Anything but Equity - On Banks' Preference for Hybrid Debt

Tanja Brieden*

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Abstract

Contingent Convertible Bonds (CoCos) are a tool for banks to partly fulfil Tier 1 capital requirements. While these instruments offer cheaper funding than equity, only some banks include them on their balance sheets. I investigate why. I find that the cheapest Tier 1-eligible CoCos, the ones with the lowest loss absorption abilities, are issued by banks that prefer a higher leverage than other banks, potentially exceeding regulatory limits in some scenarios. Post-issuance, these institutions effectively achieve Tier 1 ratios on par with their counterparts but remain to have higher systemic risk and more intense earnings management practices than peers. Using the variation in loss absorption abilities of CoCos, I demonstrate that the least expensive instruments are not issued as a safety net during financial distress, but rather to cost-effectively fulfil regulatory requirements. The results shed light on banks' capital structure choices and their implications for regulatory policy and financial stability.

JEL-Classification: G01, G21, G28

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*Vienna Graduate School of Finance (VGSF). E-Mail: tanja.brieden@vgsf.ac.at

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1 Introduction

In response to the latest global financial crisis, bank regulation has gained importance and bail-in instruments became a key feature to reduce the need for taxpayer-funded bailouts. Among the regulatory changes proposed by Basel III was the introduction of Additional Tier 1 Contingent Convertible Bonds (AT1 CoCos) as a tool for banks to meet part of their capital requirements. Until December 2022, banks in the European Economic Area (EEA) have issued $305bn worth of AT1 CoCos. But only about 45% of banks in the jurisdiction include these instruments in their capital structure. Conditional on issuance, the hybrid instruments constitute 11.4% of a bank's Tier 1 capital on average. But many institutions prefer to fulfil capital requirements without such CoCos[1]. As equity is considered "expensive" (Admati and Hellwig, 2014) and CoCos are generally less costly for banks (Avdjiev et al., 2013, von Furstenberg, 2013), the question arises:

Why do only some banks issue CoCos and for what purpose?

A bank's Tier 1 capital consists of two components, Common Equity Tier 1 (CET1) capital and Additional Tier 1 (AT1) capital. Under Basel III, CET1 and Tier 1 capital must amount to at least 4.5% and 6% respectively of a bank's risk-weighted assets (RWA). The difference between the CET1 and Tier 1 capital requirement can be met by Additional Tier 1 (AT1) capital. Tier 1 capital is considered 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 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

[1] For brevity I use the term CoCos and AT1 CoCos interchangeably. Thus, I disregard CoCos that contribute solely to a bank's Tier 2 capital without loss of generality for this study.

trigger is at least 5.125% of the issuing bank's CET1 capital to RWA, CoCos count towards AT1 capital. But 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 equipped with such a trigger level. However, a bank cannot report a CET1 capital ratio below 7% without becoming constrained in its distribution of capital. This is because all banks must hold an additional capital conservation buffer of 2.5% and a countercyclical buffer within a range of 0-2.5%[2] on top of the minimum capital requirement of 4.5% (all in terms of CET1 to RWA).[3] If a bank reports a CET1 to RWA ratio below its combined buffer requirement, it can, among other things, no longer pay out dividends, conduct share repurchases, set up new bonus payment obligations and make coupon payments to AT1 instrument holders until the buffer is restored. CoCos equipped with the minimum trigger level of 5.125%, hereafter referred as *minimum-trigger* CoCos, are issued by about 80% of all CoCo issuers in the EEA. But CoCos with higher trigger levels than 5.125%, hereafter referred as *higher-trigger* CoCos, are also issued by 35% of all CoCo issuing banks[4] and most of these CoCos (91%) are equipped with a 7% trigger level. Ceteris paribus, a CoCo bond with a trigger level of 7% requires a higher coupon than a CoCo bond equipped with only the *minimum-trigger* level.[5] Thus, another question emerges:

Why are some banks willing to issue more expensive CoCos, equipped with trigger levels higher than the regulatory minimum?

This study seeks to answer both questions. It first presents a binomial model illustrating a

[2]The bank's countercyclical capital buffer is a credit-exposure-weighted average of country-specific countercyclical buffers.

[3]To Global Systemically Important Banks another buffer of 1% to 2.5% CET1/RWA and to Other Systemically Important Institutions a buffer of 0.25% to 2% CET1/RWA is added.

[4]Hence, 15% of CoCo issuers have issued both *minimum-trigger* and *higher-trigger* CoCos.

[5]Because almost all issued CoCos offer a wealth transfer from CoCo holders to equity holders when the instruments are triggered. Then, they are either converted into shares based on conversion rates that in most cases disadvantage CoCo investors as found by Berg and Kaserer (2015) or written down.

bank's choice for Tier 1 capital composition: equity only or incorporating CoCos with high or low trigger levels. The model shows that, in the presence of bankruptcy costs, hybrid instruments provide a poorer capital buffer for debt than equity. This is due to the negative relation between the instruments' going-concern loss absorption ability and the bank's default probability. Consequently, *minimum-trigger* CoCos result in the riskiest debt, followed by *higher-trigger* CoCos and equity. On the other hand, *minimum-trigger* CoCos enable the issuer to report a higher return on equity for a given return on asset, followed by issuers of *higher-trigger* CoCos and equity-only issuers as long as the CoCo coupon payments do not offset the gains from leverage. For the empirical analysis, I create a comprehensive dataset covering 89% of all CoCo issuance volumes in the EEA issued by 69 banks until the end of 2022 and use 86 non-CoCo issuing banks as control to answer why only some banks are utilizing CoCos and why some of the issuers prefer more expensive hybrids with higher trigger levels than the regulatory minimum. I compare banks holding CoCos equipped with only the minimum trigger level, those holding CoCos with higher trigger levels and banks without any CoCo issuances. I first employ a Fama and MacBeth (1973) logistic regression to analyze which factors play a role for the issuance of CoCos. Before any issuances, *minimum-trigger* CoCo issuing banks exhibit significantly higher systemic risk and lower Tier 1 capital ratios than non-issuers. Post-issuance, these banks achieve Tier 1 ratios comparable to peers but their systemic risk levels and earnings management practices remain elevated. Excluding CoCo holdings from the calculation of Tier 1 capital, *minimum-trigger* issuers' *Adjusted Tier 1 Capital Ratios* persist to be inferior to non-issuers' ratios. In contrast, banks issuing *higher-trigger* CoCos are adequately capitalized prior to the issuance and surpass peers' Tier 1 ratios afterwards. These institutions do not exhibit any of the aforementioned characteristics of *minimum-trigger* issuers. All CoCo issuers tend to be larger institutions and more likely to be classified as global systemically important banks (G-SIBs) than non-issuers. To show that *minimum-trigger* CoCos are issued to maintain high systemic risk levels and low Tier 1 capital ratios excluding CoCo issuance amounts and not to reduce risk or leverage, I also run a multinomial logistic regression making use of the variation in trigger levels across CoCo issuers. If banks issued CoCos to have a safety net when being financially distressed, the riskiest and most undercapitalized banks should issue instruments with relatively good loss absorption abilities, but the data supports the opposite.

This paper contributes to two literature strands. It adds to the scarce empirical literature covering Contingent Convertible Bonds and the dispute whether these instruments are a good source of Tier 1 capital. It further contributes to research studying the impact of capital requirements on banks' capital structure choices. To the best of my knowledge, it is the first that focuses separately on CoCos equipped with only the *minimum-trigger* level to count towards AT1 capital and CoCos equipped with higher trigger levels. Distinguishing between those two types is important, as banks that issue instruments with the regulatory minimum trigger level should be very different from banks that voluntarily issue CoCos with a higher likelihood of absorbing losses.

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, junior debt does not experience a cost reduction from the issuance of CoCos, indicating the lowered cost of senior debt is primarily driven by an improvement of the recovery rate of this debt class and not by a reduction of the bank's probability of default.[6] Avdjiev et al.

[6]I find that CDS spreads of subordinated debt do not decrease following a CoCo issuance. CoCo issuances

(2020) further assume that CoCos are issued on top of a bank's existing capital. A model implication of this is that better capitalized banks are more likely to issue CoCos and the authors find empirical evidence for this considering all types of CoCos including instruments that do not count towards AT1 capital. Technically, the bank faces a trade-off problem when it realizes that in some scenarios it's Tier 1 capital ratio might fall below capital requirements. In this paper, I find that those constrained banks are more likely to issue the cheapest available tool, *minimum-trigger* CoCos. While *higher-trigger* CoCos are issued by unconstrained banks. Fiordelisi et al. (2020) investigate whether AT1 contingent convertibles are viewed as going-concern capital by market participants. The authors argue that CoCos with a sufficiently positive trigger probability decrease stock return volatility by reducing the stock's downside risk. They find that this is only the case for equity conversion, but not for principal write-down CoCos of European banks and that recent regulatory measures reduced the going-concern character of CoCos overall. In my quite similar dataset, 85% of all principal write-down CoCos are equipped with only the minimum trigger level while 67% of all equity conversion CoCos are equipped with a higher trigger level than the regulatory minimum. As CoCo instrument design is an endogenous choice by the issuer and the principal write-down mechanism is strongly linked to the minimum trigger level of 5.125%, the authors' results are a strong indicator for *minimum-trigger* CoCos not being perceived as going-concern instruments by market participants. If a CoCo's contractual terms impose gains for pre-existing equity 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

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increase the CDS spreads of subordinated debt and this significantly for equity conversion CoCo issuances with a trigger level not higher than 6%. 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 CoCo 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.

