CoCo Bonds and Risk: The Market View

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Abstract

This paper investigates the impact of CoCo bond design on their market prices. Focusing on two CoCo bond features which are associated with CoCo risk, I find that (1) investors are aware of the incentive problem created in write down CoCo bonds, and demand a yield premium for that feature. Additionally, and consistent with the theory on moral hazard, this premium is higher for banks which suffer from a larger conflict of interest in the first place. Moreover, I find that (2) investors take the threat of automatic CoCo capital triggers seriously, in the sense that they reward a larger buffer towards the trigger threshold with a higher price. These insights provide important clues towards the role of CoCo bond investors' monitoring, as well as the role of CoCo bonds in the mix of regulatory capital.

1 Introduction

In October 2011, the Basel Committee clarified design features which make Contingent Convertible (CoCo) bank financing eligible for Tier 1 bank capital, allowing it to play a major role in the build-up of regulatory capital as requested in the rules of Basel III. This lead to a surge of almost 300 CoCo issues, which amounts for as much as $ 270bn of regulatory capital.

At the same time, CoCos are subject to heavy debate, especially regarding the value of CoCo capital as regulatory capital relative to equity capital. CoCo bonds represent a new security class, with a unique structure, being high yield debt in good times, but suffering from a value-decreasing conversion event in times of bank distress. To account for this special design requires a high degree of sophistication on the side of the investor base: Investors need to be able to correctly identify, price and monitor CoCo bonds. As part of this process, CoCo investors have to identify the risk which underlies both the issuer of the CoCo, and the contractual rights and the incentives for risk taking which are derived from the design of the individual CoCo bond.

Yet, given the current low-yield environment, the investors' ability to correctly price CoCo bonds has been called into question:

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"High-risk, high-yield" cocos are in strong demand, as "investors are throwing caution to the wind [...] taking more risk to get that extra return", raising the question whether "risk [is] correctly priced" (FT, 2014).

Is this really the case? Do investors overlook the risk in CoCo issues? These questions will be addressed in this paper. Furthermore, on a more general stance, I will engage in the discussion on capital increases by analyzing equilibrium prices in the market for CoCo bonds.
In my analysis, I find evidence which is consistent with CoCo investors being active monitors, lending support to the notion that CoCo bonds could be a valuable instrument for bank capital increases. I conduct my analysis by looking at two different risk factors: First, I define a distance to trigger variable, defined as the difference between the contractual trigger threshold level of the CoCo's trigger ratio, and the current level of the same ratio. Given that definition, I find evidence that investors value CoCo bonds higher when the distance to the trigger is high. This shows two things: First, investors are well aware of one of the key risk in CoCo bonds. Second, and perhaps more importantly, it supports the view that investors think that an automatic trigger event is plausible, rather than thinking that a CoCo bond will only be triggered on regulator's discretion (for example in a bail-in).
Regarding the second risk factor which I analyze, I find evidence that investors are aware of the risk-taking incentives derived from the CoCo design. Most notably, I find significantly higher prices for CoCos with a write down feature relative to equity conversion CoCos. This has important policy implications: When calling for dilutive CoCo conversion terms to be required by the regulator (such as in Calomiris and Herring (2013)), we should take into account that CoCo investors are indeed aware of the agency cost from the write down feature, and require compensation in the form of a premium for it. With issuers willing to pay such a compensation, any regulation in that regard should then be balanced against the benefits that issuers derive from the write down feature.

2 Motivation and Related Literature

This paper is motivated by the discussion on increasing capital ratios, and CoCo capital's role in that respect. At the same time, it builds on a large body of theoretical research in the field of CoCo capital. Lastly, empirical research into CoCo bonds is rather scarce, so the paper contributes to the understanding of CoCo capital as employed in practice.

Following the Financial Crisis, regulators have started to call for higher capital ratios in banks. This was to address the problems of debt overhang and risk-shifting, and ultimately to reduce the probability for governments having to bail-out their banks. However, there is a fierce debate on which capital instruments should be allowed as regulatory capital. Admati et al. (2013), for instance, advocate higher common equity as the prime tool to boost bank capital, not seeing any advantage in having complicated debt-like securities in the pool of regulatory capital. On the other side, Calomiris and Herring (2013) point out the role of market discipline derived from CoCo issues, thus advocating CoCo use for means of bolstering regulatory capital. This view is also shared by the Liikanen Expert Group on bank reform, endorsing CoCo bonds in the mix of regulatory capital:

