Anything but Equity -
On Banks' Preference for Hybrid Debt

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Abstract

Contingent Convertible Bonds (CoCos) are a tool for banks to partly fulfil Tier 1 capital requirements. While these instruments are a cheaper source of funding than equity, only some banks have 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. After the issuance, these banks effectively achieve Tier 1 ratios on par with similar banks but remain to have higher systemic risk levels and more intense earnings management practices than peers. Tier 1-eligible CoCos with better loss absorption abilities are issued by larger banks and G-SIBs when facing a higher fraction of impaired loans on their balance sheet. These banks utilize CoCos to offset risk weights and hedge against potential losses resulting from non-performing loans. The results shed light on banks' capital structure choices and their implications for regulatory policy and financial stability.

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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 (AT1) Contingent Convertible Bonds (CoCos) as a tool for banks to meet part of their regulatory requirements. As of December 2022, banks in the European Economic Area (EEA) have issued $358bn worth of AT1 CoCos. But only 41% of banks in the jurisdiction include these instruments in their capital structure. Conditional on issuance, the hybrid instruments constitute 12.33% of a bank's Tier 1 capital on average. But many institutions prefer to fulfil capital requirements without CoCos. 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?*

Tier 1 capital consists of two components, Common Equity Tier 1 (CET1) capital and Additional Tier 1 (AT1) capital. Under Basel III, CET1 capital must represent at least 4.5% of a bank's risk-weighted assets (RWA) and Tier 1 capital at least 6%. 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 trigger is at least 5.125% (measured in terms of 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 a capital conservation buffer of 2.5% and a countercyclical buffer within a range of 0-2.5%[1] on top of the minimum capital requirement of 4.5% (all in terms of CET1 to RWA). To Global Systemically Important Banks (G-SIB) another buffer of 1% to 2.5% and to Other Systemically Important Institutions (O-SII) a buffer of 0.25% to 2% is added (both in terms of CET1 to RWA). If a bank reports a CET1 ratio below its combined buffer requirement, it can, among other things, no longer pay out dividends, conduct share repurchases, make coupon payments to AT1 instrument holders, or set up new obligations for bonus payments and pension rights until the buffer is restored. CoCos equipped with this minimum-trigger of 5.125%, hereafter referred as *minimum-trigger CoCos*, are issued by about 82% 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 one third of all CoCo issuing banks[2] and most of these CoCos (92%) 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.[3] Thus, another question emerges: *Why are some banks willing to issue more expensive CoCos, equipped with trigger levels higher than the regulatory minimum?*

I create a comprehensive dataset covering 91% of all AT1 CoCo issuance volumes in the

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

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

[3]This is because almost all CoCos issued so far offer a wealth transfer from CoCo holders to equity holders when the bank's CET1 ratio hits the trigger level. In such cases, CoCo investors will lose their investment if the CoCo is equipped with a principal write-down feature. For some contracts, this is only temporary, until the CET1 ratio recovers. CoCo investors of instruments with an equity-conversion feature will also be most likely diluted upon conversion. Berg and Kaserer (2015) show this is because conversion rates are based on book-values of equity and market values tend to decline earlier and more rapidly than book values.

EEA issued by 67 banks until the end of 2022 and use 96 non-CoCo issuing banks as control to answer why only some banks are utilizing CoCos[4] and why some of the issuers prefer more expensive hybrids with higher trigger levels than the regulatory minimum. I provide a binomial model that illustrates varying choices in Tier 1 capital composition, either consisting solely of equity or including CoCos with certain trigger levels, yield distinct impacts on a bank's return on debt and equity and its default probability given uncertain conversion or write-down of CoCos. The model shows that in the presence of bankruptcy costs, hybrid debt is a poorer capital buffer than equity, resulting in a higher required return on debt. In my empirical analysis covering the period 2006 to 2022, 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-MacBeth 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, lower Tier 1 capital ratios and higher return on equity (ROE) compared to return on assets (ROA), 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. Without CoCo holdings, these institutions would persistently have inferior Tier 1 capital ratios than other banks. In contrast, banks issuing higher-trigger CoCos do not exhibit any of the aforementioned characteristics. These banks are generally larger and more likely to be classified as global systemically important banks (G-SIBs) than non-issuers of CoCos. The holding of higher-trigger CoCos correlates with a higher proportion of impaired loans on the balance sheets. Given that non-performing loans (NPLs) increase a bank's risk-weighted assets and thereby worsen capital ratios[5], particularly G-SIBs facing higher capital requirements might benefit from the issuance of CoCos. Issuing higher-trigger CoCos may thus serve to offset these

[4]For brevity I use the term CoCos and AT1 CoCos interchangeably. Thus, I ignore CoCos that only constitute Tier 2 capital without loss of generality for this study.

