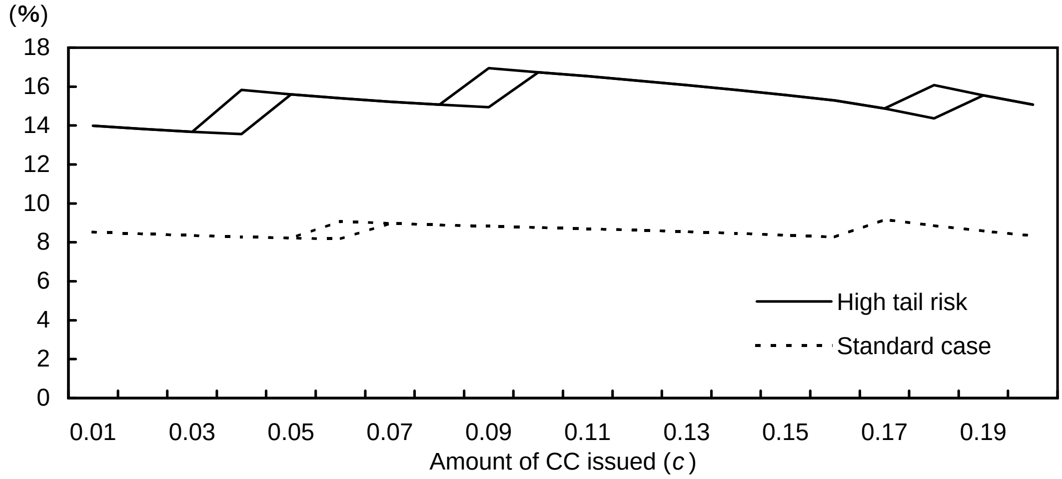
(3) Stock Price



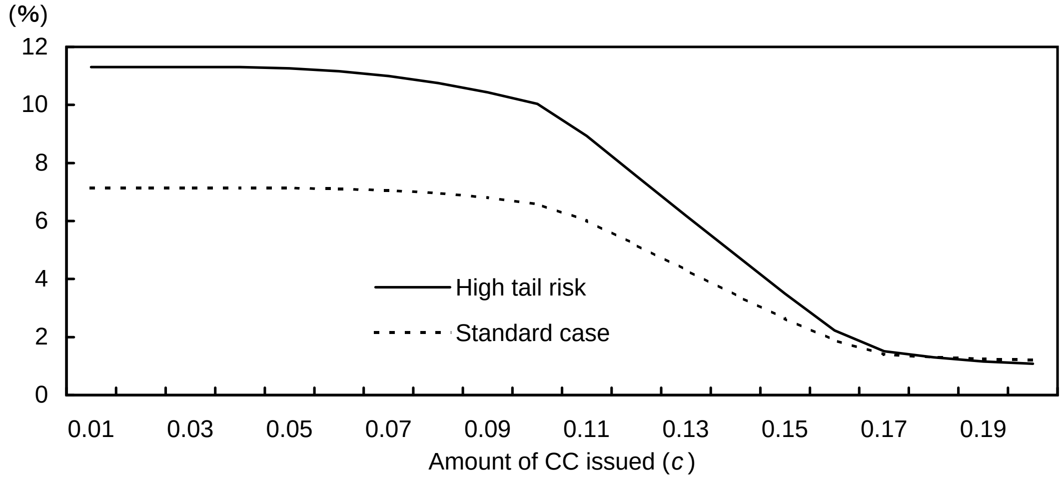
Note: The horizontal axis denotes the amount of CC issued (c) when the amount of deposits is normalized to one.