"This [designated bail-in instruments] additionally improves the incentives of creditors to monitor the bank." (Liikanen Commission, 2012, p. 103)

The question of whether or not to employ CoCo bonds as means of regulatory capital thus feeds into the discussion on Corporate Governance in banks: If the view prevails that CoCo bond investors provide meaningful monitoring, then CoCo creditors could serve as an additional layer of Corporate Governance in financial institutions. However, in absence of any direct Corporate Governance tools, CoCo investors' power in bank governance is limited to indirect modes of Corporate Governance. For the purpose of this paper, I will refer to these indirect modes of Corporate Governance as market discipline, defined as investors' willingness to accept a higher price (lower yield) for a security with favorable characteristics; and issuers' decision whether or not to rely on financing through a particular instrument given investors' demand. Evidently, for market discipline to work, investors have to engage in risk-based pricing. Investors' risk-based pricing is then also reflected in market prices. Thus, identifying drivers for CoCo prices is tantamount to finding evidence consistent with investor monitoring in the sense of disciplining actors in the Corporate Governance process of banks. As a result, my research contributes to the discussion on whether alternative forms of regulatory capital are appropriate in bolstering bank capital.

Other than the policy discussion, this paper is also motivated by theoretical research on optimal CoCo design. Much of the current theoretical literature focuses on the question of the conversion trigger design. For instance, Sundaresan and Wang (2015) reject the idea of a regulatory (accounting) trigger, and instead advocate a market price trigger in combination with a conversion which does not transfer value between equity holders and CoCo investors. This is not mirrored in practice: The regulator and the market have chosen a different avenue, and instead opted for triggers based on the regulatory capital of a bank, and conversion with a wealth transfer from CoCo holders to equity holders. Berg and Kaserer (2015) point out the repercussions of this wealth transfer for risk-taking incentives of the bank if the bank maximizes shareholder value: Whenever the bank has its capital within proximity to the trigger, it rationally engages in excessive risk-taking, as it stands to gain from both the upside and the downside. Moreover, it could even produce an outright loss (of regulatory capital) simply and exclusively in order to trigger the CoCo capital. The higher the gain is upon conversion, the larger is the misguided incentive. I will take advantage of this feature for my analysis of risk pricing by exploring the yield differentials between principal write down CoCo bonds (100% value loss for CoCo holders upon conversion) and equity conversion CoCo bonds (at least some of the value is preserved, reducing the wrong incentive).

On the empirical side, notable work on CoCo capital has been done by Avdjiev et al. (2015), conducting a comprehensive event study on CoCo capital's effect on CDS spreads. In their findings, the issuance of CoCo capital reduces CDS spreads, more so for equity conversion than for principal write down CoCo bonds. On a related note, Ammann et al. (2015) find that bank stocks experience abnormal positive returns around a CoCo bond issuance, which they attribute to CoCo bonds' more favorable position in the pecking order of bank financing.

My paper is closest to Avdjiev et al. (2015) in the sense that they use a similar sample, and they also look at CoCo bonds' design features and their impact at risk. However, while their study is looking at changes of the risk to senior debt holders at CoCo issue, I look at the cross-sectional differences of equilibrium CoCo bond prices at different points in time.

3 Data

In order to analyze CoCo bond investments, I collect both CoCo bond issue information and end-of-quarter CoCo yields (yield to maturity, (YTM) and yield to first call, (YTC)) from Bloomberg for banks from the European Economic Area (EEA) plus Switzerland from Q1 2013 to Q1 2016. I augment this data with quarterly core equity Tier 1 (CET 1) ratios from the issuing banks and senior 10 year CDS prices, which I receive from SNL and Markit, and which I match with the CoCo sample by hand. For this sample of CoCo issuing banks, I also collect the same information for subordinated bonds issued in the same period. In robustness tests, I expand the sample to starting as early as Q1 2010.

Using the YTM and YTC, I construct the yields as follows: Wherever available, I use the YTC as the security's yield. If the YTC is missing, I use the YTM instead. This follows Vallée's (2015) logic: Most CoCo bonds as well as subordinated bonds have very long maturities, some of them even being perpetuities. Yet at the same time, they have a shorter first call date, at which banks are allowed to redeem the bonds. The market expectation then is that the banks call the bonds at the first possible date, and not doing so creates a "debt relief" (Vallée, 2015) for the issuer, at the price of a reputational loss vis-à-vis the investors. As such, the bonds are clearly priced towards their first call date, and YTM only applies if there isn't any possibility of early redemption. I use the same logic for calculating the remaining life for each security at each time in the panel, using the time to call as the remaining life of the respective security, and the time to maturity only when the time to call is missing. I drop all subordinated securities with a remaining life higher than 14 years, with this number representing the highest remaining life for a CoCo bond in my sample. Finally, I calculate the distance to trigger for the CoCo bonds as the CET 1 ratio of each CoCo less the trigger ratio of the security. To be able to do so consistently, I discard all CoCos which do not base the trigger on the CET 1 ratio.

