Does the CoCo Bond Effectively Work as a Bail-in Tool?

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Abstract

The contingent convertible bond (or CoCo bond) is designed as a tool of bail-in. If an issuing-bank is non-viable and thus a trigger condition is met, the CoCo bond is written down or converted to equity and, hence, the bank can be recapitalized at the expense of creditors but not of taxpayers. The trigger condition could be either rule-based or discretion-based. This paper shows theoretically and empirically that government bail-out is more likely (and creditor bail-in is less likely) when the trigger is discretionary.

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1 Introduction

'Bail-in' is a new way to resolve failed systemically important banks. Traditionally, governments choose to bail out large banks. Government bailouts could be an important reason of next crises, as government-backed large banks will take more risky bets. Also, bailouts could initiate a so-called 'diabolic loop' as sovereign fiscal positions are damaged. Since domestic banks are primary investors of sovereign bonds, their balance-sheets are deteriorated as the fiscal positions become riskier and, therefore, the likelihood of next crisis jumps up. Furthermore, bailouts are unjust, as taxpayers should take the burden of resolving failed banks even if they are not the stakeholders of the banks.

After the global financial crisis and subsequent European sovereign debt crisis, G20 and EU countries and the Basel committee agree to adopt a bail-in system. That is, if a bank is in distress, its shareholders and creditors are required to absorb losses and, therefore, the bank's risk is reduced. Shareholders absorb losses as their shares are diluted. Creditors absorb losses as their claims (principal and interest on bank debt) are written-down or converted to the distressed bank's equity. If properly implemented, the bail-in system could prevent the moral hazard of large banks and also protect the sovereign fiscal position and taxpayers.

The contingent convertible bond (hereafter CoCo bond) is designed as a tool of bail-in. CoCo bonds are different from straight bonds in that there are bail-in clauses in the bond contracts. The bail-in clause stipulates that the principal and interests of a CoCo bond are written-down or the CoCo bond is converted to common equity of the issuing bank, if a *trigger* is activated. The trigger could be either rule-based or discretion-based. Rule-based triggers are based on accounting information such as bank capital ratio. (Other rule-based triggers could be based on market information such as market price and credit default swap premium. However, every rule-based CoCo bond that has been issued ever since the very first issuance by Lloyds banking group is based on accounting information.) If the level of a chosen indicator falls short of a pre-determined threshold, the trigger is activated and, hence, creditors absorb losses through either principal write-down or conversion to equity. By contrast, discretion-based triggers rely on governments' judgement on whether the issuing bank is distressed or not. If a competent authority determines that the issuing bank is in the point of non-viability (PONV), the trigger is activated and, hence, the creditors take losses. The authority may consider various sources of information but make a decision on its own.

However, a recent banking crisis in Italy suggests that governments may choose to bail out CoCo bond creditors. On July 2016, Italian banks confronted a serious non-performing loan crisis. In response, the Italian government tried to inject public funds into the distressed banks. It was a remarkable event since Italy have already adopted a EU-wide bail-in system. The Italian government wanted bailouts even if it it against the already adopted bail-in principle since most of the involved creditors were ordinary citizens. The large number of citizes imposed a massive political burden on the government.

This paper examines whether the CoCo bond effectively works as a bail-in tool. The hypothesis is that discretion-based trigger CoCo bonds are less effective bail-in tools than rule-based trigger CoCo bonds since governments' political burdens are higher. When CoCo bonds are discretion-based, governments have to take the dirty job of making creditors lose. This is not the case with rule-based trigger CoCo bonds whose triggers are activated automatically if trigger conditions are satisfied. Even if the gap in political pressures merely due to the difference in trigger types is small, the gap could be enlarged through a self-reinforcement mechanism. If investors know that a government face a little more burden on them when they buy a discretion-based CoCo bond rather than a rule-based CoCo bond, they believe that the government will be more likely to save them when the issuing bank is in distress. Given this belief, they invest more on the CoCo bond and, hence, the number of participating investors are larger. Since the government's pressure presumably increases in the number of affected investors, the government will indeed choose to bail out the creditors if the issuing bank is in distress. That is, the investors' belief is fulfilled and, hence, rationalized. Since the credit risks of discretion-based CoCo bonds are smaller in the rational expectations equilibria, the equilibrium interest rates of discretion-based CoCo bonds are lower than that of rule-based CoCo bonds.

The paper consists of two parts. In the first part, I construct a theoretic model to analyze CoCo bond demand, supply, equilibrium interest rate and their relationships with the trigger type. The model predicts that the interest rates at issuance of discretion-based trigger CoCo bonds are lower than that of rule-based trigger CoCo bonds. See Figure 7, which provides a country-level comparison of the average interest rate and the ratio of discretion-based CoCo bond issues to all CoCo bond issues. It shows that the average interest rate is lower, as the ratio of discretion-based CoCo bond issues rises. In the second part, I test the model prediction by conducting an empirical study. Using a dataset on CoCo bond issuance in the world during 2010-2016, I find that the interest rate at issuance of discretion-based trigger CoCo bonds is on average lower by 1.13 to 2.91%p than that of rule-based trigger CoCo bonds. This finding suggests that trigger design is critical to make CoCo bonds work effectively as bail-in tools.

The existing studies on CoCo bonds have focused on how triggers affect economic implications. Sundaresan and Wang (2015) show in a theoretic model that market trigger CoCo bonds generally result in multiple equilibria. Although the multiple equilibrium phenomenon also arises in this paper, the mechanism and focus are different. In their paper, investors' expectation on market prices endogenously affects equilibrium selection.[1] In contrast, this paper shows that investors' expectation on the likelihood of government assistence endogenously affect equilibrium selection. In general, comparative statics are not possible when

[1]Unlike Sundaresan and Wang (2015), Glasserman and Nouri (2016) consider a continuous-time framework in which market prices could be constantly adjusted. They show that the unique equilibrium could be obtained if the predetermined threshold for trigger is sufficiently high.

there are multiple equilibria. However, even after considering the multiple equilibrium phenomenon, this paper could show that discretion-based trigger CoCo bonds end up more likely with government assistence in equilibrium than accounting trigger CoCo bonds. Martynova and Perotti (2013) compare market triggers with accounting triggers in terms of their informativenesses. They show that market triggers are relatively more likely to cause the Type II error—triggers are activated even if issuing banks are sound and hence triggers should not be activated—since market prices are volatile. In contrast, it is shown that accounting triggers are more likely to cause the Type I error—triggers are not activated even if issuing banks are distressed and hence triggers should be activated—since accounting information needs to be confirmed by regulators who are vulnerable to regulatory forbearance.

Among only a handful of related empirical studies, Avdjiev et al. (2015) examine quantitative effects of CoCo bond issuance on issuing banks default risk measured by their credit default swap premia. Depending on the way to absorb losses, CoCo bonds can be classified into the mandatory conversion type and principal write-down type. By focusing on accounting trigger CoCo bonds, they show that banks can reduce their CDS premia more if they issue the mandatory conversion type rather than the principal write-down type. Although the findings are interesting, they do not control for other variables that may affect the probability of default such as capital ratio, credit rating score, sovereign interest rate etc. Due to the limited size of available sample, they employ the methodology suggested by James (1987), which is basically a sophisticated version of the T-test. Unlike their paper, the current paper conducts the standard multiple regression analysis. None of the aforementioned papers consider discretion-based CoCo bonds even if they are one third to one half (in issues and in volumns) of the total CoCo bonds that have been issued until 2016. (See Table 5.)

The paper is organized in the following way. In Section 2, I construct a theoretic model that provides some predictions on the effectiveness of CoCo bonds as bail-in tools. In Section 3, I conduct an emprical anaysis in order to test the prediction that discretion-based CoCo bonds work poorly as bail-in tools than rule-based CoCo bonds.

2 A Theoretic Analysis

There are three 'active' players in the model economy—CoCo bond investors, a systemically important bank, and a government. Depositors and short-term funders are inactive players.

There are two points in time, $t = 0, 1$. At time 0, the bank issues a CoCo bond at the (net) interest rate b. Upon observing the interest rate, investors decide whether to purchase the bond or not. At time 1, if the bank becomes insolvent so that a trigger condition is satisfied, the principal of the CoCo bond is fully written down.[2]

A key difference of the CoCo bond from straight bonds is that the former allows for the government to separate the bailout decision from the continuation decision. If the bank fails at time 1, I assume that the government has to continue it because of its systemic importance.[3] If the bond were a straight bond, the bond holders would take the control right over the bank from the equity holders. To continue the bank, the government would have to buy the control right by repaying the bond holders. That is, the government has no choice but to bail out the bond holders. Things are different with a CoCo bond. In this case, the bond holders' claims are fully written down and, hence, the government can continue the systemically important bank even without repaying the bond holders. That is, the government can choose whether to save bond holders or not, but the bank is continued in any case.

[2]There are two types of bail-in mechanism, principal write-down and mandatory conversion to equity. For expositional simplicity, I consider CoCo bonds with the principal write-down in this model. The qualitative result, however, still holds for CoCo bonds with the mandatory conversion if the conversion ends up making CoCo bond holders lose.

[3]By 'continuation', I mean both open-bank continuation and closed-bank resolution based on a going-concern.

2.1 Bank's behavior and the CoCo bond supply function

The bank chooses how much to invest on assets and how to finance the investment. That is, the bank faces a double problem of financing and investment. In the following, firstly, I shall describe the financing problem given a fixed size of the balance-sheet. Secondly, I shall describe the assets choice problem given an optimal capital structure.

There are four ways to finance the investment, deposits D, short-term debt S, (long-term) CoCo bonds C, and equity E, though deposits and equity have limited roles in the model. Hahm, Shin and Shin (2013) report that the banking sector leverage and total assets tend to move together while deposits and equity do not change much over the financial cycle. Depositors are usually protected by implicit or explicit guarantees such as the deposit insurance and depositor preference in insolvency proceedings. Therefore, total deposits do not depend much on financial markets conditions.[4] In this regard, I assume that depositors invest on the bank a fixed amount $D > 0$ at zero net interest rate. When banks increase investment on assets, they usually finance the investment via debt rather than equity. This is presumaby because equity issuance is often deemed the most expensive way of financing due to associated risks, tax disadvantage, and dilution. In this reason, I assume that equity E is fixed.

The model is focused on CoCo bonds and their relationships with short-term debt. Short-term debt is cheap since it is demandable and collaterals are posted against it, whereas CoCo bonds is expensive due to longer maturities, higher default risks, and bail-in risks. However, the merit of CoCo bonds is that they are recognized as regulatory capital according to the Basel 3 and other international regulations on capital adequacy. Therefore, it would be optimal for banks to issue CoCo bonds as much as the capital requirement is binding and finance the remaining investment outlay via short-term borrowing.

To examine the financing decision formally, consider the following financing problem that

[4] Total deposits reportedly vary with real economy conditions such as consumption and output.

the bank faces at time 0 given a fixed amount of assets $A > D$. Since the deposits D are not enough for financing the assets A, the bank may borrow S from short-term funders by posting collaterals and/or issue an amount C of a CoCo bond.

If the bank succeeds, it earns $(1+\alpha)A$, where α is the rate of return after subtracting the cost of collaterals. Let $p\left(\frac{C+E}{A}\right)$ denote the probability of success. $p\left(\frac{C+E}{A}\right)$ is increasing and concave in the capital ratio $\frac{C+E}{A}$.

If the bank fails, it has nothing but the collaterals. Thus, the bank is balance-sheet insolvent. If the trigger of the CoCo bond is rule-based, it is automatically activated and, hence, the principal is written down. Instead, if the trigger is discretionary, the government decides whether to write down the principal or not.

The bank solves the following problem.

$$\max_{S,C} \ \pi(S, C; A) \equiv p\left(\frac{C+E}{A}\right)[(1+\alpha)A - D - S - (1+b)C] \tag{2.1}$$

$$\text{subject to} \quad A = D + S + C + E, \quad \frac{C+E}{A} \geq \kappa$$

where the first and second constraints are the accounting identity and capital requirement with the regulatory minimum capital ratio κ, respectively. Note that the (net) interest rate on the short-term debt is zero since there is no default risk due to collaterals. Without loss of generality, I assume that $E = 0$.