Impacts of Increased Tail Risk on Financial Markets

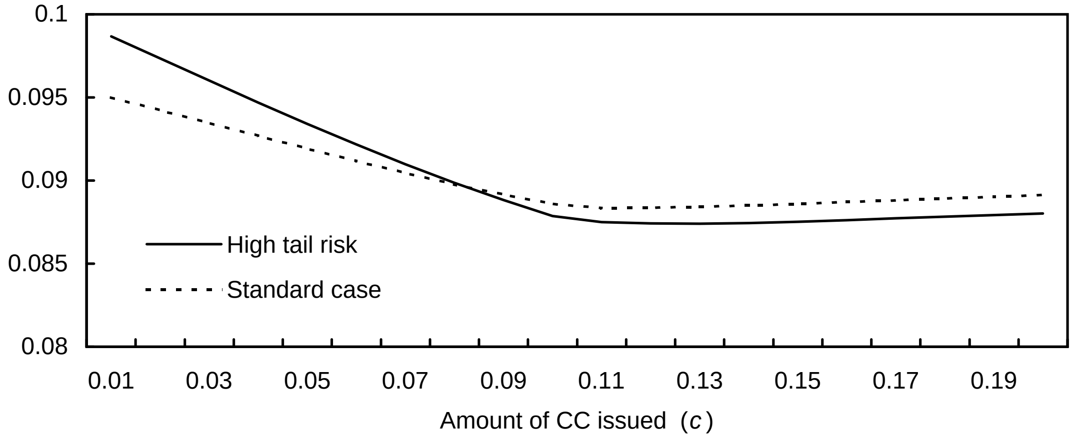
(1) Interest Rate of CC



(2) Interest Rate of Subordinated Bonds



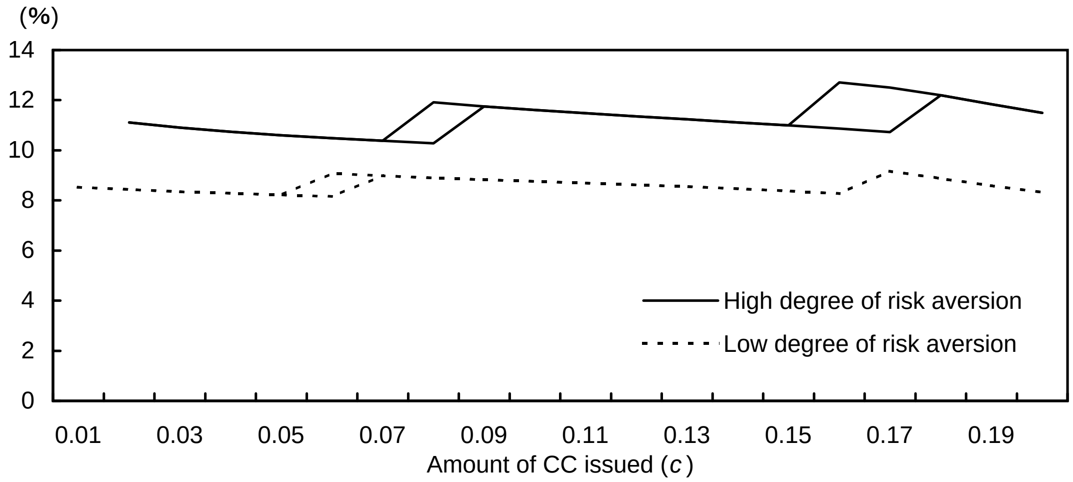
(3) Stock Price



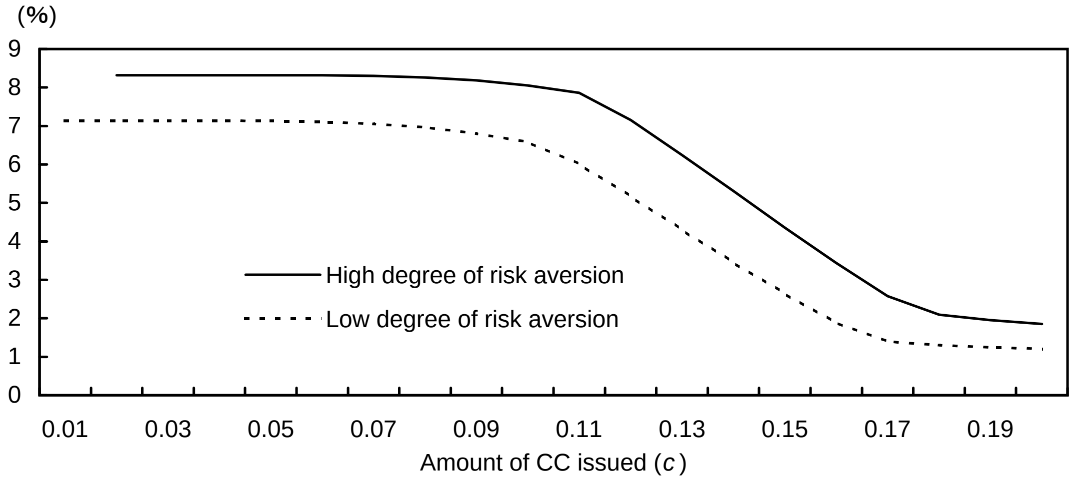
Note: The horizontal axis denotes the amount of CC issued (c) when the amount of deposits is normalized to one.

Impacts of Investors' Risk Aversion on Financial Markets

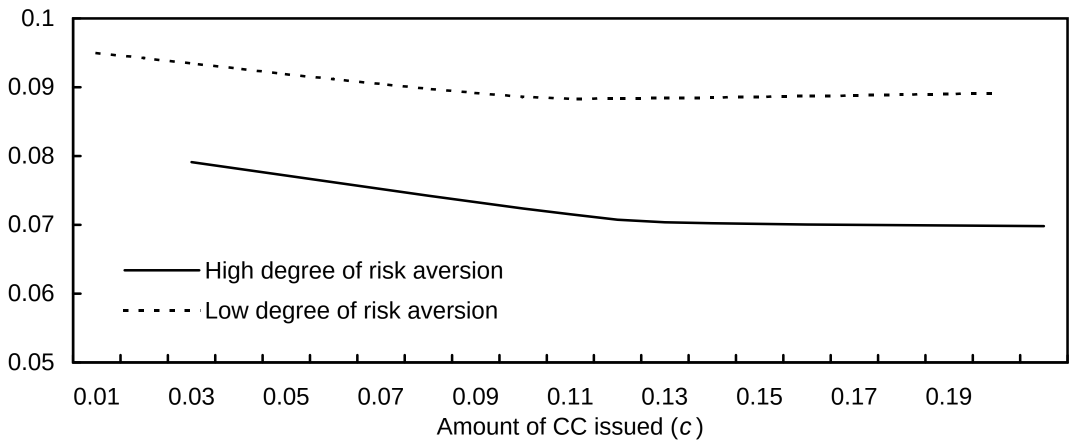
(1) Interest Rate of CC



(2) Interest Rate of Subordinated Bonds



(3) Stock Price

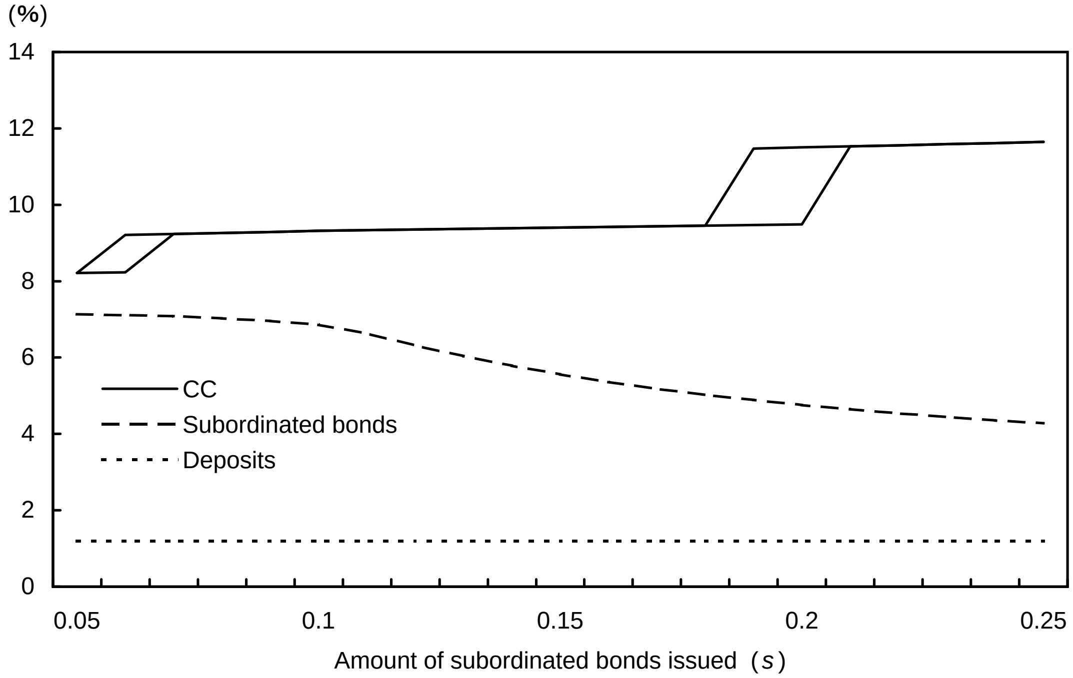


Note: The horizontal axis denotes the amount of CC issued (c) when the amount of deposits is normalized to one.