In a second step, I analyze the CoCo issuing behavior of European banks in order to find determinants of whether banks issue CoCos or not. Here, following Acharya and Steffen (2015), I look into a sample of EBA stress test banks, which I append with listed banks from the Euro Stoxx Financials Index. My main motivation to for including listed banks is to also include Swiss banks in my sample, which are not covered by the EBA. Once again, I match the EBA banks to SNL data in order to retrieve their balance sheet fundamentals.

[insert Table 1 around here]

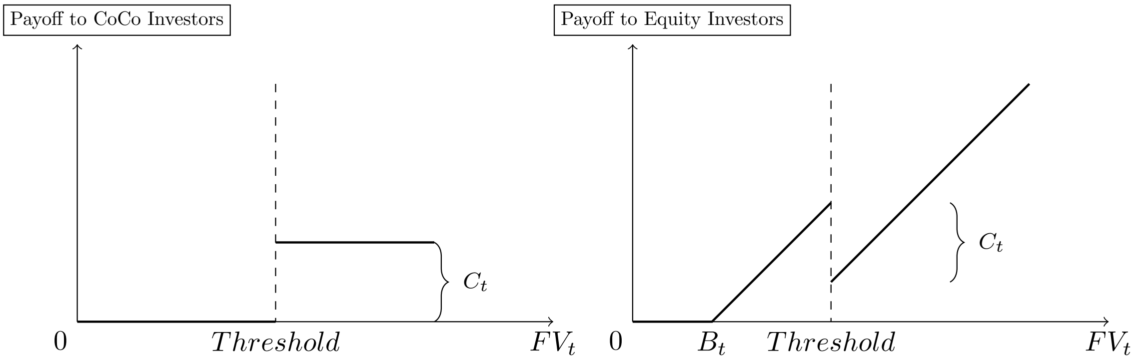
4 Hypotheses and explanatory variables

My main analysis collects evidence of market discipline in CoCo issues. To do so, I will investigate whether investors indeed are able to price risk correctly. Analyzing market prices of European CoCo bonds, I hypothesize that even in light of a search of yield, investors are aware of different risks in the CoCo bonds, and thus correctly account for risk drivers in the cross section.

The first part of the analysis deals with misguided incentives introduced by CoCo bonds. This is in line with the theoretical findings of Berg and Kaserer (2015), who explore the change of incentives which stems from the differences in conversion ratios when converting a CoCo bond into equity in times of bank distress. The logic is as follows: If conversion ratios are such that the issuer of the CoCo bond makes a gain upon a CoCo bond conversion, he will be inclined to take actions which lead to conversion if the trigger ratio is close to the threshold. Obviously, this problem is most prevalent with principal write down CoCos (see figure 1). Note the jump in the payout profile: Whenever a loss pushes the equity value below the threshold ratio, the payoff to the equity holder actually increases. As a result, in times of bank distress, the shareholder will have the lowest payout if he stays at the current level, and he profits from any change of the firm value. Consequently, rational managers (shareholders) are inclined to suffer a marginally higher loss pushing the bank over the trigger threshold, if the additional loss is offset by the gains from the write down of the CoCo capital. Given the payout profile presented in figure 1, shareholders will rationally take any gamble within proximity to the threshold: They profit from the upside in the form of an increase in bank profits, and from the downside in the form of the write down of the CoCo bond. In the context of risk-taking, the write down feature is clearly undesirable, as it induces excessive and even uncompensated risks, creating a conflict of interest between shareholders and CoCo investors, and thus resulting in an agency cost.

This setting can be used when comparing principal write down CoCo bonds with equity conversion CoCo bonds. Clearly, in that case, shareholder and CoCo holder incentives are not aligned, which burdens an agency cost on the CoCo holders. Thus, in the presence of monitoring

Figure 1: Payoffs with in a Bank with Write Down CoCo Capital
This chart shows investors' one period payoffs depending on the bank's asset value (firm value FV_t). The left panel depicts the CoCo investors' payoff, which is either zero below the threshold (write down), or principal plus interest above the threshold (C_t). The right panel shows shareholders' payoff, depending on the value of C_t (and senior debt B_t). Note the jump in S_t, which comes from the write down feature of the CoCo capital.