After the 2008-09 global financial crisis and subsequent European sovereign debt crisis, international capital regulation has been greatly strengthened. In this sense, I suppose that κ is higher than the privately optimal capital ratio.[5] Therefore, it is optimal to minimize C

[5]The privately optimal capital ratio maximizes $p\left(\frac{C}{A}\right)[\alpha A - bC]$ given A. Although the bank has limited liabilities when it fails, regulators have to bear loss in the deposit insurance fund and negative externalities the bank's failure may cause on the whole economy. In this sense, regulators may need to choose a regulatory optimal capital ratio that maximize $p\left(\frac{C}{A}\right)[\alpha A - bC] - \left(1 - p\left(\frac{C}{A}\right)\right)L$ given A, where L is the total loss given default regulators perceive. The regulatory optimal capital ratio increases in L and, hence, is greater than the privately optimal capital ratio.

subject to the captial requirement. That is, the optimal choices of C and S are given by

$$C(A) \equiv \kappa A, \quad S(A) \equiv (1-\kappa)A - D \tag{2.2}$$

Note that the success probability $p \equiv p(\kappa)$ is fixed due to the binding capital constraint.

Given the optimal capital structure above, the bank chooses the size of investment on asssets. If the bank wants to increase assets, it needs to issue more CoCo bonds in order to satisfy the binding capital requirement. If the interest cost of CoCo bonds b decreases, the bank will issue more CoCo bonds in order to make more profit by investing more on assets. Therefore, the CoCo bond supply C^S decreases in the interest rate b.

To see how optimal investment decision results in a decreasing supply function, consider the following investment problem given the optimal capital structure $(C(A), S(A))$ in (2.2).

$$\max_{A} \; \pi(A) \equiv p(\kappa)[\alpha(A) - b\kappa]A \tag{2.3}$$

The return to investment $\alpha(A)A$ is assumed to be increasing and concave in A. (Also, I use two initial conditions $\alpha(0) > 0$ and $\lim_{A\to\infty} \frac{d}{dA}\alpha(A)A = 0$.) The optimal assets choice $A = A(b)$ is characterized by the following first-order condition.

$$\frac{d}{dA}\alpha(A)A = b\kappa \tag{2.4}$$

(2.4) implies that a decrease in the interest rate b leads the bank to increase investment on assets A. As the assets size increases, the bank should issue more CoCo bonds in order to satisfy the binding capital requirement. In sum, the supply for the CoCo bond is decreasing in its interest rate. This result is summarized in the following lemma.

Lemma 1 *The CoCo bond supply function $C^S(b)$ is decreasing in the interest rate b.*

2.2 Investors' behaviours and the CoCo bond demand function

There is a unit-measure of investors who choose whether to buy the CoCo bond. If they buy the bond at time 0, they get the proceed at time 1. $\beta \in (0,1)$ is their discount factor. The investors are risk-neutral. Each investor is endowed with one unit of money.[6] Investors may use the money to buy one unit of the CoCo bond or to invest in an alternative project. The gross return from this alternative project is R, which follows a distribution F on the support $[0, \bar{R}]$.

Although straight bonds are not considered in this model, I begin with how straight bond demand function is determined in order to compare it with the CoCo bond demand function. This comparison sheds light on how CoCo bonds are distinguished from straight bonds.

Suppose that there is a straight long-term bond such that the interest rate at issuance (i.e. the coupon rate) is b and the probability of default is $(1-p)$. If the issuing bank is in default, the government decides whether to bail out the bond holders or not. Let q denote the probaility of bailout. If the government does not bail them out, the bond holders take the control right from the equity holders. The bond holders may sell off assets, fire employees, and/or shirink businesses in order to recoup their losses as much as possible. During this liquidation process, the bond holders could recoup a fraction h of their losses, whereas the financial system could face a systemic crisis as the bank's systemically important financial functions and services are impaired. Therefore, the probability of repayment Q_0 for a straight bond is given by

$$Q_0 = p + (1-p)(q + (1-q)h) \tag{2.5}$$

and, hence, the expected utility of a bond holder equals $\beta Q_0(1+b)$. The bond demand function is then equal to $\Pr(\beta Q_0(1+b) \geq R) = F(\beta Q_0(1+b))$. Analogously, it can also be

[6] In this paper, one unit of money is equal in value to one unit of consumption.

shown that the demand function for a risk-free straight bond with the same interest rate b and the same maturity of 1 equals $F(\beta(1+b))$.

Suppose instead that there is a CoCo bond with the same interest rate and probability of default. If the issuing bank is in distress and, hence, the trigger event is about to take place, the government chooses whether to save the CoCo bond holders. The government may inject public funds to prevent triggering, or may not intervene and let the principal write-down be triggered. In comparison with the straight bond case, the government may be less willing to rescue the bond holders due to the loss-absorbing nature of the CoCo bond. Let $q - \Delta$ be the probability of bailout, where $\Delta \in [0, q]$. In the absence of government assistence, the claims on the CoCo bond are written down and, hence, the control right over the distressed bank are not given to the bond holders. Thus, the government can continue the bank without bailing out the bond holders. Finally, the probability of repayment Q for a CoCo bond is given by

$$Q = p + (1-p)(q - \Delta) \tag{2.6}$$

and, hence, the CoCo bond demand function equals $F(\beta Q(1+b))$. Since any distribution function is monotone increasing, this demand function increases in b and Q.

Lemma 2 *The CoCo bond demand function $F(\beta Q(1+b))$ is increasing in the interest rate b and the repayment probability Q.*

2.3 Equilibrium

The market-clearing interest rate

The supply function for the CoCo bond is decreasing in the interest rate b (Lemma 1), while the demand function is increasing in b (Lemma 2). Therefore, there exists a unique market-clearing interest rate $b = b(Q)$ such that $C^S(b(Q)) = F(\beta Q(1 + b(Q))$.[7]

The market-clearing interest rate can be decomposed into the benchmark riskfree rate, default risk premium, and bail-in risk premium. Since the focus of this paper is on the bail-in risk, such a decomposition is not just instructive but also useful in the following empirical section. See Figure 1. Consider a hypothetical situation in which the investors perceive the CoCo bond as perfectly safe. The demand function then equals $F(\beta(1 + b))$. The market-clearing interest rate $b(1)$ in this case can be interpreted as the benchmark riskfree rate. Consider another hypothetical situation where the investors believe that the CoCo bond is as much risky as a straight bond with the same interest rate, same default probability, and same maturity. Then, the demand function equals $F(\beta Q_0(1 + b))$. The difference between the market-clearing interest rate $b(Q_0)$ in this case and the benchmark rate $b(1)$ can thus be understood as the default risk premium. Finally, if the investors fully recognize that the CoCo bond entails not juts the default risk but also bail-in risk, the demand function equals $F(\beta Q(1 + b))$. Therefore, one can regard $b(Q) - b(Q_0)$ as the bail-in risk premium.

[Insert Figure 1]

In the following theoretic analysis, I assume for simplicity that the bank is too systemically important to fail. Thus, the government would always bail out bond holders ($q = 1$), if straight bonds were issued and in default.

Assumption 1 $q = 1$

Although the default risk disappears since $q = 1$ implies $Q_0 = 1$, the bail-in risk still exists. Thus, by (2.6), the repayment probability is simplified to $Q = p + (1 - p)(1 - \Delta)$, and the bail-in risk premium equals $b(Q) - b(1)$.

[7]The two initial conditions on the return $\alpha(A)A$ and the optimality condition (2.4) imply that there is a unique market-clearing interest rate.

Expectation and the market-clearing interest rate

Note that the CoCo bond demand function $F(\beta Q(1+b))$ depends on the investors' belief on Δ, which is the probability that the government let the principal write-down be triggered when the bank is in distress. I assume that investors have common expectation since they are identical in every aspect except reservation payoff. If they believe that the government will refrain from intervention in case of bank failure ($\Delta = 1$), the market-clearing interest rate equals $b(p)$. (Refer to the expression (2.6) of the repayment probability.) See Figure 2. Let $m(Q)$ denote the market-clearing mass of CoCo bond holders $F(\beta Q(1 + b(Q)))$. In this case, the bail-in risk premium equals $b(p) - b(1)$ and the market-clearing mass of CoCo bond holders equals $m(p)$. Instead, if the investors believe that the government will rescue them in case of bank failure ($\Delta = 0$), the bail-in risk premium equals zero and the market-clearing mass of investors equals $m(1)$. Thus, Lemma 1 and 2 imply that the investors buy the CoCo bond the more, as they are more optimistic on the likelihood of government assistence. This dependence of market-clearing mass of CoCo bond holders on expectation is a key result in this model.

[Insert Figure 2]

Lemma 3 *(i) The market-clearing bail-in risk premium* $b(Q) - b(1)$ *is decreasing in the anticipated probability of government bailouts* $(1 - \Delta)$*. (ii) The market-clearing mass of CoCo bond holders* $m(Q) \equiv F(\beta Q(1 + b(Q)))$ *is increasing in the anticipated probability.*

It is worth noting that the market-clearing interest rate $b(Q)$ is not necessarily an equilibrium interest rate since the anticipated probability $(1-\Delta)$ of government intervention should equal to the actual probability in equilibrium. To see whether the market-clearing interest rate indeed constitutes an equilibrium interest rate, the government's behavior should be examined.

Government's behavior

When the bank fails, the government chooses bailouts or bail-ins. In this decision making, the government considers three different costs—fiscal, political, and shock cost.

Consider firstly the case in which the CoCo bond trigger is rule-based. If the bank failure is impending and inevitable and, hence, the trigger condition is about to be satisfied, the government decides whether to intervene. If the government does not intervene and let the trigger condition be indeed satisfied, the write-down takes place. This event could cause a shock to the investors, who may then withdraw their confidence in the financial system. Relatedly, news reported on February 2016 that Deutsche bank may be unable to pay the interests on its CoCo bonds. Immediately, the stock price and CDS spreads decreased sharply and worries about Deutsche bank and the European banking system as a whole spread quickly. These worries could cause liquidity problems. For instance, if a money market fund invests heavily on such a bank, not just the given fund but also other money market funds could suffer from runs. As a result, the government perceives $\theta \geq 0$ as a shock cost. On the contrary, suppose that the government intervenes and recapitalizes the bank so that the trigger condition is not satisfied. In this case, the shock cost does not occur while a fiscal cost $\delta T(Q)$ occurs, where $T(Q) \equiv (1 + b(Q))m(Q)$ is the CoCo bond holders' total claim and $\delta > 0$ reflects the possibility that the bank repays the public fund. (The fiscal cost for repaying deposits D does not need to be considered, since it arises irrespective of whether the governemnt rescues the CoCo bond holders or not.)

Consider secondly the case of discretionary trigger. Upon observing the balance-sheet insolvency, the government may choose to trigger the write-down or not. If it does not trigger, the government needs to repay the bond holders in order to continue the bank. Thus, the fiscal cost $\delta T(Q)$ occurs. Instead, if the government triggers the write-down, it should bear the shock cost θ but not the fiscal cost. In this case, some political cost also arises. Unlike the case of rule-based trigger, the government has full authority and responsibility to determine whether to trigger the write-down or not. As the bond holders lose from the triggering, they may protest and even sue the government. That is, the triggering makes the government get blood on its hands. Let $\pi c(m)$ denote such a political cost, where $\pi > 0$ and $c(m)$ is increasing and convex (and $c(0) = 0$). π is the unit political cost. If the CoCo bond holders consist mostly of natural persons, other financial insitutions, or pension funds, then π should be high.[8] $c(m)$ is the political cost component that depends on the size of CoCo bond holders. The government faces the more political pressure, as it anticipates the more bond holders are to lose from its triggering decision.

Rational expectations equilibrium

I consider the rational expectations equilibrium in this model. The investors form a common expectation regarding government intervention. Given the expectation, the market-clearing interest rate and mass of bond holders are determined. If the government's actual choice is consistent with the invetors' expectation, the market-clearing outcomes and the fulfilled expectation form an equilibrium.

