Anything but Equity -
On Banks' Preference for Hybrid Debt

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This version: December 17, 2022

Abstract

Banks can fulfil part of their Basel III regulatory requirements with Additional Tier 1 (AT1) capital. Hybrid instruments such as Contingent Convertible Bonds (CoCos) are - under certain conditions - eligible as AT1 capital. Unlike equity, these instruments need to be triggered to fulfil their "going-concern" character. I predict that banks holding CoCos with the lowest trigger probability are systemically riskier, engage more in earnings management and have lower Tier 1 capital ratios excluding CoCo issuance amounts than banks that fulfill their regulatory requirements with other instruments. I find support for these hypotheses using a binary logit model and use the variation in trigger levels to show that minimum-trigger CoCos are issued to maintain high systemic risk levels and low Tier 1 capital ratios and not to reduce risk or leverage.

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1 Introduction

As a response to the latest global financial crisis, bank regulation has gained importance. For too long, moral hazard made financial institutions exploit their "too big to fail" position by taking excessive risks and operating with low equity buffers. Too often governments have seen themselves forced to bailout distressed banks at the burden of taxpayers. The Basel Committee on Banking Supervision proposed the new global regulatory framework Basel III in 2010 that not only raised capital requirements but also introduced ratios aiming to limit leverage in the banking system and set minimum standards for liquidity and funding risk. Regulations such as the Capital Requirements Directive IV (CRD IV) the Capital Requirement Regulation III (CRR III) and the Bank Recovery and Resolution Directive (BRRD) converted the Basel III proposals into EU law.[1]

Additional Tier 1 (AT1) securities became an instrument for banks to fulfil part of their Tier 1 capital requirements. Under the CRD IV / CRR III regulation, Common Equity Tier 1 (CET1) capital must make up 4.5 percent of a bank's risk-weighted assets (RWA) and Tier 1 capital 6 percent. The difference between the CET1 and Tier 1 capital requirement can be met by Additional Tier 1 (AT1) capital. Capital standards under Basel III consider Tier 1 capital as going-concern capital as it should absorb losses automatically without triggering bank failure. Contingent Convertible Bonds (CoCos) can be eligible as AT1 capital but are inherently different from equity and do only absorb losses prior to a bank's default when a pre-specified trigger is hit or when regulators decide that the bank's point of non-viability (POnV) is reached. In these cases, the instruments either convert to equity or their principal is temporarily or permanently written down. If the pre-specified trigger is at least 5.125 percent (measured in terms of CET1 capital to RWA), CoCos count towards AT1 capital

[1] CRD IV and CRR III apply as of January 1, 2014 with full implementation since January 1, 2019. BRRD was adopted in spring 2014.

and thus help banks to fulfill their Tier 1 capital requirements. This minimum trigger level is alarmingly low - a bank's book-value CET1 capital would need to fall below 5.125 % of its risk-weighted assets in order to convert or write-down CoCos with such a trigger level. My paper shows that banks who issued CoCos[2] equipped with the minimum-trigger level, hereafter referred to as minimum-trigger CoCos, reveal themselves as banks that prefer higher systemic risk levels, have lower Tier 1 capital ratios absent minimum-trigger CoCo issuance amounts and have a relatively high return on equity (ROE) compared to their return on assets (ROA), an indicator for earnings management practices. In contrast, banks who issued CoCos with a higher trigger level than the regulatory minimum have lower systemic risk levels and higher Tier 1 capital ratios than their peers. These banks do not seem to target earnings excessively but issue CoCos to hedge against unexpected future loan losses from non-performing loans. If banks issued minimum-trigger CoCos to have a safety net when being financially distressed, we should have seen systemically risky and undercapitalized banks also issuing CoCos with a higher trigger level than the regulatory minimum.

Contingent Convertible Bonds have so far never been triggered prior to a bank's default in any developed country. The most prominent case in which the hybrid instruments failed to trigger before the bank became non-viable was the bail-out of Banco Popular. The bank still reported a CET1 capital ratio above 7 percent before the European Central Bank (ECB) declared the bank to be "failing or likely to fail" in June 2017. Subsequently, the bank's $1.25 billion AT1 CoCos were wiped out together with all Tier 2 debt - the only case that losses have been imposed on CoCo bondholders in developed countries at all. Arguably, the 5.125 percent trigger level for Banco Popular's CoCos was set too low for the instruments to be different from junior debt.

[2] For brevity I use the term CoCos and AT1 CoCos interchangeably.

I am concerned that banks do not issue minimum-trigger CoCos to weather financial turmoils but to maintain their high systemic risk levels (**H1**), to meet Basel III capital requirements (**H2**) and to target earnings (**H3**). These three hypotheses are inspired by a statement of the then CEO of Barclays Bob Diamond made in April 2011. He said that Barclays planned to increase its risk appetite to improve ROE numbers and would issue CoCos to fulfill part of its capital requirements as these instruments would, unlike equity, not dilute ROE.[3]. This concern is of economic importance, as global AT1 CoCo issuances[4] amount to $393.8 billion with the minimum trigger level of 5.125 being prevalent in 74.9% of all issuances. Minimum-trigger CoCo issuance amounts account on average for 11.58% of a bank's Tier 1 capital, conditional on the bank having issued minimum-trigger CoCos.

An additional issue associated with CoCos is that capital ratios used in the automatic conversion or write-down process are based on accounting figures that in most cases do not capture the true financial condition of a bank. While a bank is still able to report a sufficient CET1 capital ratio to not trigger its hybrid debt, the actual equity buffer might be much lower and the bank technically already bankrupt. Duffie (2009) notes that Citibank last reported a Tier 1 capital ratio above 7% before it was bailed-out during the financial crisis. In contrast to the bank's accounting valuation of equity, the market valuation fell to 1% of the total accounting assets at the bank's rock bottom. While Basel III triggers are based on accounting values, many researchers recommend bail-in tools with market price triggers to avoid the risk of late or no conversion. This includes the earliest paper proposing hybrid AT1 instruments by Flannery (2005) as well as Bulow and Klemperer (2015), Calomiris and Herring (2013), McDonald (2013), and Pennacchi and Tchistyi (2019). On the other hand, if triggers were based on market values, market reactions such as stock crashes and stock price manipulations could aggravate conversion risk, as argued by Sundaresan and Wang (2015).

[3]Source: Financial Times, April 4 2011 (https://www.ft.com/content/f49caaac-5eef-11e0-a2d7-00144feab49a)

[4]Data on CoCo issuances are obtained from Bloomberg spanning the period May 2009 to February 2022.

Another problem that arises is concerned with the regulatory trigger of AT1 hybrid bonds because it is set vague in terms of conversion decisions. Glasserman and Perotti (2018) argue that regulators are unlikely to activate the regulatory trigger if they fear negative market reactions. Walther and White (2020) predict that regulators will not bail-in hybrid debt if it signals negative private information to bank creditors and Hwang (2017) shows that bail-in will not be chosen by regulators if the market anticipates a bail-out and there is a large-scale, non-professional investor base for the hybrid instrument.

To sum up, a necessary but not sufficient condition for bail-in instruments to work is to have adequately high pre-specified trigger levels. If the probability of conversion or write-down is low, AT1 hybrid bonds are not going-concern instruments. I conjecture that bank managers are aware of this problematic but issue minimum-trigger CoCos for other reasons than to lower their bank's probability of default. Out of the 121 banks from the European Economic Area (EEA) in my dataset, 39 issued minimum-trigger CoCos and only 18 issued CoCos with a higher trigger level, of which 7 also have minimum-trigger CoCos outstanding.[5]

In my empirical analysis, I investigate banks that hold CoCos equipped with only the minimum trigger level and compare them with banks that hold CoCos with a higher trigger level and banks that did not issue CoCos between 2010 and 2021. I find that banks that have higher systemic risk, inferior capital ratios and the ones that engage more in earnings-targeting are more likely to hold instruments with the lowest conversion or write-down probability while banks that hold CoCos with higher conversion or write-down probabilities have a higher fraction of impaired loans in their loan portfolio. I employ a logistic model and define the dependent binary variable to be equal to 1 if the bank has issued minimum-trigger CoCos at any point in time and zero otherwise. I regress this variable on the independent variables of

[5]The number of covered banks is currently restricted by my systemic risk measure that is only available for the largest banks in the EEA. I plan to include other systemic risk proxies in the future to be able to cover more banks and CoCo issuers.

interest and use standard corporate finance determinants of bank capital structure as controls. I also control for the macroeconomic factors gross domestic product per capita (GDPP) and global systemically important bank (G-SIB) status. Gropp and Heider (2010) show that banks choose their capital structure based on time-invariant bank fixed effects and that banks appear to have stable capital structures with bank-specific leverage targets. The authors state that capital requirements are not a first-order determinant of banks' capital structure choices using cross-section and time-series variation of large banks in the US and Europe. I conjecture that if a bank is closer to the regulatory Tier 1 capital minimum than its peers but at its capital structure optimum, it is prone to issue minimum-trigger CoCos that help fulfill Tier 1 capital requirements but allow the bank to maintain its high systemic risk level and report a better return on equity than if the bank had issued equity. Following the findings of Gropp and Heider (2010), I hypothesize that minimum-trigger CoCo issuers possess higher systemic risk levels, lower Tier 1 capital ratios and a higher ROE driven by leverage than their peers, even before the issuance of the hybrid instruments. I use the variation in trigger levels to show that banks issue minimum-trigger CoCos to maintain those high risk levels and low Tier 1 capital ratios and not to reduce risk or leverage.