[5]As RWA is the numerator for both, the CET1 and Tier 1 capital ratio.

increased risk weights, allowing these banks to maintain a Tier 1 capital ratio in line with their peers. As the issuance of minimum-trigger CoCos would have the same positive effect on the Tier 1 ratio, higher-trigger CoCos could additionally function as a hedge against potential losses arising from NPLs. If a bank's CET1 ratio would indeed fall below the CoCo trigger level, the CoCo's conversion or write-down feature helps to restore the bank's capitalization. I also 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 than the regulatory minimum - but the data supports the opposite.

This paper 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. 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 capital requirements. A bank that decided to issue minimum-trigger CoCos might have different characteristics than a bank that finances itself with other forms of Tier 1 capital, even before and after the the year of CoCo issuance. 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.

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) address 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

[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%. 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.

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.

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]

This paper has five more sections. Section(2) contains the hypothesis development on which factors play a role in minimum-trigger CoCo issuances. Section(3) provides a binomial model of bank asset returns. Section(4) presents an overview of the data, Section(5) contains the main findings of the empirical analysis and Section(6) concludes. Moreover, Appendix A outlines certain concerns related toCoCos.

2 Hypothesis Development

As not all banks are utilizing minimum-trigger CoCos, I am concerned that the banks that do, do not issue them to weather financial turmoils but for three other reasons that I summarize

[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. In a similar study, Fajardo and Mendes (2020) discuss the motivation for emerging economies and developed countries to issue CoCo bonds and find that particularly large and highly leveraged banks issue such instruments. All three studies conclude that banks issue CoCos to reduce indebtedness. If this was true, the most levered banks should issue CoCos with the highest trigger levels, but I find the opposite relationship in the data.

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**). This concern is of economic importance, as AT1 CoCo issuances[8] in the EEA amount to $358bn with the minimum trigger level of 5.125 being prevalent in 74.9% of all issuances. The hypotheses are based on the following studies and statements.

First, 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. TruPS have some similarities with CoCos, as the instruments were eligible as Tier 1 capital and also had a tax-advantage relative to equity. Similar to the authors, I argue that a bank not constrained by capital requirements has no reason to issue CoCos. If it wants to increase leverage, it can do so by issuing subordinated debt with a lower coupon than required for CoCos. The same rationale applies to the tax advantage associated with hybrid instruments, as subordinated debt also enjoys these benefits.

Second, 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.

The third hypothesis is 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

[8]Data on AT1 CoCo issuances are obtained from Bloomberg spanning the period 2006 to 2022.

instruments would, unlike equity, not dilute ROE.[9]. 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.

The three hypotheses are tested in my empirical setting 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.

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

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 require an increase in Tier 1 capital. The bank can choose between equity and CoCos equipped with the minimum trigger level or equipped with 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 issued 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:

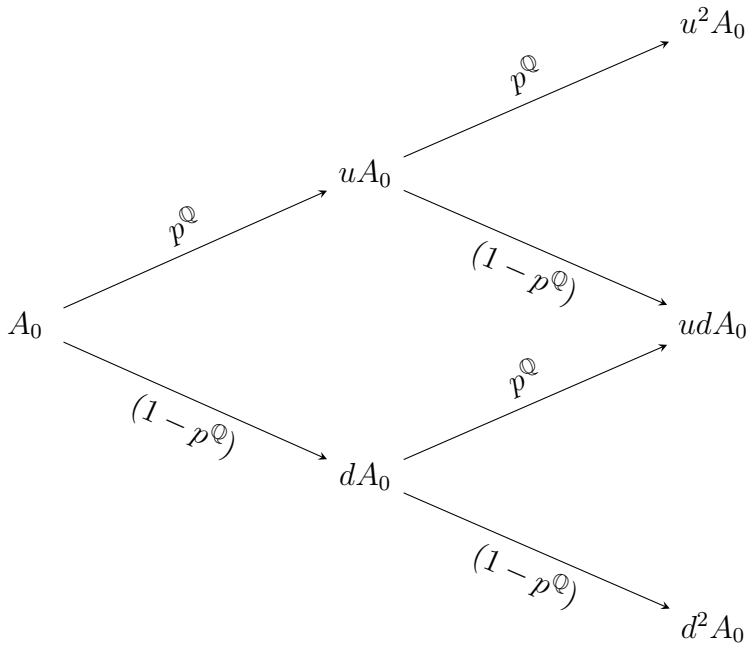
$$\mathbb{E}_t(M_{t,t+1}X_{t+1}) = \frac{1}{(1+r_f)}\mathbb{E}_t^{\mathbb{Q}}(X_{t+1}) \tag{1}$$

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:

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

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[10]:

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

Plugging in Equation(6)[11] we get the parametric restriction on the banks' leverage ratio:

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

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 $AT1_0$, and can choose between equity and CoCos equipped with the minimum-trigger level or a higher

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

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

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[12], 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.[13] Undoubtedly, the trigger probability is lower for minimum-trigger CoCos than for CoCos with a higher trigger level, i.e. $\pi^{low} < \pi^{high}$ 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[14] or converted into equity,

[12] 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.