Firstly, I solve for equilibrium with a discretionary trigger. Suppose the investors expect that the government will choose bailouts (i.e. $\Delta = 0$ and $Q = 1$) in case of bank failure. The market-clearing interest rate $b(1)$ is low and, hence, the market-clearing mass of CoCo bond holders is large as $m(1)$. If the government indeed chooses bailouts, it bears the fiscal cost $\delta T(1)$. If it chooses bail-ins, the government bears the sum of shock cost θ and political cost $\pi c(m(1))$. Therefore, bailouts constitute an equilibrium if $\theta + \pi c(m(1)) \geq \delta T(1)$. Suppose

[8] As Avdjiev et al. (2015) note, information on the CoCo bond holders is not easy to access since it is not systematically reported to supervisors. However, the central bank of South Korea, which is the third biggest CoCo bond issuing countries in the world, reported explicitly that asset management companies and broker-dealers (36%), pension funds (24%), and insurance companies (23%) are main investors of the CoCo bonds (of total amount $9 billion) issued in South Korea since January 2010 to March 2016. Avdjiev et al. (2015) also obtain a less reliable but more extensive dataset on the CoCo bond holders. From a 'subsample' of a dataset on CoCo bonds issued in the world primarily between April 2013 and March 2014, they find that private banks and retail investors constitute 52% of the bond holder base. Asset management companies, hedge funds, banks, and insurers constitute 27%, 9%, 3% and 3%, respectively.

instead that the investors expect bail-ins (i.e. $\Delta = 1$, $Q = p$) in case of bank failure. The market-clearing interest rate $b(p)$ is high and, therefore, the number of investors $m(p)$ who buy the CoCo bond is smaller. Thus, bail-ins constitute an equilibrium if $\theta + \pi c(m(p)) \leq \delta T(p)$. This equilibrium characterization is summarized in the following proposition.

Proposition 1 *Suppose that the trigger is discretionary. (i) Bailouts constitute a rational expectations equilibrium if $\theta + \pi c(m(1)) \geq \delta T(1)$. (ii) Bail-ins constitute a rational expectations equilibrium if $\theta + \pi c(m(p)) \leq \delta T(p)$.*

Secondly, I solve for equilibrium with a rule-based trigger. Suppose that the investors expect that the government will choose bailouts in case of bank failure. Then, the government indeed chooses bailouts if $\theta \geq \delta T(1)$, since the political cost does not arise with a rule-based trigger. Suppose instead that the investors expect bail-ins in case of bank failure. Then, the government indeed chooses bail-ins if $\theta \leq \delta T(p)$. This equilibrium characterization is summarized in the following proposition.

Proposition 2 *Suppose that the trigger is rule-based. (i) Bailouts constitute a rational expectations equilibrium if $\theta \geq \delta T(1)$. (ii) Bail-ins constitute a rational expectations equilibrium if $\theta \leq \delta T(p)$.*

To explain the implication of Proposition 1 and 2 vividly, suppose for the moment that the shock cost θ equals 0. Then, bail-ins constitute a unique equilibrium with a rule-based trigger. (See Proposition 2.) With a discretionary trigger, however, bailouts could also constitute an equilibrium depending on the size of political cost. (See Proposition 1.) Suppose that the unit political cost π is large. Then, bailouts constitute a unique equilibrium. But this is not an interesting story since it is quite obvious that bailouts are more likely, as the 'exogenous' political pressure is stronger.

One can think of a more subtle mechanism through which bailouts constitute an equilibrium. It is a reinforcement mechanism based on the investors' expectation. Suppose that the following assumption holds.

Assumption 2 *(i)* $\pi c(m(p)) \leq \delta T(p)$ *and (ii)* $\pi c(m(1)) \geq \delta T(1)$

(i) means that π is sufficiently small that the political cost falls short of the fiscal cost if the investors believe bail-ins. Thus, bail-ins constitute an equilibrium if the investors believe bail-ins. However, Lemma 1 states that more investors purchase the CoCo bond if they believe that the likelihood of bailouts is higher. (ii) means that this belief-size sensitivity is sufficiently large that the ranking of the political cost and fiscal cost reverses. Thus, bailouts constitute an equilibrium if the investors believe bailouts since this belief endogenously magnifies the political cost of bail-ins.

This result implies that a rule-based trigger could be used as a precommitment device. By requiring banks to use rule-based triggers when they issue CoCo bonds, the government could send a credible message to the investors that it is tough.

In general, the shock cost θ is positive. The Deutsche bank case implies that the market's reactions to triggering events are very sensitive. Even in this general case, the first main result of this paper that rule-based trigger CoCo bonds perform better as bail-in tools than discretionary trigger counterparts still hold. This result is summarized in the following corollary, which is implied by Proposition 1 and 2. (Note that Corollary 1 and 2 do not rely on Assumption 1.)

Corollary 1 *(i) Whenever bailouts constitute an equilibrium under a rule-based trigger, they constitute an equilibrium under a discretionary trigger, but not vice versa. (ii) Whenever bail-ins constitute an equilibrium under a discretionary trigger, they constitute an equilibrium under a rule-based trigger, but not vice versa.*

See Figure 3 which illustrates Corollary 1. In the figure, I choose a parametric case in which Assumption 2 holds, $T(1) < T(p)$, and $\delta T(1) < \delta T(p) - \pi c(m(p))$. If a mark

'Bailout' is put on an interval, it means that bailouts constitute an equilibrium in the interval. Similarly the mark 'Bail-in' indicates the existence of the bail-in equilibrium. The figure shows two things. First, bailouts constitute an equilibrium more likely, as the shock cost is larger. This is true for both the rule-based trigger case and discretionary trigger case. Second, fixing the size of shock cost, the CoCo bond with a discretionary trigger results in the bailout equilibrium more likely than the CoCo bond with a rule-based trigger does.

[Insert Figure 3]

The bail-in risk premium and the type of trigger

Lemma 3 and Corollary 1 make a prediction on the relationship between the bail-in risk premium and the type of trigger. Lemma 3 implies that the risk premium in the bailout equilibrium is lower than that in the bail-in equilibrium. However, there are multiple or no equilibria for some θ. For instance, see the first interval $[0, \delta T(1))$ of Figure 3. Both bail-ins and bailouts are equilibria under a discretionary trigger, whereas only bail-ins constitute an equilibrium under a rule-based trigger. In this case, the equilibrium bail-in risk premium under a discretionary trigger is either $b(p)-b(1)$ or 0 and, hence, it is no higher or sometimes strictly lower than the equilibrium risk premium $b(p) - b(1)$ under a rule-based trigger. See the second interval $[\delta T(1), \delta T(p) - \pi c(m(p)))$. Both triggers result in both equilibria and, therefore, the equilibrium bail-in risk premia cannot be compared. In the third interval $[\delta T(p) - \pi c(m(p)), \delta T(p))$, the equilibrium risk premium under a discretionary trigger is equal to or lower than that under a rule-based trigger. In the fourth interval, the equilibrium rate is the same under both triggers.

If I assume $T(1) > T(p)$, as Figure 4 illustrates, there is an interval in which no equilibrium exists under a rule-based trigger. In the interval $[\delta T(p), \delta T(1))$, the equilibrium bail-in risk premium under a discretionary trigger is 0, while there is no equilibrium risk premium under a rule-based trigger. Although the risk preimum comparison based on equilibrium analysis is not possible, note that 0 is the minimum possible bail-in risk premium. Thus, whatever the market selects as a bail-in risk premium under a rule-based trigger, it cannot be lower than the bail-in risk premium under a discretionary trigger. For some other parametric cases, there is an interval in which bail-ins constitute the unique euilibrium under a rule-based trigger and, hence, $b(p) - b(1)$ is the equilibrium risk premium, whereas no equilibrium exists under a discretionary trigger. Note that $b(p) - b(1)$ is the maximum possible bail-in risk premium. In this case, therefore, the equilibrium risk premium under a rule-based trigger cannot be lower than any risk premium the market may select under a discretionary trigger.

[Insert Figure 4]

In this sense, I introduce a selection rule of bail-in risk premium ϕ defined on the set of all possible outcomes—'no equilibrium exists,' 'bailouts constitute the unique equilibrium,' 'bail-ins constitute the unique equilibrium', and 'both bailouts and bail-ins constitute equilibria.' Let $\emptyset$, $\{out\}$, $\{in\}$ and $\{out, in\}$ denote these outcomes, respectively. See the following definition.

Definition 1 *A selection rule of bail-in risk premium* $\phi : \{\emptyset, \{out\}, \{in\}, \{out, in\}\} \to \mathbb{R}$ *satisfies* $\phi(\{out\}) = 0$, $\phi(\{in\}) = b(p) - b(1) > 0$, $\phi(\emptyset) \geq \phi(\{out\})$, $\phi(\{in\}) \geq \phi(\emptyset)$, $\phi(\{out, in\}) \geq \phi(\{out\})$, *and* $\phi(\{in\}) \geq \phi(\{out, in\})$.

By Lemma 3, Corollary 1, and Definition 1, I have the following second main result of this paper.

Corollary 2 *(i) The bail-in risk premium selected by the rule* ϕ *under a discretionary trigger is no higher than that under a rule-based trigger. (ii) The bail-in risk premium selected by* *the rule ϕ under a discretionary trigger is strictly lower than that under a rule-based trigger for some parametric cases.*

Proof: Note that $\{\emptyset, \{out\}, \{in\}, \{out, in\}\}$ is the set of all possible outcomes under a rule-based trigger. By Corollary 1, the followings are true. (1) If $\emptyset$ is the outcome under a rule-based trigger, $\emptyset$ and $\{out\}$ are possible outcomes under a discretionary trigger. (2) If $\{out\}$ is the outcome under a rule-based trigger, it is the only possible outcome under a discretionary trigger. (3) If $\{in\}$ is the outcome under a rule-based trigger, all of $\emptyset$, $\{out\}$, $\{in\}$, and $\{out, in\}$ are possible outcomes under a discretionary trigger. (4) If $\{out, in\}$ is the outcome under a rule-based trigger, $\{out\}$ and $\{out, in\}$ are possible outcomes under a discretionary trigger. By applying the rule ϕ to outcomes in each case (1)-(4), the proof of (i) is obtained. (ii) is true in the parametric cases illustrated by Figures 3 and 4. ■

3 An Empirical Analysis

3.1 Preliminaries

Hypothesis

A main finding of the previous theoretic model is that the bail-in risk measured by the interest rate at issuance—the coupon rate—is most likely lower under a discretionary trigger than the coupon rate under a rule-based trigger. In this section, this theoretic prediction shall be tested empirically. In particular, I consider the following hypothesis.

Hypothesis 1: The bail-in risk is lower (i.e. the likelihood of government assistence is higher) under a discretionary trigger than that under a rule-based trigger.

Measures of the bail-in risk: coupon rate and coupon residual

An important task is selecting a good measure of the bail-in risk, and a natural candidate is the coupon rate. The theoretic model shows that, in general, the coupon rate $b(Q)$ can be decomposed into three parts— the bail-in risk premium, the default risk premium, and the riskfree benchmark rate. (See Figure 1.) Thus, the coupon rate could be a good measure of the bail-in risk if the default risk does not exist and the benchmark rate is properly controlled. In fact, there is no default risk in the theoretic model by the assumption that the government would always rescue straight bond holders due to systemic risk concerns. (See Assumption 1 and Figure 2.) In real-life, however, market participants put non-zero probability on the event that the government does not bail out straight bond holders. That's why default indicators such as bank CDS premiums are positive and volatile. As the coupon rate reflects the default risk, it is an imperfect measure of the bail-in risk. In addition, whether CoCo bonds are AT1 or T2 instruments is an important factor. Tier 2 (T2) instruments are subordinated bonds for which a bail-in clause is added. Additional Tier 1 (AT1) instruments have more complicated structures. They are *de facto* perpetual bonds with a bail-in clause and two special options. Firstly, by the call option, the issuer can opt to repay the bond before it is matured. Since this option is usually exercized, the market is in panic if the issuer does not exercize the option—the call option risk. Secondly, the issuer can choose to suspend or even default on interest payment if the business conditions are unfavorable—the interest payment risk.[9] The coupon rate of AT1 CoCo bond reflects the call option risk and interest payment risk as well as the default risk and bail-in risk.