This paper is the first to empirically highlight the problematic of CoCos equipped with only the minimum-trigger level of 5.125%. It contributes primarily to the scarce empirical literature covering Contingent Convertible Bonds and the dispute whether these instruments are a good source of Tier 1 capital. Several empirical studies show that CoCo issuances lower the cost of senior debt (Avdjiev et al. (2020),Ammann et al. (2017), Rüdlinger (2015) and Deev and Morosan (2016)). In these studies, a reduction in the CDS spreads of senior unsecured debt after the issuance of CoCos is associated with risk-reduction capabilities of the hybrid instruments. A decrease in the cost of senior debt however does not necessarily mean CoCo issuances lower the bank's probability of default. In my simple model in Section(3), I show that the cost of senior debt is reduced by the additional added capital buffer even when there is a probability of zero that the hybrid instruments are triggered. In a previous study of mine (Brieden, 2019), I replicate the empirical analysis of Avdjiev et al. (2020) for both senior and junior debt. Unlike senior debt, junior debt does not experience a cost reduction by the issuance of CoCos, indicating that the lowered cost of senior debt is primarily driven by an improvement of the recovery rate of this debt class.[6]

Fiordelisi et al. (2020) investigate whether contingent convertibles are viewed as going-concern capital by market participants and find that this is only the case for equity conversion, but not for principal write-down CoCos. However, principal write-down CoCos dominate issuance amounts as highlighted by Goncharenko (2022). The author shows that temporary write-down CoCos, the most often issued CoCo instruments, are least effective at mitigating bank default risk as these instruments affect banks' incentives even after the trigger event.

Two empirical papers examine the determinants of bank capital structure for the issuance of CoCos. Williams et al. (2018) find that a bank's propensity to issue CoCos correlates positively with its systemic risk levels.[7] The authors claim that systemically riskier banks issue CoCos to protect themselves against the cost of future loan losses without questioning the instruments' ability to absorb losses before a bank's default. Wagner et al. (2022) also investigate the question which factors play a role in CoCo issuance. The authors do not

[6] I find that CDS spreads of subordinated debt do not decrease following a CoCo issuance. CoCo issuances increase the CDS spreads of subordinated debt and this significantly for equity conversion CoCo issuances with a trigger level not higher than 6 percent. Moreover, I find that that the recovery rate of senior unsecured debt increases relative to the recovery rate of subordinated debt and this significantly for equity converstion CoCos issuances, CoCo issuances of banks with a below-median total asset size and CoCo issuances of non-G-SIBs, indicating CoCo issuances provide a better capital buffer for senior than for junior debt.

[7] A drawback of their analysis is the data selection focusing on the world's largest 150 banks ranked by assets. By doing so, they also include jurisdictions where regulators have not permitted CoCos to be classified as AT1 capital, disincentivizing banks to issue such hybrid instruments (Fiordelisi et al., 2020). The countries covered (e.g. South Africa and China) are furthermore not characterized by a homogeneous regulatory environment.

specifically look at risk concerns or agency problems but investigate financial health and other bank balance sheet characteristics and their correlation with a bank's propensity to issue CoCos. They find that larger banks, more levered banks and those with higher Tier 1 capital, lower RWA, higher net loans and more wholesale funding are more prone to issue such instruments. Both papers seem not to report heteroskedasticity-robust standard errors, so their findings are to be treated with caution.

If a hybrid bond's contractual terms impose gains for equity holders when written down or converted into equity, a bank's shareholders prefer greater asset risk. Theoretical work on this risk-shifting problematic include Calomiris and Herring (2013), Chan and Van Wijnbergen (2016), Hilscher and Raviv (2014) and Koziol and Lawrenz (2012). Berg and Kaserer (2015) show that almost all CoCos issued so far dilute CoCo bond holders and transfer wealth towards equity holders when the regulatory capital ratio hits its trigger. The authors develop an option pricing model to show that these kind of instruments exacerbate the debt overhang (Myers, 1977) and asset substitution problem. Goncharenko et al. (2019) thematize the debt overhang possibly induced by CoCos. The authors find evidence that CoCos aggravate the debt overhang problem, as investors might be reluctant to inject more equity into a financially distressed bank that has previously issued CoCos. The authors also find that banks with more volatile assets prefer issuing equity over CoCos and are less likely to issue CoCos in the first place anticipating the debt overhang problem.

In this paper I do not specifically look at CoCo issuances but at CoCo holdings. In many empirical papers it is often assumed that CoCos are issued on top of a bank's existing Tier 1 capital. Technically, the bank still faces a trade-off problem when it realizes that in some scenarios it's Tier 1 capital ratio might fall below the Basel III minimum capital requirement. A bank that decided to issue minimum-trigger CoCos might have different characteristics than banks that finances itself with other forms of Tier 1 capital, even before and after the the year of CoCo issuance. I also do not distinguish between equity conversion and principal write-down CoCos, as I hypothesize that this distinction is of second-order importance for minimum-trigger CoCos with extremely low probabilities of conversion or write-down.

This paper has five more sections. Section(2) contains the hypothesis development on which factors play a role in minimum-trigger CoCo holdings. Section(3) provides a binomial model of bank asset returns to illustrate the different effects of equity and CoCos on a bank's assets and the cost of debt. Section(4) presents an overview of the data, Section(5) contains the main findings of the empirical analysis and Section(6) concludes.

2 Hypothesis Development

I conjecture that there are three reasons for a bank to hold minimum-trigger CoCos, summarized in three hypotheses that I test in my empirical setting:

Hypothesis 1: Systemically riskier banks hold minimum-trigger CoCos.

Banks that prefer higher systemic risk levels than their peers prefer to hold minimum-trigger CoCos over equity and over CoCos with a higher trigger level. This hypothesis is in line with Boyson et al. (2016), who argue that banks issue hybrid instruments for regulatory arbitrage purposes. An alternative explanation as conjectured by Williams et al. (2018) is that systemically riskier banks issue hybrid debt to have a buffer against potential losses. To exclude this possibility, I consider AT1 CoCos with a higher trigger than the minimum level in addition. I expect the riskiest banks to issue only minimum-trigger CoCos but no CoCos with a higher conversion or write-down probability. If the riskiest banks also issued CoCos with a higher trigger level, risky banks might indeed use CoCos to internalize unexpected losses.

Hypothesis 2: Banks with lower Tier 1 capital ratio preferences hold minimum-trigger CoCos.

Banks that prefer a lower Tier 1 capital ratio than required by Basel III issue minimum-trigger CoCos to artificially inflate their Tier 1 capital. Hybrid debt helps the bank to fulfill its Tier 1 capital requirement but has no equity characteristic if the trigger probability is extremely low. I thus expect banks that issue minimum-trigger CoCos to have lower Tier 1 capital ratios than their peers absent these CoCo issuance amounts. Boyson et al. (2016) find that U.S. banks who preferred a higher leverage ratio (debt to assets) than allowed by regulators from 1996 to Dodd-Frank used trust-preferred hybrid securities to fulfil regulatory requirements and at the same time maintain their high leverage. In my empirical analysis, I complement minimum-trigger CoCo instruments with CoCo instruments that have a higher trigger level to exclude the alternative hypothesis that banks issue minimum-trigger CoCos to lever down. If this was the case, banks that hold CoCos with a higher trigger level should have even lower Tier 1 capital ratios, but I do not expect to find this relationship in the data. The next most common trigger level after the minimum-level is 7%, present in 94% of all other CoCo issuances. The difference between the 5.125% and 7% trigger level is that banks have to hold a capital conservation buffer of 2.5% CET1 to RWA on top of the minimum capital requirement of 4.5% CET1 to RWA. Hence, to be able to convert or write-down a CoCo equipped with the minimum trigger level, the bank would need to have fallen below the capital conservation buffer and was already constrained in its distribution of capital. On the contrary, the 7% trigger level is more likely to be breached.

Hypothesis 3: Banks with higher ROE targets relative to ROA hold CoCos.