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. (2021) find empirical evidence for the debt overhang problem induced by CoCos, as investors are reluctant to inject more equity into a financially distressed bank that has previously issued CoCos and banks with more volatile assets are less likely to issue CoCos in the first place anticipating this problem. There is also a small literature exploring the determinants of bank capital structure on the issuance of CoCos but these papers only moderately touch on the questions addressed in this study.[7] Appendix A outlines further concerns related to CoCos.

This paper has five more sections. Section 2 contains the hypothesis development regarding which factors play a role in the issuance of *minimum-trigger* and *higher-trigger* CoCos. Section 3 provides a binomial model illustrating the effects of varying choices in Tier 1 capital composition on bank equity and debt returns. Section 4 presents an overview of the data, Section 5 contains the main findings of the empirical analysis and Section 6 concludes.

[7]Williams et al. (2018) find that a bank's propensity to issue CoCos correlates positively with its systemic risk levels using the world's largest 150 banks including jurisdictions where regulators have not permitted CoCos to be classified as AT1 capital. Wagner et al. (2022) also investigate which factors play a role in CoCo issuance. The authors do not 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. Both papers do not report heteroskedasticity-robust standard errors while using logistic regressions, hence their findings are to be treated with caution. Fajardo and Mendes (2020) discuss the motivation for 130 emerging and developed countries to issue CoCo bonds and find that particularly large and highly leveraged banks issue such instruments. The paper focuses on issuance years as treatment only, without distinguishing between periods before and after CoCo issuances

2 Hypothesis Development

Why do only some banks issue minimum-trigger CoCos and for what purpose?

I am concerned that banks utilizing *minimum-trigger* CoCos may not issue these instruments to weather financial turmoils but for three other reasons that I summarize in hypotheses H1 to H3: To maintain their high systemic risk levels (**H1**), to meet Basel III capital requirements (**H2**) and to target earnings (**H3**). The hypotheses are based on the following studies and statements.

H1: As in Boyson et al. (2016), who investigate which US-banks issued trust-preferred securities (TruPS) from 1996 to Dodd-Frank, I hypothesize that banks have optimally different levels of risk. The authors argue that a bank not constrained by capital requirements has no reason to issue hybrid instruments. If it wants to increase risk through leverage, it can do so by issuing subordinated debt with relatively cheaper required coupons. The same rationale applies to the tax advantage associated with hybrid instruments, as subordinated debt also enjoys these benefits. Only when a bank faces potential regulatory constraints it will consider instruments like TruPS or CoCos.

H2: As in Gropp and Heider (2010), I hypothesize that banks have optimally different levels of leverage. The authors 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. They state that capital requirements are not a first-order determinant of banks' capital structure choices unless the bank is constrained 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 leverage.

H3: Banks' CEO might utilize CoCos to improve return on equity (ROE). The then CEO of Barclays Bob Diamond, for example, stated in April 2011 the bank planned to increase its risk appetite to improve ROE numbers and intended to issue CoCos to fulfill part of its capital requirements as these instruments, unlike equity, do not dilute ROE.[8]. Banks' CEO compensations are often based on ROE, 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, as the ratio is computed as net income over equity. 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.

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

Why are some banks willing to issue relatively more expensive higher-trigger CoCos?

Banks employing *higher-trigger* CoCos should issue these instruments for other reasons than the ones summarized in hypotheses **H1**-**H3**, as these effects can be achieved by relatively cheaper *minimum-trigger* CoCos. I have no prior which bank characteristics lead to the issuance and are correlated with the holding of such instruments.

These hypotheses will be tested in the empirical analysis in Section 5 . The next section provides the theoretical foundation for the importance of distinguishing between *minimum-trigger* CoCos, *higher-trigger* CoCos and equity as Tier 1 capital.

3 Binomial model of bank asset returns

In this 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 design, I introduce senior and junior debt, distinguish between the issuance of additional equity and CoCos and consider bankruptcy costs. Section 3.1 models a bank with only equity, junior and senior debt outstanding. In Section 4.2 I introduce capital requirements that require an increase in Tier 1 capital. The bank can choose between issuing equity, CoCos equipped with the minimum trigger level and CoCos equipped with a higher trigger level. Section 3.3 analyzes the effect of this choice on the riskiness of senior and junior debt in the presence of bankruptcy costs and Section 3.4 discusses the bank's preference for either asset class.

3.1 A bank with equity, junior and senior debt

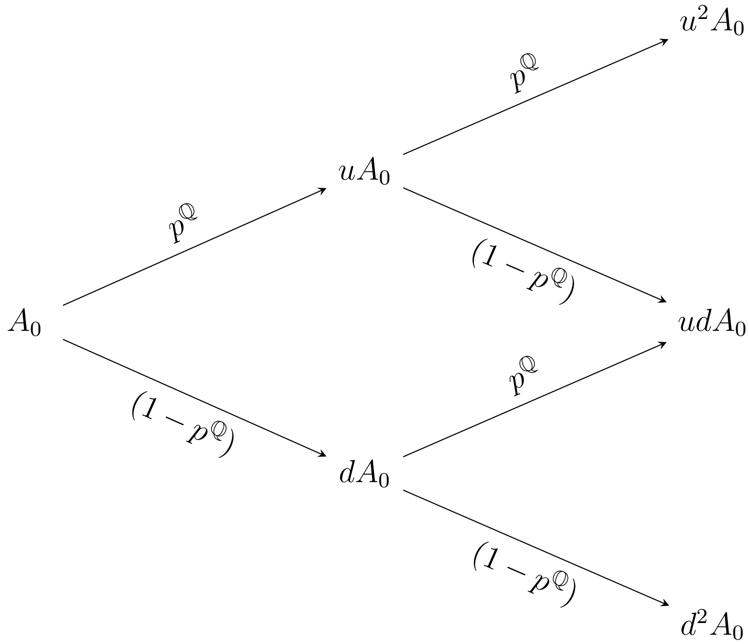
The current price of a bank's assets A_0 is the sum of the values of senior debt S_0, junior debt J_0 and equity E_0: $A_0 = S_0 + J_0 + E_0$. A cash flow X_{t+1} can be valued using the nominal pricing kernel $M_{t,t+1}$ under real-world expectations $\mathbb{E}$. Equivalently, it can be valued using 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 $d < R_f < u$. One 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. Let us 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), one 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:

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

In the presence of this default rule, the promised gross return on senior and junior debt is set fairly such that it satisfies:

$$S_0 = \frac{1}{R_f^2}[S_0R_S^2(p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}})) + (1-p^{\mathbb{Q}})^2 min(S_0R_S^2, d^2A_0)] \tag{4}$$

$$J_0 = \frac{1}{R_f^2}[J_0R_J^2(p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}})) + (1-p^{\mathbb{Q}})^2 max(0, d^2A_0 - S_0R_S^2)] \tag{5}$$

And the total value of debt $D_0 = S_0 + J_0$ corresponds to:

$$S_0 + J_0 = \frac{1}{R_f^2}[(S_0R_S^2 + J_0R_J^2)(p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}})) + (1-p^{\mathbb{Q}})^2 d^2(A_0)] \tag{6}$$

The average promised return per unit of total debt can be written as:

$$R_D = R_S \frac{S_0}{S_0 + J_0} + R_J \frac{J_0}{S_0 + J_0} \tag{7}$$

Equivalently, one can express the value of equity as:

$$\begin{aligned} E_0 =& \mathbb{E}_0^{\mathbb{Q}}(E_2)/R_f^2 \\ =& \frac{1}{R_f^2}[(u^2 A_0 - D_0 R_D^2)p^{\mathbb{Q}2} + (udA_0 - D_0 R_D^2)2p^{\mathbb{Q}}(1 - p^{\mathbb{Q}})] \end{aligned} \tag{8}$$

Given the default assumption in Equation(3), the banks' leverage ratio is restricted[9] to:

$$\frac{d^2}{R_f^2} < \frac{J_0 + S_0}{A_0} < \frac{ud}{R_D^2} \tag{9}$$

Plugging in Equation(6)[10], the parametric restriction on the banks' leverage ratio is given by:

$$\frac{d^2}{R_f^2} < \frac{J_0 + S_0}{A_0} < \frac{d[u(R_f - d) + R_f(u - R_f)]}{R_f^2(u - d)} \tag{10}$$

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 extra Tier 1 capital $T1_0$, and can choose between equity[11] and CoCos equipped with the *minimum-trigger* level or a higher trigger level. Assume the regulator demands banks to increase assets to $A_0^* = A_0 + T1_0$, 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 $T1_0 = (S_0 + J_0)(\frac{R_f^2}{d^2} - 1) - E_0$.