[13] 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.

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

the bank will not default at t=2.[15] 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. Hence, the promised gross returns satisfy:

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

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

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 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 $R_J^{*\delta}$, in the presence of

simplicity.

[15] 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.

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 now 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 (5) 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 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

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 $u = 1/d = \mathrm{e}^{0.2}$, $R_f = 1$, $D_0/E_0 = 10/3$, $J_0/E_0 = 1/6$ and δ=80%.

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 new Tier 1 capital the fair promised return of senior debt decreases for all trigger probabilities π, but the fair promised return of junior debt only decreases for trigger probabilities higher than 17% in this illustration. 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 or are written down 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 added 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 - 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 $c^A < c^B < \frac{NI*E^A}{E+E^A}$[16], 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.[17]

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

In my empirical analysis, I focus on banks on the fully consolidated level in the EEA and do not incorporate insurance companies or shadow banks. 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 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

[16] see Section(**??**) for derivation.

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

Focus. My data spans from 2006 to 2022 and also includes years before the first CoCo issuances. I cover 163 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 subjected the CoCo and bank balance sheet data to careful scrutiny. This includes supplementing the CoCo data with hand-collected data from prospectuses and other reports and extending and correcting balance sheet data with assistance from annual reports. I then match CoCo issuances with banks by hand, as some CoCos were issued by special-purpose entities whose parents could not be identified manually. I pay special attention to not falsely mark a non-CoCo issuer as issuer and vise versa. The final dataset covers 91% of all CoCo issuance volumes in the EEA issued by 67 banks until the end of 2022.[18]

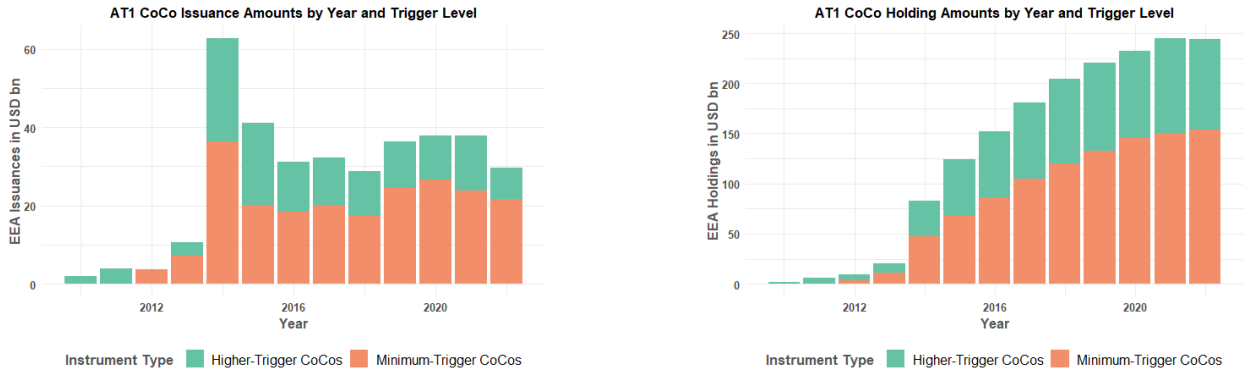
4.1 CoCo Descriptive Statistics

A look into the data of all EEA AT1 CoCo issuances until the end of December 2022 shows that 74% (61% 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 92% (94% if weighted by volume) of all remaining CoCo issuances. Other trigger levels range between 5.25% and 9%. Banks issued 577 AT1 CoCos with a total face-value of $358bn between 2010 and 2022. 425 issuances are still active with an outstanding amount of $241bn 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

[18]The final dataset covers 70% of all CoCos. This is because some small banks could not be fetched from Orbis Bank Focus, are not incorporated in the data by Gehrig and Iannino (2021) or were dropped because of missing information about crucial CoCo or issuer characteristics.

with CoCos. While in the first two years only higher-trigger CoCos, with a trigger level higher than 5.125%, were issued, minimum-trigger CoCos dominate issuance amounts since 2012. 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 issuance amounts in Panel (a) do not align with the holding amounts in Panel (b).

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

Out of the 163 banks in the dataset, 67 banks decided to issue CoCos - 55 banks issued minimum-trigger CoCos and 22 issued CoCos with a higher trigger level. Hence, 10 banks have issued both CoCo types. 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 the 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 12.3% of a bank's Tier 1 capital on average, with minimum-trigger CoCos and higher-trigger CoCos comprising 11.7% and 10% of a bank's Tier 1 capital, respectively (means are first calculated by bank and then aggregated across banks).