Banks with higher return on equity targets relative to their peers issue CoCos rather than equity. ROE is computed as net income over equity. Banks' CEO compensation is often based on ROE and perceived as a meaningful measure of performance even though the simple ROE computation does not account for bankers' risk taking behavior (Admati and Hellwig, 2014). ROE's simplicity also attracts stakeholders' attention such that banks that face potential deposit runs might be more likely to target earnings in order to maintain investor confidence (Shen and Chih, 2005). A problem with the ROE calculation is its sensitivity to leverage. Assume a bank's assets A are financed by equity E and debt D. The bank's ROE is calculated as net income NI over equity: $ROE = \frac{NI}{E}$. Now assume there is a regulator who demands this bank to issue additional Tier 1 capital AT. The bank can choose between issuing additional equity E^A and CoCos C^A that require a coupon c. If the bank issues additional equity, the ROE calculation becomes $ROE^E = \frac{NI}{E+E^A}$ and if the bank issues cocos, the ROE is calculated as $ROE^C = \frac{NI-c}{E}$. The bank might choose to issue CoCos as a method of earnings management if the CoCo coupon payments are not too high, i.e as long as $ROE^C > ROE^E \Leftrightarrow c < \frac{NI*E^A}{E+E^A}$. By substituting equity with debt, ROE is magnified when the returns from the asset offset the cost of borrowing. While the cost of issuing new equity to fulfill capital requirements is high for highly levered banks (Admati et al., 2013, Admati and Hellwig, 2014), in most jurisdictions coupon payments made on AT1-eligible CoCo bonds are tax deductible. Therefore, a bank aiming to target ROE may find CoCo issuances a more viable tool than equity to fulfil capital requirements. I thus expect CoCo issuers to have a higher ROE relative to ROA compared to their peers.

3 Binomial model of bank asset returns

In the following section I set up a simple discrete-time two-period model for valuing a bank's assets with dates $t = 0$, $t = 1$ and $t = 2$ following the binomial framework of Cox et al. (1979). The model is inspired by Fiordelisi et al. (2020) who model a bank's stock return volatility after the issuance of CoCos. In contrast to their model, I introduce senior and junior debt, distinguish between the issuance of additional equity and CoCos and introduce bankruptcy costs. Section (3.1) models a bank with only equity, junior and senior debt outstanding. In section (3.2) I introduce capital requirements that call for the issuance of additional Tier 1 capital. The bank can choose between equity and CoCos with the minimum trigger level or a higher trigger level. Section (3.3) analyzes the effect of bankruptcy costs on the riskiness of senior and junior debt conditional on the bank's choice of added Tier 1 capital.

3.1 A bank with equity, junior and senior debt

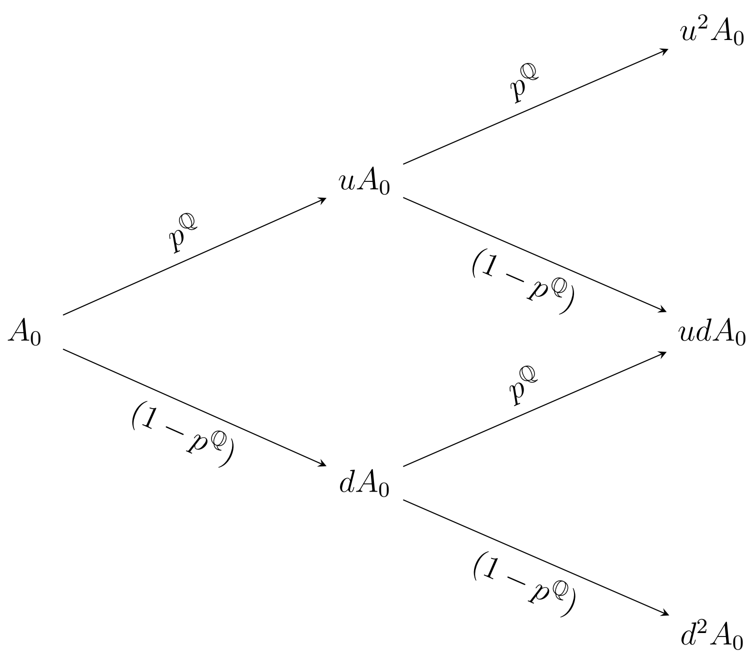
The current price of a bank's assets A_0 is the sum of the values of senior debt S_0, junior debt J_0 and equity E_0: $A_0 = S_0 + J_0 + E_0$. A cash flow X_{t+1} can be valued using the nominal pricing kernel $M_{t,t+1}$ under real-world expectations $\mathbb{E}$. Equivalently, it can be valued using the risk-neutral expectation $\mathbb{E}^{\mathbb{Q}}$ and the per-period risk-free rate r_f:

$$\mathbb{E}_t(M_{t,t+1}X_{t+1}) = \frac{1}{(1+r_f)}\mathbb{E}_t^{\mathbb{Q}}(X_{t+1}) \tag{1}$$

Define the risk-free gross return as $R_f = (1+r_f)$ and assume risky bank assets with a binomial distribution each period. After one period, the banks assets either yield a gross return u in the up state occurring with probability p or a gross return d in the down state occurring with probability $(1-p)$ where $d < R_f < u$. We can also express the the bank's asset value using risk-neutral probabilities $p^{\mathbb{Q}}$ and $(1-p^{\mathbb{Q}})$ for the up and down state respectively, assuming complete markets. We can set the asset value at t equal to the discounted risk-neutral expectation of the t+1 asset value:

$$A_t = \frac{1}{R_f}\mathbb{E}_t^{\mathbb{Q}}(A_{t+1}) = \frac{1}{R_f}(p^{\mathbb{Q}}uA_t + (1-p^{\mathbb{Q}})dA_t) \tag{2}$$

From Equation (2) we can derive the risk-neutral probabilities $p^{\mathbb{Q}} = (R_f - d)/(u-d)$ and $(1-p^{\mathbb{Q}}) = (u - R_f)/(u-d)$. The binomial tree under risk-neutral probabilities is as follows:



Define the per period promised gross return on senior debt R_S and on junior debt R_J with $R_J > R_S$.

Let us further assume the bank defaults if and only if it has a low return in both periods, i.e. the probability of default is $(1-p^{\mathbb{Q}})^2$ at t=0. This implies:

$$\begin{aligned} udA_0 &> (R_S^2 S_0 + R_J^2 J_0) \\ d^2A_0 &< (R_S^2 S_0 + R_J^2 J_0) \end{aligned} \tag{3}$$

The promised gross return on senior and junior debt is set fairly such that it satisfies:

$$S_0 = \frac{1}{R_f^2}[S_0 R_S^2(p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}})) + (1-p^{\mathbb{Q}})^2 min(S_0 R_S^2, d^2 A_0)] \tag{4}$$

$$J_0 = \frac{1}{R_f^2}[J_0 R_J^2(p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}})) + (1-p^{\mathbb{Q}})^2 max(0, d^2 A_0 - S_0 R_S^2)] \tag{5}$$

The total value of debt $D_0 = S_0 + J_0$ corresponds to

$$S_0 + J_0 = \frac{1}{R_f^2}[(S_0 R_S^2 + J_0 R_J^2)(p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}})) + (1-p^{\mathbb{Q}})^2 d^2(A_0)] \tag{6}$$

We can write the average promised return per unit of total debt as $R_D = R_S \frac{S_0}{S_0+J_0} + R_J \frac{J_0}{S_0+J_0}$. Using the default assumption in Equation(3), we can express the value of equity as:

$$\begin{aligned} E_0 =& \mathbb{E}_0^{\mathbb{Q}}(E_2)/R_f^2 \\ =& \frac{1}{R_f^2}[(u^2 A_0 - D_0 R_D^2)p^{\mathbb{Q}2} + (udA_0 - D_0 R_D^2)2p^{\mathbb{Q}}(1-p^{\mathbb{Q}})] \end{aligned} \tag{7}$$

and can restrict the banks' leverage ratio[8]:

$$\frac{d^2}{R_f^2} < \frac{J_0 + S_0}{A_0} < \frac{ud}{R_D^2} \tag{8}$$

Plugging in Equation(6)[9] we get the parametric restriction on the banks' leverage ratio:

$$\frac{d^2}{R_f^2} < \frac{J_0 + S_0}{A_0} < \frac{d[u(R_f - d) + R_f(u - R_f)]}{R_f^2(u-d)} \tag{9}$$

[8] Using $d^2 A_0 < R_f^2 D_0$ with $R_D > R_F$ as default occurs in the worst state.

[9] By solving for $R_D^2 = \frac{R_f^2 - (1-p^{\mathbb{Q}})^2 d^2 \frac{A_0}{D_0}}{p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}})}$ and using $p^{\mathbb{Q}} = (R_f - d)/(u-d)$

3.2 Issuing Tier 1 Capital

Now assume there is a regulator who demands banks to hedge against default in the worst state of the second period. At t=0, the bank must issue additional Tier 1 capital $AT1_0$, and can choose between equity and CoCos equipped with the minimum-trigger level or a higher trigger level. Assume the regulator demands banks to increase assets to $A_0^* = A_0 + AT1_0$, such that $d^2 A_0^* = (S_0 + J_0)R_f^2$. The idea is that if the bank has low returns in both periods, senior and junior debt sustain no loss, but Tier 1 capital has a zero payoff. The required amount of additional Tier 1 capital equals $AT1_0 = (S_0 + J_0)(\frac{R_f^2}{d^2} - 1) - E_0$.

I will consider three types of Tier 1 capital. Equity in the form of common equity or preferred shares[10], CoCos with the minimum-trigger level and CoCos with a higher trigger level. The values at t=0 are denoted by E_0^*, C_0^{low} and C_0^{high} respectively.

The new capital is subordinated to previous debt, as it constitutes Tier 1 capital. Preferred shares and CoCos pay fixed dividends, i.e. a fixed return. The bank does not default if it fails to pay a dividend to preferred shareholders and it can choose to cancel dividend payments on CoCo bondholders. However, the bank can default on the outstanding face value of CoCos.