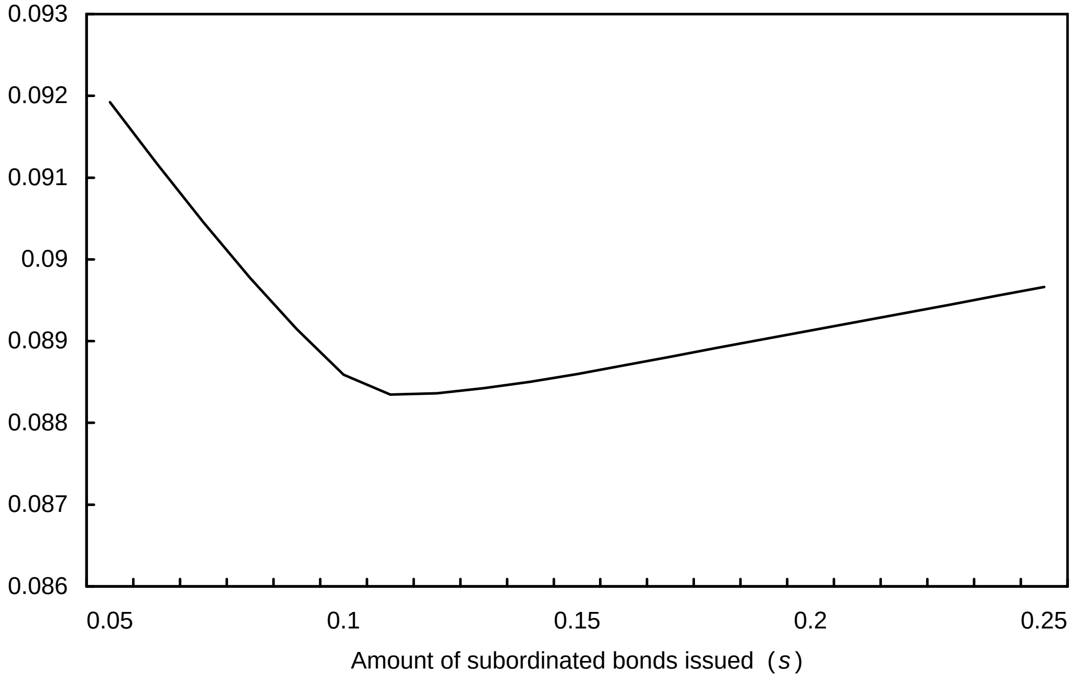
(Chart 10)

Impacts of Subordinated Bond Issuance on Other Financial Markets

(1) Interest Rates of CC, Subordinated Bonds, and Deposits



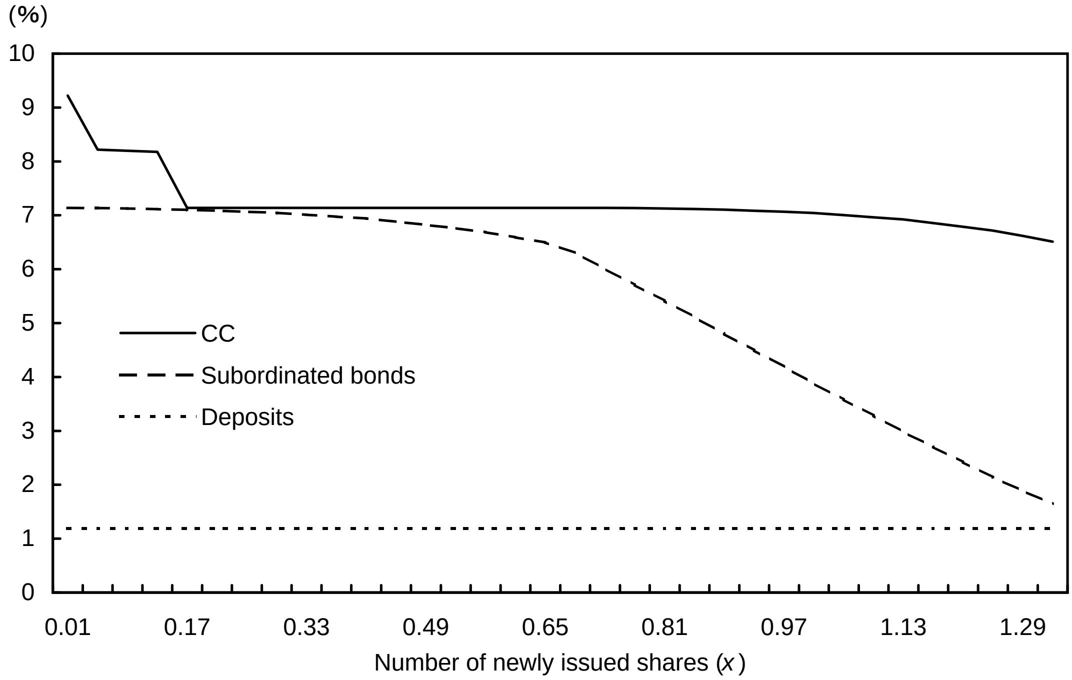
(2) Stock Price



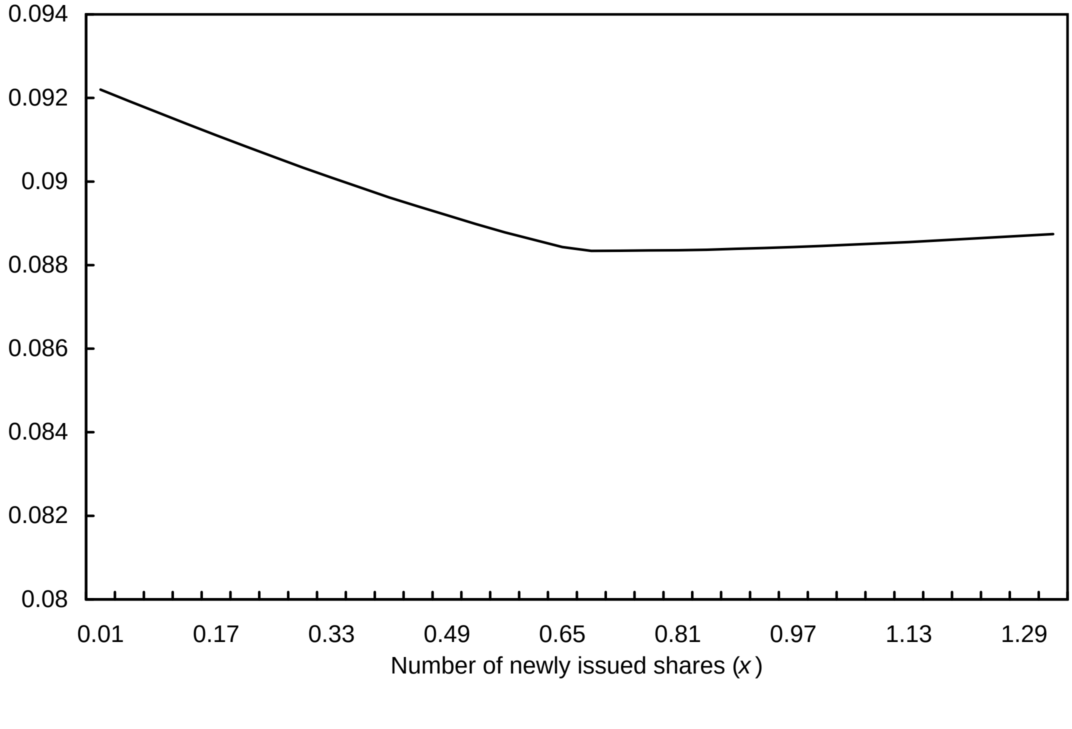
Note: The horizontal axis denotes the amount of subordinated bonds issued (*s*) when the amount of deposits is normalized to one.