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(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. 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 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 minimum-trigger CoCo issuance amounts. Figure(5) shows a similar 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.

5 Empirical Analysis

Why don't all banks issue minimum-trigger CoCos? To answer this question, I analyse a bank's propensity to issue and hold (minimum-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.

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

Figure 4: Time-series plot of equally-weighted Tier 1 capital ratio for issuers of minimum-trigger CoCos and non-issuers of CoCos from 2010 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.

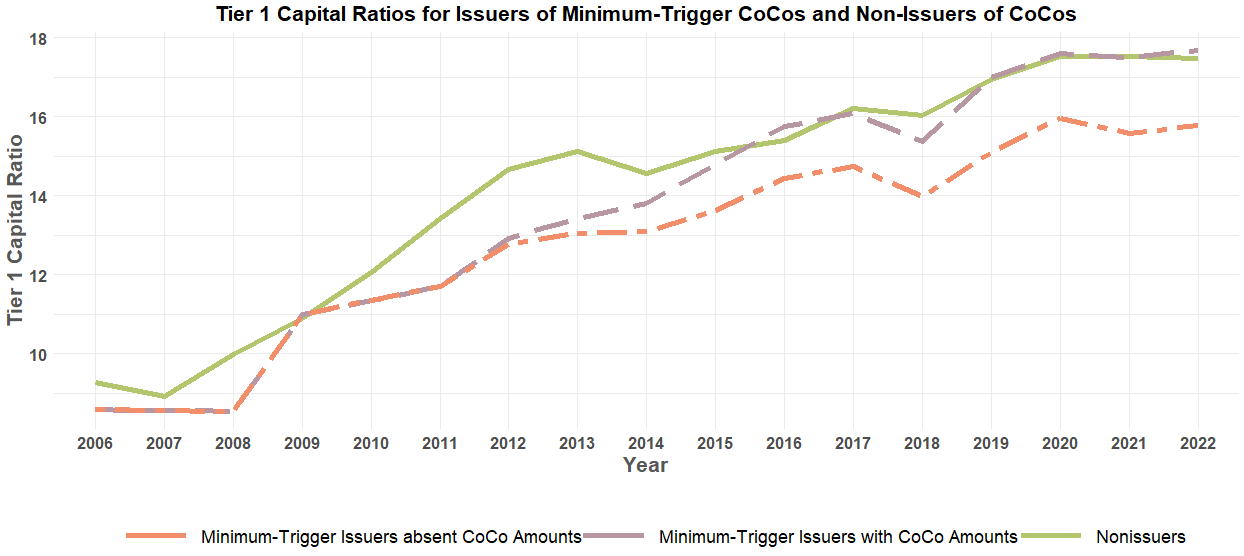
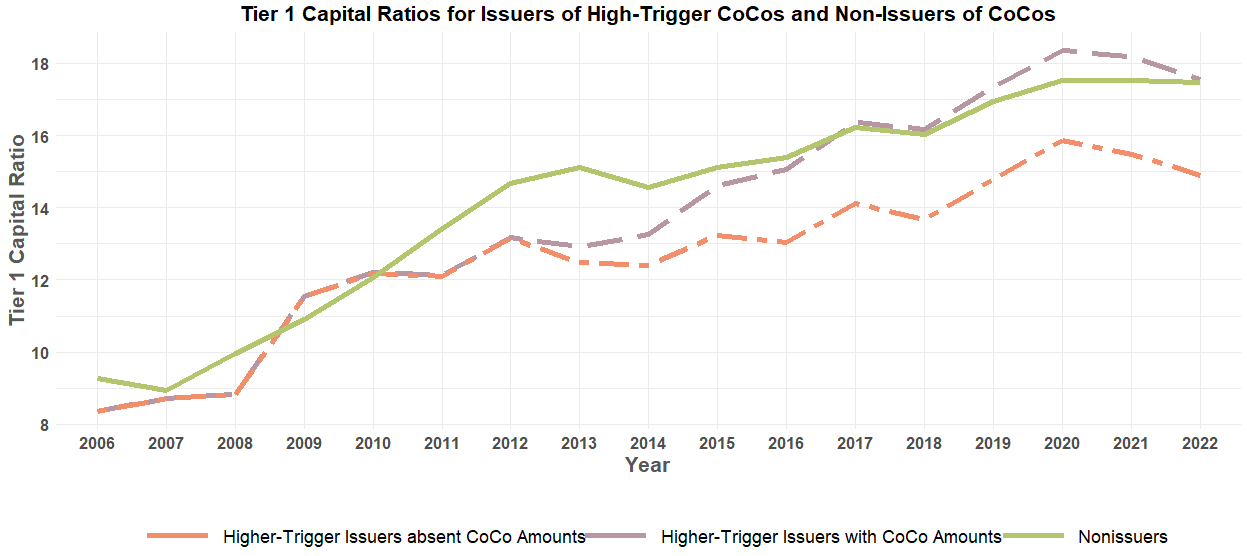


Figure 5: Time-series plot of equally-weighted Tier 1 capital ratio for issuers of higher-trigger CoCos and non-issuers of CoCos from 2010 to 2022. The green solid line plots average Tier 1 capital ratios of banks that have never issued CoCos. The purple and orange dashed lines show average Tier 1 capital 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.