CoCos are not triggered - i.e. written down or converted into equity - with certainty. Instead, I assume that if the bank experiences a return of d in t=1, there is a probability π with $0 < \pi < 1$ that the hybrid bonds are triggered.[11] Undoubtedly, the trigger probability is lower for minimum-trigger CoCos than for CoCos with a higher trigger level, i.e. $\pi^{low} < \pi^{high}$

[10] As banks cannot default on their outstanding equity, it is irrelevant whether equity exists in the form of common equity or preferred shares for the cost of debt in this setting.

[11] Reasons for uncertain conversion or write-down include that the trigger levels are based on accounting values, which are easier to manipulate (see for example Begley et al. (2017) and Plosser and Santos (2018)) and react slower to changing market conditions than market values, as they are reported quarterly. AT1 hybrid bonds also have a discretionary trigger that regulators can activate if they decide the point of non-viability (PoNV) is reached. Under Basel III these triggers are however vague in terms of conversion decisions.

ceteris paribus. If a CoCo issuing bank has a low return in both periods and the issued CoCo was not triggered in the first, the bank will default on its outstanding debt. If the bank experiences a low return at $t = 1$ and CoCos are fully written down[12] or converted into equity, the bank will not default at t=2.[13] An equity issuing bank will also never default at t=2.

After the issuance of additional capital, the returns on senior and junior debt, R_S^* and R_J^*, become risk-free. Even if CoCos are issued and there is a positive default probability, senior and junior debt are always fully recovered. The promised gross returns are set fairly such that they satisfy:

$$S_0 = \frac{1}{R_f^2}[S_0 {R_S^*}^2 (p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}}) + (1-p^{\mathbb{Q}})^2)] = \frac{1}{R_f^2}[S_0 {R_S^*}^2] \tag{10}$$

$$J_0 = \frac{1}{R_f^2}[J_0 {R_J^*}^2 (p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}}) + (1-p^{\mathbb{Q}})^2)] = \frac{1}{R_f^2}[J_0 {R_J^*}^2] \tag{11}$$

3.3 Bankruptcy Costs

In the absence of bankruptcy costs, the value of senior and junior debt is only affected by the additional subordinated capital provided. The fair promised return becomes risk-free even if the trigger probability π is zero. But in the presence of bankruptcy costs, the values of senior and junior debt are affected by the choice of additional capital provided.

Assume now that if the bank fails to repay its debt obligations, its asset are only worth a fraction δ with $0 \leq \delta < 1$. The fraction $(1-\delta)$ of assets is lost in default due to direct and indirect bankruptcy costs. If the bank issues equity, bankruptcy does not occur, but if the

[12]A minority of CoCos is equipped with a partial write-down feature, but we will ignore this case for simplicity.

[13]For brevity, I do not distinguish between CoCos who have a principal write-down (PWD) feature and CoCos who have an equity conversion (EC) feature. Results for one CoCo class can be translated to results for the other as Fiordelisi et al. (2020) show.

bank issues CoCos, bankruptcy occurs with probability $(1-p^{\mathbb{Q}})^2(1-\pi)$ - i.e. bankruptcy occurs if the bank ends up in the worst state at t=2 and the hybrid debt has not been triggered at t=1.

The fair promised returns for senior and junior debt, ${R_S^*}^\delta$ and ${R_J^*}^\delta$, with bankruptcy costs must satisfy:

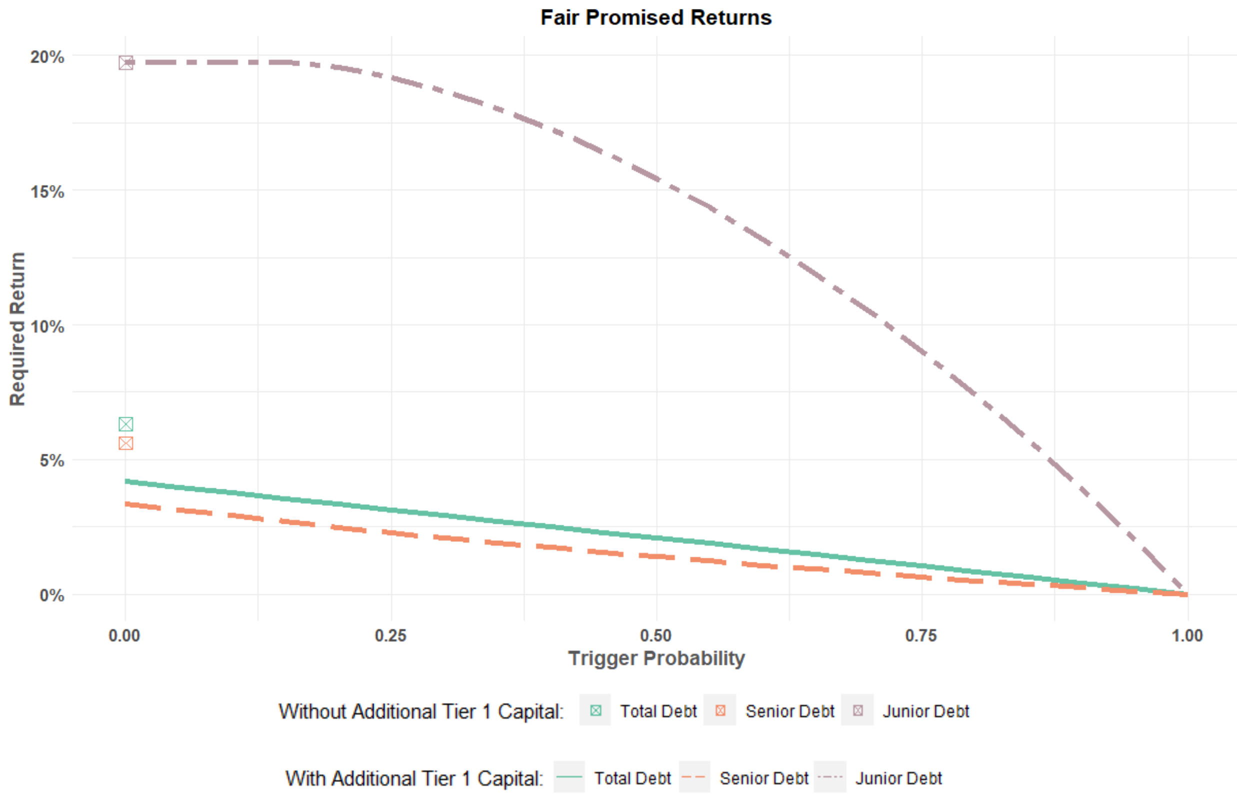
$$S_0 = \frac{1}{R_f^2}[S_0 {R_S^*}^{\delta 2}(p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}}) + \pi * (1-p^{\mathbb{Q}})^2) + (1-\pi)(1-p^{\mathbb{Q}})^2 min(S_0 {R_S^*}^{\delta 2}, d^2 \delta A_0^*)] \tag{12}$$

$$J_0 = \frac{1}{R_f^2}[J_0 {R_J^*}^{\delta 2}(p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}}) + \pi * (1-p^{\mathbb{Q}})^2) + (1-\pi)(1-p^{\mathbb{Q}})^2 max(0, d^2 \delta A_0^* - S_0 {R_S^*}^{\delta 2})] \tag{13}$$

The required return for senior and junior debt in the presence of bankruptcy costs after the issuance of AT1 capital depends on the type of additional capital provided. If equity or CoCos with a trigger probability of 1 are issued, the returns for senior and junior debt are risk free, as the bankruptcy probability is zero. If CoCos with a trigger probability below 1 are issued, the fair total promised return per unit of debt depends on the trigger probability π. The required returns increase with the probability that hybrid debt is not triggered $(1-\pi)$, as a relatively higher compensation for risk is required. Thus, in the presence of bankruptcy costs, the already existing senior and junior debt with fixed coupon payments will have a lower value when hybrid bonds are issued compared to the issuance of equity. The value reduction is more severe for junior debt as it is lower in the payment hierarchy and thus more sensitive to bankruptcy costs.

