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Contingent convertible bonds and the stability of bank funding: the case of partial writedown

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Non-technical summary

Research Question

In this paper we discuss the effect of Contingent Convertible Bonds' loss absorption mechanisms on the stability of bank funding. We discuss three different loss absorption mechanisms: (i) *Conversion-to-Equity* (CE), (ii) *Principal WriteDown* (PWD) loss absorption with a *full* principal writedown feature, and (iii) *Principal WriteDown* (PWD) loss absorption with *partial* principal writedown. Whereas all types of loss absorption mechanisms have the advantage that the issuing bank will reduce its debt when the trigger of the contingent Convertible Bond (CoCo) is breached, the latter loss absorption mechanism can create additional liquidity pressure. This is because the bank has to make a cash payment to CoCo investors in times when its liquidity position is likely to be under pressure. For our analysis, we draw on a model of bank funding with which we are able to take into account both the positive effect of reducing bank debt and the negative liquidity effect. Hence, we are able to derive the net effect of CoCos with a *partial* writedown feature on the bank's stability of funding position.

Contribution

Whereas the earlier literature has a more general focus and discusses CoCos in a broader context, a vast amount of the recent literature stresses the importance of the appropriate *design* of CoCos. However, to the best of our knowledge, the effect of CoCos with a partial writedown feature on the stability of bank funding has not yet been discussed in an analytical framework.

Results

We derive conditions under which a CoCo with a partial writedown feature improves, leaves unchanged or worsens a bank's stability of funding position.Our results depend on the fraction of the CoCo's face value that has to be paid out to CoCo investors when the trigger is breached, the liquidation values of long term assets, and the gross interest rate on CoCos. However, this result is subject to uncertainty. Whereas the fraction of the CoCo's face value that has to be paid and the gross interest rate on CoCos are known ex ante, this is not true of the liquidation values. This uncertainty about the liquidation values of the bank assets at the time of the breach of the trigger can create uncertainty about the bank's ex post solvency position. In the event of CoCo conversion, liquidation values can be assumed to be comparatively low. This is because both the breach of the trigger as well as low liquidation values seem to be more probable in times of adverse market developments. As a result, PWD CoCos with a partial writedown feature not only have the potential to negatively affect the bank's solvency condition. They also create ex ante uncertainty about when exactly this effect will be negative.

Nichttechnische Zusammenfassung

Fragestellung

In der vorliegenden Studie wird der Einfluss der Verlustabsorptionsmechanismen von bedingten Pflichtwandelanleihen (Contingent Convertible Bonds, kurz CoCos) auf die Stabilität der Bankenrefinanzierung untersucht. Dabei werden drei verschiedene Verlustabsorptionsmechanismen analysiert: a) Conversion-to-Equity (CE), also Wandlung in Eigenkapital, b) die Verlustabsorption über Principal Write-down (PWD) mit einer vollständigen Forderungsabschreibung und c) die Verlustabsorption über Principal Write-down (PWD) mit einer teilweisen Forderungsabschreibung. Wenngleich alle Arten von Verlustabsorptionsmechanismen den Vorteil haben, dass die emittierende Bank ihre Verschuldung reduziert, sobald das Auslösungskriterium (Trigger) für die CoCos aktiviert wird, kann der letztgenannte Verlustabsorptionsmechanismus zu zusätzlichen Liquiditätsengpässen führen. Grund hierfür ist, dass die Bank zu einem Zeitpunkt, zu dem ihre Liquiditätsposition vermutlich schon unter Druck geraten ist, eine Barzahlung an die CoCos-Anleger leisten muss. Die Untersuchung greift auf ein Modell der Bankenrefinanzierung zurück, mit dem sich sowohl der positive Effekt der verminderten Verschuldung der Bank als auch der negative Liquiditätseffekt berücksichtigenn läßt. Dies ermöglicht die Ableitung des Nettoeffekts von CoCos mit einer teilweisen Forderungsabschreibung auf die Refinanzierungssituation der Bank.

Beitrag

Während die frühere Literatur CoCos in einem eher breiteren Kontext diskutiert, stellt eine Vielzahl der neueren Beitrage die Bedeutung der adäquaten Ausgestalltung von CoCos heraus. Eine theoretische Betrachtung der Auswirkungen von CoCos mit einer teilweisen Forderungsabschreibung auf die Refinanzierungssituation einer Bank wurde unseres Wissens jedoch noch nicht diskutiert.

Ergebnisse

Wir leiten Bedingungen ab, unter denen CoCos mit einer teilweisen Forderungsabschreibung bei Aktivierung des Triggers die Refinanzierungssituation einer Bank verbessern, unverändert belassen oder verschlechtern. Das Ergebnis hängt von dem an Investoren auszuzahlenden Teilbetrag des Nennwerts der CoCos, vom Veräußerungswert der langfristigen Vermögenswerte und vom Zinssatz für die CoCos ab. Allerdings ist dieses Ergebnis mit Unsicherheit behaftet. Während der auszuzahlende Teilbetrag des Nennwerts der CoCos und der Zinssatz ex ante bekannt sind, ist dies bei den Veräußserungswerten nicht der Fall. Diese Ungewissheit hinsichtlich der Veräußerungswerte der Bankaktiva zum Zeitpunkt der Aktivierung des Triggers kann zu Unsicherheit bezüglich der Ex-post-Solvabilität des Kreditinstituts führen. Im Fall einer Umwandlung der CoCos ist davon auszugehen, dass die Veräußerungswerte vergleichsweise niedrig ausfallen, da sowohl die Aktivierung des Triggers als auch niedrige Veräußerungswerte aller Wahrscheinlichkeit nach eher dann eintreten, wenn sich die Märkte ungünstig entwickeln. Daher können PWD-CoCos mit einer teilweisen Forderungsabschreibung nicht nur die Solvabilitätsbedingungen einer Bank negativ beeinflussen, sondern sie schaffen auch ex-ante Unsicherheit darüber, wann genau dieser Effekt negativ ausfällt.