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 to ROA* 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, lagged by one period in the regressions:

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* (TA): 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 pairwise correlations between the explanatory variables to mitigate multicollinearity concerns.[19] The only greater correlations are between Delta CoVaR and

[19]In unreported results, I replace ratio by Adjusted Tier 1 ratio. The correlations do not change more than two decimal places.

Total Assets (0.382) and between ROA and ROE (0.489). The higher correlations between those variables are due to the facts that Delta CoVaR 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. The other independent variables show low pairwise correlation coefficients.

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

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Delta CoVaR	1	−0.151	0.018	−0.007	−0.055	−0.215	0.382	0.053
(2) Tier 1 Ratio	−0.151	1	0.049	0.088	−0.128	−0.052	−0.227	0.050
(3) ROE	0.018	0.049	1	0.489	−0.014	−0.254	−0.026	0.090
(4) ROA	−0.007	0.088	0.489	1	0.017	−0.149	−0.112	0.056
(5) Net Loans to Assets	−0.055	−0.128	−0.014	0.017	1	−0.019	−0.247	0.309
(6) Impaired Loans to Net Loans	−0.215	−0.052	−0.254	−0.149	−0.019	1	−0.118	−0.289
(7) Log(Total Assets)	0.382	−0.227	−0.026	−0.112	−0.247	−0.118	1	−0.193
(8) GDPP	0.053	0.050	0.090	0.056	0.309	−0.289	−0.193	1

Appendix B provides summary statistics of the explanatory variables calculated separately for issuers and non-issuers of minimum-trigger CoCos and higher-trigger CoCos respectively.

5.1 Fama-MacBeth Logistic Regression

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

$$CoCo - Issuer_i = \alpha + \beta_1 * DeltaCoVaR_{i,t} + \beta_2 * Tier1_{i,t} + \beta_3 * ROE_{i,t} + \beta_4 * ROA_{i,t} + \beta_5 * LTA_{i,t} + beta_6 * ILL_{i,t} + \beta_7 * TA_{i,t} + \beta_8 * GSIB_{i,t} + \beta_9 * GDPP_{c,t} + \varepsilon_{i,t} \tag{14}$$

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: $CoCo - Issuer_i = log\left(\frac{Prob(Y=1)}{1-Prob(Y=1)}\right)$. I run the logistic regression in a Fama-MacBeth two-step procedure. I thus first run a cross-sectional regression for every

year, to better compare bank balance sheet characteristics for given years, and then take the average of the coefficients obtained. I use Newey-West standard errors in all computations.

In Tables (2) and (3), I test hypotheses H1, H2 and H3 at once. In the first table, 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 second table, 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 minimum-trigger CoCo issuing banks are all banks that do not issue minimum-trigger CoCos. The control group for higher-trigger CoCo issuing banks are all banks that do not have any CoCos on their balance sheets.

Table(2) gives insights into CoCo issuers Tier 1 capital ratios, systemic risk levels and earnings management practices before issuance of the hybrid instruments. Column (1) reports the results for minimum-trigger CoCo issuers and column (2) for higher-trigger CoCo issuers. Before any issuances, minimum-trigger CoCo issuing banks exhibit significantly higher systemic risk, lower Tier 1 capital ratios and higher return on equity (ROE) compared to return on assets (ROA), than non-issuers. The banks also have a significantly higher fraction of net loans to assets and are significantly less likely to be G-SIBs. Banks issuing higher-trigger CoCos also have a significantly higher ROE than peers. Before issuance, these banks have a lower fraction of net loans to assets. Size and G-SIB status seem to positively influence the issuance of higher-trigger CoCo bonds, as the regression coefficient is significant for the two variables.