CoCo investors, and with the mechanisms of market discipline at work, CoCo prices should be lower (the yield should be higher) in the presence of a write down CoCo relative to an equity conversion CoCo. This leads me to my first hypothesis:

Given monitoring investors, CoCo bonds trade at lower prices (higher yields), whenever they have a write down feature.

A second part of the analysis focuses on the interplay between the contractual design of the CoCo, and bank health. This will be studied in the context of distance of the bank CET 1 ratio to the threshold level. Clearly, a higher distance makes it less likely that a CoCo bond will be triggered, thus making the bond safer. Also, we can observe whether investors take the threat of automatic conversion seriously, or whether they see CoCo capital at par with other subordinated capital, which not subject to automatic conversion (yet which is subject to discretionary restructuring upon supervisory action). Thus, my second hypothesis is as follows:

Investors take automatic conversion seriously, and thus value a high distance to the trigger ratio with higher prices (lower yields).

5 Empirical Strategy and Results

My identification strategy rests on pooling my sample of CoCo bonds together with the subordinated bonds in order to gauge the unobserved, time-fixed effects which determine the yields on junior debt in general. From there, I will identify the yield differentials between ordinary subordinated debt and CoCo debt by assigning a number of CoCo design dummies relating to the design features subject to my first hypothesis. Also, I will include the distance to trigger for the CoCo bonds in my sample. For the subordinated debt, the distance to trigger will be set to zero, as these securities are not subject to a trigger risk.
My baseline empirical strategy looks as follows:

$$Yield_{i,t} = \beta_0 + \beta_1 * distancetotrigger_{i,t} + \beta_{2,3} * cocodummies + \Gamma * Controls_{i,t} + FE + \epsilon \quad (1)$$

As stated above, the distance to trigger is the difference between the CET 1 ratio at time t, and the pre-specified contractual trigger ratio. I include two dummies for CoCo debt in my regression: One for CoCo bonds relative to ordinary subordinated debt, and one that is one for CoCo bonds with a principal write down upon reaching the trigger ratio, and zero otherwise (i.e. for CoCos with an equity conversion feature, and for subordinated debt). My controls include the 10-year senior CDS spread for the issuing bank. The CDS spreads play a major role as a control here, as they control for a wide range of price-driving factors in my regression, including both the capital structure, as well as the bank's strategy in terms of its risk appetite. I chose the senior rather than subordinated CDS for its wide availability, reasoning that any event that affects more senior debt should also be reflected in the junior tranches. As an additional control, I include the remaining life of the respective security, in the form of the logarithm to account for nonlinearities in its contribution to the yield. Finally, my baseline fixed effects include bank fixed effects, controlling for bank-specific time stable yield drivers, and time fixed effects in order to smooth out general market movements.
My identification includes the subordinated bonds which allows me to overcome a weakness in my CoCo bond sample, namely that only few issuers issue both write down and conversion CoCo bonds, making it harder to differentiate between effects that are driven by issuing entity,

and effects which stem from the CoCo design. Rather, we now have a sample with a significant amount of variation per bank in terms of the kinds of securities issued, allowing for more robust estimation. Identification then comes from the cross-sectional differences in yields among the different kinds of securities. While this does not rule out any bias from other security features per se, it reduces the potential source of such a bias to features which are prevalent *across the sample* of the write down CoCo bonds, but which can't be found in any other subsample.

[insert Table 2 around here]

Column (1) in Table 2 shows the result of my baseline regression. Note the following interesting results:

- The write down dummy has the predicted sign and is statistically significant. This lends support to the theory that there is an agency cost from the write down design, and that investors demand a compensation for that.
- In all specifications, the distance to the trigger lowers the yield significantly. This supports the second hypothesis that CoCo investors value a high buffer towards the trigger ratio.
- All the other variables have the expected signs and high significance levels: The CoCo dummy confirms that investors see contingent convertible bonds as riskier than ordinary forms of subordinated debt; higher CDS spreads, signifying increased bank risk or deteriorated bank health, are significant upward drivers of CoCo yields; and the control for the CoCo bonds' remaining life drives the yields up.