BUNDESBANK DISCUSSION PAPER NO 28/2014

Contingent Convertible Bonds and the Stability of Bank Funding: The Case of Partial Writedown [*]

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Abstract

This paper adds to the growing body of literature on the design of Contingent Convertible Bonds (CoCos). We discuss how the design of the loss absorption mechanism affects the stability of bank funding and distinguish between *Conversion-to-Equity* (CE) CoCos, *Principal WriteDown* (PWD) CoCos with a *full* writedown feature and PWD CoCos with a *partial* writedown feature. As we show, the first two loss absorption mechanisms unambiguously improve a bank's stability of funding position. By contrast, the latter type of loss absorption mechanism can increase solvency risk and, moreover, is identified as a source of uncertainty regarding a bank's ex post solvency position. Bank managers, investors as well as supervisors and regulators should be aware of these potentially destabilizing effects. In this context, one important aspect is the regulatory treatment of PWD CoCos with a partial writedown feature.

Keywords: Contingent capital, banking regulation, liquidity, wholesale funding

JEL classification: G18, G20, G21, G28

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[*] The views expressed in the analysis are those of the author and do not necessarily reflect the views of the Deutsche Bundesbank or its staff. I am grateful to Monika Beck, Falko Fecht, Benjamin Lacey, Jens Lindemann, Thomas McClymont, Ian McLoughlin and Christoph Memmel. Moreover, I wish to express my thanks to the participants of the Bundesbank research seminar for their valuable comments. Affiliation: Deutsche Bundesbank, Wilhelm-Epstein-Strasse 14, 60431 Frankfurt am Main.

1 Introduction

On March 12, 2010 the Dutch Rabobank issued a version of contingent convertible bonds (CoCos) whose value would be written down by only 75% and the remaining 25% returned immediately in cash to investors if the issuer's core Tier 1 ratio breached 7%.[1] As pointed out in various publications (Avdjiev et al., 2013, Ramirez, 2011, Morgan Stanley, 2011, Bank of America Merrill Lynch, 2014) such a loss absorption mechanism has the potential to create additional liquidity pressure, since the breach of the trigger forces the bank to make an additional cash payment in times when its liquidity position is likely to be under pressure.

Whereas the earlier literature has a more general focus and discusses CoCos in a broader context (such as Flannery (2002) and Duffie (2010)), a vast amount of the recent literature stresses the importance of the appropriate *design* of CoCos. Flannery (2009) discusses important design features of CoCos.[2] The design choices of *various* CoCo proposals are also discussed in Calomiris and Herring (2013). However, to the best of our knowledge, the effect of CoCos with a partial writedown feature on the stability of bank funding has not yet been discussed in an analytical framework.

From a stability of bank funding perspective, the advantage of Cocos is that the issuing bank will reduce its debt and, thus, save funding costs when the trigger of the CoCo is breached. While this also holds for CoCos with a *partial* writedown feature, these types of CoCos have the disadvantage that the breach of the trigger simultaneously generates a negative liquidity effect due to the cash payout obligation. As a result, the net effect on the bank's stability of funding position is not clear.

In general, regulators and supervisors consider CoCos as beneficial, since they absorb losses when the issuing bank's capital falls below a certain level.[3] This is also reflected in the Basel III framework, which allows banks to boost their regulatory capital by issuing CoCos. It is important to point out that CoCos with a partial writedown feature do not qualify for *Additional Tier 1 (AT1)* capital[4] and, thus, it might be tempting to conclude that the issuance of such types of CoCos is not particularly attractive from a regulatory viewpoint. However, these instruments allow banks to increase their *Tier 2 (T2)* capital. This is an important aspect in the context of bail-in, since T2 capital serves as a buffer to protect senior bond holders in the case of bail-in. Consequently, regulation might provide an incentive for banks to issue CoCos with a partial writedown feature.

In this paper, we theoretically analyze how CoCos with a partial writedown feature affect a bank's stability of funding position. To do so, we draw on a model of bank funding introduced by Eisenbach et al. (2014). Based on this framework we are able to take into account both the

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[1] More precisely, the cash payment would be due if the bank's Core Tier 1 ratio still remained below the threshold of 7% after 20 business days. For detailed information regarding the design of this version of CoCo, see Ramirez (2011).

[2] He identifies seven features: (i) the conversion trigger, (ii) the conversion price for stock, (iii) the risk features, (iv) the selection of CoCos that convert, (v) the role of stock price errors, (vi) policy parameters (such as what should be the new target capital ratio after conversion) and (vii) the incentives of the managers' institutions which issue CoCos. In addition, Flannery picks up *death spirals* as a central theme. If CoCo conversion depends on the market stock price, this might lead to market manipulation and cause a negative impact on the issuing institution. As pointed out, for example, by Berg and Kaeserer (2009), Hilscher and Raviv (2012) as well as Albul et al. (2013) CoCos can generate perverse management incentives on risk-taking if not properly designed.

[3] See, for example, Deutsche Bundesbank (2013).

[4] Note that one important condition for a CoCo to qualify for AT1 capital is full writedown or full conversion-to-equity.

positive effect of reducing bank debt and the negative liquidity effect. We derive conditions under which a CoCo with a partial writedown feature improves, leaves unchanged or worsens a bank's stability of funding position. As we will demonstrate, our results depend on the fraction of the CoCo's face value that has to be paid out to CoCo investors when the trigger is breached, the liquidation values of long term assets, and the gross interest rate on CoCos. However, this result is subject to uncertainty. Whereas the fraction of the CoCo's face value that has to be paid and the gross interest rate on CoCos are known ex ante, this is not true of the liquidation values. This uncertainty about the liquidation values of the bank assets at the time of the breach of the trigger can create uncertainty about the bank's expost solvency position.