Impacts of Market Price Issuance of New Shares on Financial Markets

(1) Interest Rates of CC, Subordinated Bonds, and Deposits



(2) Stock Price

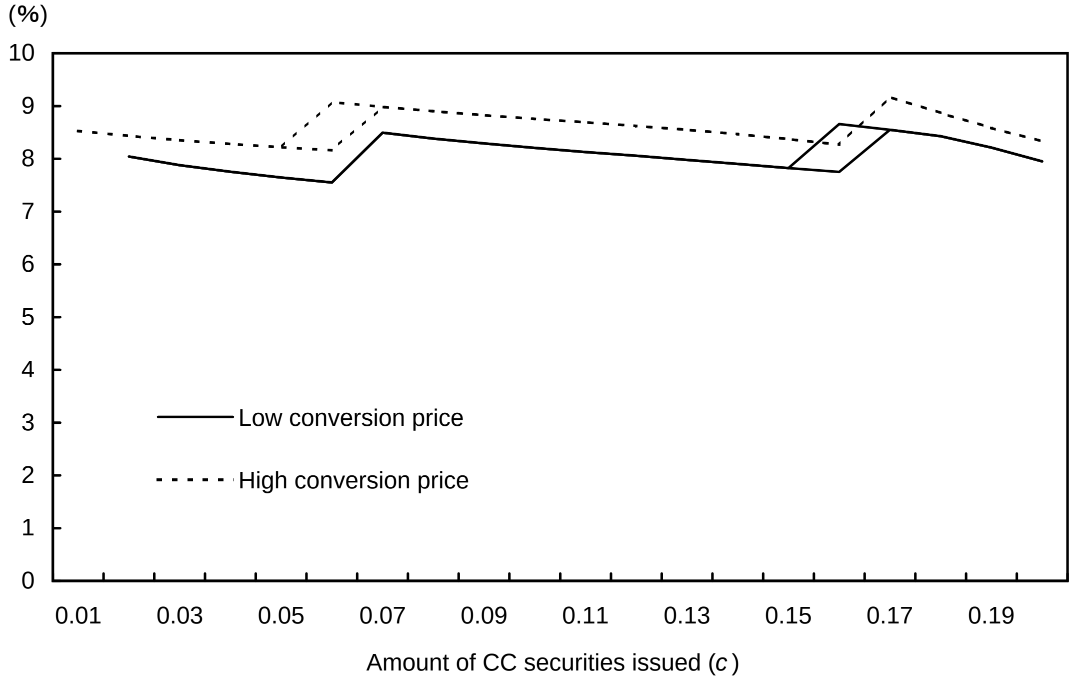


Note: The horizontal axis denotes the number of newly issued shares (*x*) when the number of existing shares is normalized to one.