Figure (1) graphically explains the required returns to total, senior and junior debt before and after the issuance of additional Tier 1 capital. For illustrative purposes I assume a 20% asset volatility, i.e. $u = 1/d = \mathrm{e}^{0.2}$, a risk-free gross return of $R_f = 1$, a total debt to equity ratio of $D_0/E_0 = 10/3$ and a junior debt to equity ratio of $J_0/E_0 = 1/6$. I assume the assets

Figure 1: Fair promised returns on total debt, senior debt and junior debt depending on the CoCo's trigger probability π. The lines depict the fair promised returns when additional Tier 1 capital is issued. The boxes depict the fair promised returns for debt before the issuance of additional Tier 1 capital. The model's parameters are set with $u = 1/d = e^{0.2}$, $R_f = 1$, $D_0/E_0 = 10/3$, $J_0/E_0 = 1/6$ and δ=80%.



are only worth δ=80% in case of default, as several papers estimate marginal bankruptcy costs to be in the range of 20% and 30% of the bank's asset value (see for example Davydenko et al. (2012)). The crossed boxes at $\pi = 0$ depict the fair promised returns on debt before the issuance of additional Tier 1 capital and the lines the fair promised returns after the issuance, conditional on the additional capital's trigger probability π. The dashed lines represent the promised returns to senior and junior debt separately and the solid line the promised return to total debt. The required returns decrease in the trigger probability, as debt becomes saver the less likely bankruptcy occurs. Equity issuance corresponds to a trigger probability $\pi = 1$. After the issuance of additional Tier 1 capital the promised return of senior debt decreases for all trigger probabilities π, but the promised return of junior debt only decreases for trigger probabilities higher than 17%. Before this threshold, bankruptcy costs eat up the recovery rate on junior debt such that no value will be recovered in case of default. The risk reduction of senior debt for a zero trigger probability comes only from improvements in the recovery rate of capital, not in the reduced probability of default. This is why it is important to distinguish between instruments that eventually convert into equity and instruments that have very low trigger probabilities. The latter behave like deeply subordinated debt but still count as equity for Basel III Tier 1 capital requirements.

Assume there are three banks in the economy with different choices of additional Tier 1 capital but same issuance amounts $AT1_0$. Bank A decides to issue minimum-trigger CoCos, bank B to issue CoCos with a higher trigger level and bank C decides to issue equity. The trigger probabilities of the issued instruments are π_A, π_B and π_C respectively with $\pi_A < \pi_B < \pi_C = 1$. All three banks now fulfill regulatory requirements, but bank A has the highest default probability followed by bank B. Bondholders of bank A now also have the riskiest debt, succeeded by bondholders of bank B. In this simple model, the default probability of bank C becomes zero and the debt risk-free. However, the return on equity will be higher for the riskier banks A and B than for bank C as long as the periodic CoCo coupon payments c do not offset the returns from the asset. ROE is a multiplicative result of ROA and leverage. Thus, while all banks have the same ROA, the riskier banks A and B will have a higher ROE if coupon payments on CoCos are not too high.

This model shows that even CoCos with a zero trigger probability lower the cost of senior debt, but this is not an indicator for CoCos to be going-concern instruments. When banks decide to issue minimum-trigger CoCos, they forgo the issuance of equity or CoCos with a higher trigger level. I thus conjecture that banks that choose to issue minimum-trigger CoCos are inherently different from other banks: They prefer a higher probability of default, lower Tier 1 capital ratios absent minimum-trigger CoCo issuance amounts and a higher ROE relative to ROA.

4 Data and Descriptive Statistics

The data on CoCo issuances is retrieved from Bloomberg in daily frequency from May 2009 to February 2022. May 2009 marks the very first CoCo issuance by Danske Bank A/S. I focus on AT1 instruments issued by banks and neglect AT1 instruments issued by insurance companies and shadow banks. Systemic risk measures are provided by the Volatility Laboratory (V-Lab) of the NYU Stern Volatility and Risk Institute. Data on the annual GDP per capita (GDPP) is obtained from World Bank and G-SIB status from the Financial Stability Board. For all banks in the European Economic Area (EEA) covered by V-Lab, I collect annual balance sheet data on the fully consolidated level from Orbis Europe. I choose this subset as Basel III requirements were converted into EU laws relatively homogeneously across EEA member states and apply on the fully consolidated level.

A look into the data of all AT1 CoCo issuances until the end of February 2022[14] shows

[14]AT1 hybrid debt exists in Europe, Australia, New Zealand and Japan while in the U.S. there are no AT1

that 74.9% are equipped with only the minimum trigger level of 5.125%. As previously mentioned, a low trigger level implies a low probability that the bail-in instrument is converted into equity or its principal is written-down prior to a bank's liquidation. The next most common trigger level is 7% that makes up 94% of all remaining CoCo issuances. Other trigger levels range between 5.25% and 9%. Banks issued 554 AT1 CoCos with a total amount of $380 billion between May 2009 and February 2022. 413 issuances are still active with an outstanding amount of $267 billion as of February 2022. Figure(1) plots AT1 CoCo issuances over time, showing that CoCo issuances have been high since 2014 and have not decreased after the European debt crisis. While in the first years only higher-trigger CoCos[15] were issued, minimum-trigger CoCos dominate issuance amounts since 2013.

Figure 3: Time-series plot of AT1 CoCo issuance amounts by year and trigger level in USD billion from 2009 to 2021 for banks in Europe, Australia and Japan.

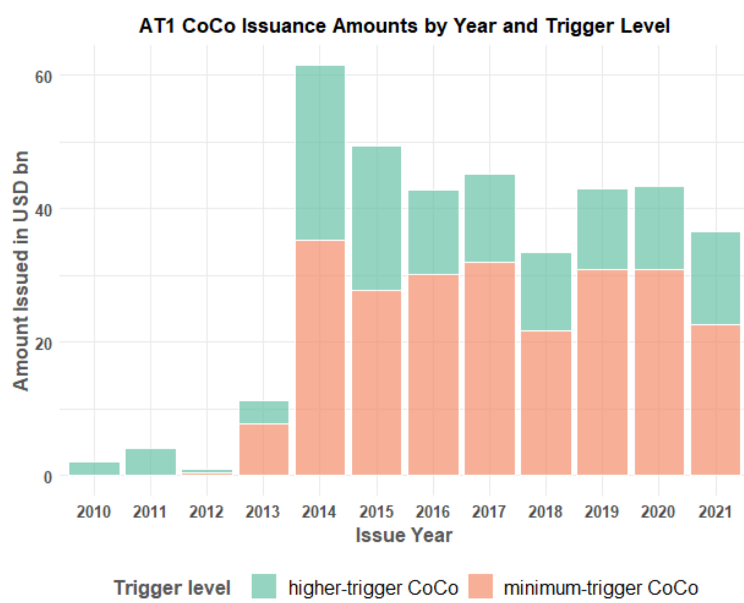


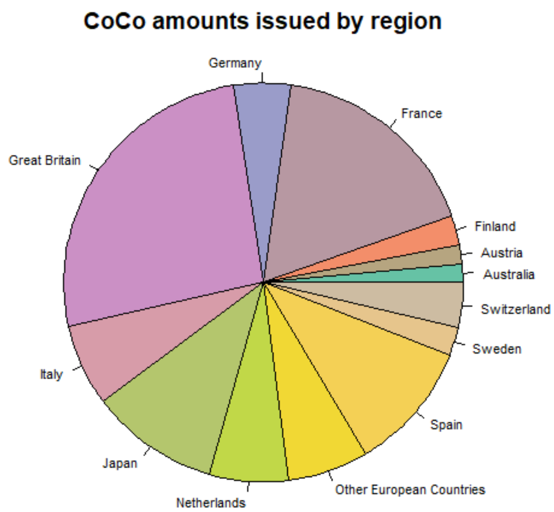
Figure (2) shows AT1 CoCo issuances by country. CoCo issuance amounts are largest in

hybrid bonds existing.

[15] I define higher-trigger CoCos as CoCos with a trigger level higher than 5.125%

Great Britain, France, Japan, Spain and Italy.

Figure 4: Pie-chart of AT1 CoCo issuance amounts by country from 2009 to 2021 for banks in Europe, Australia and Japan.



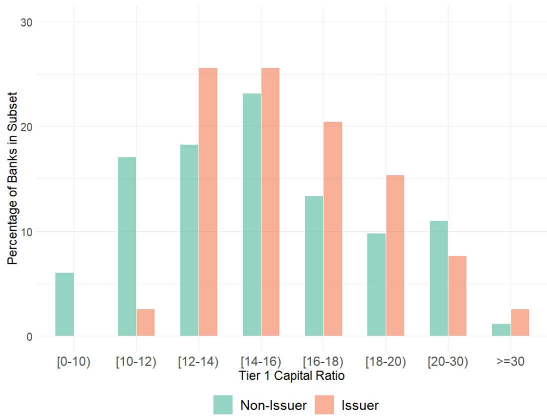
For the empirical analysis, I focus on banks in the European Economic Area (EEA). I match the data on CoCo issuances with bank balance sheet data from Orbis Europe in annual frequency. The matching is necessary as bank balance sheet data neither from Orbis Europe nor from Bloomberg report AT1 capital divided into its components. I fill gaps in CoCo instrument information by referring to the instruments' prospectuses. Out of the 117 banks in the dataset, 50 banks decided to issue CoCos - 39 banks were issuing minimum-trigger CoCos and 18 were issuing CoCos with a higher trigger level, of which 7 also have minimum-trigger CoCos outstanding. The total issuance amount of minimum-trigger CoCos in the European dataset equals \$172bn. CoCos eligible as AT1 capital with a low trigger (5.125% of RWA) account on average for 11.58% of a bank's Tier 1 capital, conditional on the bank having issued minimum-trigger CoCos.