The article continues as follows. Section 2 below offers a quick guide to loss absorption mechanisms of CoCos. Section 3 introduces a simple stability of bank funding model. In Section 4 we modify this model to analyze the effects of the different loss absorption mechanisms. In particular, we focus on how CoCos with a partial writedown feature affect a bank's stability of funding condition. Finally, Section 5 concludes this paper.

2 A Quick Guide to Loss Absorption Mechanisms of Contingent Convertible Bonds

According to Avdjiev et al. (2013), for a CoCo's loss absorption mechanism a distinction can be made between *Conversion-to-Equity* (CE) and *Principal WriteDown* (PWD) loss absorption. The former mechanism increases a bank's Common Equity Tier 1 capital by converting the bond into equity at a pre-set rate. This rate can either be based on the market price of the stock at the time of the breach of the trigger, or on a pre-set price, for example, the stock price at the time of issuance. PWD CoCos usually possess a *full* principal writedown feature, which means that the holder of the CoCo would lose 100% of the face value. From the issuer's point of view, CE CoCos seem to be less attractive than PWD CoCos, since the former type requires the approval of the shareholder and, in some cases, pre-emption rights have to be respected. However, if the trigger of a PWD CoCo is breached, the holder of such a CoCo has to face a 100% loss. By contrast, CE CoCos still offer a chance of (some) recovery and, thus, they seem to be more attractive from the investor's point of view.[5] One way to make PWD CoCos more attractive for investors is to include a *partial* writedown feature, where the holder of the CoCo would lose only a fraction less than 100% of the face value and receive the remaining fraction in cash. Ramirez (2011) states that this instrument is an interesting alternative for unlisted banks such as Rabobank, since such institutions are not able to issue instruments that convert into common stocks. However, one major criticism is that the issuer would have to fund a cash payout in times of stress.

3 A Simple Model for the Analysis of the Stability of Funding

For our analysis, we use a simple stability of funding model developed by Eisenbach et al. (2014).

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[5] A detailed discussion of the advantages and disadvantages of CE and PWD CoCos from both the issuer's and the investor's perspective is provided in Bank of America Merrill Lynch (2014).

3.1 Model Set-up

The model considers three different dates $(t = 0, 1, 2)$. On the asset side of the representative bank's balance sheet we distinguish between safe, liquid assets (m), also called cash, and risky, long-term assets (y). The gross return on the liquid asset is r_1 between periods 0 and 1 and r_s between periods 1 and 2. The gross return on the long-term asset is a random variable labeled θ if held until $t = 2$. However, in case the long-term asset has to be liquidated, the long-term asset earns a smaller return $\tau\theta$. All agents observe the realized value of θ at the beginning of period 1.

On the liability side of the representative bank's balance sheet we have short-term debt (s), long-term debt (l), and equity (e). The short-term debt matures after one period. Thus, at $t = 1$ the short-term debtholders have to decide whether they would like to roll over or withdraw. The rollover decision for the short-term liability depends on the realized value of θ at the beginning of period 1.[6] For the sake of simplicity, it is assumed that the return on short-term debt is the same as for the liquid asset, i.e. r_1 between periods 0 and 1 and r_s between periods 1 and 2. Note that for the subsequent analysis this gross interest rate is normalized to $r_1 = 1$.[7] The long-term debt matures in $t = 2$ and yields a gross return of $r_l > r_s$ between $t = 0$ and $t = 2$. If the bank remains solvent, equity holders will obtain any remaining funds at $t = 2$. However, if the bank becomes insolvent the fraction ϕ of its assets is lost to bankruptcy costs and all remaining assets will be distributed to debtholders on a pro-rata basis.

The model requires two assumptions: *Assumption 1* states that $r_s < r_l < \frac{1}{\tau}$, where $\frac{1}{\tau}$ is the cost of paying off short-term debtholders, which forces the bank to liquidate long-term assets because they do not want to roll over their short-term debt. This assumption is required, since neither short-term nor long-term financing should strictly dominate the other form of financing. *Assumption 2* states that $\tau\theta \leq 1$. It states that paying a withdrawal with reserve holdings that are refinanced with short-term debt raised in $t = 0$ is cheaper than liquidating a long-term asset.

3.2 Solvency Conditions

We now derive the solvency conditions of the bank. First, solvency depends on the realized returns on the bank's assets. Second, the short-term debtholders' rollover decision matters. The bank can use its cash holdings to pay its claims in cash if $\alpha s \leq m$, where α is the fraction of short-term debt which is not rolled over at $t = 1$. However, the bank has to liquidate long-term assets to ensure it can pay all cash claims if $\alpha s > m$.

For $\alpha s \leq m$, the solvency conditions at $t = 2$ are given by

$$\theta y + r_s(m - \alpha s) \geq (1 - \alpha)sr_s + lr_l. \tag{1}$$

This expression states that the matured value of the bank's remaining assets at $t = 2$ has to be equal to or larger than its remaining debt. Note that $(1 - \alpha)$ on the right-hand side of (1) denotes the fraction of short-term debtholders that decided to roll over at $t = 2$. Note, too, that, by definition, the bank is able to meet its cash obligations at $t = 1$, since $\alpha s \leq m$.

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[6] For details regarding the rollover decision of an individual short-term debtholder, see the appendix on page 46 of Eisenbach et al. (2014).

[7] Alternatively, s, l and m can be interpreted as the $t = 1$ values of these variables, which include all interest accrued between $t = 0$ and $t = 1$.