An alternative measure of the bail-in risk is the coupon residual obtained after subtracting a benchmark sovereign bond rate and a relevant CDS premium from the coupon rate. At least for T2 instruments, this coupon residual is conceptually an ideal measure for the bail-in risk. Table 1 and 2 describe how the coupon rates of CoCo bonds are determined in real-life.

[9]Also, regulators could mandate such default on interest payment if business conditions are worse.

See Table 1. Woori bank (a Korean bank) issued a T2 CoCo bond (in USD) on April 2014 at the coupon rate of 4.75%. The coupon rate can be decomposed into a benchmark country rate 3.17% (measured by a similar-term US Treasury bond rate), a default risk premium 1.40% (measured by the CDS premium on a similar-term Woori bank's subordinated bond), and a residual 0.18%. Since it is a T2 instrument, investors concern only the default risk and bail-in risk. As the CDS premium accounts for the default risk, the coupon residual could be construed as a good measure of the bail-in risk. The coupon residual, however, becomes less ideal for the AT1 instruments. See Table 2. Barclays issued an AT1 CoCo bond on August 2015 at the coupon rate of 7.86%. As it is an AT1 instrument, the coupon rate reflects not just the default risk and bail-in risk but also the call option risk and interest payment risk. However, it is hard to find objective measures of the call option risk premium and interest payment risk premium.

[Insert Table 1]

[Insert Table 2]

Despite of its drawbacks, the coupon rate could still be a good measure of the bail-in risk. Although the coupon residual is conceptually a better measure, only a few samples are available. This is because most CoCo bonds in real-life have no counterpart sovereign bonds or subordinated bonds for which CDSs are traded. The maturity of most CoCo bonds is 10-year or 30-year. However, some countries do not issue 10-year or 30-year sovereign bonds. Problems are even worse with CDS contracts. For many banks, CDSs are not traded at all on any subordinated bond. To increase the sample size, I need to choose counterpart sovereign bonds and subordinated bonds for which CDSs are traded whose maturities are within the 5-year window of the maturity of the given CoCo bond. Due to this maturity mismatch during the data collection process, the coupon residual could be contaminated to some extent. In contrast, if the coupon rate is used as the bail-in risk measure, then the available sample size is larger (by three times) and the data is not contaminated.

In the following empirical analyses, I use two different approaches. Firstly, I use the coupon rate as the primary measure of the bail-in risk and try to control the default risk as much as possible. Various different specifications shall be considered and robustness checks will be conducted. Secondly, I choose the coupon residual as the measure of the bail-in risk.

Data

I assemble a dataset on the CoCo bond issues undertaken exclusively by banks in the world from January 2010 to September 2016 based on information from the Moody's Quarterly Rated and Tracked CoCo Monitor Database (2016 3Q) and the Bloomberg terminal. The dataset also contains information on issuing banks and their countries of domicile. The dataset covers 632 distinct CoCo bond instruments issued by 222 banks. The aggregate face value is worth $460 billion. (Short-term CoCo bonds that mature less than three years are excluded, since CoCo bonds are designed as long-term loss absorbing capacities.)

Figure 5 and 6 provide an overview of CoCo bond issuance. See Figure 5. The volume of CoCo bonds has been increased up to 185 billion US$ until 2014 and then decreased to $124 billion in 2015. The number of issues have steadly been increasd until 2015. See Figure 6. According to the convention of international bond markets, I classify countries into five regions—Asia Pacific, EU Euro, EU non-Euro, North and Latin America, and Middle East and Africa. Asia Pacific banks have been main issuers that cover 44% (281 issues) of the total issues and 45% ($207 billion) of the total volume. European banks in the Euro area and in the non-Euro area have issued 19% ($87 billion) and 24% ($112 billion) of the total volume, respectively. Country-level comparison shows that Chinese banks have been the largest issuers ($107 billion, 23% of the total volume). Then follows UK ($57 billion), Swiss

($41 billion), Australian ($40 billion), Canadian ($29 billion), French ($20 billion), Japanese ($18 billion), Spanish ($15 billion), Korean ($14 billion), Irish ($12 billion), and Brazilian ($11 billion) banks according to the country-wide volumn. The average of country-wide volumn is $10 billion.

Country-wide comparison

Among many variables in the dataset, the coupon rate is a key variable. (Definition of each variable is contained in Table 3.) Table 4 shows that the coupon rate is 5.75% on average, and its standard deviation is 2.66. Consider the eleven major countries. Figure 7 shows that Japanese banks have been able to borrow at the world lowest interest rate of 1.66% on average. Korean and Canadian banks have also paid low interests of 3.57% and 4.02% on average, respectively. By contrast, French (7.34%), Brazilian (7.89%), Spanish (8.28%), and Irish banks (9.00%) have paid double or more interests.

Another key variable is the type of trigger. There are two types of trigger—CET1 and PONV. First, the CET1 trigger is a rule-based trigger based on the ratio of the core equity tier 1 (CET1) capital to the risk-weighted assets. The Basel III accord classifies capital into various groups according to the power of loss absorbency. The core equity tier 1 capital has the largest such power as it mainly consists of common equity. Under the CET1 trigger, the write-down or conversion is activated if the CET1 ratio falls below a predetermined threshold. The threshold for most issues is 5.125%, as the Basel III accord deems 5.125% a minimum capital ratio that a going-concern bank should maintain. (Table 4 shows that the threshold is on average equal to 5.38% with a small standard deviation of 1.28.) Second, the PONV trigger is a discretionary trigger. Under this trigger, the government activates the write-down or conversion if it determines that the issuing bank is at the point of non-viability (PONV). See Table 5. The ratio of CoCo bonds with a discretionary trigger to all CoCo bonds is 49.1% in terms of the number of issuance and 35.4% in terms of the total volume.

In fact, there is an additional type of trigger—the mixed trigger. Under the mixed trigger, the write-down or conversion is activated if either the CET1 ratio falls short of the threshold or the government determines the issuing bank is at the point of non-viability. Usually, the PONV condition is deemed more difficult to be satisfied than the CET1 condition, since the point of non-viability corresponds to the case in which assets are less than liabilities (i.e. 0% of the CET1 ratio). In this sence, I regard the mixed trigger as a rule-based trigger. However, Japan is special. According to the Japanese Comprehensive Guidelines for Supervision of Major Banks, etc., III-2-1-1-3 (2), a bank that have issued a CoCo bond with the mixed trigger can avoid the activation of the write-down or conversion even though the CET1 condition is satisfied (but the PONV condition is not yet satisfied), if the bank submits a resolution plan to the supervision authority and gets an approval of it. See Lee and Pang (2014). Thus, I regard the mixed trigger of Japanese banks as a discretionary trigger in the following empirical analysis.

Figure 7 shows that the discretionary trigger ratio varies much across countries. (In the figure, mixed triggers are classified as rule-based triggers. For Japanese banks, however, mixed triggers are classified as discretionary triggers due to the aforementioned specialty of Japanese regulation.) Japan, Korea, and Canada are in one exterem case. The trigger of every CoCo bond is discretionary. France, Brazil, Spain, and Ireland are in the other extreme. The trigger of every CoCo bond is rule-based. Australian, Swiss, Chinese, and UK banks use both types of trigger in CoCo bond issuance.

[Insert Figure 7]

The country-level comparison of the discretionary trigger ratio and that of the coupon rate suggest that there is a negative relationship between the two variables. See Figure 7. In Japan, Korea, and Canada, banks have issued only discretionary trigger CoCo bonds and the coupon rates are low. In France, Brazil, Spain, and Ireland, only rule-based trigger CoCo bonds have been issued and the coupon rates are high. In other countries, both types of CoCo bonds have been issued and the coupon rates are intermediate. One might argue that the negative relationship between the coupon rate and discretionary trigger ratio is spurious, since the coupon rates are primarily explained by the low sovereign credit risk rather than the discretionary trigger ratio. However, Figure 8 shows that the CDS premium on 5-year sovereign debt does not have clear relationship with the country-wide coupon rate. (The sovereign CDS premium in the figure is the average of the sovereign CDS premiums at the issue dates of CoCo instruments.) French banks pay high interests even though the CDS premium on France is the lowest. In contrast, Japanese, Korean, and Chinese banks pay low interests even if the sovereign CDSs are relatively high. The correlation between the sovereign CDS and coupon rate is as low as 0.33, while the correlation between the discretionary trigger ratio and coupon rate is as high (in magnitude) as -0.88. Although the country-wide comparison is consistent with the **Hypothesis 1**, more formal empirical analysis is required.

[Insert Figure 8]

3.2 Empirical analysis 1: the coupon rate

In this subsection, I examine the empirical relationship between the bail-in risk measured by the coupon rate and the type of trigger in the CoCo bond issuance. To see briefly how the coupon rate and the type of trigger are related, see Table 6. The average coupon rate of discretionary trigger CoCo bonds is 4.60%, which is 2.33%p lower than the average coupon rate of rule-based trigger CoCo bonds. This difference is significant at the 1 % level.

[Insert Table 6]

To examine the relationship formally, I shall construct a regression model based on the theory. Figure 1 shows that the equilibrium coupon rate $b(Q)$ depends on the probability Q that CoCo bond holders are repaid. This repayment probability is given by (2.6). That is, three factors that determine the equilibrium coupon rate are bank prudence p, the probability of bailouts of straight bond holders q, and the reduction in the bailout probability $\Delta \in [0, q]$, where this reduction is originated from the fact that the given bond is a CoCo bond rather than a straight bond. Figure 1 also shows that the coupon rate is a good measure of the bail-in risk if the default risk and benchmark riskfree rate are properly controlled. In the following regression model, independent variables are chosen so as to control for the three factors (p, q, Δ), default risk, and benchmark rate.

$$Coupon\ rate_i = \alpha + \beta_1 Discretionary_i + \beta_2 Country\ rate_i + \beta_3 Credit\ score_i + \gamma X_i + \varepsilon_i \quad (3.1)$$

The key independent variable is $Discretionary_i$, which equals 1 if the trigger of CoCo bond i is discretionary or 0 if it is rule-based. According to the theory, the type of trigger is related to the political pressure that the government has to bear when it lets bail-ins take place. That is, $Discretionary_i$ is presumably related to the reduction Δ in the bailout probability.

$Country\ rate_i$ and $Credit\ score_i$ are used to control for the benchmark rate and default risk, respectively. $Country\ rate_i$ is the market interest rate on a sovereign bond whose residual maturity is similar with the CoCo bond i's maturity. Although sovereign bond rates may not be riskfree, I still use them as benchmark (risky) interest rates. This is simply because in practice bond coupon rates are determined by adding up margins on sovereign bond rates. $Credit\ score_i$ reflects the baseline credit assessment conducted by Moody's. The baseline credit assessment represents the credit rating agency's opinion on the probability of standalone failure of the issuing bank's senior unsecured debt in the absence of external support. $Credit\ score_i$ is equal to 21 if the issuing bank's credit grade is Aaa (the highest grade) but equal only to 1 if the grade is C (the lowest grade). One notch of credit rating corresponds to one point.

X_i is a set of control variables. See Table 3 and 4 for definitions and summary statistics. These control variables can be categorized into three groups.

The first group consists of variables that reflect characteristics of the CoCo bond instrument i. These variables are $Conversion_i$, $CET1\ threshold_i$, $Maturity_i$, and $Face\ value_i$. $Conversion_i$ is 1 if the bail-in mechanism is conversion to equity or 0 if the mechanism is principal write-down. $CET1\ threshold_i$ is a minimum level of the CET1 that the issuing bank of the CoCo bond i should maintain in order to prevent the bail-in from taking place. If the bond i has the CET1 trigger or a mixed trigger, such a minimum CET1 level is explicitly written down in the bond contract. For a purely discretionary CoCo bond that uses only the PONV trigger, the bond contract has no clause regarding a mimimum CET1 level. However, the PONV usually corresponds to the case in which the bank's capital is close to zero. In practice, regulators and investors often deem 2% as a minimum capital ratio a healthy bank should maintain in order to avoid insolvency. That's why, every CET1 trigger CoCo bond in my dataset has a threshold no less than 2%. (See Table 4.) In this reason, for the following analysis, I put 2% as the $CET1\ threshold_i$ for discretionary CoCo bonds. (A robustness check will also be conducted.)