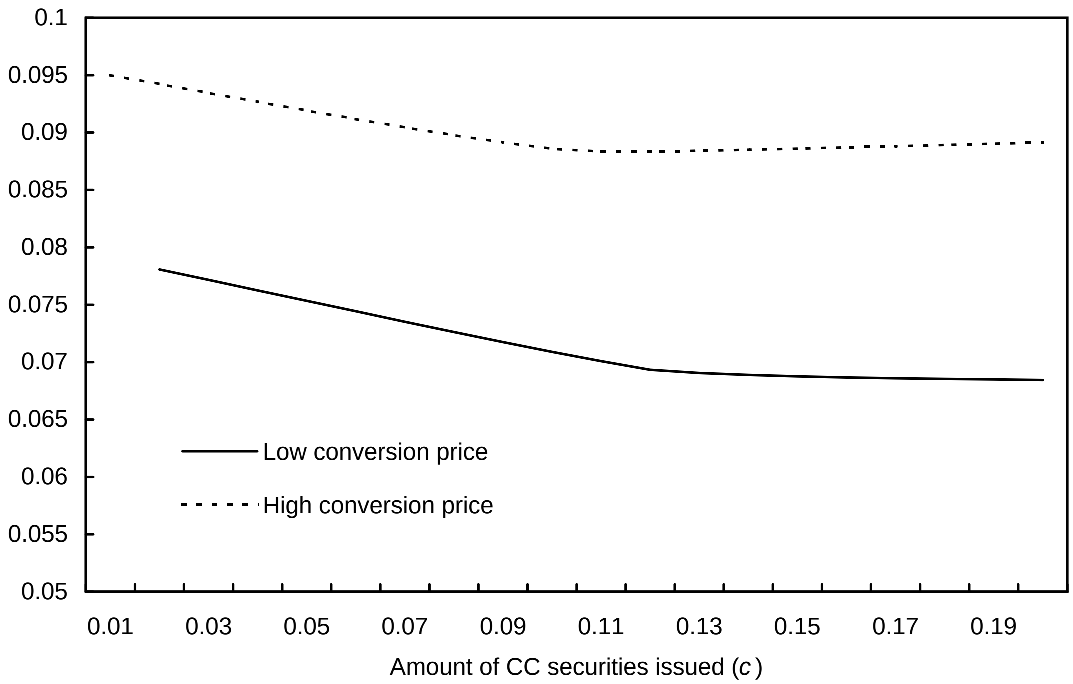
（Chart 12）

Impacts of a Conversion Price on the CC Interest Rate

(1) Interest Rate of CC



(2) Stock Price

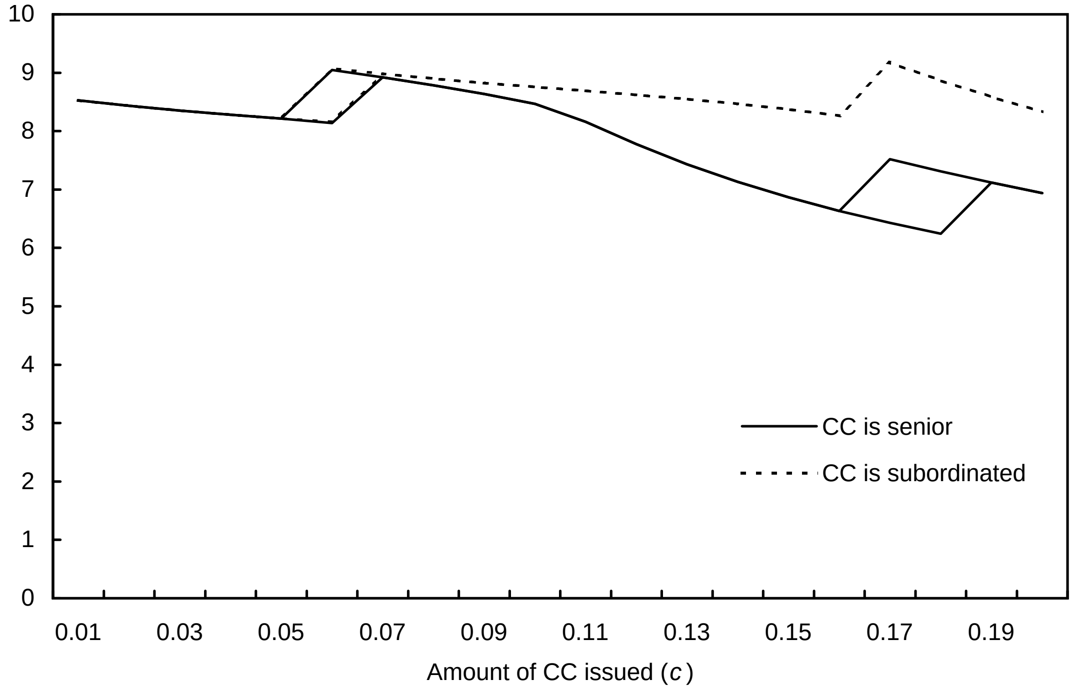


Note: The horizontal axis c represents the amount of CC securities issued when the amount of deposits is one.

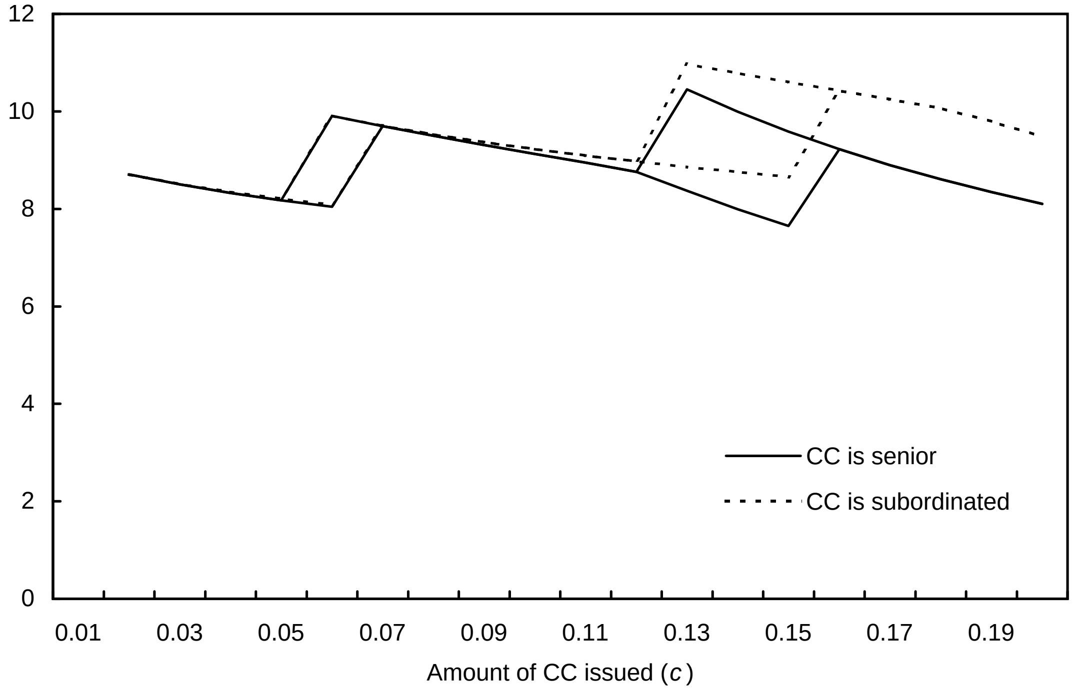
（Chart 13）

Impacts of Priority on the CC Interest Rate

(1) 2% Growth Economy



(2) Zero Growth Economy



Note: The horizontal axis denotes the amount of CC issued (c) when the amount of deposits is normalized to one.

(Chart 14)

An Overview of CC Issued by the Lloyds Banking Group and Rabobank

	Lloyds Banking Group (United Kingdom)	Rabobank (Netherlands)
Name	Enhanced capital notes (ECNs)	Senior contingent notes (SCNs)
Date of initial issuance/public announcement	Publicly announced on November 3, 2009	Issued on March 12, 2010
Conversion trigger	Core Tier 1 ratio < 5%	Equity capital ratio[1] < 7%
Conversion price or details of conversion	The conversion price was the higher of the weighted average trading price of the stock during the period of November 11−17 and 90% of the closing price on November 17, with some adjustments.	The principal and interest are to be reduced to 25% and redeemed in cash before maturity.
Priority before conversion	*Pari passu* with lower Tier 2 capital	Senior to subordinated bonds
Regulatory status before conversion	Lower Tier 2	Unregulated
Maturity	Approximately 10-15 years	10 years
Amounts issued	Up to 7.5 billion pounds	1,250 million euros
Coupon rate	1.5−2.5% premium on top of the interest rate of the financial instrument to be exchanged (Note) Issued as an exchange with Lloyds Bank's existing hybrid products	Issuing rate: 6.875%