Hypothesis (2) states that banks issue minimum-trigger CoCos to meet Basel III requirements, as banks that issue minimum-trigger CoCos prefer to have less capital than other banks absent minimum-trigger CoCo issuance amounts. As these instruments make up a large fraction of a bank's Tier 1 capital if issued, I illustrate in Figure(3) the relationship between minimum-trigger CoCo issuing banks' and other banks' Tier 1 ratios.[16] I first compute a bank's average Tier 1 ratio and then bin those ratios into intervals separately for both types of banks. Panel (a) shows that banks that issue minimum-trigger CoCos seem to have higher Tier 1 capital ratios than banks that do not. The average Tier 1 capital ratio for a minimum-trigger CoCo issuing bank is 14.11%[17] whereas the average Tier 1 capital ratio for non-issuers is 15.82%. Hence, the unconditional average Tier 1 capital ratio for minimum-trigger CoCo issuers is already lower than the average Tier 1 capital ratio for banks that do not issue such instruments. Keeping in mind that minimum-trigger CoCos have a very low conversion probability, I compute hypothetical Tier 1 ratios as if those instruments did not count as Tier 1 capital. If minimum-trigger CoCo issuance amounts are excluded from the calculation of Tier 1 capital the average Tier 1 capital ratio of minimum-trigger CoCo issuers decreases to 13.07%. This is a first indication that banks who issue minimum-trigger CoCos have a lower capitalization than other banks. If Basel III regulation did not allow those banks to issue instruments with extremely low trigger probabilities, they might have issued instruments with better going-concern characteristics than CoCos with a trigger level of 5.125%.

[16] In this illustration, I ignore Tier 1 ratios of minimum-trigger CoCo issuing banks before the issuance date.

[17] Including Tier 1 ratios before the issuance of minimum-trigger CoCos.

Figure 5: Barplot of binned Tier 1 capital ratio range for issuers and non-issuers of minimum-trigger CoCos. Panel (a) plots the percentage of banks per Tier 1 ratio bin categorized into issuers and non-issuers if minimum-trigger CoCo issuance amounts are included in the calculation of Tier 1 capital. Panel (b) plots the same relationship but excludes issuance amounts of minimum-trigger CoCos for the calculation of Tier 1 capital and thus reports hypothetical Tier 1 ratios as if minimum-trigger CoCos did not count as Tier 1 capital. *This figure is preliminary and for visualization purposes, as Tier 1 ratios for minimum-trigger CoCo issuing banks before the issuance dates are excluded.*



(a) Reported Tier 1 Ratios

(b) Hypothetical Tier 1 Ratios

5 Empirical Analysis

Why do some banks issue minimum-trigger CoCos and others don't? To answer this question, I use a binary logistic model to analyse a bank's propensity to hold CoCos. The dependent variable is a dummy that can take on two values, 1 if a bank is holding CoCos and 0 otherwise.

I hypothesize that banks hold minimum-trigger CoCos for the three reasons: To maintain their preferred systemic risk levels (**H1**), to meet Basel III capital requirements (**H2**) and to target earnings (**H3**). I test all my hypotheses at once, as I conjecture that a bank's decision to issue minimum-trigger CoCos is a combination of these three reasons. Hence, I run the following logistic regression:

$$\begin{aligned} Holding_i = \alpha + \beta_1 * SRISK_{i,t} + \beta_2 * Tier1_{i,t} + \beta_3 * ROE_{i,t} + \beta_4 * ROA_{i,t} + \beta_5 * LTA_{i,t} \\ + \beta_6 * ILL_{i,t} + \beta_7 * Assets_{i,t} + \beta_8 * GSIB_{i,t} + \beta_9 * GDPP_{c,t} + \varepsilon_{i,t} \end{aligned} \tag{14}$$

The left hand side of the regression estimates the log of the odds, i.e. the log of the probability of the dependent dummy variable taking on value 1 divided by the probability of the dummy variable taking on value 0: $Holding_i = log\left(\frac{Prob(Y=1)}{1-Prob(Y=1)}\right)$. The model is estimated by the maximum likelihood estimator.

The explanatory variables of interest are the ones used to test Hypotheses 1-3:

H1. *SRISK*: The expected capital shortfall of a bank in the event of a crisis is a measure of systemic risk. SRISK incorporates the size of the bank, its leverage and the Long Run Marginal Expected Shortfall (LRMES). The latter is a measure of the expected equity loss conditional on the MSCI index declining by 40% in a six-month period, incorporating the volatility of the financial institution, its correlation with the market and its performance in extreme events. SRISK and LRMES were proposed by Acharya et al. (2012) and Brownlees and Engle (2017) and are provided by the Volatility Laboratory (V-Lab) of the NYU Stern Volatility and Risk Institute. I use the relative SRISK measure, computed as SRISK in USD over total SRISK in the dataset, as a proxy for systemic risk.

H2. *Tier 1 Capital Ratio*: In this setting, I exclude minimum-trigger CoCo issuance amounts from the computation of Tier 1 capital. I want to see whether banks that issue such instruments have a lower capitalization absent these issuances than banks that do not. In a robustness setting, I also exclude higher-trigger CoCo issuance amounts from the computation of Tier 1 capital.

H3. *ROE to ROA* and *ROA*: The joint consideration of return on assets and return on equity relative to return on assets is used to identify earnings management practices.

Furthermore, I control for the following variables:

β5. *Net Loans to Total Assets (LTA)*: I control for a bank's loan activity using net loans (total loans minus possible default losses and unearned interest).

β6. *Impaired Loans to Net Loans (ILL)*: I use impaired loans to net loans as a proxy for loan quality.

β7. *Total Assets*: I use the natural logarithm of total assets as a proxy for bank size.

β8. *G-SIB status (GSIB)*: A dummy variable taking on value 1 if the bank is a global systemically important bank.

β9. *GDP per Capita (GDPP)*: A control for macroeconomic factors that are important determinants of default probabilities per country.

Table(1) shows the correlation between the explanatory variables used in the regressions. There is a high correlation between SRISK and assets as well as between ROA and ROE. The higher correlations between those variables are due to the fact that SRISK is a function of leverage and ROE a function of ROA. *The correlation coefficients are still below the absolute correlation cutoff of >.8 to speak of multicollinearity. However, especially the high correlation between SRISK and bank size is an indicator that the proxy systemic risk is not yet ideal.* The other independent variables show low pairwise correlation coefficients. Appendix A provides summary statistics of the explanatory variables calculated separately for issuers and non-issuers of minimum-trigger CoCos and higher-trigger CoCos respectively.

Table 1: Cross-Correlation Table of independent variables used in the empirical analysis

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) SRISK	1	0.186	0.010	0.074	0.429	0.110	0.698	0.018
(2) Tier 1 Ratio - minimum-trigger CoCo	0.186	1	0.215	0.280	0.172	0.200	0.189	0.211
(3) ROE	0.010	0.215	1	0.596	0.078	0.247	0.008	0.084
(4) ROA	0.074	0.280	0.596	1	0.098	0.406	0.098	0.101
(5) Net Loans to Assets	0.429	0.172	0.078	0.098	1	0.036	0.223	0.030
(6) Impaired Loans to Net Loans	0.110	0.200	0.247	0.406	0.036	1	0.162	0.286
(7) Log(Total Assets)	0.698	0.189	0.008	0.098	0.223	0.162	1	0.066
(8) GDPP	0.018	0.211	0.084	0.101	0.030	0.286	0.066	1

In the baseline estimation reported in Table(2), the binary dependent variable takes on value 1 if a bank has issued CoCos at any point in time between 2009 and 2021 and 0 otherwise. This definition of the response variable is described as *"CoCo issuing Bank"* in the regression table. In Table(3) I make adjustments to the classification of the binary response variable. In this setting, the binary dependent variable takes on value 1 if a bank has currently CoCos outstanding and 0 otherwise. I abbreviate this definition of the binary dependent variable by *"CoCo holding Bank"* in the regression table. All explanatory variables are one period lagged for the second specification of the response variable.

In Table(2), columns (1), (2) and (3) report the results for minimum-trigger CoCo issuers and column (4), (5) and (6) for issuers of CoCos with a higher trigger level. The second class of issuers is included as a diagnostic test. By comparing the results for both issuer classes, I can better identify the cause of the observed signs in the variables of interest. The main specification are columns (1) and (4) for minimum-trigger CoCo issuers and issuers of CoCos with higher trigger levels respectively. Columns (2) and (5) report the results without year fixed effects. In columns (3) and (6) I exclude all CoCo issuance amounts from the computation of the Hypothetical Tier 1 capital ratio. Table(3) is similarly structured, but reports results with year fixed effects only.

I discuss the results of the logit estimation in the following subsections for each stated hypothesis separately. In the last subsection, I comment on the control variables included in the regression. Standard errors are clustered at the bank level to account for heteroskedasticity and serial correlation of errors.