Table(3) looks at banks' characteristics post-issuance. Columns (1) and (2) report the results for minimum-trigger CoCo issuers and columns (3) and (4) for higher-trigger CoCo issuers. For each issuer category, I run the regressions once with *Adjusted Tier 1 capital* (odd columns) and once with total Tier 1 capital (even columns). After the issuance, holders of minimum-trigger CoCos remain to have high systemic risk and more intense earnings management practices (indicated by a significantly higher ROE than their peers). They also

continue to have a higher loan activity. 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. However, excluding CoCo volumes these banks continue to have significantly lower Tier 1 capital ratios. The holding of higher-trigger CoCos is correlated with G-SIB status and bank size as well as with a higher proportion of impaired loans to net loans and a higher proportion of net loans to assets. Hence, these banks have a significantly higher fraction of NPLs on their balance sheets than peers. These NPLs worsen the banks' Tier 1 capital ratio, as they are eqipped with a 100% risk-weight. I interpret this as evidence that banks utilize higher-trigger CoCos to offset these increased risk weights, especially if they are G-SIBs and thus face higher capital requirements. As the issuance of minimum-trigger CoCos would have the same positive effect on the Tier 1 ratio, higher-trigger CoCos could additionally function as a hedge against potential losses arising from NPLs. If a bank's CET1 ratio would indeed fall below the CoCo trigger level, the CoCo's conversion or write-down feature helps to restore the bank's capitalization.

5.2 Multinomial Logistic Regression

I also 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 than the regulatory minimum - but the data supports the opposite.

In the multinomial logistic regression, I analyse four different Tier 1 composition decisions of a bank: no CoCos, only minimum-trigger CoCos, only higher-trigger CoCos and both CoCo

Table 2: This table reports Fama-MacBeth logistic regression results of Equation(14). The dependent variable is a dummy that takes on the value 1 before an issuer issues CoCos. Issuers leave the system after issuance. The control group for minimum-trigger CoCo issuing banks are all banks that do not issue minimum-trigger CoCos. The control group for higher-trigger CoCo issuing banks are all banks that do not have any CoCos on their balance sheets. Column (1) reports the results for minimum-trigger CoCo issuers and column (2) for higher-trigger CoCo issuers. Independent variables of interests are lagged by one year. Data is in annual frequency from 2006 to 2022. Newey-West standard errors are in parentheses below.

	Dependent variable:	
	Minimum-Trigger CoCo issuing Bank	Higher-Trigger CoCo issuing Bank
	(1)	(2)
Delta CoVaR	352.819***	262.506
	(74.132)	(2,804.850)
Tier 1 Ratio	−0.112***	−1.673
	(0.026)	(3.766)
ROE	0.058*	3.500*
	(0.030)	(1.919)
ROA	−0.831**	−37.999
	(0.369)	(40.226)
Net Loans to Assets	0.032***	−0.652**
	(0.005)	(0.304)
Impaired Loans to Net Loans	0.003	1.236
	(0.050)	(2.619)
Log(Total Assets (in mm))	0.064	13.857**
	(0.099)	(6.516)
G-SIB	−4.754*	62.610**
	(2.589)	(23.758)
GDPP	0.0001	0.003
	(2.091)	(157.878)
Constant	−10.685***	−362.720**
	(2.091)	(157.878)
Observations	1241	932
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 3: This table reports Fama-MacBeth logistic regression results of Equation(14). The dependent variable is a dummy that takes on the value 1 after an issuer issues CoCos. Issuers enter the system in the year of issuance. The control group for minimum-trigger CoCo issuing banks are all banks that do not issue minimum-trigger CoCos. The control group for higher-trigger CoCo issuing banks are all banks that do not have any CoCos on their balance sheets. Column (1) reports the results for minimum-trigger CoCo issuers and column (2) for higher-trigger CoCo issuers. Independent variables of interests are lagged by one year. Data is in annual frequency from 2006 to 2022. Newey-West standard errors are in parentheses below.

	Dependent variable:			
	Minimum-Trigger CoCo holding Bank		Higher-Trigger CoCo holding Bank	
	(1)	(2)		
Delta CoVaR	511.696***	422.239***	1,982.827	987.920
	(137.508)	(125.278))	(1,481.145)	(677.591)
Adjusted Tier 1 Ratio	−0.389**		−1.738	
	(0.138)		(1.930)	
Tier 1 Ratio		−0.048		1.788
		(0.040)		(1.209)
ROE	0.157**	0.065**	0.129	0.183
	(0.063)	(0.026)	(0.510)	(0.548)
ROA	−3.411	−2.726	1.658	−7.284
	(2.140)	(2.049)	(9.671)	(14.873)
Net Loans to Assets	0.022***	0.024**	0.174*	0.111
	(0.007)	(0.009)	(0.081)	(0.079)
Impaired Loans to Net Loans	−0.187	−0.168	0.536**	0.144**
	(0.204)	(0.164)	(0.276)	(0.094)
Log(Total Assets (in mm))	−0.031	0.069	12.197**	12.374**
	(0.321)	(0.171)	(5.163)	(5.275)
G-SIB	2.314	2.491	18.586***	19.077***
	(2.457)	(1.923)	(2.330)	(2.526)
GDPP	−0.00003	−0.0001	0.001	0.0005
	(5.983)	(4.307)	(98.099)	(107.657)
Constant	−7.280	−9.893**	−210.630*	−228.519*
	(5.983)	(4.307)	(98.099)	(107.657)
Observations	1128	1128	820	820