For $\alpha s > m$, the bank has to liquidate long-term assets if it has any cash outflows. More precisely, paying out an additional dollar at $t = 1$ requires liquidating $\frac{1}{\tau\theta}$ of the long-term assets. Thus, the matured value of the bank's remaining assets is given by $\theta(y - \frac{\alpha s - m}{\tau\theta})$. By rearranging this expression we obtain the following solvency conditions at $t = 1$ for $\alpha s > m$:

$$\theta y + \frac{1}{\tau}(m - \alpha s) \geq 0. \tag{2}$$

If condition (2) is violated, the bank is unable to meet its cash obligations at $t = 1$ even after liquidating all of its assets. For $\alpha s > m$, the solvency condition at $t = 2$ is given by

$$\theta y + \frac{1}{\tau}(m - \alpha s) \geq (1 - \alpha) s r_s + l r_l. \tag{3}$$

Since (3) implies (2), the bank's solvency for $\alpha s > m$ is given by (3).

From (1) and (3) we can derive the variable $\theta(\alpha)$, which gives the minimum return on the long-term asset that is needed for bank solvency, conditional on the fraction of short-term debtholders' withdrawals at $t = 1$:

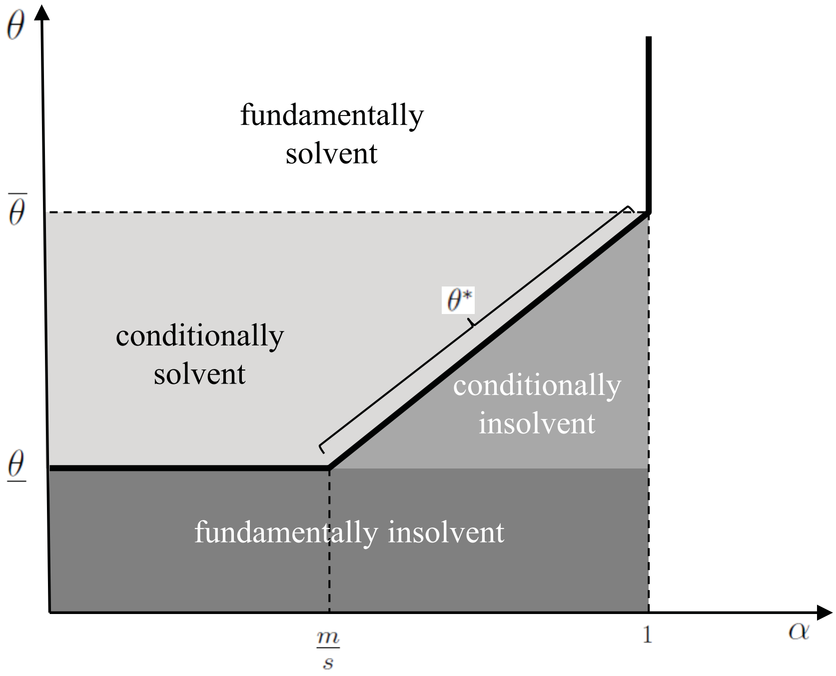
$$\theta(\alpha) = \begin{cases} \dfrac{(s-m)r_s + l r_l}{y} \equiv \underline{\theta} & \text{for all} \quad \alpha \leq \frac{m}{s}, \\ \dfrac{s r_s + l r_l + [\frac{1}{\tau} - r_s]\alpha s - \frac{1}{\tau} m}{y} \equiv \theta^*(\alpha) & \text{for all} \quad \alpha > \frac{m}{s}, \\ \dfrac{\frac{1}{\tau}(s-m) + l r_l}{y} \equiv \overline{\theta} & \text{for} \quad \alpha = 1. \end{cases} \tag{4}$$

When $\alpha \leq \frac{m}{s}$ and no long-term assets have to be liquidated at $t = 1$, the bank's solvency only depends on the bank's asset and debt values at $t = 2$. Note that, in this case, the minimum return on the bank's long-term assets for solvency, labeled $\underline{\theta}$, is independent of the fraction of short-term debt withdrawals at $t = 1$. This is because the promised returns on short-term debt are the same as the return on cash holdings and, thus, the value of the bank is not affected by short-term debt withdrawals at $t = 1$ as long as these withdrawals can be paid out of cash holdings.

For $\alpha > \frac{m}{s}$, however, the minimum return on long-term assets required for solvency becomes an increasing function in α. Now the bank has to liquidate long-term assets to pay off short-term debtholders who decide not to roll over at $t = 1$. Since the costs of liquidating a long-term asset are higher than the cost reduction caused by holding less short-term debt, a higher return for the remaining long-term assets is needed to maintain solvency.

Finally, if $\alpha = 1$, none of the short-term debtholders will roll over in $t = 1$. In this case, the bank will be solvent at $t = 2$ if the return on the long-term asset is greater than $\overline{\theta}$. Note that this value is independent of the short-term debtholders' decision at $t = 1$. Figure 1 provides a graphical illustration of (4). The horizontal axis shows the fraction of short-term debtholders, who decide to withdraw their funds at $t = 1$, α, and the vertical axis depicts the minimum return on the long-term assets required for solvency, θ. For values of θ below $\underline{\theta}$, the return on the long-term asset is insufficient for solvency. Since this area does not depend on α, the bank is said to be *fundamentally insolvent*. Between $\underline{\theta}$ and $\overline{\theta}$ the bank's solvency depends on α. Thus, the bank can either be *conditionally solvent* or *conditionally insolvent*. These two areas are separated by a line that represents θ^*. For a bank to be conditionally solvent, higher values of α require higher values of θ. For values of θ larger than $\overline{\theta}$ the bank is *fundamentally solvent*, since solvency is independent of α.