The remaining columns show that the results are robust to some slightly different specifications: Column (2) includes the remaining life in years, rather than its logarithm, giving similar results both in magnitude and regarding the statistical significance.

Column (3) adds the Common Equity Tier 1 ratio as an additional control for both the CoCo bonds and the subordinated debt. This allows me to correctly gauge the distance to the trigger. While the Tier 1 ratio itself is not significant (though it has the predicted sign), it leads to a lower impact of the distance to the trigger both in terms of economic impact as well as statistical significance. Still, it remains significant at the 95% significance level.

Finally, in column (4) I add currency fixed effects as an additional control to my baseline regression. This is to address the potential concern that some of the issuers do not issue in their home currency, but in some other currency (e.g. the US $), and thus the currency effect is not captured by the bank fixed effect. The inclusion of the currency fixed effects does not change my insights from the baseline specification.

In table 3, I address the question of the timing of my sample, showing that it does not drive my results.

[insert Table 3 around here]

In the baseline regression, I chose a sample from 2013 to 2016, as from 2013 onwards, I have a sufficient sample of CoCo bonds in my panel to derive meaningful results. At the same time, I avoid the market turmoil around the European Sovereign Debt Crisis, which by and large has died down until then. In column (1) of table 3, I repeat the baseline regression with an enlarged sample, going back to 2010 rather than starting in 2013. The analysis confirms the results from my baseline regression. Similarly, in column (2), I go back to the baseline sample, but remove Q1 2016 from my analysis, to make sure that my results are not driven by the financial market distress in that period. Again, my conclusions from this exercise remain unchanged relative to the baseline regression.

The identification strategy which includes the subordinated debt corroborates the internal validity of the analysis. For instance, looking at the write down feature, it is unlikely that it is driven by sample selection. This is because the analysis not only measures the difference between different CoCos, but also controls for unobserved, time-invariant bank heterogeneity by looking at the cross-sectional yield differential between the ordinary subordinated debt and the CoCo debt of the CoCo issuing banks. Thus, to introduce an *upward* bias in the analysis, the sample selection would have to govern higher yields for banks issuing write down coco debt, but not for non-issuers. Rather, the opposite is plausible: Write down CoCo debt should be issued by banks, which have the lowest cost of doing so, thus creating a *downward* bias in my analysis, making it harder to find an effect.

While I do not think it is plausible that my results are driven by sample selection, I nevertheless explore this, analyzing the differences between banks which issue equity, various forms of CoCo debt, and those which do not issue at all. The preliminary results are presented in table 4.

[insert Table 4 around here]

While the analysis in Table 4 gives us interesting insights on the choice between equity and CoCo capital (see option "2"), it gives us little evidence in the direction on the presence of a selection bias: Note that in columns (3), (4), (5) and (6), the differences between the price-to-book ratios, as well as the Tier 1 ratios are insignificant for write down and equity conversion CoCo bonds issuers.

Having established that CoCo bonds with a write down feature indeed have a premium, it remains the question whether this premium is correctly priced. Ideally, this would be tested with banks in severe distress and their CET1 ratios close to the trigger. Here, we would test whether banks with write down CoCos indeed increase their risk or even create deliberate losses. However, this given the high CET1 ratios at the moment, such data is not available.

Instead, we could proxy such future behavior by looking at variables which are known to drive moral hazard already today. According to this notion, in distress, these drivers will exacerbate the problem from the skewed incentives from write down CoCo bonds, as banks have lower incentives not to engage in opportunistic behavior in the first place. One such driver for has been discussed Gropp and Vesala (2004), pointing to banks' charter values, proxied by Tobin's q. The charter value represents a going concern premium for a bank, being higher whenever the bank as an ongoing operation is worth more then setting up the same bank from scratch. As such, it includes intangible assets like pricing power, customer relationships, operational expertise and a good reputation. These factors hard to build in a new venture, which cannot be sold readily on the market from an existing bank, but they contribute to the bank in the form of higher future cash flows. As a consequence, a low charter value increases the risk of opportunistic behavior, as there's less to lose for the decision makers in a bank.

In relation to CoCo bond financing, this leads me to my third hypothesis:

A high charter value inhibits opportunistic behavior. Thus, the write down premium is lower *for banks with a high charter value.*

Table 5 shows the results for the test of hypothesis number 3. Note that the sample size is reduced as the price to book ratio has come in as an additional data requirement. Note that I checked the validity of my baseline results with the reduced sample in an unreported regression.