5.1 Testing Hypothesis 1: Systemically riskier banks hold minimum-trigger CoCos

The coefficient on SRISK is positive for issuers of minimum-trigger CoCos and negative for issuers of CoCos with a higher trigger level across all models in Table(2) and Table(3). In the baseline setting, a one unit increase in the relative SRISK is associated with a 16.8% increase in the odds of the bank being an issuer of minimum-trigger CoCos and a 21.3% decrease in the odds of the bank being a issuer of CoCos with a higher trigger level. Hence, the riskier the bank, the more likely it will issue minimum-trigger and the less likely higher-trigger CoCos. The fact that systemically riskier banks tend to issue minimum-trigger CoCos while systemically less risky banks tend to issue CoCos with a higher trigger level is alarming. In adverse market conditions, systemically riskier banks are likely to suffer a higher proportion of losses, however these banks are prone to issuing CoCos with a lower trigger probability before default instead of equity or instruments with a higher trigger probability and thus are

Table 2: This table reports logistic regression results of Equation(14). The response variable is a dummy that takes on the value 1 if the bank has *at any point in time* issued CoCos and 0 otherwise. Column (1) and (2) report the results for minimum-trigger CoCo issuers and column (3) and (4) for higher-trigger CoCo issuers. The independent variables of interest are: SRISK in USD and relative, Tier 1 Capital Ratio absent minimum-trigger CoCo issuance amounts, ROE and ROA. Controls: Net Loans to Assets, Impaired Loans to Net Loans, Total Assets, G-SIB status and GDPP. Data is in annual frequency from 2010 to 2021. Standard errors are in parentheses below the coefficients and clustered at the bank level.

	Dependent variable:					
	Minimum-Trigger CoCo issuing Bank			Higher-Trigger CoCo issuing Bank		
	(1)	(2)	(3)	(4)	(5)	(6)
Relative SRISK	16.806	17.312	18.187	-21.268	-21.169	-24.292
	(14.397)	(15.148)	(14.802)	(14.242)	(14.309)	(14.795)
Tier 1 Ratio - minimum-trigger CoCo	-0.177^{**}	-0.113^{**}		0.108^{**}	0.097^{**}	
	(0.072)	(0.053)		(0.053)	(0.045)	
Tier 1 Ratio - all CoCo			-0.133^{**}			-0.0001
			(0.066)			(0.053)
ROE	0.062^{*}	0.053^{*}	0.059^{*}	0.007	0.007	0.010
	(0.032)	(0.030)	(0.031)	(0.008)	(0.008)	(0.010)
ROA	-0.139	-0.114	-0.139	-0.282	-0.277	-0.274
	(0.476)	(0.449)	(0.453)	(0.185)	(0.185)	(0.205)
Net Loans to Assets	0.039^{**}	0.040^{**}	0.040^{**}	-0.012	-0.012	-0.017
	(0.019)	(0.018)	(0.018)	(0.017)	(0.017)	(0.018)
Impaired Loans to Net Loans	1.205	0.937	1.148	3.538^{*}	3.376^{*}	3.130
	(2.644)	(2.573)	(2.430)	(2.025)	(1.871)	(1.939)
Log(Total Assets (in mm))	0.429^{**}	0.404^{**}	0.403^{**}	0.705^{***}	0.702^{**}	0.687^{**}
	(0.207)	(0.202)	(0.203)	(0.273)	(0.273)	(0.280)
G-SIB	-0.211	-0.147	-0.226	1.344	1.322	1.255
	(1.021)	(1.046)	(1.070)	(1.061)	(1.066)	(1.099)
GDPP	0.00003^{***}	0.00003^{***}	0.00003^{***}	0.00002^{**}	0.00002^{**}	0.00002^{**}
	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Constant	-7.812^{**}	-7.493^{**}	-7.937^{**}	-11.054^{***}	-11.280^{***}	-9.476^{**}
	(3.143)	(2.953)	(3.135)	(4.139)	(4.140)	(4.166)
Observations	1,012	1,012	1,012	1,012	1,012	1,012
Year fixed effects	YES	NO	YES	YES	NO	YES
Log Likelihood	-524.749	-536.243	-534.203	-387.469	-388.686	-394.692
Akaike Inf. Crit.	1,093.497	1,092.487	1,112.406	818.937	797.373	833.385

Note: *p<0.1; **p<0.05; ***p<0.01

Table 3: This table reports logistic regression results of Equation(14). In contrast to the regression in Table(2), the response variable is now a dummy that takes on the value 1 if the bank has CoCos *outstanding* and 0 otherwise. Column (1) and (2) report the results for banks that are holding minimum-trigger CoCos and column (3) and (4) for banks that hold higher-trigger CoCos. All explanatory variables are one year lagged. The independent variables of interest are: SRISK in USD and relative, Tier 1 Capital Ratio absent minimum-trigger CoCo issuance amounts and absent all CoCo issuance amounts, ROE and ROA. Controls: Net Loans to Assets, Impaired Loans to Net Loans, Total Assets, G-SIB status and GDPP. Data is in annual frequency from 2010 to 2021. Standard errors are in parentheses below the coefficients and clustered at the bank level.

	Dependent variable:			
	Minimum-Trigger CoCo holding Bank		Higher-Trigger CoCo holding Bank	
	(1)	(2)	(3)	(4)
Relative SRISK	17.470	19.843	−19.004*	−24.815**
	(13.716)	(14.495)	(10.324)	(11.164)
Tier 1 Ratio - minimum-trigger CoCo	−0.210**		0.147***	
	(0.089)		(0.052)	
Tier 1 Ratio - all CoCo		−0.149*		−0.040
		(0.080)		(0.066)
ROE	0.078*	0.072*	0.002	0.010
	(0.045)	(0.043)	(0.006)	(0.015)
ROA	−0.017	−0.022	−0.324	−0.357
	(0.454)	(0.431)	(0.229)	(0.284)
Net Loans to Assets	0.036*	0.038**	0.008	0.003
	(0.020)	(0.019)	(0.025)	(0.026)
Impaired Loans to Net Loans	2.427	2.260	4.497*	3.947*
	(2.540)	(2.330)	(2.579)	(2.349)
Log(Total Assets (in mm))	0.478**	0.439**	0.908***	0.903***
	(0.196)	(0.192)	(0.287)	(0.311)
G-SIB	−0.031	−0.094	1.696**	1.485*
	(1.004)	(1.075)	(0.762)	(0.790)
GDPP	0.00003***	0.00002***	0.00002**	0.00003***
	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Constant	−26.391***	−26.495***	−17.851***	−15.570***
	(3.485)	(3.508)	(4.697)	(5.022)
Observations	1,005	1,005	1,005	1,005
Year fixed effects	YES	YES	YES	YES
Log Likelihood	−369.241	−379.788	−265.075	−273.294
Akaike Inf. Crit.	782.481	803.576	574.149	590.587

Note: *p<0.1; **p<0.05; ***p<0.01

even more likely to default. The coefficients are however not statistically significant except for columns (3) and (4) of Table(3). Thus, consistent with my hypothesis **H1**, I find some evidence that systemically riskier banks issue minimum-trigger CoCos to maintain their high systemic risk levels. The finding that the riskiest banks are prone to issue minimum-trigger CoCos but not CoCos with a higher trigger level mitigates the concern of an alternative explanation that minimum-trigger CoCos are issued to utilize CoCos' going-concern loss absorption mechanism. The evidence is however weak, as the coefficients are not statistically significant for minimum-trigger CoCos.

5.2 Testing Hypothesis 2: Banks with lower Tier 1 capital hold minimum-trigger CoCos

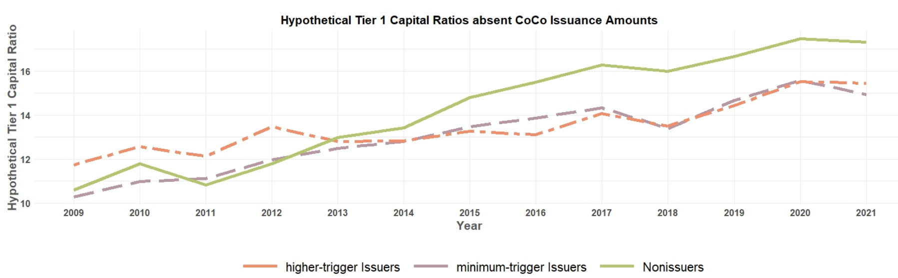
My second hypothesis, **H2**, is that banks that issue minimum-trigger CoCos prefer lower Tier 1 capital ratios than required by Basel III. I find strong support for this hypothesis as the coefficient on the Hypothetical Tier 1 Capital Ratio[18] is statistically significant and negative for minimum-trigger "*CoCo issuing banks*" and "*CoCo holding banks*" across all models in Table(2) and Table(3). A potential concern for my hypothesis is that banks might be issuing minimum-trigger CoCo instruments to reduce leverage. But if this was the case, banks with low Hypothetical Tier 1 Capital Ratios should also be issuing CoCos with a higher trigger level. In the data I however find that the Hypothetical Tier 1 Capital Ratio coefficient is positive and statistically significant for higher-trigger "*CoCo issuing banks*" and "*CoCo holding banks*" if minimum-trigger CoCo issuance amounts are excluded from the computation of Tier 1 Capital and slightly negative but insignificant if all CoCo issuances

[18]Hypothetical Tier 1 Capital Ratios are calculated as the Tier 1 Capital Ratios as if minimum-trigger CoCo issuances did not count towards Tier 1 capital. In columns (2) and (5) also higher-trigger CoCo issuance amounts are excluded from the calculation of the Hypothetical Tier 1 Capital Ratio.

are excluded. I can confirm my hypothesis **H2** as CoCos equipped with the minimum-trigger level are issued instead of other capital while CoCos equipped with a higher trigger level are issued on top of other capital according to these findings.