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

[10]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 $p^{\mathbb{Q}} = (R_f - d)/(u - d)$

[11]As banks cannot default on their outstanding equity, the exact type - whether common or preferred - is irrelevant for the model results.

Let us consider three types of Tier 1 capital: Equity, 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^{min} and C_0^{high} respectively. The new capital is subordinated to the issuing bank's existing debt, as it constitutes Tier 1 capital.

CoCos are not written down or converted into equity with certainty. Instead, 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.[12] Undoubtedly, the trigger probability is lower for *minimum-trigger* CoCos than for CoCos with a higher trigger level, i.e. $\pi^{min} < \pi^{high}$ 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[13] or converted into equity, the bank will not default at t=2. A bank that issued additional equity 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 as they rank senior to equity and CoCos in the payment hierarchy. Hence, the promised gross returns satisfy:

$$S_0 = \frac{1}{R_f^2}[S_0 {R_S^*}^2 (p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}}) + (1-p^{\mathbb{Q}})^2)] = \frac{1}{R_f^2}[S_0 {R_S^*}^2] \tag{11}$$

$$J_0 = \frac{1}{R_f^2}[J_0 {R_J^*}^2 (p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}}) + (1-p^{\mathbb{Q}})^2)] = \frac{1}{R_f^2}[J_0 {R_J^*}^2] \tag{12}$$

[12] 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 Tier 1 ratios 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.

[13] Few CoCos are equipped with a partial write-down feature, but for simplicity we will ignore this case.

3.3 Bankruptcy Costs

In the absence of bankruptcy costs, the value of senior and junior debt is only affected by the face value of 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 honour 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. Before the issuance of additional capital and in the presence of bankruptcy costs, the fair promised returns for senior and junior debt, R_S^δ and R_J^δ, satisfy:

$$S_0 = \frac{1}{R_f^2}[S_0 {R_S^\delta}^2(p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}})) + (1-p^{\mathbb{Q}})^2 min(S_0 {R_S^\delta}^2, d^2\delta A_0)] \tag{13}$$

$$J_0 = \frac{1}{R_f^2}[J_0 {R_J^\delta}^2(p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}})) + (1-p^{\mathbb{Q}})^2 max(0, d^2\delta A_0 - S_0 {R_S^\delta}^2)] \tag{14}$$

After the issuance of additional capital and in the presence of bankruptcy costs, the fair promised returns for senior and junior debt, ${R_S^*}^\delta$ and ${R_J^*}^\delta$, depend on the new capital's trigger probability π and satisfy:

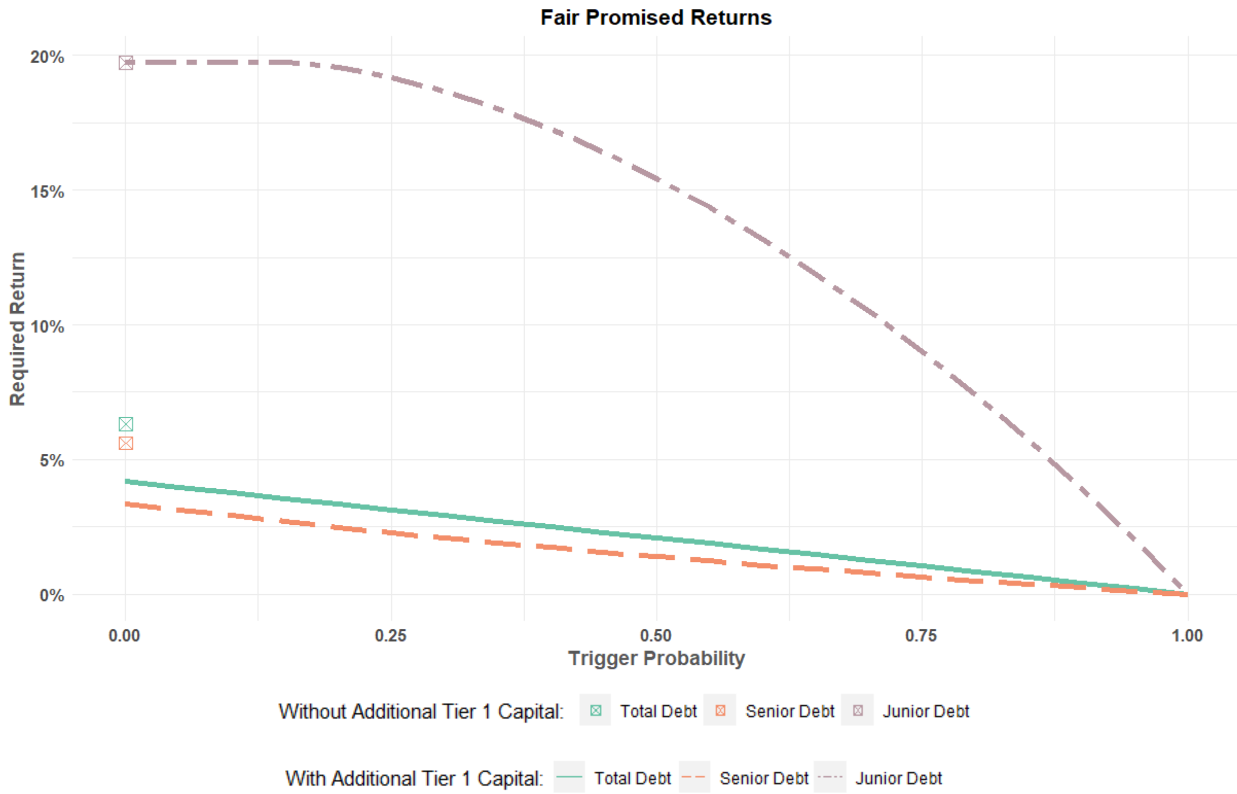
$$S_0 = \frac{1}{R_f^2}[S_0 {R_S^*}^{\delta 2}(p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}}) + \pi * (1-p^{\mathbb{Q}})^2) + (1-\pi)(1-p^{\mathbb{Q}})^2 min(S_0 {R_S^*}^{\delta 2}, d^2\delta A_0^*)] \tag{15}$$

$$J_0 = \frac{1}{R_f^2}[J_0 {R_J^*}^{\delta 2}(p^{\mathbb{Q}2} + 2p^{\mathbb{Q}}(1-p^{\mathbb{Q}}) + \pi * (1-p^{\mathbb{Q}})^2) + (1-\pi)(1-p^{\mathbb{Q}})^2 max(0, d^2\delta A_0^* - S_0 {R_S^*}^{\delta 2})] \tag{16}$$

The required returns for senior and junior debt now depend on the type of additional capital provided. If the bank issues equity or CoCos with a trigger probability of $\pi = 1$, bankruptcy will not occur and the returns become risk free. But if the bank issues CoCos with a trigger probability below 1, bankruptcy occurs with probability $(1-p^{\mathbb{Q}})^2(1-\pi)$[14]. The required

[14] I.e. if the bank ends up in the worst state at t=2 and the hybrid debt has not been triggered at t=1.

Figure 1: Fair promised percentage returns on total debt, senior debt and junior debt depending on the CoCo's trigger probability π. The boxes depict the fair promised returns for debt before, and the lines after 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%.



returns on debt decrease with the probability π that the hybrid debt is triggered, as it makes bankruptcy less likely.

Figure 4 illustrates the required percentage returns to total, senior and junior debt before and after the issuance of additional Tier 1 capital in the presence of bankruptcy costs. For descriptive purpose, I assume a 20% asset volatility, i.e. $u = 1/d = e^{0.2}$, 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 assets 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 zero trigger probability ($\pi = 0$) depict the fair promised returns to debt before the issuance of new 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. After the issuance of new Tier 1 capital, the fair promised return of senior debt decreases even for trigger probability $\pi = 0$. While the bank's probability of default remains unchanged in this case, senior debt experiences a risk reduction due to improvements in its recovery rate. With the given parameters, senior debt is initially valued at $\frac{J_0}{A_0} = \frac{3}{4}$ of total assets. In default and after the issuance of additional Tier 1 capital, bank assets are only worth $\frac{d^2 \delta A_0^*}{A_0} = \frac{5}{8}$ of initial assets. Consequently, even after the issuance, $\frac{1}{6}$ of senior debt's face value is not recovered if the issued instrument is not triggered and the bank defaults. In this setting, the face value of junior debt is always eaten up by bankruptcy costs and thus this debt class only experiences a risk reduction from decreases in the bank's probability of default. For low trigger probabilities there is little to no decrease in the fair promised return of junior debt and the risk reduction only picks up for higher π. This is why it is important to distinguish between hybrid instruments with high and low trigger levels. If the instrument's trigger probability is low, which is equivalent to a low trigger level, it acts like subordinated debt and does not sufficiently improve the bank's default probability to benefit pre-existing junior debt. For all debt classes, risk reduction benefits increase with higher trigger probabilities of the hybrid instruments.

3.4 Bank Preferences

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.