[insert Table 5 around here]

Table 5 is structured as follows: Column (1) repeats the baseline regression including the price to book ratio as a proxy for a bank's charter value. In column (2), I additionally add the interaction term between the write down dummy and the price to book ratio, while in column (3), I only include the interaction term without the price to book ratio. Note the following interesting results: As it turns out, the non-interacted price to book ratio never drives the yields of the respective securities. This is consistent with them being fixed-claim securities, where the upside potential of a high charter value does not translate into higher payoffs (other than through the decreased risk of the security, which however has been captured with the CDS control variable already). Yet, the interaction between the write down dummy and the price to book ratio indeed drives the yields. This is consistent with my hypothesis: The write down feature is a less worse CoCo bond property for issuing banks who have more skin in the game, as this reduces the moral hazard problem. Consequently, investors demand a lower premium for the write down feature.

Columns (4), (5) and (6) repeat the robustness tests from the baseline regression in the interacted framework: Column (4) switches the control for the remaining life of the security from a logarithmic to a linear one; column (5) additionally controls for the Tier 1 ratio; and column (6) includes currency dummies. The results on the interaction between the price to book ratio and the write down dummy are qualitatively unchanged from this exercise.

Finally, Table 6 contains a the test on a different hypothesis, namely that the write down premium prices payoffs rather than agency costs. According to that view, a write down CoCo bond has by construction a lower payoff than an equity conversion CoCo bond, and thus should have a larger yield. Evidently, this is because the post-trigger payoff of a write down CoCo is always zero, whereas that of an equity conversion CoCo bond (weakly) bigger; the current yield of a (not yet triggered) CoCo bond is then the weighted combination of the payoffs of the non-default state and the post-trigger payoffs. This we can test in a similar as the agency cost, namely by interacting the write down dummy with a measure of (default) risk. For clarity, in the extreme case where the bank risk was inexistent (i.e. the CDS spreads are zero), the payoffs of a write down coco should be the same as for an equity conversion CoCo bonds, as payoffs would only be determined by the default-free state. Consequently, the write down premium should then increase with bank risk.

Table 6 shows the results for this test, not supporting the view that the write down premium prices payoffs rather than agency costs. In column (1), we repeat the baseline regression, while including the interaction between the CDS spreads and the write down dummy. Columns (2), (3) and (4) then repeat the baseline robustness tests, including a linear remaining life control, a Tier 1 ratio control and currency fixed effects, respectively. None of the four regressions show a significant effect for the interaction between the CDS spreads and the write down dummy, rejecting the idea that the write down premium prices payoffs rather than agency costs. Moreover, in column (5), I include the interaction between the charter value and the write down dummy, and in column (6), I additionally include the non-interacted price to book ratio. All previous results hold, namely that a lower agency cost indeed additionally decreases yields for write down bonds relative to the other securities, whereas lower risk does not. This further supports the idea that investors demand a write down premium as compensation for the agency costs derived from the CoCo bond design.

6 Conclusion

After the Financial Crisis of 2007-2009, there has been a consensus among economists, regulators and politicians to call for higher bank capital ratios. While CoCo capital has been accepted as regulatory capital in many countries, its value has been subject to numerous discussions. In this paper, I contribute to these discussions by shedding light on the risk features of outstanding CoCo issues, and by investors' appreciation of these features. For instance, I analyze the automatic triggers of CoCo bonds, finding that investors value the buffer towards the trigger ratio, which shows us that they take the risk of automatic conversion seriously. Moreover, I evaluate the premium of write down CoCo bonds relative to equity conversion CoCo bonds. As suggested by theory, I find that investors charge a premium for the former. In addition, my findings show that investors indeed price the agency cost introduced by that feature, and not the differential in payoffs which stems from the different contractual designs.

My empirical findings have several important policy implications: First, CoCo capital is not necessarily a replacement for bail-in capital, but rather a complement: Given its automatic trigger, it could trigger in bank distress before any formal bail-in proceedings, thus making bail-in capital less risky and more attractive to investors. As a result, banks with CoCo capital would have multiple buffers in distress, rather than just one (large) buffer pool including CoCo capital. Second, given the premium on write down CoCo bonds, regulators can call upon CoCo investors to not only monitor the bank itself, but also to take into account the agency cost which is derived from a CoCo bond's design. As a result, issuers have to pay a price for a write down design if they choose it, implying that they also enjoy a benefit from that design if they are willing to pay the price. Consequently, rules against non-dilutive CoCo bond designs would have to be balanced against such a benefit.