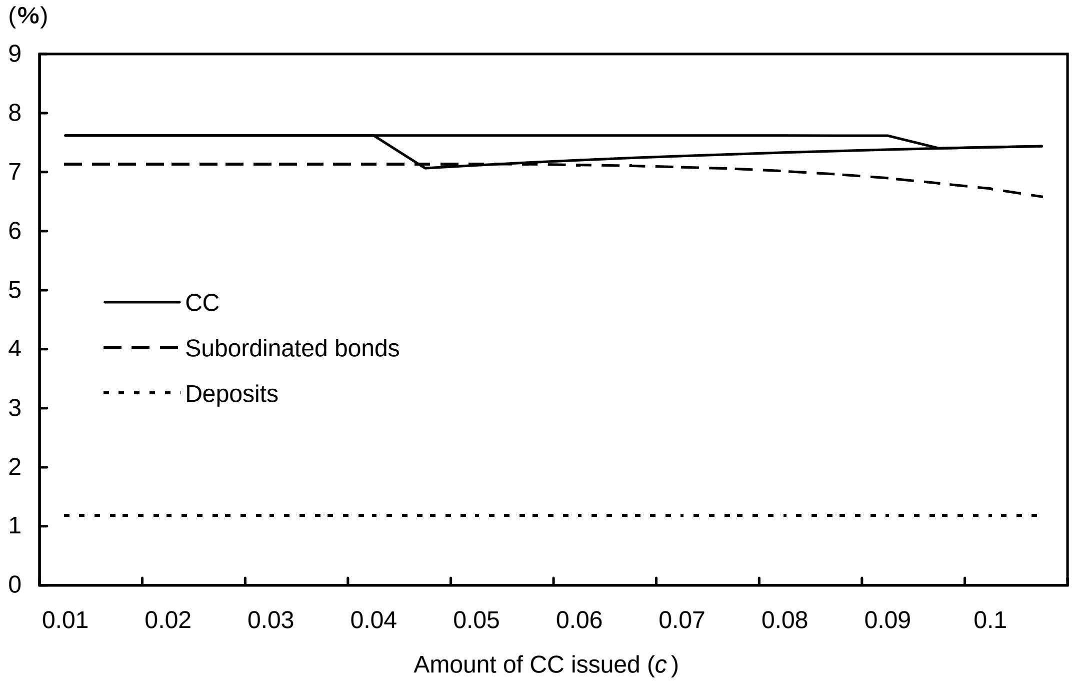
Note: 1. The equity capital ratio of Rabobank was calculated using the following formula because Rabobank is organized as a cooperative and is not a company limited by shares:

Equity capital ratio = (earned surplus + capital contribution by partners) / risk assets

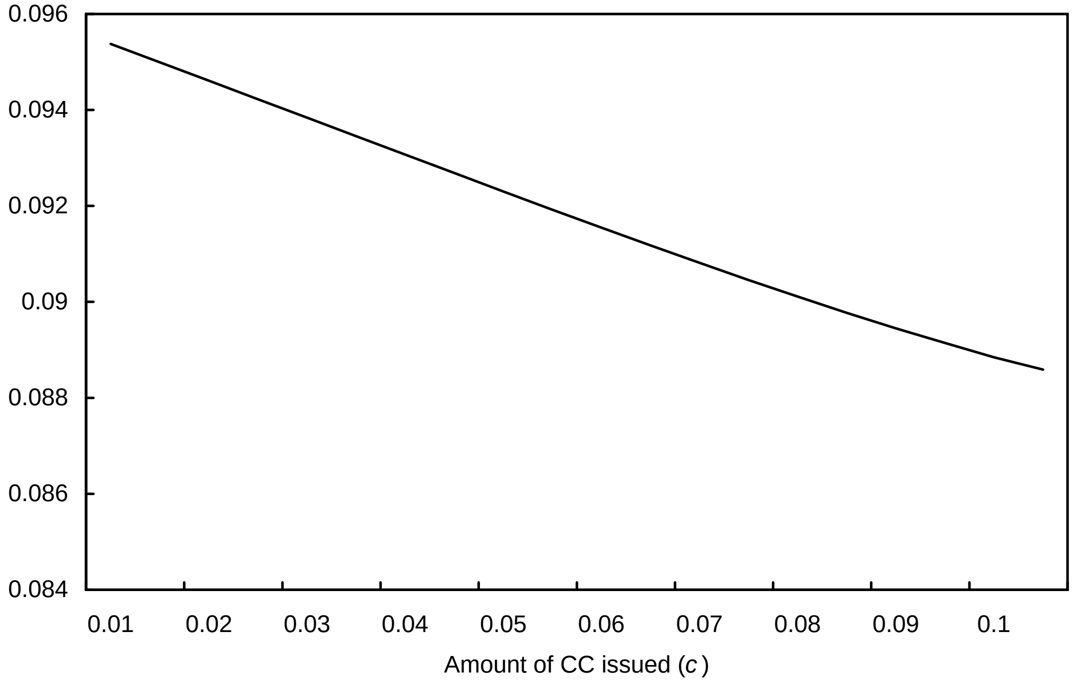
Sources: Lloyds Banking Group, Rabobank Group, Reuters.

CC Interest Rate with a Stock-Price Conversion Trigger

(1) Interest Rates of CC, Subordinated Bonds, and Deposits



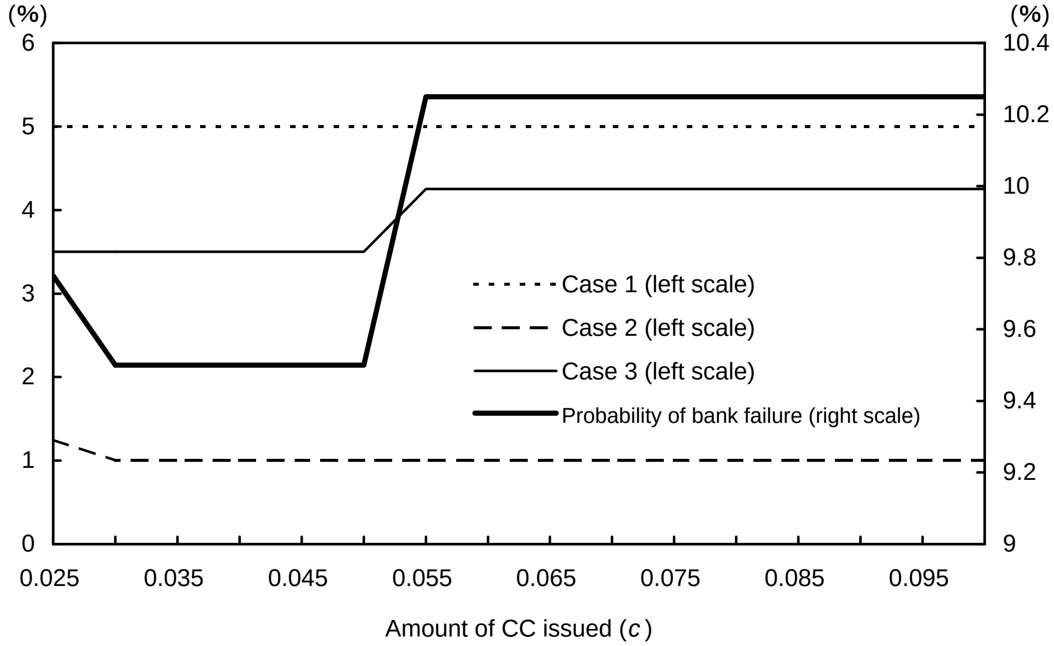
(2) Stock Price



Note: The horizontal axis denotes the amount of CC issued (c) when the amount of deposits is normalized to one.