Figure 1: Solvency Areas for the Space of Pairs (α, θ)



4 Loss Absorption Mechanisms of Contingent Convertible Bonds and the Stability of Bank Funding

4.1 Solvency Conditions for Contingent Convertible Bonds

By using a modified version of the framework introduced in Section 2 we now analyze how a CoCo's loss absorption mechanism affects the funding stability of a bank.[8] Before we discuss the role of PWD CoCos with a *partial* writedown feature, we will first consider CoCos with no cash payout requirements, i.e. CE CoCos and PWD CoCos with a *full* writedown feature.[9] If we assume that the trigger is breached at $t = 1$, for both types of CoCos the bank's long-term debt decreases at $t = 1$ by μ.[10] The bank's equity increases at $t = 1$ by μ. For $\alpha s \leq m$, the bank's solvency conditions are given by

$$\theta y + r_s(m - \alpha s) \geq (1 - \alpha)sr_s + (l - \mu)r_l. \tag{5}$$

For $\alpha s > m$, the solvency conditions are given by

$$\theta y + \frac{1}{\tau}(m - \alpha s) \geq (1 - \alpha)sr_s + (l - \mu)r_l. \tag{6}$$

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[8] Note that we do not discuss issues related to the design of the trigger. This includes not specifying the point at which the loss absorption mechanism is activated. For the sake of simplicity, the trigger event is driven by an exogenous factor.

[9] Although the distribution within the banks' equity position will be affected by the differences between CE CoCos and PWD CoCos with full writedown, this will not affect the banks' aggregated equity position. Thus, our analysis will lead to identical results for both types of CoCos with no cash payout requirements.

[10] For the sake of simplicity we assume that the gross interest rate on CoCos is equal to the gross interest rate on long-term debt.

For a PWD CoCo with a *partial* writedown feature the bank has to make an additional cash payment of $\beta\mu$ at $t = 1$, where $0 \leq \beta \leq 1$ gives the fraction of the CoCo's face value that has to be paid out in cash. Moreover, the bank's equity only increases by $(1 - \beta)\mu$. For $\alpha s + \beta\mu \leq m$, the bank's solvency conditions are given by

$$\theta y + r_s(m - \alpha s - \beta\mu) \geq (1 - \alpha)sr_s + (l - \mu)r_l. \tag{7}$$

For $\alpha s + \beta\mu > m$, the solvency conditions are given by

$$\theta y + \frac{1}{\tau}(m - \alpha s - \beta\mu) \geq (1 - \alpha)sr_s + (l - \mu)r_l. \tag{8}$$

Note that (5) and (6) are a special case of (7) and (8) with $\beta = 0$. The minimum return on the long-term asset that is needed for bank solvency, $\theta(\alpha)$, conditional on the fraction of short-term debtholders' withdrawals at $t = 1$, is then given by

$$\theta(\alpha) = \begin{cases} \dfrac{(s + \beta\mu - m)r_s + (l - \mu)r_l}{y} \equiv \underline{\theta} & \text{for all} \quad \alpha \leq \frac{m - \beta\mu}{s}, \\ \dfrac{sr_s + (l - \mu)r_l + [\frac{1}{\tau} - r_s]\alpha s - \frac{1}{\tau}(m - \beta\mu)}{y} \equiv \theta^*(\alpha) & \text{for all} \quad \alpha > \frac{m - \beta\mu}{s}, \\ \dfrac{\frac{1}{\tau}(s + \beta\mu - m) + (l - \mu)r_l}{y} \equiv \overline{\theta} & \text{for} \quad \alpha = 1. \end{cases} \tag{9}$$

4.2 Discussion of the Results

We now study the effect of CoCo bond conversion on solvency. We first discuss the case for CE CoCos and PWD CoCos with a full writedown feature, i.e. $\beta = 0$. From (9) we can derive that the breach of the trigger lowers $\theta = \underline{\theta} = \theta^* = \overline{\theta}$ by $(\mu r_l)/y$. This is illustrated in Figure 2. The curve that represents θ for alternative α shifts down. Note that the cut-off point given by $\alpha = \frac{m}{s}$ remains unchanged. As a result, for $\beta = 0$ breaching the trigger unambiguously improves a bank's stability of funding position due to the positive effect of reducing bank debt.

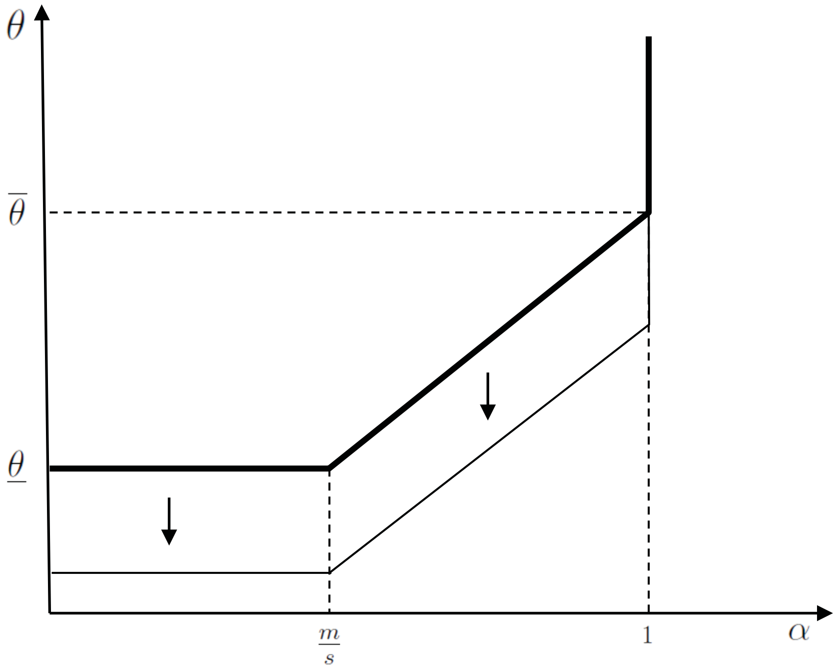
However, for $\beta > 0$ the effect of CoCo bond conversion on funding stability is not that clear. To start with, we consider how the breach of the trigger affects the area where insolvency is fundamental—and the boundary is horizontal. Put differently, we ask how the decrease in long-term debt by μ and the bank's obligation to make a cash payment of $\beta\mu$ at $t = 1$ changes $\underline{\theta}$. This change is given by

$$\frac{d\underline{\theta}}{d\mu} = \frac{\beta r_s - r_l}{y} \tag{10}$$

Since $r_l > r_s$ and $\beta \leq 1$, (10) will always be negative. Thus, the horizontal boundary given by $\underline{\theta}$ will unambiguously shift down. However, note that the size of the shift will depend on β. The higher the fraction of the CoCo's face value that has to be paid to the CoCo holders, the less pronounced the shift of $\underline{\theta}$ will be.