The second group is the set of variables that control for the issuing bank's characteristics. To control for prudence, size, and state ownership, I use $CET1_i$, $Total\ assets_i$, and $State\ bank_i$, where $State\ bank_i$ is 1 if the bank is a subsidiary of sovereign or central bank, but 0 otherwise. $Total\ assets_i$ and $State\ bank_i$ are importantly related to the probability q of bailing out straight bond holders. This is because the government may find no choice but to bail out the straight bond holders if their claims are issued by too big to fail banks. Also, straight bond holders are usually protected by explicit or implicit guarantees if their claims are issued by state banks.

The variables in the third group control for country effects. I use $Country\ rate_i$ and $Country\ CDS_i$ in order to control for the mean and variance effects of the country in which the headquarter of the issuing bank is located. $Country\ CDS_i$ is the CDS premium on a sovereign bond. All flow variables are evaluated at the dates of CoCo bond issuance.

Table 7 shows the estimation result. I consider five different model specifications (1-5). As the number increases, more control variables are included. Among many control variables, $Country\ rate_i$ and $Credit\ score_i$ are considered importantly, as the theory suggests that the benchmark country rate and default risk are important factors that determine the coupon rate. The estimation result is consistent with the theory, as the coupon rate turns out to be positively associated with $Country\ rate_i$ and negatively associated with $Credit\ score_i$ in most specifications. Interestingly, the goodness of fit measured by the R-square increases dramatically by adding only those two control variables. (See specification 1 and 2.) Other many control variables and region/year dummies have smaller effects on the goodness of fit. (See specification 3-5.)

[Insert Table 7]

The coefficient of $Discretionary_i$ is negative and significant at the 1% level in all specifications. This result indicates that the change of trigger from rule-based to discretionary is associated with a decrease in the coupon rate. Depending on specifications, the coupon discount of discretionary trigger is around 1.72%p to 2.39%p. Given the low interest rate trend during the sample period of 2010-2016, this size of coupon discount is meaningfully large.

There are several points worth noting. First, the empirical model seems not facing a serious endogeneity problem. Countries have regulations on the acceptable triggers of CoCo bonds and, hence, selection problems arise less likely. In China, AT1 instruments should use the CET1 trigger with the threshold of 5.125%, whereas T2 instruments should use the PONV trigger. All Chinese banks in my dataset have complied with these regulations. Similarly, the European version of the Basel III (i.e. the CRRD4) requires banks to use the CET1 trigger with the threshold no less than 5.125% when they issue AT1 instruments. Although there are no clear regulations on T2 instruments, the PONV trigger is recommended. In this reason, European banks use the CET1 trigger more frequently when they issue AT1 instruments but use the PONV trigger more frequently when they issue T2 instruments. As the choice of trigger depends largely on regulations, I use $Country\ rate_i$, $Country\ CDS_i$, and region dummies in order to control for this country effect. Even after controlling for these country-related variables, the coefficient of $Discretionary_i$ is still negative and significant.

Second, one might argue that a rule-based trigger CoCo bond has higher bail-in risk than a discretionary trigger CoCo bond simply because the former uses a high trigger level while the latter uses a low trigger level. The threshold of the CET1 trigger is around 5.125%, whereas the PONV trigger usually corresponds to 2% of the CET1. However, even after controlling for this difference in trigger levels by using $CET1\ threshold_i$, the estimation results show that the measured bail-in risks are lower with discretionary triggers. As a robustness check, I put 0% as the hypothetical $CET1\ threshold_i$ for discretionary CoCo bonds. See Table 8. The estimation result does not show any remarkable change. The coefficient of $Discretionary_i$ is still negative and significant at the 1% level in all the five specifications.

[Insert Table 8]

Robustness check

(1) Control variables of the default risk

In order to separate out the default risk from the coupon rate, I use $Credit\ score_i$ as a control variable. $Credit\ score_i$ is based on the baseline credit assessment conducted by Moody's. The baseline credit assessment does not take account of the possibility that the parent company or the government provides the issuing bank with financial assistence. If this possibility of getting external support is not considered, the coefficient of $Discretionary_i$ could be over-estimated. With this coefficient, I want to capture the effect of trigger being discretionary on the likelihood of government bailout. There are many other reasons that increase the likelihood of government bailout but are not related to CoCo bond characteristics. Examples of such reasons are systemic importance, complexity, interconnectedness, and state ownership. These reasons could be controlled to some extent by using the *adjusted* baseline credit assessment, which reflects the possibility of getting external support.

I estimate the regression model by replacing $Credit\ score_i$ with $Adjusted\ credit\ score_i$, which is a monotone transformation of the adjusted baseline credit assessment.[10] Table 9 shows the estimation result of the regression model in which $Credit\ score_i$ is replaced by $Adjusted\ credit\ score_i$. The coefficient of $Discretionary_i$ is negative and significant at the 1% level in all specification 2-5. Remarkably, the size of coefficient is more or less the same as before. This is presumably due to that bank characteristics that increase the probability of government bailouts are already properly controlled by existing control variables such as $State\ bank_i$ and $Total\ assets_i$.

[Insert Table 9]

[10] $Adjusted\ credit\ score_i$ is 21 if the credit grade from the adjusted baseline credit assessment is Aaa (the highest grade) and 1 if the grade is C (the lowest grade). One notch of credit rating corresponds to one point.

Neither $Credit\ score_i$ nor $Adjusted\ credit\ score_i$ is based on market information. Thus, information updating may not be instantaneous, and information gathering from a large group of informed investors may be limited. As an alternative, I use the bank CDS premium, as it is one of the leading market indicators of the default risk. In particular, I use $CDS\ senior_i$, which is the CDS premium on the bank's senior unsecured bonds whose maturities are close to the maturity of the given CoCo bond. Table 10 shows the estimation result of the regression model in which $Credit\ score_i$ is replaced by $CDS\ senior_i$. The coupon discounting effect of discretionary trigger is still observed in all specification 2-5. Also, the size of coupon discount measured by the coefficient of $Discretionary_i$ does not change much.

[Insert Table 10]

$CDS\ senior_i$ controls for the default risk of a senior unsecured bond rather than a subordinated bond. Since the CoCo bond is a special subordinated bond, the CDS premium on a subordinated bond could account for the default risk of a CoCo bond better than $CDS\ senior_i$. In this sense, I replace $CDS\ senior_i$ with $CDS\ sub_i$, which is the CDS premium on the subordinated bank bond whose maturity is close to the maturity of the given CoCo bond. (A drawback of $CDS\ sub_i$ is that the available sample size is smaller, as CDSs are not traded on many banks' subordinated bonds. Furthermore, $State\ bank_i$ should be dropped as it causes a severe multi-collinearity problem. This multi-collinearity problem seems to arise because the sample size is small.) Table 11 shows the estimation result. The coefficient of $Discretionary_i$ is still negative and significant at the 1% level in all specification 2-5. There is no meaningful change in the coefficient size.

[Insert Table 11]

(2) Mixed triggers

In the baseline empirical model (3.1), I classify all but Japanese mixed trigger CoCo bonds as rule-based trigger CoCo bonds. This is because the CET1 condition is deemed easier to be satisfied than the PONV condition. However, the reverse is not impossible. The CET1 is a lagged indicator of a given bank's viability since it is usually reported quarterly. Suppose a bank faces a serious insolvency shock and, therefore, has to shed liabilities immediately. Although the CET1 level is not yet updated and, hence, is still good, the government may choose to declair that the given bank is at the point of non-viability in order to shed bank liabilities. If such a preemptive move is anticipated, mixed trigger CoCo bonds should be classified as discretionary trigger CoCo bonds. However, concerns on regulatory forbearances suggest that the government is less likely to move preemptively. Due to this complexity, I drop mixed trigger CoCo bonds for the moment and consider only purely discretionary or purely rule-based trigger CoCo bonds. See Table 12. The estimation result shows that the coefficient of $Discretionary_i$ is negative in all five specifications and significant in all but specification 5. Although the significance is weaker, the estimation result is still consistent with the **Hypothesis 1**. If significant, the estimated size of coupon discount is around 1.13%p to 2.29%p, which is slightly lower than the estimated size under the baseline model.

[Insert Table 12]

Another concern with $Discretionary_i$ is on the treatment of Japanese mixed trigger CoCo bonds. Although I believe Japanese mixed trigger CoCo bonds should be classified as discretionary CoCo bonds due to the Japan's creditor-friendly regulation, I classify them for the moment as rule-based trigger CoCo bonds in order to check robustness. Table 13 shows the estimation result. The coefficient of $Discretionary_i$ is negative in all five specifications and significant at the 1% level in specifications 1-3. The estimated sizes of coupon discount in specifications 1-3 are slightly higher than 2%p.

[Insert Table 13]

State ownership and too-big-to-fail

The objective of this empirical study is to estimate the effect of the trigger type on the likelihood of government bailouts. However, the likelihood depends not just on the trigger type but also ownership structure, bank size, etc. For instance, the government may be more willing to support creditors with public funds, if the given bank is state-owned or its size is too big to fail. I need to distinguish the effects of state-ownership and bank size from the effect of trigger type.

The estimation results show that $State\ bank_i$ and $Total\ assets_i$ are significantly and robustly associated with the coupon rate. (See Table 7–13.) The results indicate that the coupon rates of state banks are roughly 1%p lower than that of private banks. Also, it turns out that a 1%p increase in bank size attributes to roughly a 0.3%p discount in the coupon rate, which is consistent with the hypothesis of too-big-to-fail. It is worth noting that the coupon discounting effect of discretionary trigger is robust to ownership structure and size.

3.3 Empirical analysis 2: the coupon residual

I shall examine an empirical relationship between the coupon residual(= the coupon rate - the default risk premium measured by a relevant CDS premium - the benchmark country rate) and the trigger type. The coupon residual can be measured in two different ways depending on the choice of a relevant CDS premium. I use the CDS premium on bank subordinated debt in the first regression model and the CDS premium on senior unsecured debt in the second regression model. The former is conceptually better since CoCo bonds are subordinated bonds with some special clauses. However, the latter allows me to utilize more samples and avoid multi-collinearity problems with respect to $State\ bank_i$.

Coupon residual based on a CDS contract on subordinated debt

At first, I conduct a simple t-test to illustrate the empirical relationship briefly. See Table 14. The average coupon residual of discretionary trigger CoCo bonds is -0.40%, which is lower by 3.06%p than the average coupon residual of rule-based trigger counterparts. The difference in the coupon residual is significant at the 1% level.

[Insert Table 14]

Next, I shall conduct a regression analysis. I exclude $Country\ rate_i$ and $Credit\ score_i$ from the set of control variables since $Country\ rate_i$ is a measure of the benchmark rate and $Credit\ score_i$ is a measure of the default risk premium. I also exclude $State\ bank_i$ because its inclusion causes a severe multi-collinearity problem.

Table 15 provides the estimation result. I consider four different model specifications. The coefficient of $Discretionary_i$ is negative in all specifications and significant in all but specification 2. The sizes of discount in the coupon residual (in specification 1, 3, and 4) are also meaningfully large as around 2.01%p to 3.07%p.

[Insert Table 15]

$Conversion_i$ is negatively and significantly associated with the measured bail-in risk. In particular, the coupon residual is about 1%p lower if the bail-in mechanism is conversion to equity rather than principal write-down. This result is intuitive since CoCo bond holders could recoup losses when their bonds are converted to equity, if the issuing banks revive in the future. However, CoCo bond holders whose principals are fully written down have no hope to recoup losses. This result is not observed in the previous empirical model where the coupon rate is used for the measure of bail-in risk. This is presumably due to that the coupon residual is a more carefully constructed measure and, hence, reflects the characteristics of CoCo bond better than the coupon rate does.

Coupon residual based on a CDS contract on senior unsecured debt

Conisder firtly a simple t-test. See Table 16. The coupon residual is lower by 3.46%p if the trigger is discretionary rather than rule-based. This difference is significant at the 1% level.

[Insert Table 16]

Next, I shall conduct a regression analysis. Unlike the case where the CDS on subordinated debt is used, $State\ bank_i$ can be included in the regression model. The estimation result is provided in Table 17. The coefficient of $Discretionary_i$ is negative and significant in all four specifications. The measured discount in the coupon residual is 1.62%p at low and 3.50%p at high. Except the specification 2, the measured discount is as high as 3.41-3.50%p.