Assume there are three otherwise equal banks in the economy with different choices of added Tier 1 capital but same issuance amounts $T1_0$. 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 - as the probability of default is given by $PD = (1-p^{\mathbb{Q}})^2(1-\pi)$ and hence $PD_A > PD_B > PD_C = 0$. Bondholders of bank A now also have the riskiest debt, succeeded by bondholders of bank B, i.e. $R^{*\,\delta}_{DA} > R^{*\,\delta}_{DB} > R^{*\,\delta}_{DC} = R_f$. 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 as long as the banks are a going concern, the riskier banks A and B will have a higher ROE if coupon payments on CoCos are not too high, i.e. $ROE_A > ROE_B > ROE_C$ as long as $c^A < c^B < \frac{NI * E^A}{E+E^A}$[15], where c^A and c^B are the required coupon payments for CoCos issued by bank A and bank B respectively. As the trigger probability is lower for bank A's CoCos than for bank B's, required coupon payments for the *minimum-trigger* CoCos of bank A are lower than for the CoCos of bank B as long as there is a wealth transfer from CoCo bond holders towards equity upon conversion or write-down.[16]

[15] see Section 2 for derivation.

[16] Berg and Kaserer (2015) find that this is the case for almost all CoCo issuances.

4 Data

In my empirical analysis, I focus on banks on the fully consolidated level in the European Economic Area (EEA). I choose this subset as Basel III requirements were converted into laws relatively homogeneously across EEA member states and apply on the fully consolidated level for banks. The data on CoCo issuances is retrieved from Bloomberg in daily frequency from the first AT1-eligible CoCo issuances in 2010 to the end of 2022. Systemic risk measures are provided by the authors Gehrig and Iannino (2021). Data on the annual GDP per capita (GDPP) is obtained from World Bank and G-SIB status from the Financial Stability Board. I collect annual balance sheet data from Orbis Bank Focus. My data spans from 2006 to 2022 and also includes years before the first CoCo issuances. I cover 155 banks on the fully consolidated level and match subsidiaries to parent banks manually to correctly account for mergers, acquisitions and spin-offs. Due to potential errors, I subject the CoCo and bank balance sheet data to careful scrutiny. This includes supplementing the CoCo data with hand-collected data from prospectuses and double-checking bank data with information directly obtained from annual reports. Bloomberg reports 42 CoCo issuances twice, as some CoCos are issued both as Regulation S notes and Rule 144A notes with a joint notional. I correct for these duplicates. I then match CoCo issuances with banks by hand, as some CoCos were issued by special-purpose entities whose parents could not be identified automatically. I pay special attention to not falsely mark a non-CoCo issuer as issuer and vise versa. The final dataset covers 89% of all CoCo issuance volumes[17] in the EEA issued by 69 banks until the end of 2022.

[17]66% of all CoCo bonds if weighted equally, as some small banks could not be fetched from Orbis Bank Focus, are not incorporated in the data provided by the authors Gehrig and Iannino (2021) or were omitted due to missing information about crucial issuer characteristics.

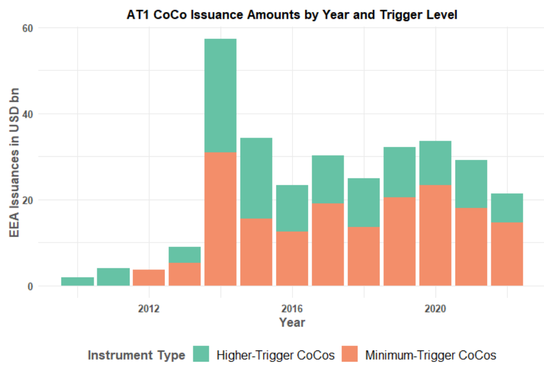
4.1 CoCo Descriptive Statistics

A look into the data of all EEA AT1 CoCo issuances until the end of December 2022 shows that 73% (58% if weighted by volume) 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 91% (94% if weighted by volume) of all remaining CoCo issuances. Other trigger levels range between 5.25% and 9%. Ceteris paribus, a *higher-trigger* CoCo should pay a higher coupon than a *minimum-trigger* CoCo. In line with this argument, banks in my dataset that issue both types of CoCos pay on average a 39 bp (or 8.3%) higher coupon on their *higher-trigger* CoCos[18]. Across all CoCo issuers however, coupons on *higher-trigger* CoCos are 24.4 bp (or 3.8%) lower. This is a first indicator that *minimum-trigger* CoCo issuers are riskier than *highter-trigger* issuers and thus need to pay higher coupons on their debt.

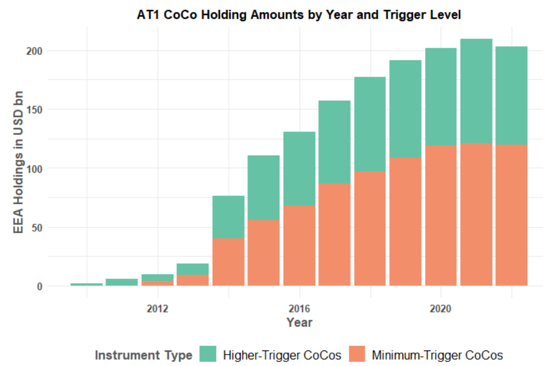
Banks in the EEA issued 526 AT1 CoCos with a total face-value of $305bn between 2010 and 2022. 384 issuances are still active with an outstanding amount of $200bn as of December 2022. Figure 3 plots EEA AT1 CoCo issuances and holdings over time, showing that CoCo issuances have been high since CRD IV became effective in January 2014, converting Basel III proposals into EU law. Since then, banks can fulfill part of their Tier 1 capital requirements with AT1 CoCos. Banks typically redeem their CoCo instruments at the earliest possible call date, which is five years after issuance, and then replace them with new CoCos. This practice explains why the cumulative CoCo holding amounts in Panel (b) cannot be derived by a simple summation of the issuing amounts in Panel (a). Aggregate CoCo holdings have reached their peak in 2021. The plots also show that *minimum-trigger* CoCos dominate overall issuance and holding amounts.

[18]Means are first calculated by bank and then aggregated across banks

Figure 3: Time-series plot of AT1 CoCo issuance (panel a) and holding (panel b) amounts by year and trigger level in USD billion from 2010 to 2021 for banks in the EEA.



(a) CoCo Issuances



(b) CoCo Holdings

Table 1 breaks up CoCo issuance amounts by loss-absorption mechanism, trigger level and country. The CoCo data covers the two principal write-down (PWD) mechanisms permanent write-down and temporary write-down as well as the equity conversion (EC) mechanism. PWD CoCos' principal is written down if the trigger level (in terms of CET1 to RWA) is breached. For temporary write-down CoCos, the principal can be reinstated if the bank's capitalization improves thereafter. CoCos with an equity conversion mechanism are converted into common shares if the trigger is hit. *Minimum-trigger* CoCos are mainly issued with a temporary write-down mechanism. 69% of all *minimum-trigger* CoCos are temporarily written down, 2% permanently written down and 29% converted into equity if the bank's CET1 to RWA ratio falls below 5.125%. In contrast, *higher-trigger* CoCos are mainly equipped with an equity conversion feature. 82% of all *higher-trigger* CoCos are converted into common shares, 11% permanently and 7% temporarily written down if the bank's CET1 to RWA asset ratio falls below the trigger level. Loss absorption mechanisms also vary across countries. CoCos with temporary write-down features exist in almost all countries (except Cyprus) but CoCos with equity conversion or permanent write-down mechanisms are not always present. In the empirical analysis, I do not differentiate between loss-absorption mechanisms because

Table 1: Summary Statistics CoCos

The table breaks up CoCo issuance volumes (in million USD) and numbers (in parentheses) by loss-absorption mechanism, trigger level and country. The loss-absorption mechanisms are: Permanent Write-Down, Temporary Write-Down and Equity Conversion. The table distinguishes between minimum-trigger (Min-trig.) levels of 5.125% and higher-trigger (High-trig.) levels.