On a larger scale, this paper contributes to the discussion on whether to bolster capital with equity only, or whether to allow for other forms of capital increases. Given the results from my analysis, we can reject the idea that investors blindly accept risks from the CoCo capital in which they invest. Rather, the paper indeed supports the view that CoCo investors do provide meaningful monitoring, as they distinguish between different qualities of CoCo designs as well as issuing banks. While this finding does not show that CoCo capital is at par with equity capital in terms of quality, it backs the proponents of CoCo by showing that CoCo capital fulfils the minimum requirements for market discipline to work.

Going forward, we will have to evaluate how different CoCo bonds fare in times of actual, severe bank distress, and compare them to banks which have not made use of CoCo capital in order to increase their regulatory capital. Especially when we see actual trigger events of CoCo bonds, or situations in which we are close to it, we can critically review CoCo bond investors' behavior, and compare the results to our pre-distress expectations.

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7 Appendix

Table 1: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
yield_	4.876	2.72	0.2	29.565	1019
CDS_	123.023	50.251	57.4	438.83	1019
time_to_call	5.861	2.806	0.099	13.959	1019
coco	0.518	0.5	0	1	1019
Tier1_	13.191	2.797	8.5	24.1	949
distance_to_trigger_	8.086	3.133	2.4	18.975	528
writedown_all	0.686	0.465	0	1	528

Table 2: Baseline

	(1)	(2)	(3)	(4)
	yield_	yield_	yield_	yield_
coco	3.404***	3.434***	3.401***	3.108***
	(0.000)	(0.000)	(0.000)	(0.000)
writedown_all	0.729***	0.645**	0.740**	0.533**
	(0.006)	(0.013)	(0.014)	(0.015)
distance_to_trigger_	-0.123***	-0.100***	-0.125**	-0.113***
	(0.000)	(0.003)	(0.023)	(0.000)
Tier1_			-0.0114	
			(0.952)	
CDS_	0.00863***	0.00852***	0.00921***	0.00774***
	(0.001)	(0.001)	(0.001)	(0.000)
log_time_to_call	0.936***		0.905***	0.692***
	(0.000)		(0.000)	(0.000)
time_to_call		0.212***		
		(0.000)		
N	1019	1019	949	1019
adj. R^2	0.555	0.564	0.554	0.684

p-values in parentheses

This is the baseline regression including time fixed effects and bank fixed effects. Distance to default is zero for all non-cocos. Note the different maturity specifications.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Baseline

	(1)	(2)
	yield_	yield_
coco	3.736***	3.227***
	(0.000)	(0.000)
writedown_all	0.592**	0.669**
	(0.023)	(0.020)
distance_to_trigger_	-0.141***	-0.118***
	(0.000)	(0.003)
CDS_	0.0226***	0.00785***
	(0.000)	(0.004)
log_time_to_call	0.852***	0.909***
	(0.000)	(0.000)
N	1264	954
adj. R^2	0.706	0.538

p-values in parentheses

This is the baseline regression including time fixed effects and bank fixed effects. Distance to default is zero for all non-cocos. Note the different maturity specifications.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4 shows a multinomial logit with the choice of capital issuance as dependent variable. The options are coded as follows:

- "1" is no issue whatsoever;
- "2" is banks issuing equity;
- "3" any CoCo debt;
- "4" no CoCo issue whatsoever;
- "5" is equity conversion CoCo debt, and
- "6" is write down CoCo debt. spec3 is the other dummy
- "main" takes a different roles in the different columns. In columns (1) and (2), and (5) and (6) it takes the role of option 1 (no issue whatsoever), in columns (3) and (4), it takes the role of option 4 (no CoCo issue whatsoever).
- Options 3 and 5 become the base categories in the multinomial logit (regressors are omitted).