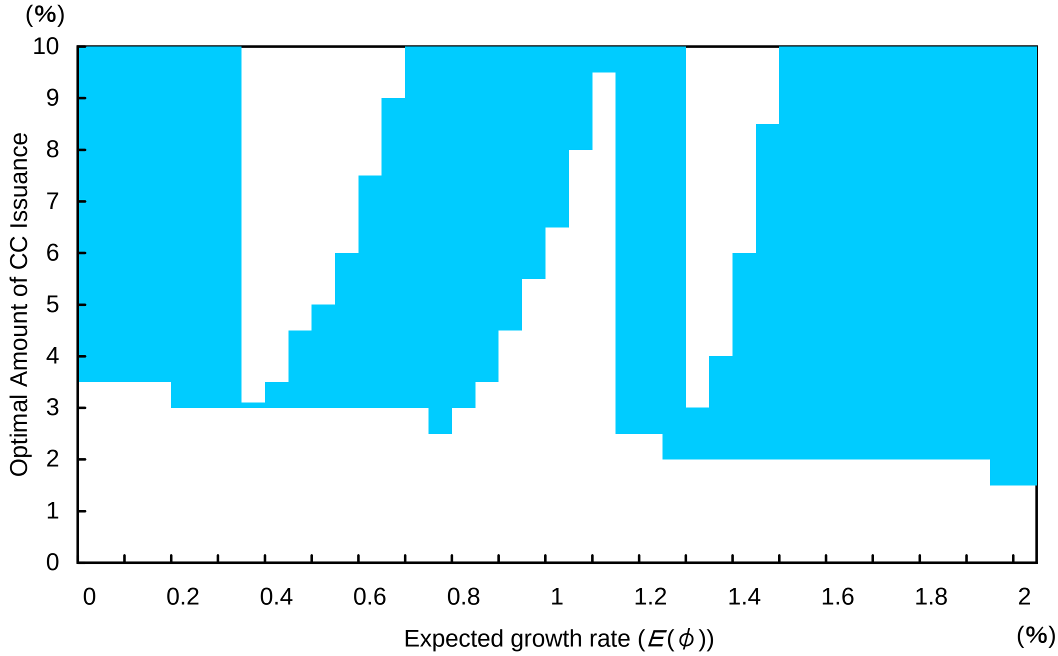
Impacts of CC Issuance on the Likelihood of Bank Failure

(1) Relationship between the Amount of CC Issued and Bank Failure Probability



Note: Assuming the total amount of subordinated bonds and CC issued is 15% of the amount of deposits and the expected growth rate is 0.5%.
Case 1: Failure in period 1
Case 2: Failure in period 2, with conversion of CC in period 1
Case 3: Failure in period 2, with no conversion of CC in period 1

(2) Relationship between the Expected Growth Rate and the Optimal Amount of CC Issuance

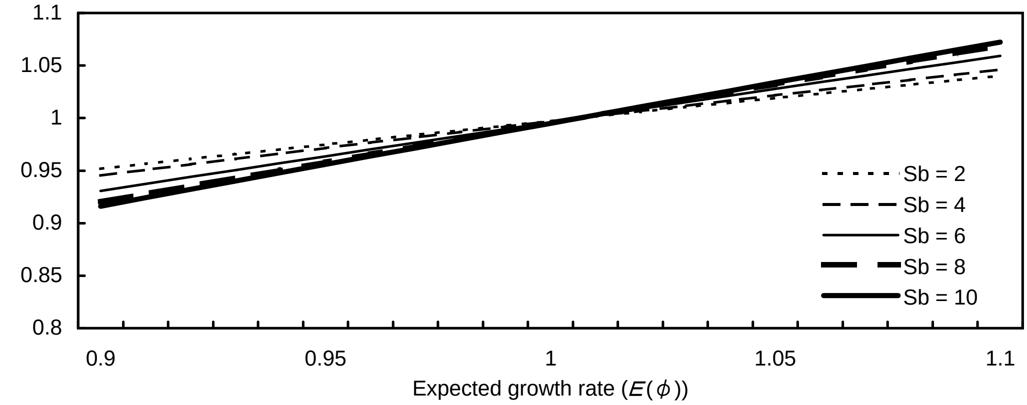


Note: Assuming that the sum of subordinated bonds and CC issued is 15% of the amount of deposits.

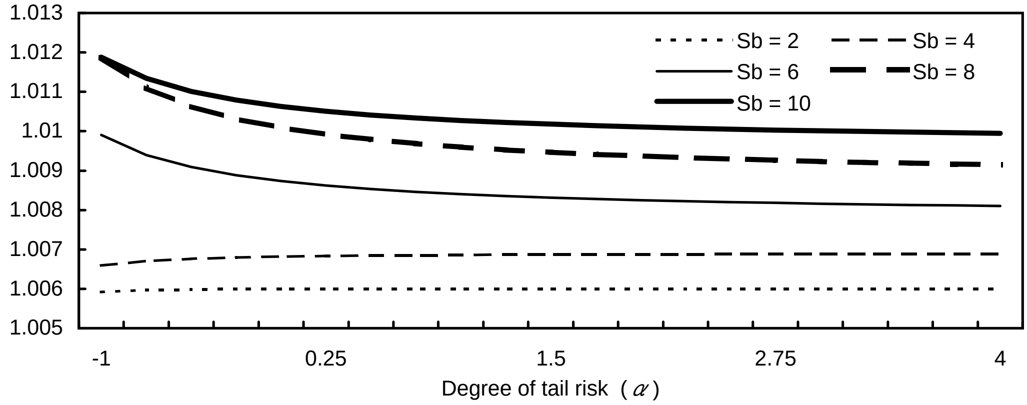
(Chart A1)