Next we analyze how the conditionally solvent/ insolvent areas are affected by the breach of the trigger of a CoCo with a partial writedown feature. The cut-off point which separates the fundamentally insolvent area and the conditionally solvent/ insolvent areas, shifts to the left from $\frac{m}{s}$ to $\frac{m - \beta\mu}{s}$. For fixed μ a higher β will lead to a more pronounced shift of the cut-off point to the left.

Figure 2: Effect of CoCo Bond Conversion on Solvency for $\beta = 0$



Looking at the threshold for conditional solvency, θ^*, in (9) we have

$$\frac{d\theta^*}{d\mu} = \frac{\frac{1}{\tau}\beta - r_l}{y} \begin{cases} < 0 & \text{if} \quad r_l > \frac{1}{\tau}\beta, \\ = 0 & \text{if} \quad r_l = \frac{1}{\tau}\beta, \\ > 0 & \text{if} \quad r_l < \frac{1}{\tau}\beta. \end{cases} \tag{11}$$

Expression (11) shows the conditions under which the bank's conditional solvency will improve, remain unchanged or worsen following the breach of the trigger of a CoCo bond with a partial writedown feature. The sign of $\frac{d\theta^*}{d\mu}$ depends on the fraction of the CoCo's face value that has to be paid to the CoCo holders, β, the liquidation value of long-term bonds at $t = 1$, τ, and the gross interest rate on long-term debt (or rather on CoCos), r_l. Figure 3, Figure 4 and Figure 5 provide graphical illustrations of the three cases.

First, a higher β will increase the likelihood that the bank's conditional solvency will be negatively affected by the breach of the trigger. In Figure 3, β is relatively low, so the line that separates the conditionally solvent area from the conditionally insolvent area shifts to the right. In this case, the threshold for conditional solvency, θ^*, decreases for fixed α. The size of β in Figure 4 will leave the threshold for θ^* unchanged. In Figure 5, β is high enough to increase θ^* for given α. Intuitively, a higher β increases the amount of cash that the bank has to pay out to CoCo investors in $t = 1$ if the trigger is breached. Hence, it becomes more probable that the bank has to liquidate long-term assets at $t = 1$ to meet its payment obligations. If the bank has to liquidate too many long-term assets, this destabilizing liquidity effect will be greater than the stabilizing effect of decreasing the bank's debt that is due to CoCo conversion. As a result, the critical threshold for conditional solvency, θ^*, will increase if β is high enough.

Second, the effect of the breach of the trigger on the threshold for conditional solvency, θ^*, depends on the asset liquidation value, τ. The lower the liquidation value, the more likely

Figure 3: Effect of CoCo Bond Conversion on Solvency for $\beta > 0$ and $r_l > \frac{1}{\tau}\beta$

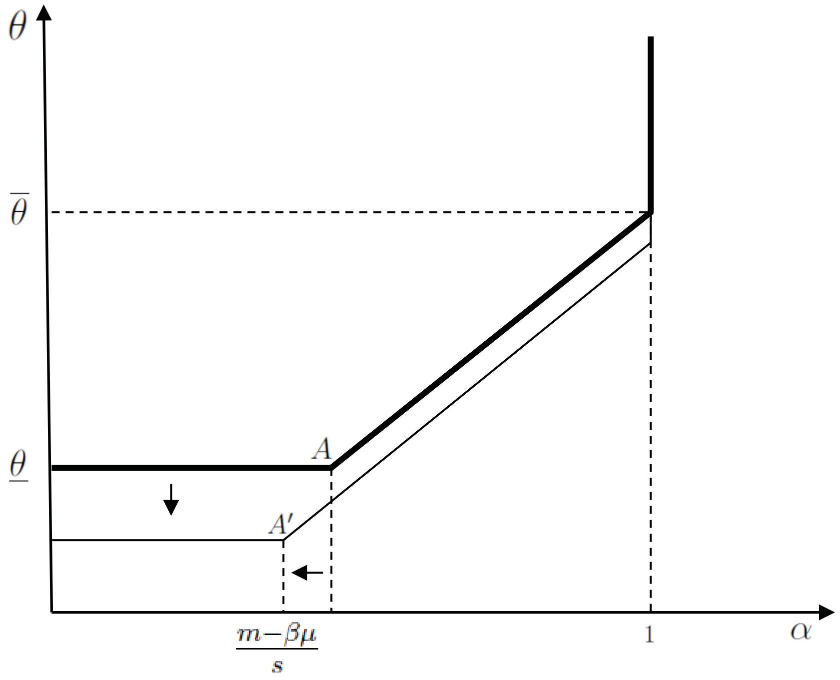


Figure 4: Effect of CoCo Bond Conversion on Solvency for $\beta > 0$ and $r_l = \frac{1}{\tau}\beta$