	Total	Permanent Write-Down			Temporary Write-Down			Equity Conversion		
		Total	Min-trig.	High-trig.	Total	Min-trig.	High-trig.	Total	Min-trig.	High-trig.
Austria	6,966	25	25	-	6,941	6,615	326	-	-	-
	(34)	(1)	(1)	-	(33)	(25)	(8)	-	-	-
Belgium	4,022	-	-	-	4,022	4,022	-	-	-	-
	(4)	-	-	-	(4)	(4)	-	-	-	-
Cyprus	346	-	-	-	-	-	-	346	174	172
	(2)	-	-	-	-	-	-	(2)	(1)	(1)
Denmark	7,126	1,162	35	1,127	3,647	293	3,354	2,317	67	2,250
	(38)	(6)	(3)	(3)	(27)	(15)	(12)	(5)	(2)	(3)
Finland	6,217	-	-	-	3,967	3,467	500	2,250	2,250	-
	(12)	-	-	-	(10)	(9)	(1)	(2)	(2)	-
France	43,426	-	-	-	43,311	43,311	-	115	115	-
	(39)	-	-	-	(38)	(38)	-	(1)	(1)	-
Germany	20,429	1,310	469	841	19,059	17,247	1,812	60	60	-
	(38)	(10)	(5)	(5)	(26)	(17)	(9)	(2)	(2)	-
Greece	727	-	-	-	727	727	-	-	-	-
	(1)	-	-	-	(1)	(1)	-	-	-	-
Iceland	186	-	-	-	86	86	-	100	100	-
	(2)	-	-	-	(1)	(1)	-	(1)	(1)	-
Ireland	2,200	-	-	-	2,200	1,104	1,096	-	-	-
	(4)	-	-	-	(4)	(2)	(2)	-	-	-
Italy	23,835	487	487	-	23,348	21,302	2,046	-	-	-
	(36)	(2)	(2)	-	(34)	(30)	(4)	-	-	-
Luxembourg	148	-	-	-	148	148	-	-	-	-
	(1)	-	-	-	(1)	(1)	-	-	-	-
Netherlands	25,073	5,091	1,091	4,000	11,232	11,232	-	8,750	-	8,750
	(21)	(3)	(1)	(2)	(10)	(10)	-	(8)	-	(8)
Norway	5,565	67	64	3	5,498	5,487	11	-	-	-
	(137)	(6)	(5)	(1)	(131)	(130)	(1)	-	-	-
Portugal	4,253	-	-	-	458	458	-	3,795	3,795	-
	(2)	-	-	-	(1)	(1)	-	(1)	(1)	
Spain	46,362	2,938	1,154	1,784	3,159	3,159	-	40,265	39,411	854
	(47)	(3)	(1)	(2)	(7)	(7)	-	(37)	(36)	(1)
Sweden	8,708	123	123	-	2,835	2,835	-	5,750	5,750	-
	(25)	(4)	(4)	-	(11)	(11)	-	(10)	(10)	-
United Kingdom	99,432	6,150	336	5,814	96	96	-	93,186	-	93,186
	(82)	(9)	(4)	(5)	(2)	(2)	-	(71)	-	(71)
Total Issued	**305,020**	**17,353**	**3,784**	**13,569**	**130,733**	**121,588**	**9,145**	**156,934**	**51,722**	**105,212**
	(525)	**(44)**	**(26)**	**(18)**	**(341)**	**(304)**	**(37)**	**(140)**	**(56)**	**(84)**

I contend that they are of secondary importance if the trigger probability is extremely low. Even if this argument didn't hold, given that 85% of all principal write-down CoCos are equipped with only the *minimum-trigger* level and 67% of all equity conversion CoCos are equipped with higher trigger levels than the regulatory minimum, distinguishing between loss absorption mechanisms would only add unnecessary complexity to the analysis.

4.2 Bank Descriptive Statistics

Out of the 155 banks in the dataset, 69 decided to issue CoCos - 55 banks issued *minimum-trigger* CoCos and 24 issued CoCos with a higher trigger level. Hence, 10 banks have issued both CoCo types. Table 2 reports the number of CoCo issuers and non-issuers by country (Panel (a)) and year (Panel (b)). The columns named *All* report total number of banks per sub-category (Minimum-Trigger Issuers, Higher-Trigger Issuers, Both Type Issuers and Non-Issuers) and the columns named *G-SIB* report the number of G-SIBs per sub-category. Banks that are issuers of both *minimum-trigger* and *higher-trigger* CoCos are only represented in the columns belonging to "Both Type Issuers". Panel (a) clusters banks by country. There are in total 24 different countries in the dataset and for some of them there is no variation in issuer sub-category. I will thus not include country fixed-effects in the regressions, as they would absorb the entire data for such countries. Instead, I use other macro variables as controls. Panel (b) clusters banks by year. Because the paneldata is unbalanced, the total number of banks per year is not equal to the total number of banks in the entire dataset (155). Reasons include that there is no data for some banks in early years and that some banks get acquired or spinned-off during the data horizon. As there is enough variation across sub-categories per year, I use year fixed effects in all my regressions. The columns named *New* report the number of first time issuers of CoCos per issuer sub-category. There has not been any new CoCo issuer in the last year which supports my assumption that, as of December 2022, non-issuers are unlikely to become issuers of CoCos in the future. This is critical for the accuracy of the empirical tests but will also be validated more formally later. CoCo issuing banks are unlikely to become non-issuers in the future (not shown in table). There are only two issuers of *minimum-trigger* CoCos that called their instruments without replacing them with new ones and two issuers of each CoCo class that called their instruments but replaced them with instruments of the other CoCo class.

Banks' annual reports lack specific details on the components of AT1 capital. To assess the proportion of reported Tier 1 capital attributable to CoCos, I manually match outstanding CoCo volumes with balance sheet data. I also introduce a new measure, *Adjusted Tier 1 ratio*, measuring a bank's Tier 1 ratio excluding CoCo volumes, as if these instruments did not count towards Tier 1 capital. Conditional on issuance, CoCos eligible as AT1 capital account for 11.4% of a bank's Tier 1 capital on average, with *minimum-trigger* CoCos and *higher-trigger* CoCos comprising 10.5% and 9.9% of a bank's Tier 1 capital, respectively . For banks with below-median asset size, CoCos account for 9.9%, *minimum-trigger* CoCos for 9.3% and *higher-trigger* CoCos for 10.5% of a bank's Tier 1 capital. (Means are first calculated by bank and then aggregated across banks)

Table(3) provides summary statistics of the explanatory variables calculated separately for issuers and non-issuers of *minimum-trigger* and *higher-trigger* CoCos respectively.

Hypothesis(2) states that banks issue *minimum-trigger* CoCos to meet Basel III requirements, as banks that issue these instruments 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 4 the relationship between *minimum-trigger* CoCo issuing banks' and other banks' Tier 1 ratios over time including and excluding *minimum-trigger* CoCo issuances in the calculation of Tier 1 capital. The figure shows that banks that issue *minimum-trigger* CoCos appear to have equivalent Tier 1 capital ratios to banks that do not issue these instruments in the later years. If *minimum-trigger* CoCo issuance amounts are excluded from the calculation of Tier 1 capital, the average Tier 1

Table 2: Summary Statistics Banks

The table shows the number of Minimum-Trigger Issuers, Higher-Trigger Issuers and Non-Issuers of CoCos by country (Panel A) and year (Panel B). For every issuer category the table reports the number of all banks and the number of G-SIBs respectively. Panel B further reports the number of first-time issuers per category in column *New*.

PANEL A	Total	Minimum-Trigger Issuers		Higher-Trigger Issuers		Both Type Issuers		Non-Issuers	
COUNTRY		All	G-SIB	All	G-SIB	All	G-SIB	All	G-SIB
Austria	**8**	3	-	-	-	1	-	4	-
Belgium	**2**	1	-	-	-	-	-	1	-
Bulgaria	**3**	-	-	-	-	-	-	3	-
Croatia	**2**	-	-	-	-	-	-	2	-
Cyprus	**1**	-	-	-	-	1	-	-	-
Denmark	**10**	1	-	5	-	1	-	3	-
Finland	**5**	1	-	-	-	1	1	3	-
France	**7**	4	3	-	-	-	-	3	-
Germany	**10**	2	1	2	-	-	-	6	-
Greece	**4**	-	-	-	-	-	-	4	-
Hungary	**1**	-	-	-	-	-	-	1	-
Iceland	**1**	1	-	-	-	-	-	-	-
Ireland	**5**	1	-	-	-	1	-	3	-
Italy	**25**	2	-	-	-	2	1	22	-
Malta	**1**	-	-	-	-	-	-	1	-
Netherlands	**5**	1	-	1	1	-	-	3	-
Norway	**23**	17	-	-	-	-	-	6	-
Poland	**10**	-	-	-	-	-	-	10	-
Portugal	**1**	1	-	-	-	-	-	-	-
Romania	**2**	-	-	-	-	-	-	2	-
Spain	**10**	5	1	-	-	2	1	3	-
Sweden	**7**	4	-	-	-	-	-	3	-
United Kingdom	**12**	1	-	6	3	1	-	4	-
Total	**155**	**45**	**5**	**14**	**4**	10	3	**86**	**-**

PANEL B	Total	Minimum-Trigger Issuers			Higher-Trigger Issuers			Both Type Issuers			Non-Issuers	
YEAR		All	New	G-SIB	All	New	G-SIB	All	New	G-SIB	All	G-SIB
2010	**74**	-	-	-	2	2	1	-	-	-	72	9
2011	**81**	-	-	-	2	-	1	-	-	-	79	9
2012	**89**	1	1	-	2	-	1	-	-	-	86	9
2013	**102**	5	4	2	3	1	2	1	1	-	93	6
2014	**104**	13	8	4	6	5	2	2	1	1	83	3
2015	**110**	19	9	4	8	3	4	5	3	2	78	-
2016	**113**	23	4	4	10	1	4	4	-	2	76	-
2017	**115**	28	7	3	9	-	4	4	1	3	74	-
2018	**120**	32	6	4	13	3	4	5	1	2	70	-
2019	**120**	38	6	4	13	-	4	5	-	2	64	-
2020	**117**	40	3	5	15	2	4	5	1	1	57	-
2021	**109**	41	4	5	15	1	4	5	-	1	48	-
2022	**105**	39	-	5	15	-	4	5	-	1	46	-

Table 3: This table reports means for the independent variables of interest and controls calculated separately for banks that issue only *minimum-trigger*, banks that issue only *higher-trigger* (Panel (a)) banks that issue both types of CoCos (Panel (b)) versus non-issuers of CoCos. The independent variables of interest are: Delta CoVaR, Tier 1 Capital Ratio and *Adjusted Tier 1 Capital Ratio*, ROE and ROA. Controls: ROA^2,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% level. Data is in annual frequency from 2006 to 2022. Statistically significant differences at the 10% , 5% , and 1% level are indicated with *, **, and ***, respectively.