[Insert Table 17]

Figures and Tables

Figure 1: The interest structure of a CoCo bond

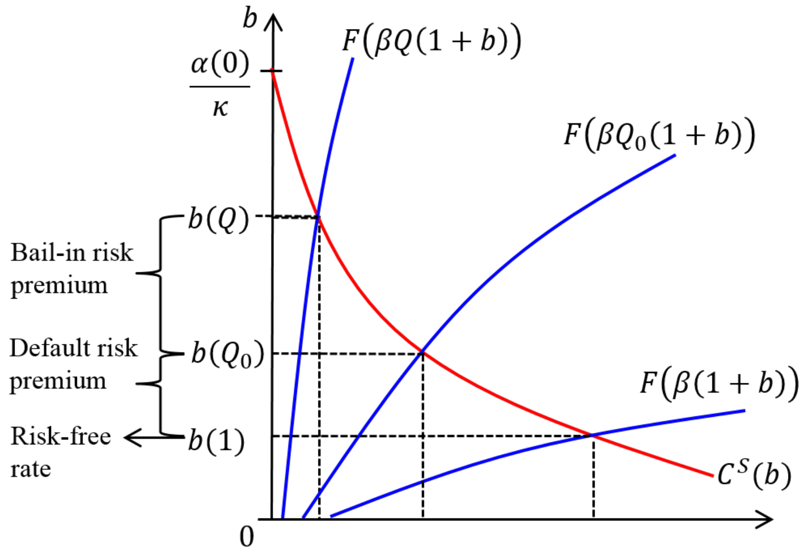


Figure 2: The dependence of market-clearing outcome on expectation

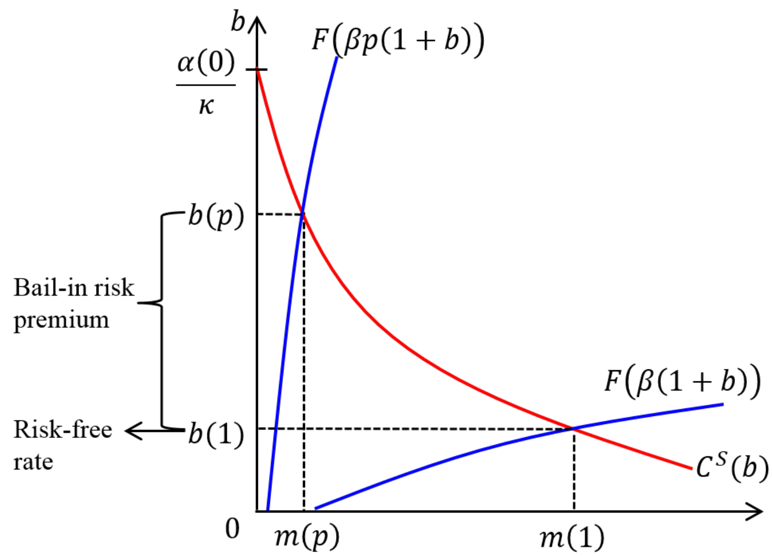


Figure 3: Equilibria under a discretionary and rule-based trigger I

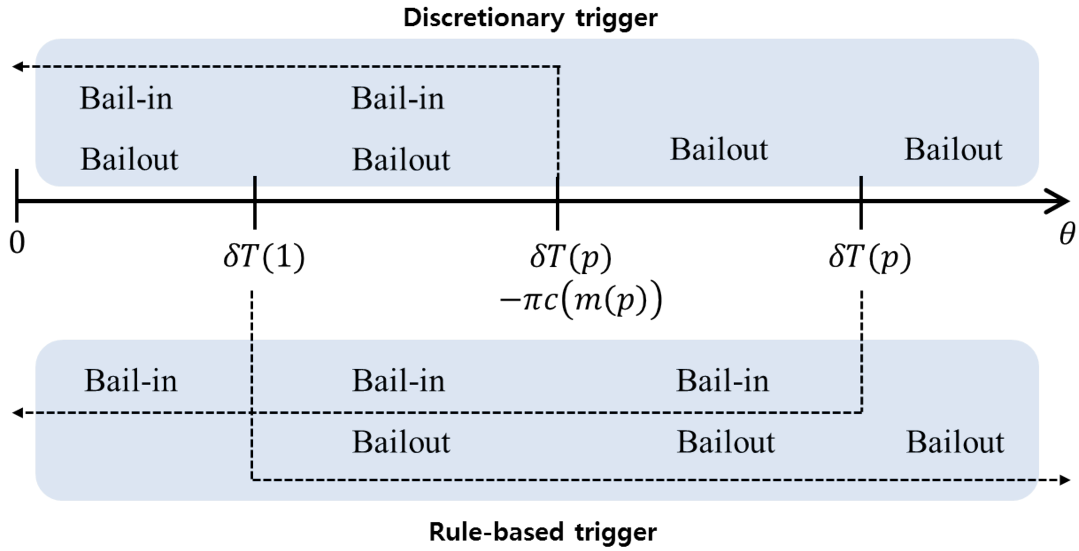


Figure 4: Equilibria under a discretionary and rule-based trigger II

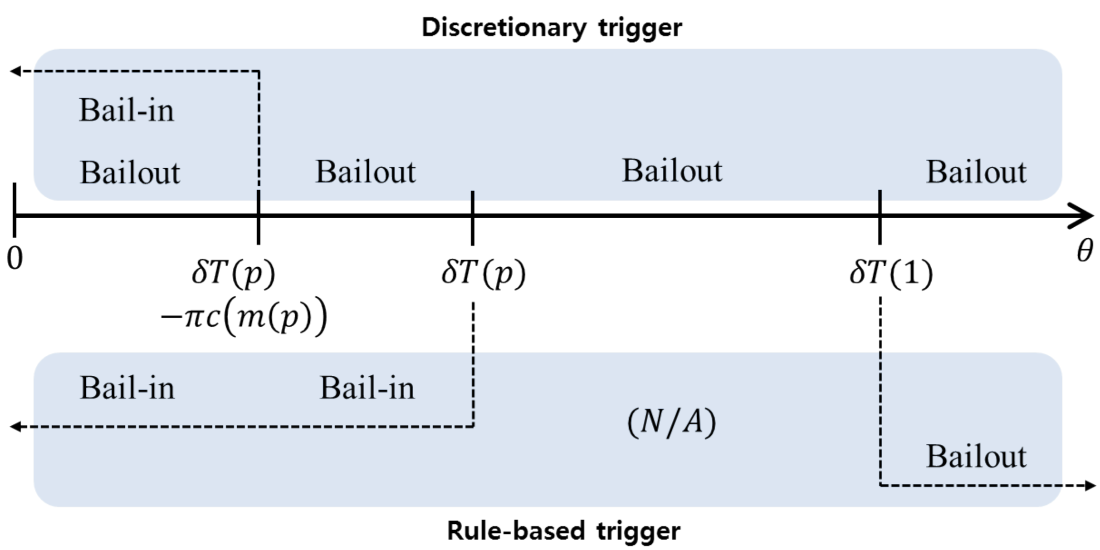
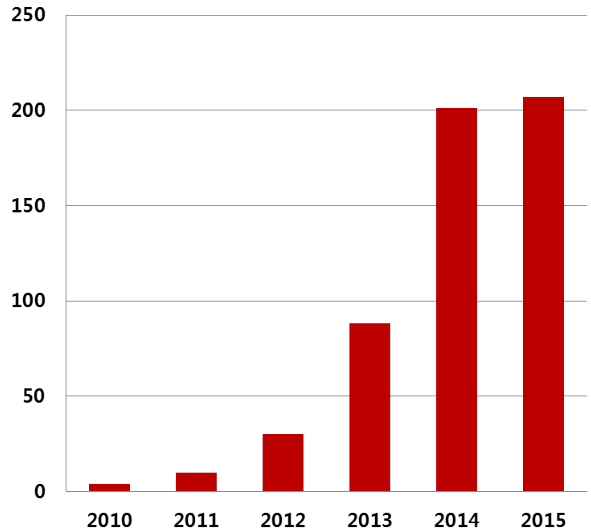
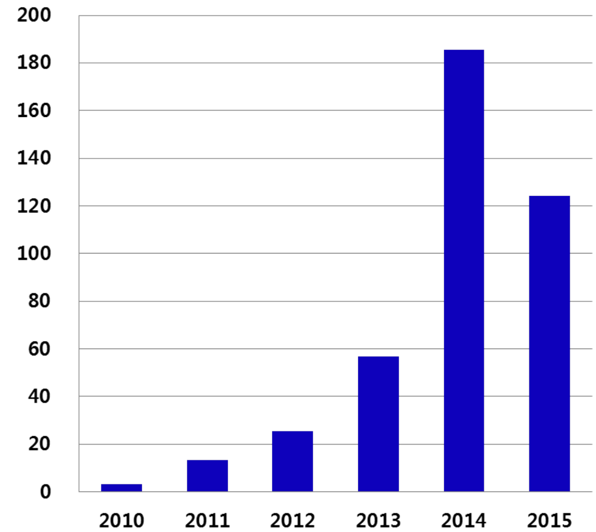


Figure 5: Yearly CoCo bonds issuance

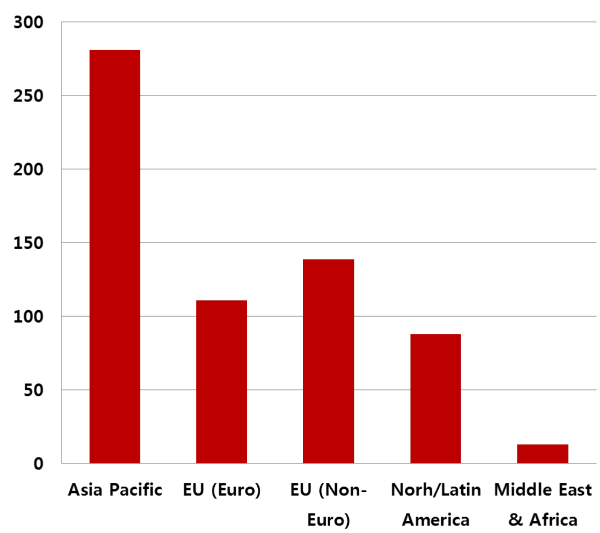


(a) Number of issuance

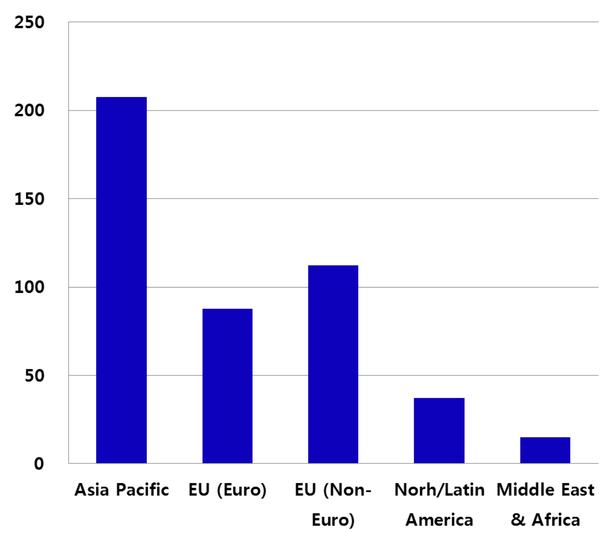


(b) Total volumn ($1 billion)

Figure 6: Regional CoCo bonds issuance



(a) Number of issuance



(b) Total volumn ($1 billion)

Figure 7: Coupon rate and discretionary trigger ratio (Correlation: -0.88)