Figure(6) shows that Hypothetical Tier 1 Capital Ratios have a positive time trend. However, the difference between Hypothetical Tier 1 Capital Ratios of banks that do not issue CoCos and banks that do increases. Hence, banks that utilize minimum-trigger CoCos to fulfill their Basel III capital requirements might be more and more lacking behind their peers in terms of capitalization.

Figure 6: Time-series plot of Hypothetical Tier 1 Capital Ratios absent CoCo issuance amounts for minimum-trigger CoCo issuers, issuers of CoCos with a higher trigger level and banks that did not issue CoCos so far from 2009 to 2021.



5.3 Testing Hypothesis 3: Banks with lower ROA and higher ROE hold CoCos

My third hypothesis, **H3**, is that conditional on having CoCos outstanding, banks report lower ROA but higher ROE. To test this prediction, we look at the coefficients of ROE and ROA. The coefficient on ROE is positive and statistically significant for "*Minimum-Trigger CoCo issuing Banks*" and "*Minimum-Trigger CoCo holding Banks*" in Table(2) and Table(3) and positive but insignificant for "*Higher-Trigger CoCo issuing Banks*" and "*Higher-Trigger CoCo* *holding Banks*". The coefficient on ROA is negative but insignificant for all specifications in both tables. It is no concern that ROA is statistically insignificant, as long as the other measure, ROE, is positive and statistically significant. This suggests that banks are using particularly minimum-trigger CoCos for ROE targeting purposes.

5.4 Control Variables

Banks with higher net loans to assets are more likely to issue minimum-trigger CoCos while banks with higher impaired loans to net loans are more likely to issue CoCos with a higher trigger than the regulatory minimum. The latter finding is particularly interesting, as this result points towards banks utilizing CoCos with a higher trigger level to hedge against unexpected loan losses from non-performing loans. Bank size, proxied by the natural logarithm of total assets, affects banks' tendency to issue all CoCos positively. G-SIB status has a significant effect on the issuance of CoCos for "*Higher-Trigger CoCo holding Banks*", indicating these banks have generally higher going-concern capital needs. Banks in countries with a higher GDP per capita are more likely to issue CoCos. Control variable signs are in line with findings from previous CoCo literature.

6 Future Research Design and Conclusion

Which type of banks are holding minimum-trigger Contingent Convertible Bonds? According to the findings in this paper, the ones that have higher systemic risk levels, inferior capital ratios and that engage more in earnings-targeting. By allowing CoCos with a 5.125% trigger level to count towards Tier 1 capital, Basel III gave banks a tool in the hand that is cheaper to issue than equity [19] but has little going-concern characteristic. Minimum-trigger CoCo issuing banks take effort to include *anything but equity* - a term borrowed from Admati and Hellwig (2014) - in their balance sheets to meet Basel III capital requirements while being able to maintain their high systemic risk levels and low capital ratios.

CoCos have the same effect as debt for ROE calculations. A bank that issues CoCos is thus able to report a higher ROE to its stakeholders as long as the returns from the asset offset the coupon payments made on CoCos. Minimum-trigger CoCo issuers seem to issue these instruments as a method for earnings management, as they report a higher ROE relative to ROA than their peers. Higher-trigger CoCo issuers may not be able to profit from the leverage effect in ROE, as required coupon payments increase with CoCo trigger levels. These banks however seem to use CoCo issuances to hedge against unexpected loan losses from non-performing loans.

My empirical analysis indicates that minimum-trigger CoCos do not contribute to a safer banking system but constitute a large fraction of a bank's Tier 1 capital if issued (11.58% on average). My concern of treating all AT1-eligible instruments equally is that the current conditions for hybrid bonds to be eligible as AT1 capital are too slack. To be able to absorb losses in time and reduce the bank-wide probability of default, trigger levels of bail-inable instruments must be much higher than the minimum-trigger level of 5.125% currently accepted by Basel III regulation.

In the next step, I aim to proxy systemic risk by other measures than SRISK. The V-Lab dataset not only reduces the number of banks I can cover in my empirical analysis but also the number of bank-year observations conditional on the number of banks covered, as there are many missing observations. Suitable proxies are value at risk and a bank's distance to

[19] von Furstenberg (2013) finds that the average premium paid for equity is three times higher than the cost of issuing CoCos with an 7% trigger level when the issuer's CET1 ratio is above 10%.

default. I also plan to extend my empirical analysis. I want to employ a multinominal choice framework as in Goncharenko et al. (2019) and a tobit model to regress outstanding CoCo amounts relative to Tier 1 capital similar as in Boyson et al. (2016).

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Appendix

Appendix A: Panel A reports means for the independent variables of interest and controls calculated separately for issuers and non-issuers of minimum-trigger CoCos and higher-trigger CoCos respectively. In Panel B and Panel C I report regression results of the variables of interest controlled for bank size and year fixed effects for CoCo issuing banks and CoCo holding banks. The independent variables of interest are: SRISK in USD and relative, Tier 1 Capital Ratio absent minimum-trigger CoCo issuance amounts and absent all CoCo issuance amounts, ROE and ROA. Controls: Net Loans to Assets, Impaired Loans to Net Loans, Total Assets, G-SIB status and GDPP. Summary statistics are calculated by bank and then across banks, and are winsorized at the 1% and 99% tails. Data is in annual frequency from 2010 to 2021. Statistically significant differences at the 10% , 5% , and 1% level are indicated with *, **, and ***, respectively.

Panel A

	Minimum-Trigger CoCos			Higher-Trigger CoCos		
	Issuers	Nonissuers		Issuers	Nonissuers	
	Mean	Mean	Difference	Mean	Mean	Difference
SRISK (USD mm)	16610.6	4930.8	11679.8**	24113.9	6044.1	18069.8***
Tier 1 Ratio (%)	15	15.10	−0.1	15.3	15	0.3
Tier 1 Ratio - minimum-trigger CoCos (%)	13.90	15.10	−1.2*	14.8	14.7	0.1
Tier 1 Ratio - all CoCo (%)	13.80	14.90	−1.1	13.6	14.7	−1*
ROE (%)	6.30	3.50	2.8	3.4	4.6	−1.2
ROA (%)	0.50	0.50	0	0.2	0.5	−0.3**
Net Loans to Assets (%)	59.80	56.50	3.4	52.4	58.5	−6.1
Impaired Loans to Net Loans (%)	0.10	0.10	0	0.1	0.1	0
Log(Total Assets(USD mm))	11.6	10.4	1.2 ***	12.6	10.5	2.2 ***
GDPP	50864	40711.6	10152.4 **	48647.9	43268.1	5379.8

Panel B

	Dependent variable:					
	Minimum-Trigger CoCo issuing Bank			Higher-Trigger CoCo issuing Bank		
	(1)	(2)	(3)	(4)	(5)	(6)
Relative SRISK	6.133			−8.171		
	(10.874)			(11.747)		
Tier 1 Ratio - minimum-trigger CoCo		−0.081*			0.099**	
		(0.047)			(0.049)	
ROE			0.002			0.018*
			(0.007)			(0.010)
ROA			0.092			−0.443**
			(0.119)			(0.201)
Log(Total Assets (in mm))	0.314*	0.356***	0.388***	0.654**	0.590***	0.520***
	(0.164)	(0.124)	(0.128)	(0.280)	(0.197)	(0.189)
Constant	−4.268**	−3.804**	−5.084***	−9.211***	−9.719***	−7.708***
	(1.781)	(1.609)	(1.508)	(3.425)	(2.819)	(2.468)
Observations	1,055	1,055	1,051	1,055	1,055	1,051
Log Likelihood	−630.492	−622.645	−628.052	−429.384	−422.566	−426.748
Akaike Inf. Crit.	1,290.984	1,275.290	1,288.105	888.768	875.131	885.496

Note: *p<0.1; **p<0.05; ***p<0.01

Panel C

	Dependent variable:					
	Minimum-Trigger CoCo holding Bank			Higher-Trigger CoCo holding Bank		
	(1)	(2)	(3)	(4)	(5)	(6)
Relative SRISK	8.897			−10.897		
	(9.747)			(11.471)		
Tier 1 Ratio - minimum-trigger CoCo		−0.105*			0.109**	
		(0.058)			(0.054)	
ROE			0.038			0.014
			(0.030)			(0.012)
ROA			−0.158			−0.500***
			(0.299)			(0.193)
Log(Total Assets (in mm))	0.355**	0.418***	0.457***	0.818***	0.724***	0.640***
	(0.169)	(0.126)	(0.140)	(0.307)	(0.218)	(0.196)
Constant	−23.152***	−22.514***	−24.266***	−13.314***	−13.742***	−11.339***
	(1.934)	(1.950)	(1.879)	(3.818)	(3.464)	(2.678)
Observations	1,045	1,045	1,041	1,045	1,045	1,041
Log Likelihood	−433.373	−424.759	−429.790	−303.790	−298.841	−301.853
Akaike Inf. Crit.	896.746	879.517	891.579	637.580	627.682	635.705

Note: *p<0.1; **p<0.05; ***p<0.01