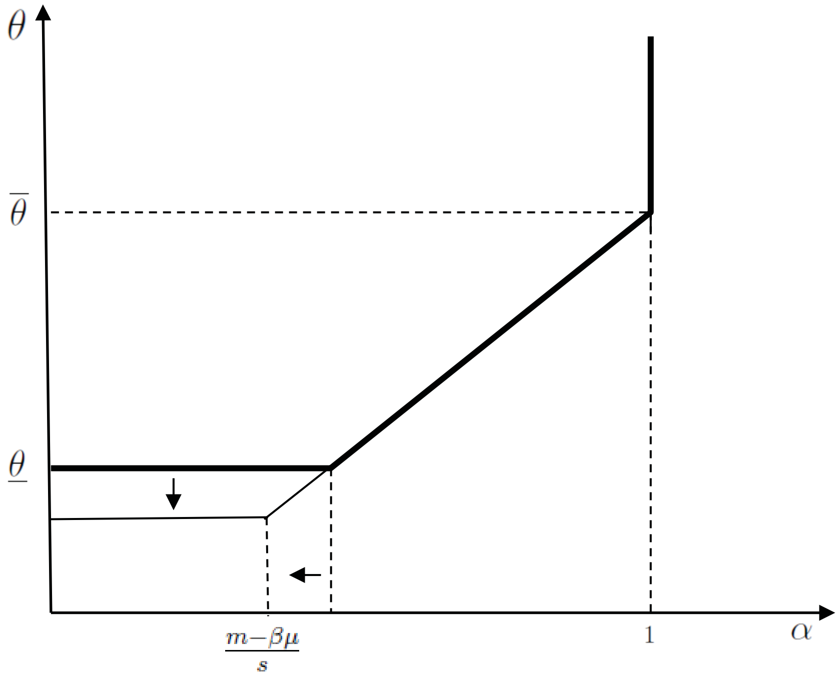
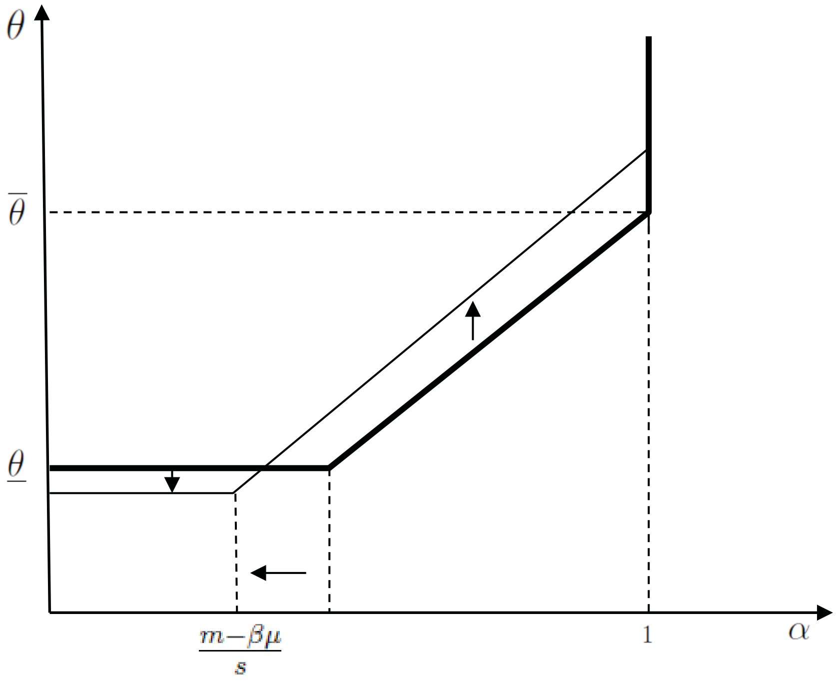


Figure 5: Effect of CoCo Bond Conversion on Solvency for $\beta > 0$ and $r_l < \frac{1}{\tau}\beta$



it is that the banks' conditional solvency will deteriorate if the trigger is breached. If solvency is conditional, the bank has to liquidate long-term assets at $t = 1$ to be able to make the cash payments to the CoCo holders. Lower liquidation values make these payments more expensive in terms of period-2 resources. Referring to our graphical representations, lower liquidation values make the θ^* line that separates the conditional solvency area from the conditional insolvency area steeper.[11] From (9) it becomes clear that the fundamentally insolvent area is not affected by a change in the liquidation value, since $\underline{\theta}$ does not depend on τ. However, $\overline{\theta}$ positively depends on τ and, thus, lower liquidation values shift up the the fundamentally solvent area. From Figure 3 it becomes apparent that a decrease in the liquidation value can turn the positive net effect of the breach of the trigger on the stability of bank funding into a negative net effect. This would be the case if the upward rotation around the cut-off points A and A' is sufficient to make the thin θ^* line, which represents the situation after the the breach of the trigger, to lie above the bold θ^* line, which represents the situation if the trigger is not breached. Intuitively, for the case of conditional solvency, a lower liquidation value forces the bank to liquidate more long-term assets at $t = 1$ to obtain the additional liquidity that is required to pay out CoCo investors. If the liquidation value is too low, this destabilizing liquidity effect will be greater than the stabilizing effect of reducing the bank's debt burden that is due to the breach of the trigger.

Third, the higher the gross interest rate on CoCos, r_l, is the more probable it will be that the breach of the trigger will improve the bank's conditional solvency. The bank's (long-term) debt burden in terms of period-2 values increases in r_l. Thus, a higher r_l will make the breach of the trigger more beneficial to the bank, since the decrease in the debt burden will be more pronounced in terms of period-2 values. Put differently, higher interests rates for a CoCo imply

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[11] For a graphical discussion of the role of the liquidation value, see Eisenbach et al. (2014), pages 35-36.

a higher relief in the bank's funding costs if the trigger of this CoCo is breached.

Turning to the threshold for fundamental solvency, $\overline{\theta}$, it can be shown that

$$\frac{d\overline{\theta}}{d\mu} = \frac{d\theta^*}{d\mu}. \tag{12}$$

The effects of the breach of the trigger on the threshold for fundamental solvency, $\overline{\theta}$, are the same as for conditional solvency, θ^*, and, thus, are given by (11). Figure 3 represents the case where the upper boundary of θ shifts down, i.e. $r_l > \frac{1}{\tau}\beta$. In Figure 4 the upper boundary of θ remains unchanged, since $r_l = \frac{1}{\tau}\beta$ and Figure 5 illustrates the case of $r_l < \frac{1}{\tau}\beta$, which shifts the upper boundary upwards.