Table 4: Choice

	(1)	(2)	(3)	(4)	(5)	(6)
	spec2	spec2	spec3	spec3	spec4	spec4
main						
Tier1_lag	0.000176	0.0127	0.0389	0.0159	0.0837	0.0586
	(0.997)	(0.829)	(0.667)	(0.870)	(0.378)	(0.564)
price_to_book_lag	-0.00515*	-0.00492*	-0.00359	-0.00405	-0.00180	-0.00265
	(0.061)	(0.074)	(0.433)	(0.354)	(0.701)	(0.550)
GIIPS		0.266		-0.539		-0.604
		(0.505)		(0.349)		(0.296)
2						
Tier1_lag	-0.206**	-0.183**			-0.124	-0.139
	(0.011)	(0.031)			(0.260)	(0.234)
price_to_book_lag	-0.0156***	-0.0149***			-0.0124**	-0.0127**
	(0.002)	(0.003)			(0.047)	(0.038)
GIIPS		0.433				-0.432
		(0.357)				(0.491)
3						
Tier1_lag	0	0				
	(.)	(.)				
price_to_book_lag	0	0				
	(.)	(.)				
GIIPS		0				
		(.)				
5						
Tier1_lag			0	0	0	0
			(.)	(.)	(.)	(.)
price_to_book_lag			0	0	0	0
			(.)	(.)	(.)	(.)
GIIPS				0		0
				(.)		(.)
6						
Tier1_lag			0.112	0.0462	0.124	0.0608
			(0.268)	(0.671)	(0.239)	(0.589)
price_to_book_lag			0.00430	0.00368	0.00469	0.00379
			(0.371)	(0.412)	(0.342)	(0.410)
GIIPS				-1.616**		-1.591**
				(0.031)		(0.033)
N	394	394	394	394	394	394
adj. R^2						

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Interaction

	(1)	(2)	(3)	(4)	(5)	(6)
	yield_	yield_	yield_	yield_	yield_	yield_
coco	3.577***	2.903***	2.892***	2.941***	2.881***	3.070***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
writedown_all	0.930***	2.780***	2.808***	2.670***	2.791***	1.518***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
price_to_book_	-0.00944	-0.00192		-0.00192	-0.00188	-0.00385
	(0.300)	(0.841)		(0.840)	(0.843)	(0.607)
interaction		-0.0223***	-0.0227***	-0.0220***	-0.0225***	-0.00946**
		(0.000)	(0.000)	(0.000)	(0.000)	(0.031)
distance_to_trigger_	-0.145***	-0.0454	-0.0437	-0.0252	-0.0412	-0.0964**
	(0.000)	(0.233)	(0.247)	(0.489)	(0.536)	(0.015)
Tier1_					-0.0183	
					(0.931)	
CDS_	0.00760**	0.00960**	0.0100***	0.00950**	0.00959**	0.00824**
	(0.048)	(0.016)	(0.000)	(0.017)	(0.017)	(0.013)
log_time_to_call	0.859***	0.850***	0.850***		0.845***	0.627***
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)
time_to_call				0.195***		
				(0.000)		
N	885	885	885	885	877	885
adj. R^2	0.548	0.554	0.554	0.562	0.552	0.665

p-values in parentheses

This is the baseline regression including time fixed effects and bank fixed effects.

Distance to default is zero for all non-cocos. Note the different maturity specifications.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Placebo Test Interaction

	(1)	(2)	(3)	(4)	(5)	(6)
	yield_	yield_	yield_	yield_	yield_	yield_
coco	3.345***	3.367***	3.339***	3.018***	2.959***	2.964***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
writedown_all	0.382	0.248	0.325	-0.0124	3.431***	3.407***
	(0.455)	(0.626)	(0.512)	(0.977)	(0.000)	(0.000)
distance_to_trigger_	-0.114***	-0.0903**	-0.116**	-0.0996***	-0.0533	-0.0541
	(0.003)	(0.013)	(0.031)	(0.002)	(0.180)	(0.173)
Tier1_			-0.000655			
			(0.997)			
CDS_	0.00866***	0.00854***	0.00930***	0.00777***	0.00995***	0.00973**
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.015)
price_to_book_						-0.00106
						(0.913)
interaction					-0.0237***	-0.0235***
					(0.000)	(0.000)
interaction_CDS	0.00305	0.00349	0.00369	0.00479	-0.00462	-0.00455
	(0.411)	(0.357)	(0.336)	(0.155)	(0.162)	(0.187)
log_time_to_call	0.939***		0.908***	0.696***	0.841***	0.841***
	(0.000)		(0.000)	(0.000)	(0.000)	(0.000)
time_to_call		0.213***				
		(0.000)				
N	1019	1019	949	1019	885	885
adj. R^2	0.555	0.564	0.554	0.685	0.554	0.554

p-values in parentheses

This is the baseline regression including time fixed effects and bank fixed effects.
Distance to default is zero for all non-cocos. Note the different maturity specifications.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	(1)
	price_year
2013	157
2014	297
2015	500
2016	65
Total	1019
N	1019

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$