Panel (a)

	Minimum-Trigger Issuers			Higher-Trigger Issuers		
	Issuers Mean	Nonissuers Mean	Difference	Issuers Mean	Nonissuers Mean	Difference
Delta CoVaR (%)	0.72	0.56	0.16***	0.73	0.56	0.17**
Tier 1 Ratio (%)	15.34	15.47	-0.13	15.65	15.47	0.18
Adjusted Tier 1 Ratio (%)	14.32	15.43	−1.11	14.4	15.43	−1.04
ROE (%)	8.44	5.44	3**	5.27	5.44	-0.17
ROA (%)	0.7	0.63	0.07	0.35	0.63	-0.28**
Net Loans to Assets (%)	66.19	55.6	10.59***	53.19	55.6	−2.42
Impaired Loans to Net Loans (%)	3.71	9.53	-5.81***	5.65	9.53	-3.88
Log(Total Assets (USD mm))	10.49	9.57	0.92 **	11.86	9.57	2.29 ***
ROA^2	0.85	1.92	-1.07 ***	0.61	1.92	-1.32***
GDPP (USD tsd)	59.67	39.38	20.29***	50.26	39.38	10.88***
Number of Banks	55	96		12	96	

Panel (b)

	Both Type Issuers		
	Issuers	Nonissuers	
	Mean	Mean	Difference
Delta CoVaR (%)	0.84	0.56	0.28***
Tier 1 Ratio (%)	14.5	15.47	-0.97
Adjusted Tier 1 Ratio (%)	12.93	15.43	−-2.5**
ROE (%)	5.29	5.44	-0.15
ROA (%)	0.41	0.63	-0.22
Net Loans to Assets (%)	58.02	55.6	2.42
Impaired Loans to Net Loans (%)	9.8	9.53	0.27
Log(Total Assets(USD mm))	12.05	9.57	2.48 ***
ROA^2	0.82	1.92	-1.11 ***
GDPP(USD tsd)	44.55	39.38	5.17
Number of Banks	10	96	

capital ratio of *minimum-trigger* CoCo issuers is lower than the one of non-issuers. This is a first indication that banks who issue *minimum-trigger* CoCos have a lower capitalization than other banks absent CoCo issuance amounts. Figure 5 shows the relationship between *higher-trigger* CoCo issuing banks' and non-issuing banks' Tier 1 ratios over time including and excluding *higher-trigger* CoCo issuances in the calculation of Tier 1 capital. The figure shows that banks that issue *higher-trigger* CoCos appear to have higher Tier 1 capital ratios relative to banks that do not issue these instruments after 2017.

Figure 4: Time-series plot of equally-weighted Tier 1 capital ratios for issuers of *minimum-trigger* CoCos and non-issuers of CoCos from 2006 to 2022. The green solid line plots average Tier 1 capital ratios of banks that have never issued CoCos. The purple and orange dashed lines show average Tier 1 capital ratios of CoCo issuers with and without *minimum-trigger* CoCo issuance amounts respectively. The orange dashed line excludes *minimum-trigger* CoCo issuance amounts for the calculation of Tier 1 capital and thus reports the *Adjusted Tier 1 Ratio* as if *minimum-trigger* CoCos did not count towards Tier 1 capital.

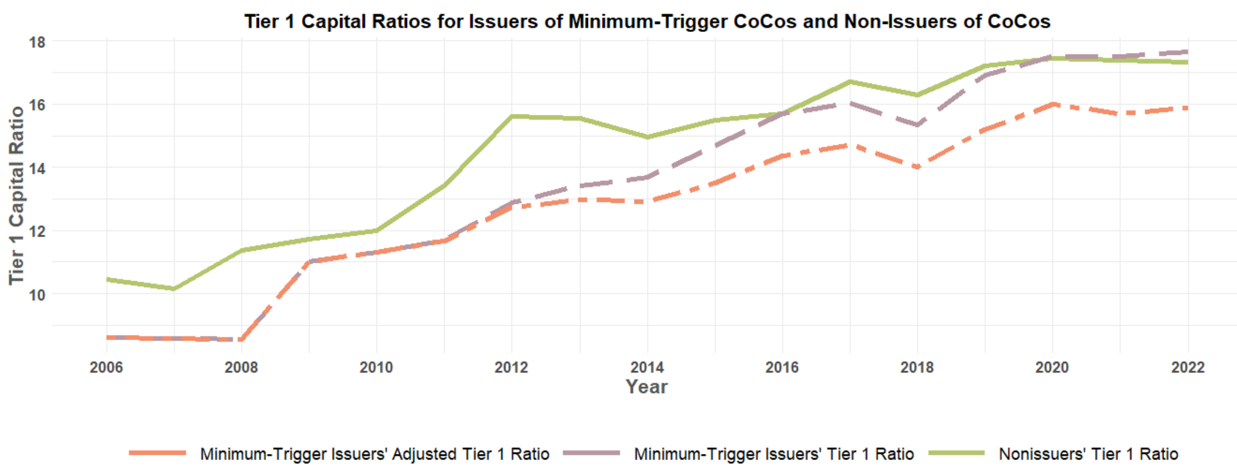
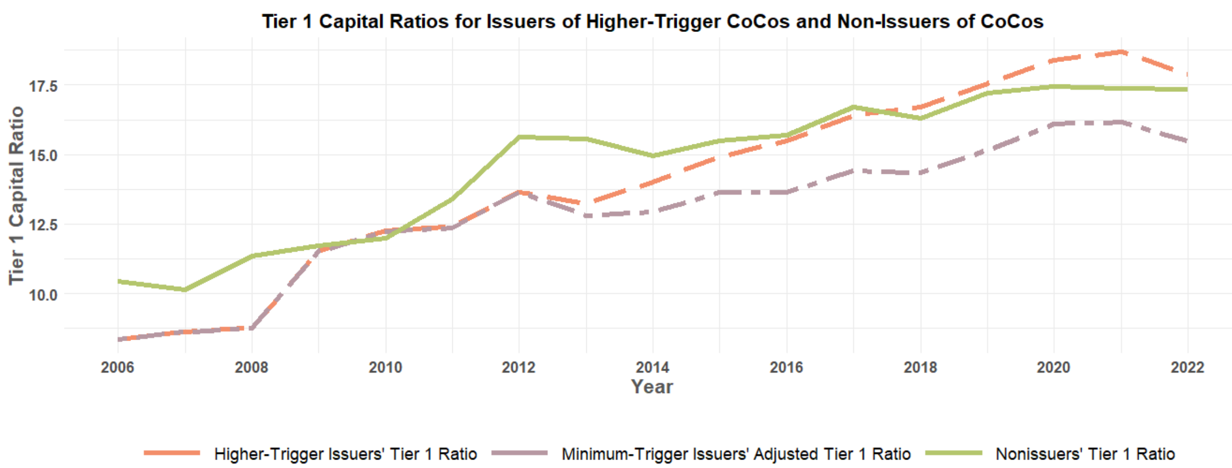


Figure 5: Time-series plot of equally-weighted Tier 1 capital ratio for issuers of *higher-trigger* CoCos and non-issuers of CoCos from 2006 to 2022. The green solid line plots average Tier 1 capital ratios of banks that have never issued CoCos. The purple and orange dashed lines show average Tier 1 capital ratios of CoCo issuers with and without *higher-trigger* CoCo issuance amounts respectively. The orange dashed line excludes *higher-trigger* CoCo issuance amounts for the calculation of Tier 1 capital and thus reports the *Adjusted Tier 1 ratio* as if *higher-trigger* CoCos did not count towards Tier 1 capital.



5 Empirical Analysis

Why don't all banks issue minimum-trigger CoCos? and *Why do some banks issue more expensive CoCos than the regulatory minimum?* To answer these questions, I analyse a bank's propensity to issue and hold *minimum-trigger* and *higher-trigger* CoCos. In the following subsections, I present findings in support of my hypotheses that banks hold *minimum-trigger* CoCos for three main 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 and hold *minimum-trigger* CoCos is a combination of these three reasons. In contrast, I do not expect these variables to explain the issuance and holding of *higher-trigger* CoCos but I include various control variables that might help explain why some banks are willing to issue relatively more expensive CoCos than the regulatory minimum.

The explanatory variables of interest are the ones used to test hypotheses H1 to H3:

H1. *Delta CoVaR*: The contribution to systemic risk of the overall financial system by the bank developed by Adrian and Brunnermeier (2011). The measure is the market Value-at-Risk conditional on the financial institution being financially distressed.

H2. *(Adjusted) Tier 1 Capital Ratio*: I consider Tier 1 capital ratios and *Adjusted Tier 1* capital ratios in separate settings.