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

types. The multinomial logit model estimates how bank characteristics affect the four choices. The parameter estimates are then interpreted relative to the reference category. In the first regression, the reference category is "no CoCos" and in the second regression, the reference category is "Higher-Trigger CoCos".

$$P(Type_i = j|\mathcal{F}) = \frac{e^{(\alpha_j + \beta_{1,j} * DeltaCoVaR_{i,t} + \beta_{2,j} * Tier1_{i,t} + \beta_{3,j} * ROE_{i,t} + \beta_{4,j} * ROA_{i,t} + \gamma_j \mathcal{X}_{i,t})}}{\sum_{k=0}^{3} e^{(\alpha_k + \beta_{1,k} * DeltaCoVaR_{i,t} + \beta_{2,k} * Tier1_{i,t} + \beta_{3,k} * ROE_{i,t} + \beta_{4,k} * ROA_{i,t} + \gamma_k \mathcal{X}_{i,t})}} \quad (15)$$

The dependent variable $Type_i$ can take on four different values, 0 to 3 for the respective categories in the first setting ("no CoCos"=0, "only minimum-trigger CoCos"=1, "only higher-trigger CoCos"=2 and "both CoCo types"=3) and 0 to 2 for the respective categories in the second setting (excluding the reference category "no CoCos").

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 to 3 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(4) report the results for the first setting. Overall, the results are in line with the ones from Subsection 5.1. Over the entire period, minimum-trigger CoCo issuers have significantly higher systemic risk, lower *Adjusted Tier 1* capital ratios and more intense earnings management practices than banks that do not issue any CoCos whereas higher-trigger CoCo issuers are larger, more likely to be G-SIBs and have more NPLs on their balance sheets.

Table(5) analyzes the decision to issue minimum-trigger CoCo issuing banks relative to issuing higher-trigger CoCos. 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. 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 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 even more likely to default. Equivalently, banks with the lowest *Adjusted Tier 1* capital ratio are more prone to issue minimum-trigger CoCos than higher-trigger CoCos. A potential concern for my hypothesis is that banks might issue minimum-trigger CoCo instruments to reduce leverage. But if this was the case, banks with the lowest Tier 1 Capital Ratios absent CoCo issuance amounts should issue CoCos with a higher trigger level. The results 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.

6 Conclusion and Future Research Design

I investigate why only some banks are issuing CoCos and whether they issue these instruments on top of Tier 1 capital comparable to peers or not. According to the findings in this paper, banks that have higher systemic risk levels, inferior capital ratios and that engage more in earnings-targeting are issuing minimum-trigger CoCos. 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 but has little going-concern characteristic. Minimum-trigger CoCo issuing banks take effort to include *anything but equity* - a term borrowed from Admati

Table 4: This table reports multinomial logistic regression results of Equation(15) with four categories: no CoCos (a), Minimum-Trigger CoCos (b), Higher-Trigger CoCos (c), Both CoCos (d). All explanatory variables are one year lagged. Data is in annual frequency from 2006 to 2021. Standard errors are clustered at the bank level.

	Dependent variable:		
	b. Minimum-Trigger Issuer	c. Higher-Trigger Issuer	d. Both Type Issuer
Delta CoVar	$+184.820^{***}$	-111.297	$+39.108$
Tier 1 Ratio - all CoCo	-0.181^{***}	-0.008	-0.235^{*}
ROE	$+0.036^{***}$	$+0.004$	$+0.017$
ROA	-0.001	$+0.008$	$+0.222$
Net Loans to Assets	$+0.024^{**}$	-0.017	-0.002
Impaired Loans to Net Loans	-0.075	$+0.015^{**}$	$+0.055$
Log(Total Assets (in mm))	$+0.559$	$+0.712^{**}$	$+0.731^{**}$
G-SIB	$+7.481$	$+8.383^{**}$	$+8.183$
GDPP	$+0.0001$	$+0.0001$	$+0.0001$
Constant	-10.083^{***}	-11.353^{***}	-10.757^{***}
Year FE	YES	YES	YES
Observations	1549	1549	1549

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

Table 5: This table reports multinomial logistic regression results of Equation(15) 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.

	Dependent variable:	
	b. Minimum-Trigger Issuer	c. Both Type Issuer
Delta CoVaR	+ 378.572***	+ 359.324*
Tier 1 Ratio - all CoCo	− 0.174***	− 0.162***
ROE	+ 0.062*	− 0.139
ROA	+ 0.465	+ 2.924
Net Loans to Assets	+ 0.071*	+ 0.023
Impaired Loans to Net Loans	− 7.508*	+ 10.978
G-SIB	− 0.616	− 0.151
Log(Total Assets (in mm))	− 1.289	+ 0.273
GDPP	− 0.00005	− 0.00004
Constant	+ 8.258**	+ 3.136
Observations	507	507
Year FE	YES	YES

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.