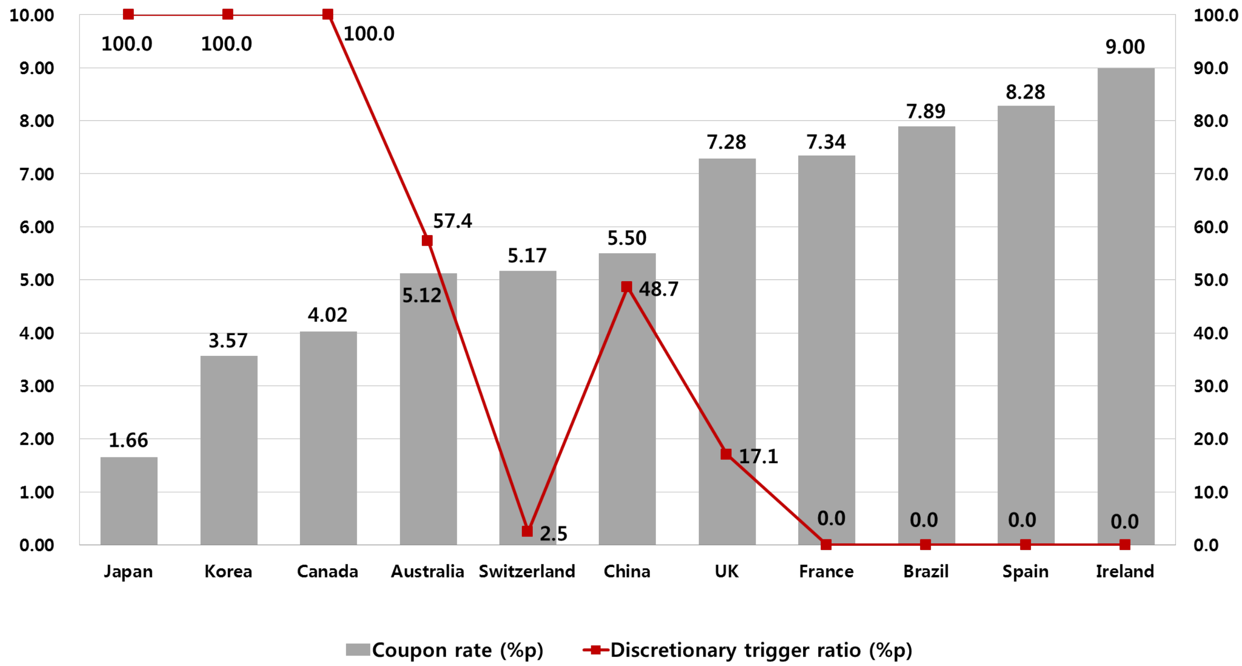


Figure 8: Coupon rate and 5-year CDS premium (Correlation: 0.33)

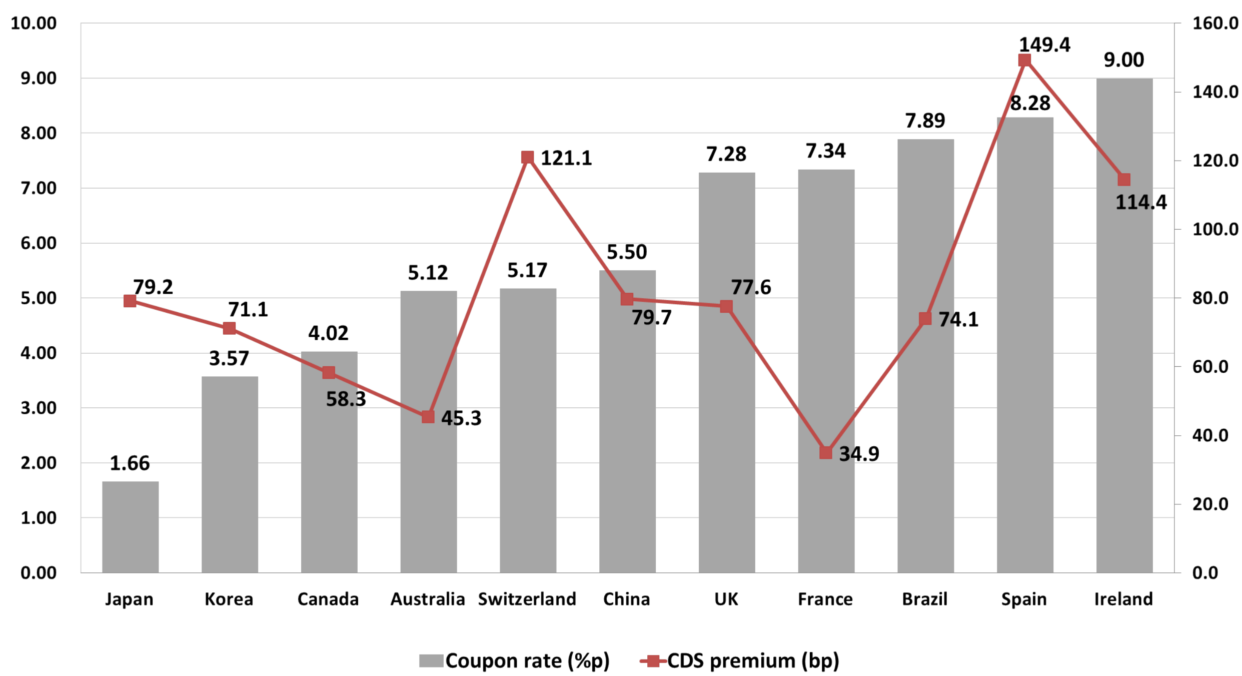


Table 1: The interest structure of Woori bank's T2 CoCo bond

Premium	**Measure**	**Value**
Bail-in risk	The coupon residual[a]	0.18%
Default risk	CDS premium on 10-year subordinated bond	1.40%
Benchmark rate	Interest rate on 10-year US Treasury bond	3.17%
Coupon rate	Coupon rate	4.75%

The CoCo bond (ISIN: US98105FAC86) was issued in April 30 2014. The maturity is 10 years. The face value is $10 billion.

[a] The coupon residual = the coupon rate - the benchmark rate - the default risk premium

Table 2: The interest structure of Barclays's AT1 CoCo bond

Premium	**Measure**	**Value**
Bail-in risk Call option risk Interest payment risk	The coupon residual[a]	3.14%
Default risk	CDS premium on 30-year subordinated bond	2.27%
Benchmark rate	Interest rate on 30-year US Treasury bond	2.45%
Coupon rate	Coupon rate	7.86%

The CoCo bond (ISIN: XS1274156097) was issued in August 11 2015. The maturity is 34 years. The face value is $15.6 billion.

[a] The coupon residual = the coupon rate - the benchmark rate - the default risk premium

Table 3: Definition of variable

Variable	Unit	Definition
Coupon rate	%p	The interest rate at issuance
Coupon residual (sub)	%p	Coupon rate - Benchmark country rate[1] - CDS on benchmark subordinated bond[2]
Coupon residual (senior)	%p	Coupon rate - Benchmark country rate[1] - CDS on benchmark senior bond[3]
Discretionary	Dummy	1 if the trigger is discretionary but 0 if it is rule-based or mixed. For Japanese banks, mixed triggers are regarded as discretionary.
AT1	Dummy	1 if the capital type is AT1 but 0 if it is T2
Conversion	Dummy	1 if the bail-in mechanism is conversion to equity but 0 if it is principal write-down
CET1 threshold	%p	The numerical trigger. For discretionary trigger instruments, I put 0%p.
Maturity	Year	The nominal maturity. The longest finite maturity in the dataset is 42.5. I put 42.5 if the nominal maturity is infinite.
Face value	USD bil.	The principal amount denominated in USD by the exchange rate at issuance.
Credit score	21-scale	21 if the issuing bank's credit grade rated by Moody's is Aaa (the highest grade). One notch corresponds to one point. It is 1 if the grade is C (the lowest grade).
State bank	Dummy	1 if the ultimate parent company is sovereign or central bank.
Total assets	USD bil.	Calculated based on the Basel standard
CET1	%p	The CET1 to risk-weighted assets ratio at issuance
Country rate	%p	Market interest rate on the benchmark government bond. Among all government bonds, the benchmark bond is the one whose remaining maturity is the closest to the maturity of the given CoCo instrument.
Sovereign CDS	%p	Market premium on the CDS contract on the 5-year government bond

[*] Coupon residual (sub), coupon residual (senior), credit score, total assets, CET1, country rate, and sovereign CDS are evaluated at the issue date of the given CoCo instrument.

[1] Market interest rate on the benchmark government bond whose remaining maturity is within the 5-year window of the maturity of the given CoCo instrument

[2] Market premium on the CDS contract on the benchmark subordinated bond whose remaining maturity is within the 5-year window of the maturity of the given CoCo instrument

[3] Market premium on the CDS contract on the benchmark senior unsecured bond whose remaining maturity is within the 5-year window of the maturity of the given CoCo instrument

Table 4: Summary statistics: variables

	Unit	Obs.	Mean	S.D.	Min.	Max.
Coupon rate	%p	630	5.75	2.66	0.59	20.82
Coupon residual (sub)	%p	127	0.49	2.00	-4.35	5.10
Coupon residual (senior)	%p	167	0.80	2.23	-4.16	6.04
Discretionary	Dummy	630	0.50	0.50	0	1
AT1	Dummy	632	0.55	0.49	0	1
Conversion	Dummy	618	0.34	0.47	0	1
CET1 threshold[1]	%p	315	5.38	1.28	2	9
Maturity[2]	Year	279	10.65	3.51	3.5	36.5
Face value	USD bil.	632	0.72	0.93	0.002	7.2
Credit score	21-scale	558	13.32	3.03	2	18
State bank	Dummy	632	0.16	0.37	0	1
Total assets	USD bil.	467	637.06	672.86	0.23	2,671.31
CET1	%p	574	11.40	3.27	5.17	30.12
Country rate	%p	582	2.81	2.11	-0.21	12.44
Sovereign CDS	%p	476	0.91	1.19	0.11	9.92

[1] Only rule-based and mixed trigger CoCo bonds are considered.
[2] Only T2 instruments are considered since AT1 instruments are deemed perpetual.

Table 5: Summary statistics: CoCo bond types

	Number of issuance		Total volumn	
	Obs.	**Fraction**	**Volumn[1]**	**Fraction**
Total	632	100%	460	100%
Discretionary	310	49.1%	163	35.4%
Rule-based	200	31.6%	168	36.5%
Mixed	120	19.0%	127	27.7%
Uncertain	2	0.3%	2	0.4%
Additional Tier 1	353	55.9%	289	62.8%
Tier 2	279	44.1%	171	37.2%
Conversion	213	33.7%	215	46.7%
Write-down	405	64.1%	241	52.4%
Uncertain	14	2.2%	4	1.0%

[1] Face values are denominated in USD by the exchange rate at the issue date. The unit is $1 billion.

Table 6: T-test: Coupon rate and trigger type

	Obs.	**Mean (%p)**	**S.D.**	**S.E.**
Discretionary	317	4.60	2.23	0.12
Rule-based	311	6.93	2.55	0.14

Table 7: Regression for the coupon rate

Specification	**1**	**2**	**3**	**4**	**5**
Discretionary	-2.33***	-2.15***	-2.39***	-1.85***	-1.72***
	(0.19)	(0.14)	(-0.42)	(0.44)	(0.49)
Country rate		0.52***	0.52***	0.73***	0.65***
		(0.06)	(0.06)	(0.08)	(0.09)
Credit score		-0.26***	-0.29***	-0.16***	-0.09
		(0.04)	(0.03)	(0.05)	(0.05)
AT1			0.77	-0.25	0.00
			(1.05)	(0.42)	(0.46)
Conversion			0.53*	0.07	-0.18
			(0.29)	(0.23)	(0.25)
CET1 threshold			-0.13	0.02	-0.05
			(0.11)	(0.10)	(0.10)
Maturity			-0.02	0.02	0.01
			(0.03)	(0.01)	(0.01)
Face value (in log)			0.11	0.34***	0.48***
			(0.07)	(0.08)	(0.10)
State bank				-1.02***	-0.91***
				(0.32)	(0.30)
Total assets (in log)				-0.13	-0.26***
				(0.09)	(0.09)
CET1				0.10**	0.00
				(0.04)	(0.04)
Sovereign CDS (in %p)				0.12	0.02
				(0.09)	(0.11)
Region	No	No	No	No	Yes
Year	No	No	No	No	Yes
Obs.	628	509	495	263	263
R-squard	0.19	0.57	0.58	0.69	0.75

The dependent variable is the coupon rate. The Huber-White robust standard errors are in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Table 8: Regression for the coupon rate: 0% trigger level for discretionary triggers