H3. *ROE* and *ROA*: The joint consideration of return on assets and return on equity is used to identify earnings management practices, as ROE is a multiplicative result of ROA and leverage.

Furthermore, I control for the following variables:

$\beta 5$. *ROA^2*: Return on assets squared is added to capture non-linear effects in bank profitability and mitigate multicollinearity concerns from including both ROA and ROE in the regressions.

$\beta 6$. *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).

$\beta 7$. *Impaired Loans to Net Loans (ILL)*: I use impaired loans to net loans as a proxy for loan quality.

$\beta 8$. *Total Assets* (TA): I use the natural logarithm of total assets as a proxy for bank size.

$\beta 9$. *G-SIB status (GSIB)*: A dummy variable taking on value 1 if the bank is a global systemically important bank.

$\beta 10$. *GDP per Capita (GDPP)*: A control for macroeconomic factors that are important determinants of default probabilities per country.

Table 4 shows the pairwise correlations between the explanatory variables.[19] The only greater correlation is between ROA and ROE (0.687), as ROE is a function of ROA and leverage. The correlation coefficient is still below the absolute correlation cutoff of 0.8 to speak of multicollinearity, but nevertheless I add ROA^2 to the regressions to capture non-linear effects.

[19] In unreported results, I replace Tier 1 Ratio by Adjusted Tier 1 Ratio. The correlations do not vary beyond two decimal places.

Table 4: Cross-Correlation Table of independent variables used in the empirical analysis

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Delta CoVaR	1	−0.147	0.013	−0.033	−0.059	−0.210	0.383	0.046
(2) Tier 1 Ratio	−0.147	1	0.051	0.129	−0.171	−0.064	−0.220	0.044
(3) ROE	0.013	0.051	1	0.687	−0.014	−0.240	−0.027	0.084
(4) ROA	−0.033	0.129	0.687	1	0.003	−0.256	−0.165	0.085
(5) Net Loans to Assets	−0.059	−0.171	−0.014	0.003	1	−0.020	−0.224	0.303
(6) Impaired Loans to Net Loans	−0.210	−0.064	−0.240	−0.256	−0.020	1	−0.113	−0.292
(7) Log(Total Assets)	0.383	−0.220	−0.027	−0.165	−0.224	−0.113	1	−0.196
(8) GDPP	0.046	0.044	0.084	0.085	0.303	−0.292	−0.196	1

5.1 Fama and MacBeth Logistic Regression

I run the following logistic regression to analyze which factors play a role for the issuance of CoCos:

$$\begin{aligned} CoCo\ Issuer_i = \alpha + \beta_1 * DeltaCoVaR_{i,t} + \beta_2 * Tier1_{i,t} + \beta_3 * ROE_{i,t} + \beta_4 * ROA_{i,t} \\ + \beta_5 * ROA^2_{i,t} + \beta_6 * LTA_{i,t} + \beta_7 * ILL_{i,t} + \beta_8 * TA_{i,t} \\ + \beta_9 * GSIB_{i,t} + \beta_{10} * GDPP_{c,t} + \varepsilon_{i,t} \end{aligned} \tag{17}$$

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 (if the bank is a CoCo issuer) divided by the probability of the dummy variable taking on value 0 (if the bank is no CoCo issuer): $CoCo\ Issuer_i = log\left(\frac{Prob(Y=1)}{1-Prob(Y=1)}\right)$.

The regression residuals are likely to be cross-sectionally correlated: from Figure 4 we know for example that Tier 1 capital ratios are increasing over time. If one bank's Tier 1 capital is relatively high in a given year, another bank's Tier 1 capital is likely to be also high. To account for this, I run the regression using the Fama and MacBeth (1973) procedure for panel data as in Fama and French (2000). I run year-by-year cross-sectional regressions and then take the average coefficients and time-series standard errors for inference. In this procedure, the intercept α_t captures year fixed effects. I follow Hong et al. (2019) and use Newey-West standard errors as they have a lower bias than Fama-MacBeth standard errors when there is additional time-series correlation (Petersen, 2008).

Table 5 reports the results of the Fama and MacBeth Logistic Regression for Minimum-Trigger Issuers and Higher-Trigger Issuers respectively. In column (1) and (4), the binary dependent variable takes on value 1 before an issuer issued CoCos for the first time. Issuers leave the system after issuance. In the other columns, the binary dependent variable takes on value 1 after an issuer issued CoCos for the first time. Issuers enter the system after issuance. The control group for both issuer types are only non-issuers of CoCos. I do not compare *minimum-trigger* and *higher-trigger* CoCo issuers with one another in this part of the analysis. In the columns named *Pre-Issuance*, the table gives insights into CoCo issuers Tier 1 capital ratios, systemic risk levels and earnings management practices before the issuance of the hybrid instruments. Column (1) reports the results for *minimum-trigger* CoCo issuers and column (4) for *higher-trigger* CoCo issuers. Before any issuances, *minimum-trigger* CoCo issuing banks exhibit significantly higher systemic risk and lower Tier 1 capital ratios than non-issuers. The banks also have a significantly higher fraction of net loans to assets, a significantly lower fraction of impaired loans to net loans and are significantly more likely to be G-SIBs and large institutions than non-issuers of CoCos. Banks issuing *higher-trigger* CoCos are also more likely to be G-SIBs and large institutions, but they have a higher fraction of impaired loans to net loans and a lower fraction of net loans to assets before the issuance of CoCos than non-issuers. Their Tier 1 ratios and systemic risk levels are not significantly different from non-issuer of CoCos. The columns named *Post-Issuance* analyse bank characteristics for the holding of CoCos. Columns (2) and (3) report the results for *minimum-trigger* CoCo issuers and columns (5) and (6) for *higher-trigger* CoCo issuers. For each issuer category, CoCos are once included (columns (2) and (5)) and once excluded (columns (3) and(6)) from the calculation of Tier 1 capital. After the issuance, holders of *minimum-trigger* CoCos remain to have high systemic risk. They also manage to report a higher ROE when controlling for both ROA and ROA^2, an indicator for earnings management practices. By incorporating CoCos in their capital structure, *minimum-trigger* CoCo issuing banks effectively achieve to report Tier 1 capital ratios on par with their peers, as seen in column (2). However, excluding CoCo volumes in column (3), these banks continue to have significantly lower *Adjusted Tier 1 Capital* ratios. Minimum-trigger CoCo issuers continue to have a higher loan activity and a better loan quality. Higher-Trigger Issuers exceed peers' Tier 1 ratios after the issuance of CoCos (column (5)). The holding of *higher-trigger* CoCos types is correlated significantly higher loan activity. Size and G-SIB status seem to positively influence the holding of both CoCo types.

5.2 Multinomial Logistic Regression

In this section I run a multinomial logistic regression 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 excluding CoCo issuance amounts and not to reduce risk or leverage. If banks issued *minimum-trigger* CoCos to have a safety net when being financially distressed, *minimum-trigger* CoCos should be issued by less systemically risky and less under capitalized banks than CoCos with a higher trigger level - but the data supports the opposite.

In the multinomial logistic regression, I analyse three different Tier 1 composition decisions of a bank: only *minimum-trigger* CoCos, only *higher-trigger* CoCos and both CoCo types. The multinomial logit model estimates how bank characteristics affect the three choices. The parameter estimates are then interpreted relative to the reference category, "Minimm-Trigger CoCos".

$$P(Type_i = j|\mathcal{F}) = \frac{e^{(\alpha_j + \beta_{1,j} * DeltaCoVaR_{i,t} + \beta_{2,j} * Tier1_{i,t} + \beta_{3,j} * ROE_{i,t} + \beta_{4,j} * ROA_{i,t} + \gamma_j \mathcal{X}_{i,t})}}{\sum_{k=0}^{3} e^{(\alpha_k + \beta_{1,k} * DeltaCoVaR_{i,t} + \beta_{2,k} * Tier1_{i,t} + \beta_{3,k} * ROE_{i,t} + \beta_{4,k} * ROA_{i,t} + \gamma_k \mathcal{X}_{i,t})}} \quad (18)$$

Table 5: Fama-MacBeth logistic regression results of Equation(17). The dependent variable is a dummy that takes on the value 1 before an issuer issues CoCos in the columns named Pre-Issuance. Issuers leave the system after issuance. For the other columns is the dependent variable a dummy that takes on the value 1 after an issuer issues CoCos. Issuers enter the system in the year of issuance. Columns (1)-(3) reports the results for *minimum-trigger* CoCo issuers and column (4)-(6) for *higher-trigger* CoCo issuers. Data is in annual frequency from 2006 to 2022. Newey-West standard errors are in parentheses below.