Tobin's Q

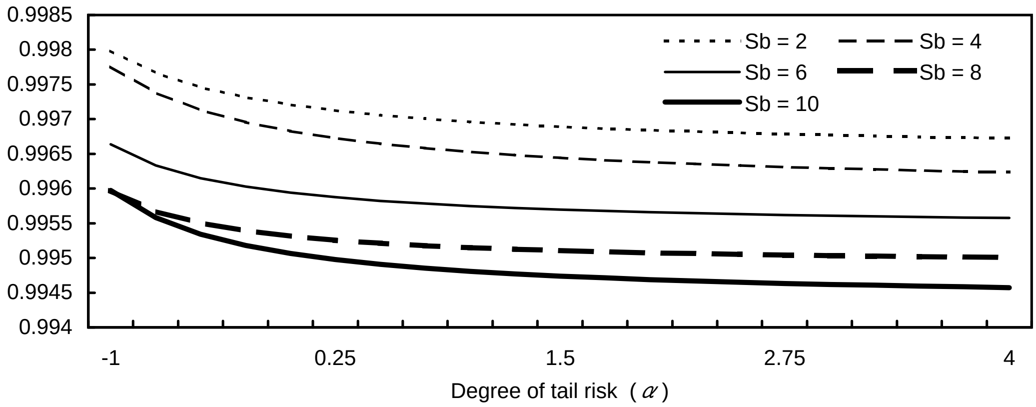
(1) Expected Growth Rate and Tobin's Q



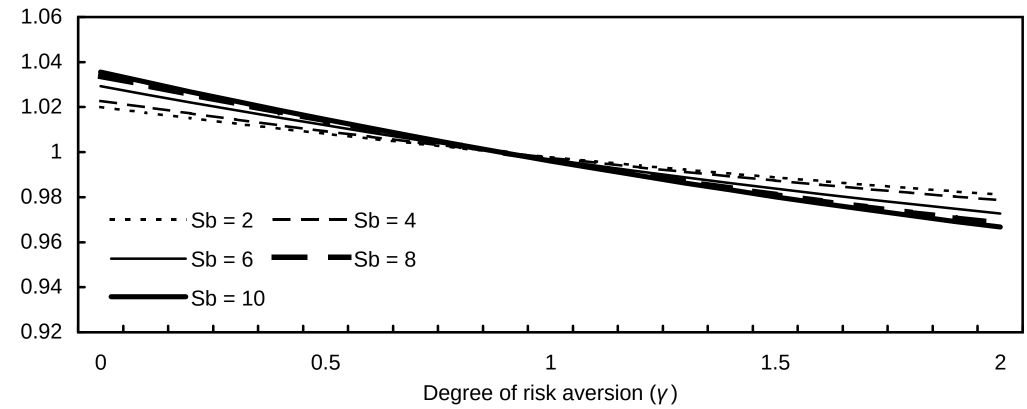
(2) Tail Risk and Tobin's Q (for a High-Growth Economy)



(3) Tail Risk and Tobin's Q (for a Low-Growth Economy)



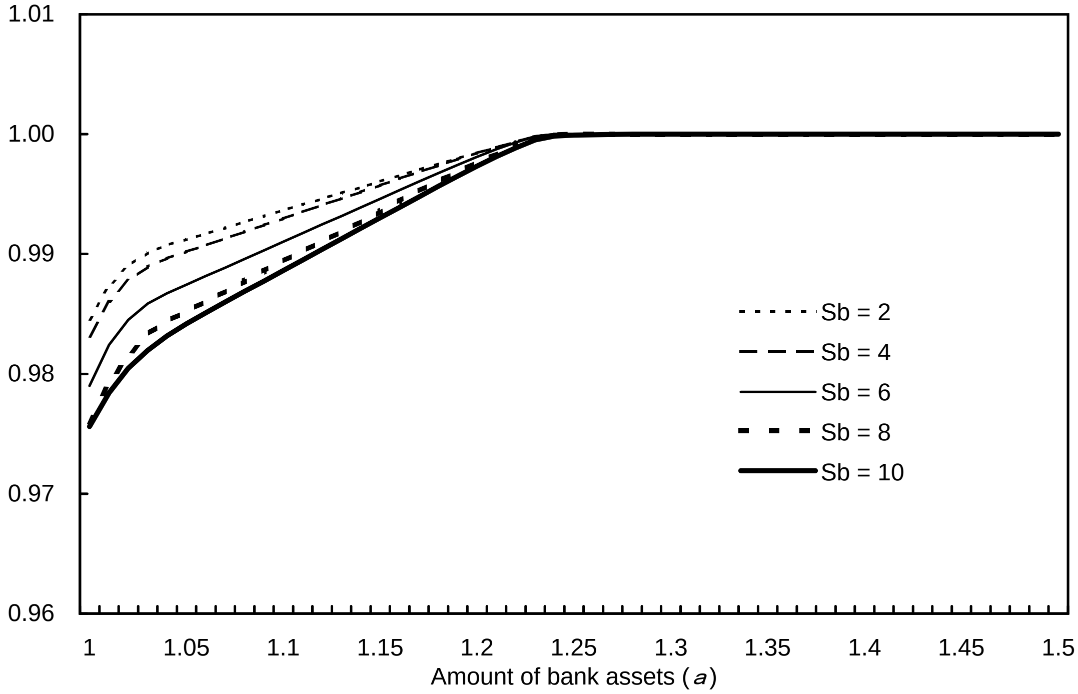
(4) Degree of Risk Aversion and Tobin's Q



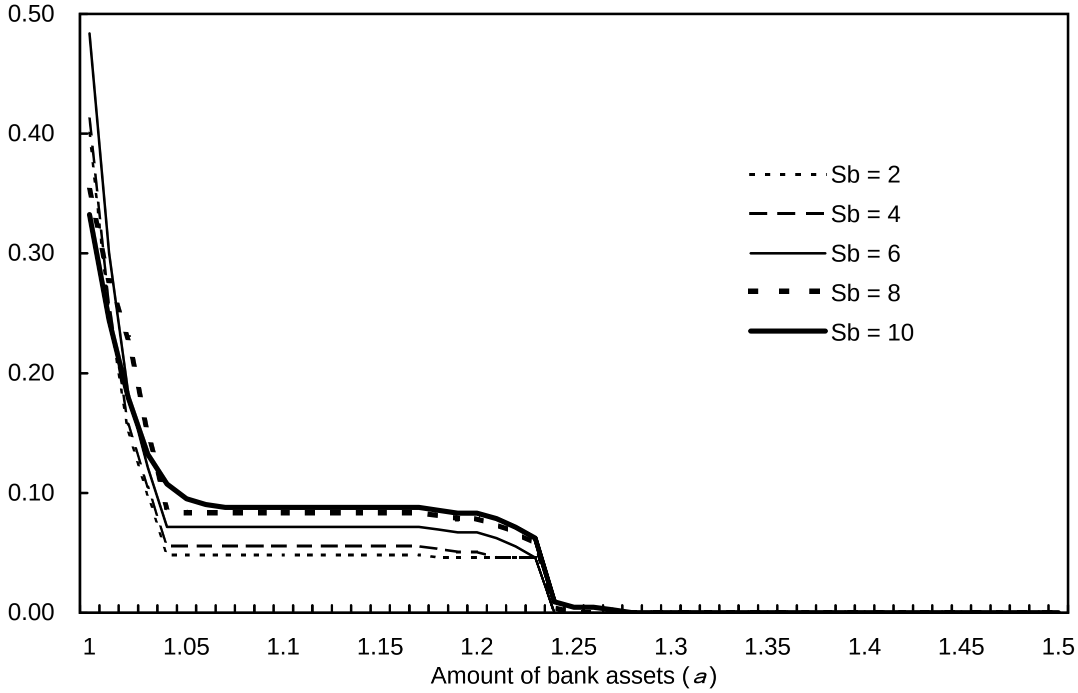
(Chart A2)

Impacts of Asset Size on the Deposit Burden on a Bank

(1) Level of Deposit Burden on a Bank



(2) Changes in the Deposit Burden on a Bank



Note: The horizontal axis denotes the amount of bank assets (*a*) when the amount of deposits is one.