Summing up our results in this section, we showed that holding CE CoCos and PWD CoCos with a full writedown feature strictly reduces a bank's insolvency risk. Breaching the trigger lowers the bank's debt burden, meaning that the bank is better able to withstand shocks to both its asset values and its funding. However, for PWD CoCos with a partial writedown feature we arrive at more complex results. The minimum return on the long-term asset that is needed for not being fundamentally insolvent, given by $\underline{\theta}$, will always decrease when the trigger is breached. However, the size of this effect will decrease in β. By contrast, the minimum return on θ that is required for the bank to be fundamentally solvent, given $\overline{\theta}$, can decrease, remain unchanged or increase. If the negative liquidity effect, which is due to the cash pay-out obligation to CoCo holders, is greater than the positive effect caused by the reduction in funding costs, $\overline{\theta}$ increases. More precisely, the net effects depends on the fraction of the CoCo's face value that has to be paid out, β, the liquidation value, τ, and the interest rate on CoCos, r_l. A high β, and low values for τ and r_l increase the probability of $\overline{\theta}$ shifting upwards. Between $\underline{\theta}$ and $\overline{\theta}$ bank solvency depends on the fraction of short-term debt which is not rolled over at $t = 1$, α. In this area the bank becomes more vulnerable to roll over-risks if the the negative liquidity effect due to the cash pay-out obligation to CoCo holders is greater than the positive funding effect caused by the reduction in debt. Again, a high β, and low values for τ and r_l increase the probability of the net effect being negative.

5 Conclusion

This paper adds to the growing body of literature on the design of CoCos. We discussed how the design of the loss absorption mechanism affects the stability of bank funding and distinguished between CE CoCos, PWD CoCos with a full writedown feature and PWD CoCos with a partial writedown feature. As we showed, the first two loss absorption mechanisms unambiguously improve the bank's stability of funding position. By contrast, the latter type of loss absorption mechanism can increase the risk of insolvency. Whereas the risk of fundamental insolvency still decreases, the risk of conditional insolvency – which positively depends on the fraction of short-term debt which is not rolled over – can increase. This is the case if a large fraction of the CoCo's face value has to be paid out to CoCo investors, and liquidation values and the gross interest rate on CoCos are low.

Whereas the fraction of the CoCo's face value that has to be paid and the gross interest rate on CoCos are known ex ante, this is not true of the liquidation values. This uncertainty about the liquidation values of the bank assets at the time of the breach of the trigger can create uncertainty about the bank's ex post solvency position. In the event of CoCo conversion, liquidation values can be assumed to be comparatively low. This is because both the breach of the trigger and low liquidation values seem to be more probable in times of adverse market developments. As a result, PWD CoCos with a partial writedown feature not only have the potential to negatively affect the bank's solvency condition. They also create ex ante uncertainty about when exactly this effect will be negative.

Bank managers, investors as well as supervisors and regulators should be aware of these potentially destabilizing effects. In this context, one important aspect is the regulatory treatment of PWD CoCos with a partial writedown feature. Although such CoCos do not qualify for AT1 capital, regulation might still provide incentives for a bank to issue these CoCos. This is because PWD CoCos with a partial writedown feature boost a bank's T2 capital and therefore serve as a buffer to protect senior bond holders in the case of bail-in. However, simply excluding PWD CoCos with a partial writedown feature from the list of regulatory capital requirements might not be sufficient, since banks might wish to issue this type of CoCos irrespective of the regulatory treatment.

References

Albul, Boris, Dwight M. Jaffee and Alexei Tchistyi (2013), Contingent convertible bonds and capital structure decisions, University of California, Berkeley, working paper.

Avdjiev, Stefan, Anastasia Kartasheva and Bilyana Bogdanova (2013), CoCos: a primer, BIS Quarterly Review, September 2013, pp. 43-56.

Bank of America Merrill Lynch (2014), Contingent Capital - what we think, 14 January 2014.

Berg, Tobias and Christoph Kaserer (2012), Does capital induce excessive risk-taking and prevent an efficient recapitalization of banks?, working paper.

Calomiris, Charles W. and Richard J. Herring (2013), How to design a contingent convertible debt requirement that helps solve our too-big-to-fail problem, *Journal of Applied Corporate Finance*, Volume 25, No. 2, pp. 21-44.

Deutsche Bundesbank (2013), Financial Stability Review, Deutsche Bundesbank, Frankfurt am Main, November 2013.

Duffie, Darrell (2010), A Contractual Approach to Restructuring Financial Institutions, in Ending Government Bailouts as We Know Them, edited by George P. Schultz, Kenneth E. Scott, and John B. Taylor, Hoover Institute Press, Stanford University.

Eisenbach, Thomas, Todd Keister, James McAndrews and Tynju Yorulmazer (2014), Stability of Funding Models: An Analytical Framework, Federal Reserve Bank of New York Economic Policy Review, pp. 29-47.

Flannery, Mark, J. (2002), No Pain, No Gain? Effecting Market Discipline via Reverse Convertible Debentures, working paper, subsequently published in Capital adequacy beyond Basel: Banking, securities, and insurance, edited by Hal S. Scott, Oxford University Press, 2005.

Flannery, Mark, J. (2009), Stabilizing large Financial Institutions with Contingent Capital Certificates, working paper.

Hilscher, Jens and Alon Raviv (2012), Bank stability and market discipline: The effect on contingent capital on risk taking and default probability, Brandeis University Working Paper Series No. 53.

Morgan Stanley (2011), Coco Compendium, 4 March 2011.

Ramirez, Juan (2011), Handbook of corporate equity derivatives and equity capital markets, John Wiley & Sons, West Sussex.