	Minimum-Trigger Issuers			*Higher-Trigger Issuers*		
	Pre-Issuance	Post-Issuance		Pre-Issuance	Post-Issuance	
	(1)	(2)	(3)	(4)	(5)	(6)
Delta CoVaR (%)	3.931***	3.929**	2.69***	2.077	3.783	4.141
	(0.795)	(1.654)	(0.493)	(1.313)	(3.07)	(3.069)
Tier 1 Ratio (%)	-0.219**	-0.078		-0.206	0.168***	
	(0.097)	(0.048)		(0.127)	(0.022)	
Adjusted Tier 1 Ratio (%)			-0.499**			-0.097
			(0.145)			(0.068)
ROE (%)	-0.042	0.036**	0.065**	0.038	0.01	-0.005
	(0.056)	(0.015)	(0.02)	(0.036)	(0.056)	(0.057)
ROA (%)	3.822**	5.95***	6.823**	5.401*	1.37	1.328
	(1.636)	(1.529)	(2.665)	(2.739)	(1.579)	(1.447)
ROA^2	-3.014***	-2.645**	-2.607*	-3.369**	-1.313**	-1.243**
	(0.94)	(0.939)	(1.192)	(1.264)	(0.498)	(0.399)
Net Loans to Assets (%)	0.037***	0.098**	0.08*	-0.069***	0.031***	0.015*
	(0.011)	(0.03)	(0.036)	(0.019)	(0.007)	(0.007)
Impaired Loans to Net Loans (%)	-0.236**	-0.172**	-0.162**	0.255***	0.041	0.025
	(0.089)	(0.058)	(0.061)	(0.069)	(0.024)	(0.033)
Log(Total Assets (in USD mm))	0.773***	1.175***	1.212**	0.879***	1.104***	0.917***
	(0.174)	(0.194)	(0.394)	(0.167)	(0.115)	(0.065)
G-SIB	16.843***	18.448***	18.462***	19.538***	18.969***	18.434***
	(1.219)	(1.567)	(2.389)	(0.706)	(0.656)	(0.524)
GDPP (in USD tsd)	0.107***	0.089***	0.125***	0.209***	0.094***	0.106***
	(0.011)	(0.009)	(0.019)	(0.033)	(0.015)	(0.019)
Year FE	YES	YES	YES	YES	YES	YES
Observations	950	750	750	834	759	759

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

The dependent variable $Type_i$ can take on three different values, 0 to 2 for the respective categories ("only *minimum-trigger* CoCos"=0, "only *higher-trigger* CoCos"=1 and "both CoCo types"=2).

The left hand side of the regression estimates the log of the odds, i.e. the log of the probability of the dependent variable taking on value 1 or 2 relative to the dependent variable taking on value 0. The model is estimated by the maximum likelihood estimator. The regression includes time fixed effects and clustered standard errors at the bank level.

Table 6 reports the results for the multinomial logistic regression analyzing the decision to issue *minimum-trigger* CoCos relative to issue *higher-trigger* CoCos and both types of CoCos. Pre-Issuance and post-issuance, *minimum-trigger* CoCo issuing banks have significantly higher systemic risk and lower Tier 1 capital ratios than *highter-trigger* CoCo issuing banks. One might argue banks issue *minimum-trigger* CoCos to have a going-concern safety net when being financially distressed. If this was the case, banks with relatively high systemic risk levels and low Tier 1 capital ratios should more extensively issue CoCos with a higher trigger level than the regulatory minimum. It is alarming that systemically riskier banks tend to issue *minimum-trigger* CoCos while systemically less risky banks tend to issue CoCos with a higher trigger level. 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 even more likely to default. Equivalently, banks with the lowest *Tier 1* capital ratio are more prone to issue *minimum-trigger* CoCos than *higher-trigger* CoCos. The results confirm that constrained banks issue CoCos equipped with the *minimum-trigger* level instead of other capital while unconstrained banks issue CoCos equipped with a higher trigger level on top of other capital.

Table 6: This table reports multinomial logistic regression results of Equation(18) with three categories: Higher-Trigger CoCos (a), Minimum-Trigger CoCos (b), Both CoCos (c). All explanatory variables are one year lagged. Data is in annual frequency from 2006 to 2022. Standard errors are clustered at the bank level.

	b. Higher-Trigger Issuers			*Both Type Issuers*		
	Pre-Issuance	Post-Issuance		Pre-Issuance	Post-Issuance	
	(1)	(2)	(3)	(4)	(5)	(6)
Delta CoVaR (%)	-3.549***	-1.221**	-1.256**	-0.781	0.302	0.290
	(1.335)	(0.509)	(0.537)	(1.063)	(0.425)	(0.446)
Tier 1 Ratio (%)	0.371***	0.203***		-0.005	0.068	
	(0.108)	(0.079)		(0.224)	(0.122)	
Adjusted Tier 1 Ratio (%)			0.206**			0.093
			(0.082)			(0.131)
ROE (%)	0.037	-0.097	-0.062	-0.393***	-0.186**	-0.203**
	(0.057)	(0.123)	(0.114)	(0.130)	(0.088)	(0.087)
ROA (%)	-0.074	0.366	-0.282	9.836***	2.803**	2.949**
	(0.825)	(1.967)	(1.824)	(3.090)	(1.230)	(1.282)
ROA^2	-0.033	-1.300	-1.206	-0.970	-0.211	-0.228
	(0.140)	(1.552)	(1.461)	(0.976)	(0.204)	(0.207)
Net Loans to Assets (%)	-0.055*	-0.016	-0.019	-0.049	0.011	0.012
	(0.030)	(0.033)	(0.033)	(0.050)	(0.042)	(0.042)
Impaired Loans to Net Loans (%)	0.140**	-0.015	-0.029	0.328***	0.217**	0.230**
	(0.068)	(0.098)	(0.108)	(0.107)	(0.091)	(0.106)
Log(Total Assets (in USD mm))	0.099	0.178	0.128	-0.403	0.688*	0.725*
	(0.354)	(0.323)	(0.305)	(0.451)	(0.390)	(0.418)
G-SIB	0.211	0.375	0.298	0.880	-0.330	-0.354
	(1.064)	(1.175)	(1.192)	(1.387)	(1.188)	(1.137)
GDPP (in USD tsd)	-0.034	0.001	-0.005	-0.074***	-0.005	-0.010
	(0.023)	(0.019)	(0.018)	(0.026)	(0.038)	(0.043)
Constant	-0.566	-4.196	-2.242	5.813	-12.053	-13.283
	(5.537)	(5.884)	(5.635)	(10.139)	(7.866)	(8.691)
Year FE	YES	YES	YES	YES	YES	YES
Observations	388	436	436	388	436	436

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

6 Conclusion

This study investigates why not all banks issue *minimum-trigger* CoCos and finds that constrained banks, with relatively low Tier 1 capital ratios are issuing these instruments. These banks exhibit higher systemic risk levels and utilize CoCos to engage more in earnings-targeting. By allowing CoCos with a 5.125% trigger level to count towards Tier 1 capital, Basel III gave these banks a tool which is cheaper than equity but has little going-concern character. *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. I further find that banks issuing *higher-trigger* CoCos do not exhibit any of these characteristics and are better capitalized than peers after the issuance.

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. 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 current regulatory minimum of 5.125%.

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Appendix

Appendix A: Issues with CoCos

The trigger levels of CoCos have so far never been breached 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 of 10.02% 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. Arguably, the 5.125% trigger level for Banco Popular's CoCos was set too low for the instruments to be different from junior debt.

On March 19, 2023, the Swiss regulator FINMA declared a "Viability Event" for Credit Suisse and instructed the bank to write-down its AT1 CoCos with a par value of $17.3bn and a market value of $8bn. In contrast to the Banco Popular event, equity was not wiped out. During the press conference on March 19, 2023, FINMA also announced the purchase of Credit Suisse by UBS to avert resolution procedures.[20] AT1 CoCos are designed to recapitalize banks in a going-concern way and the Swiss regulator has discretion to declare a bank "failing or likely to fail" if extraordinary government support is provided[21], due to a special clause in Swiss CoCos' prospectuses. This was the case for Credit Suisse's CoCos, as the Swiss National Bank pledged to provide liquidity assistance up to CHF 50bn on March 16, 2023. Some market participants argued that the CoCo write-down violated the creditor hierarchy as equity should take losses first in resolution but equity investors retained $3bn. However, Credit Suisse was not in a resolution. From a prudential perspective, CoCos need to take losses

[20] Seehttps://www.ft.com/content/4f0c9cc8-192c-4b2b-bd78-4943d23b17a3

[21] The statement by FINMA about the decision to write down AT1 capital instruments can be found here: https://www.finma.ch/en/news/2023/03/20230323-mm-at1-kapitalinstrumente)

before equity as going concern instruments. Otherwise, they would only be subordinated debt and useless for regulatory purposes. Following the events, other financial authorities such as the European Central Bank, the Bank of England, the Office of the Superintendent of Financial Institutions (Canada) and the Monetary Authority of Singapore announced that in a resolution the authorities would honour creditor hierarchy, to avoid further market turmoil. My simple model in Section 3 incorporates the distinction between CoCos being triggered before resolution and not being triggered once the bank enters resolution. Ideally, Credit Suisse's CoCos would have been triggered automatically without the intervention of FINMA, but the bank last reported a CET1 ratio of 14.1% in December 2022, too high for its CoCos to be triggered.

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).

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 problem but issue *minimum-trigger* CoCos for other reasons than to lower their bank's probability of default.