Specification	**1**	**2**	**3**	**4**	**5**
Discretionary	-2.33***	-2.15***	-2.60***	-2.09***	-1.90***
	(0.19)	(0.14)	(0.46)	(0.41)	(0.48)
Country rate		0.52***	0.52***	0.73***	0.65***
		(0.06)	(0.06)	(0.08)	(0.09)
Credit score		-0.26***	-0.29***	-0.16***	-0.09
		(0.04)	(0.03)	(0.05)	(0.05)
AT1			0.78	-0.20	0.03
			(1.05)	(0.43)	(0.46)
Conversion			0.52*	0.06	-0.18
			(0.29)	(0.23)	(0.25)
CET1 threshold			-0.12	-0.03	-0.07
			(0.08)	(0.07)	(0.06)
Maturity			-0.02	0.02	0.01
			(0.03)	(0.01)	(0.01)
Face value (in log)			0.11	0.34***	0.49***
			(0.07)	(0.08)	(0.11)
State bank				-1.03***	-0.93***
				(0.32)	(0.30)
Total assets (in log)				-0.12	-0.25***
				(0.09)	(0.09)
CET1				0.10**	0.00
				(0.04)	(0.03)
Sovereign CDS (in %p)				0.12	0.02
				(0.09)	(0.11)
Region	No	No	No	No	Yes
Year	No	No	No	No	Yes
Obs.	628	509	495	263	263
R-squard	0.19	0.57	0.58	0.69	0.75

The dependent variable is the coupon rate. The Huber-White robust standard errors are in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Table 9: Regression for the coupon rate: adjusted baseline credit assessment

Specification	**1**	**2**	**3**	**4**	**5**
Discretionary	-2.33*** (0.19)	-2.20*** (0.14)	-2.38*** (0.41)	-1.90*** (0.45)	-1.69*** (0.49)
Country rate		0.52*** (0.06)	0.51*** (0.06)	0.74*** (0.08)	0.67*** (0.09)
Adjusted credit score		-0.27*** (0.04)	-0.29*** (0.04)	-0.14** (0.05)	-0.06 (0.05)
AT1			0.77 (1.03)	-0.20 (0.44)	0.00 (0.46)
Conversion			0.51* (0.29)	0.01 (0.23)	-0.25 (0.24)
CET1 threshold			-0.10 (0.11)	0.04 (0.10)	-0.04 (0.10)
Maturity			-0.02 (0.03)	0.01 (0.01)	0.00 (0.01)
Face value (in log)			0.08 (0.08)	0.33*** (0.08)	0.48*** (0.11)
State bank				-1.00*** (0.32)	-0.89*** (0.30)
Total assets (in log)				-0.13 (0.10)	-0.27*** (0.10)
CET1				0.09** (0.04)	-0.00 (0.04)
Sovereign CDS (in %p)				0.11 (0.10)	0.04 (0.11)
Region	No	No	No	No	Yes
Year	No	No	No	No	Yes
Obs.	628	508	494	263	263
R-squard	0.19	0.57	0.58	0.69	0.75

The dependent variable is the coupon rate. The Huber-White robust standard errors are in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Table 10: Regression for the coupon rate: CDS on senior debt

Specification	**1**	**2**	**3**	**4**	**5**
Discretionary	-2.33***	-2.67***	-1.93***	-2.53***	-1.57***
	(0.19)	(0.15)	(0.38)	(0.40)	(0.49)
Country rate		0.61***	0.65***	0.71***	0.53***
		(0.05)	(0.05)	(0.14)	(0.13)
CDS senior (in %p)		0.49***	0.51***	0.21	0.03
		(0.15)	(0.16)	(0.21)	(0.23)
AT1			-0.21	-0.15	-0.49
			(0.41)	(0.51)	(0.48)
Conversion			-0.25	-0.27	0.01
			(0.15)	(0.23)	(0.23)
CET1 threshold			0.23***	0.13	-0.03
			(0.08)	(0.10)	(0.10)
Maturity			-0.00	0.00	0.03*
			(0.01)	(0.02)	(0.01)
Face value (in log)			0.15	0.33***	0.31***
			(0.06)	(0.08)	(0.09)
State bank				-0.88**	-0.96***
				(0.37)	(0.32)
Total assets (in log)				-0.38**	-0.40***
				(0.14)	(0.13)
CET1				0.01	-0.06
				(0.05)	(0.06)
Sovereign CDS (in %p)				0.10	0.07
				(0.10)	(0.09)
Region	No	No	No	No	Yes
Year	No	No	No	No	Yes
Obs.	628	346	342	194	194
R-squard	0.19	0.67	0.69	0.73	0.80

The dependent variable is the coupon rate. The Huber-White robust standard errors are in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Table 11: Regression for the coupon rate: CDS on subordinated debt

Specification	**1**	**2**	**3**	**4**	**5**
Discretionary	-2.33***	-2.91***	-1.79***	-2.36***	-1.45***
	(0.19)	(0.18)	(0.45)	(0.45)	(0.53)
Country rate		0.56***	0.65***	0.64***	0.38***
		(0.10)	(0.10)	(0.14)	(0.14)
CDS sub (in %p)		0.35***	0.40***	0.37**	0.22
		(0.11)	(0.13)	(0.18)	(0.19)
AT1			0.45	-0.05	-1.09*
			(0.61)	(0.72)	(0.62)
Conversion			-0.54***	-0.68***	-0.16
			(0.20)	(0.22)	(0.24)
CET1 threshold			0.32***	0.24***	0.05
			(0.09)	(0.09)	(0.09)
Maturity			-0.02	-0.00	0.05**
			(0.02)	(0.02)	(0.02)
Face value (in log)			0.14	0.21**	0.18*
			(0.10)	(0.10)	(0.09)
Total assets (in log)				-0.36**	-0.53***
				(0.14)	(0.15)
CET1				0.03	-0.03
				(0.05)	(0.05)
Sovereign CDS (in %p)				0.00	-0.01
				(0.09)	(0.10)
Region	No	No	No	No	Yes
Year	No	No	No	No	Yes
Obs.	628	247	245	166	166
R-squard	0.19	0.63	0.66	0.75	0.81

The dependent variable is the coupon rate. The Huber-White robust standard errors are in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Table 12: Regression for the coupon rate: mixed triggers are omitted

Specification	**1**	**2**	**3**	**4**	**5**
Discretionary	-2.04***	-2.29***	-1.13*	-1.38**	-0.64
	(0.21)	(0.17)	(0.58)	(0.64)	(0.82)
Country rate		0.64***	0.65***	0.85***	0.67***
		(0.07)	(0.06)	(0.08)	(0.10)
Credit score		-0.17***	-0.21***	-0.09	-0.07
		(0.05)	(0.04)	(0.06)	(0.06)
AT1			1.23	-0.37	0.17
			(1.48)	(0.35)	(0.45)
Conversion			0.45	-0.06	-0.28
			(0.34)	(0.23)	(0.26)
CET1 threshold			0.19	0.18	0.20
			(0.13)	(0.14)	(0.16)
Maturity			-0.03	0.02**	0.01
			(0.05)	(0.01)	(0.01)
Face value (in log)			0.19**	0.39***	0.61***
			(0.08)	(0.09)	(0.11)
State bank				-1.04***	-0.98***
				(0.30)	(0.31)
Total assets (in log)				-0.14	-0.28***
				(0.09)	(0.09)
CET1				0.05	-0.02
				(0.04)	(0.04)
Sovereign CDS (in %p)				0.10	0.03
				(0.10)	(0.11)
Region	No	No	No	No	Yes
Year	No	No	No	No	Yes
Obs.	509	418	405	230	230
R-squard	0.15	0.56	0.59	0.71	0.75

The dependent variable is the coupon rate. The Huber-White robust standard errors are in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Table 13: Regression for the coupon rate: Japanese mixed triggers are classified as rule-based

Specification	**1**	**2**	**3**	**4**	**5**
Discretionary	-2.17***	-2.02***	-2.06***	-0.28	-0.15
	(0.19)	(0.14)	(0.53)	(0.77)	(0.69)
Country rate		0.53***	0.51***	0.73***	0.61***
		(0.06)	(0.05)	(0.08)	(0.10)
Credit score		-0.27***	-0.32***	-0.21***	-0.07
		(0.04)	(0.03)	(0.05)	(0.05)
AT1			0.62	-0.47	-0.32
			(1.04)	(0.38)	(0.41)
Conversion			0.63**	0.27	-0.01
			(0.30)	(0.23)	(0.24)
CET1 threshold			-0.06	0.33*	0.15
			(0.13)	(0.17)	(0.16)
Maturity			-0.02	0.03**	0.03**
			(0.03)	(0.01)	(0.01)
Face value (in log)			0.10	0.33***	0.46***
			(0.07)	(0.09)	(0.11)
State bank				-1.13***	-0.95***
				(0.32)	(0.28)
Total assets (in log)				-0.15	-0.30***
				(0.10)	(0.09)
CET1				0.11**	-0.00
				(0.04)	(0.04)
Sovereign CDS (in %p)				0.14	0.07
				(0.11)	(0.11)
Region	No	No	No	No	Yes
Year	No	No	No	No	Yes
Obs.	628	509	495	263	263
R-squard	0.16	0.55	0.56	0.67	0.74

The dependent variable is the coupon rate. The Huber-White robust standard errors are in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Table 14: T-test: Coupon residual (sub) and trigger type

	Obs.	**Mean (%p)**	**S.D.**	**S.E.**
Discretionary	88	-0.40	1.18	0.12
Rule-based	38	2.66	1.82	0.29

Table 15: Regression for the coupon residual (sub)

Specification	**1**	**2**	**3**	**4**
Discretionary	-3.07***	-1.27	-2.01**	-3.22***
	(0.32)	(0.97)	(0.87)	(0.86)
AT1		-0.60	-1.08	-0.92
		(0.97)	(0.68)	(0.79)
Conversion		-0.88***	-1.13***	-1.11**
		(0.24)	(0.31)	(0.50)
CET1 threshold		0.35*	0.24	-0.08
		(0.18)	(0.18)	(0.16)
Maturity		0.02	0.04	0.04
		(0.03)	(0.02)	(0.04)
Face value (in log)		0.41*	0.41**	0.47**
		(0.21)	(0.19)	(0.22)
Total assets (in log)			-0.16	-0.11
			(0.10)	(0.20)
CET1			-0.05	-0.06
			(0.07)	(0.09)
Sovereign CDS (in %p)			-0.05	-0.05
			(0.22)	(0.28)
Region	No	No	No	Yes
Year	No	No	No	Yes
Obs.	126	124	86	86
R-squard	0.50	0.61	0.65	0.71

The dependent variable is the coupon residual(= the coupon rate - the benchmark rate - the default premium). The Huber-White robust standard errors are in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Table 16: T-test: Coupon residual (senior) and trigger type

	Obs.	**Mean (%p)**	**S.D.**	**S.E.**
Discretionary	122	-0.05	1.31	0.11
Rule-based	43	3.42	2.19	0.33

Table 17: Regression for the coupon residual (senior)

Specification	**1**	**2**	**3**	**4**
Discretionary	-3.47***	-1.62**	-3.50***	-3.41***
	(0.35)	(0.71)	(0.88)	(0.77)
AT1		-1.31**	-1.68***	-1.50***
		(0.55)	(0.51)	(0.55)
Conversion		0.35	-0.40	-0.46
		(0.23)	(0.32)	(0.36)
CET1 threshold		0.46***	0.10	-0.11
		(0.16)	(0.17)	(0.15)
Maturity		0.06***	0.09***	0.07***
		(0.01)	(0.01)	(0.02)
Face value (in log)		0.31**	0.30**	0.38***
		(0.13)	(0.13)	(0.11)
State bank			-1.53***	-1.29***
			(0.39)	(0.37)
Total assets (in log)			-0.24*	-0.15
			(0.13)	(0.11)
CET1			-0.14	-0.09
			(0.10)	(0.08)
Sovereign CDS (in %p)			0.06	0.04
			(0.18)	(0.15)
Region	No	No	No	Yes
Year	No	No	No	Yes
Obs.	165	165	100	100
R-squard	0.48	0.58	0.69	0.81

The dependent variable is the coupon residual(= the coupon rate - the benchmark rate - the default premium). The Huber-White robust standard errors are in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

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