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 minimum-trigger level of 5.125% currently accepted by Basel III regulation.

In the following, I want to discuss how I plan to design this paper forward. I intent to make adjustments to the model, extend my dataset and improve the empirical analysis. I summarize the plan for the future research design in bullet points:

1. *Model:* So far, my simple binomial model does not include banks' capital structure preferences. I introduce three banks in the economy that choose different additional Tier 1 capital instruments to fulfill regulatory requirements. I aim to extend the model by introducing bank characteristics (e.g. different franchise values) that justify the banks' different choices of capital.

2. *Non-issuers might still become issuers:* Non-issuers of CoCos might still become issuers in the future. So far I treat all issuing banks equally, irrespective whether they were early or late adopters of CoCos. In a diagnostic test, I thus plan to employ an ordered probit regression where the dependent variable will be "Years to Issue". The regression will allow me to investigate whether banks that issue CoCos later are different from banks that issue CoCos early.

3. *Multicollinearity concerns:* I will add further tests to mitigate multicollinearity concerns, especially between ROE and ROA.

4. *CET 1 and Tier 1 buffer requirements:* I will add data on the combined buffer requirements for banks. Analyzing CoCo issuers distance to their buffer requirements will add further insights into why only some banks issue minimum-trigger Contingent convertible bonds. I expect that constrained banks (the ones with lower distance to their Tier 1 buffer requirement) are more likely to issue minimum-trigger CoCos. I am curious to investigate the effect of a bank's distance to its CET1 buffer requirement on the propensity to issue CoCos.

5. *Net issuance of common stock, perpetual preferred stock, dividend payments and trust preferred securities:* I will add this data to further explore whether banks replace equity by minimum-trigger CoCos.

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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.

Appendix B: This table reports means for the independent variables of interest and controls calculated separately for issuers of minimum-trigger CoCos and higher-trigger CoCos (Panel (a)) and both-type CoCos (Panel (b)) versus non-issuers of CoCos respectively. Minimum-trigger CoCo issuers are banks that issued exclusively minimum-trigger CoCos, higher-trigger CoCo issuers banks that only issued higher-trigger CoCos and both-type issuers banks that issued both minimum-trigger and higher-trigger CoCos. The independent variables of interest are: Delta CoVaR absolute and relative, SRISK in USD and relative, Tier 1 Capital Ratio and *Adjusted Tier 1 Capital Ratio* (=Tier 1 Capital Ratio absent 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 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	Nonissuers		Issuers	Nonissuers	
	Mean	Mean	Difference	Mean	Mean	Difference
Delta CoVaR (scaled by 100)	0.74	0.57	0.17***	0.71	0.57	0.14*
Relative Delta CoVaR	1.16	0.92	0.23 ***	1.15	0.92	0.23 *
SRISK (USD mm)	17774.2	4384.3	13389.9**	40538	4384.3	36153.7**
Relative SRISK	1.2	0.38	0.81*	2.63	0.38	2.24**
Tier 1 Ratio (%)	15.41	15.17	0.24	15.21	15.17	0.04
Adjusted Tier 1 Ratio (%)	14.28	15.15	−0.86	13.89	15.15	−1.25
ROE (%)	8.5	2.08	6.42**	5.41	2.08	3.33
ROA (%)	0.7	0.24	0.46	0.38	0.24	0.14
Net Loans to Assets (%)	66.1	56.42	9.68***	50.95	56.42	−5.47
Impaired Loans to Net Loans (%)	3.71	9.43	-5.72***	6.07	9.43	-3.36
Log(Total Assets(USD mm))	10.53	9.65	0.88 **	12.01	9.65	2.36 ***
GDPP(USD mm)	60207.61	38487.98	21719.63***	50989.49	38487.98	12501.51***
Number of Banks	55	96		12	96	

Panel (b)

	Both Type Issuers		
	Issuers	Nonissuers	
	Mean	Mean	Difference
Delta CoVaR (scaled by 100)	0.86	0.57	0.28***
Relative Delta CoVaR	1.32	0.92	0.4 ***
SRISK (USD mm)	27232.7	4384.3	22848.4*
Relative SRISK	1.74	0.38	1.35*
Tier 1 Ratio (%)	13.94	15.17	0.24
Adjusted Tier 1 Ratio (%)	12.27	15.15	−-2.88***
ROE (%)	4.09	2.08	2.01
ROA (%)	0.32	0.24	0.08
Net Loans to Assets (%)	54.97	56.42	−1.45
Impaired Loans to Net Loans (%)	10.93	9.43	1.5
Log(Total Assets(USD mm))	12.24	9.65	2.59 ***
GDPP(USD mm)	44589.1	38487.98	6101.12
Number of Banks	10	96	