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Incentive Effect from Write-down CoCo Bonds: An Empirical Analysis

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Incentive Effects from Write-down CoCo Bonds: An Empirical Analysis*

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Abstract

Departing from the principle of absolute priority, CoCo bonds are particularly exposed to bank losses despite not having ownership rights. This paper shows the link between adverse CoCo design and their yields, confirming the existence of market discipline in designated bail-in debt. Specifically, focusing on the write-down feature as loss absorption mechanism in CoCo debt, I do find a yield premium on this feature relative to equity conversion CoCo bonds as predicted by theoretical models. Moreover, and consistent with theories on moral hazard, I find this premium to be largest when existing incentives for opportunistic behavior are largest, while this premium is non-existent if moral hazard is perceived to be small. These findings underline the idea of monitoring CoCo investors, which is a prerequisite for a meaningful role of CoCo debt in banks' regulatory capital mix.

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1 Introduction

In 2011, the reformed capital adequacy rules from the Basel III accord opened up for Contingent Convertible (CoCo) capital, including this capital category to become part of Basel III's Tier 1 capital class. This allowed banks to issue CoCo bonds to bolster their capital ratios, following the regulator's direction to create a more resilient banking sector by increasing individual banks' capital buffers.

Since the reform of the capital adequacy rules, CoCo bond issues in Europe have surged. At the same time, CoCos are subject to intense debate, with one important focus on the value of CoCo capital relative to equity capital. While proponents of CoCo bonds argue that the new capital class introduces an additional layer of Corporate Governance in the bank, by giving creditors an additional incentive to monitor the bank (Liikanen Commission, 2012, p. 103), opponents of CoCo capital argue that there is no benefit relative to common equity, and that CoCo bonds may even cause problems due to their complexity (Admati et al., 2013). So far, neither view has been confirmed or rejected by empirical evidence; yet, at the same time, more than half a trillion US dollars of capital have been raised through CoCo bonds worldwide since 2009 (Avdjiev et al., 2017).

In addition to the debate on CoCo versus equity capital and the role of monitoring investors, the CoCo capital debate focuses on how CoCo bond design features influence their value as regulatory capital. Policy discussions on CoCo bonds emphasize the role of CoCo conversion terms, which are due to dilute existing shareholders as a means to improve incentives for bank owners and managers to avoid excessive risks (Calomiris and Herring, 2013). However, the insights from this discussion have not been taken up by the Basel Committee, which allows CoCo bonds to be issued with a write-down feature instead of calling for a mandatory dilution. Write-down CoCo bonds, rather than converting into equity in times of bank distress, and diluting the old shareholders, are wiped out as a bank liability when the CoCo bond hits the trigger, resulting in a gain for the old shareholders. This mechanism is a departure from the absolute priority rule, in which the owners of the firm are also the first ones to suffer from losses. Evidently, a write-down CoCo bond reverses Calomiris and Herring's (2013) argument: Aligned managers have incentives to increase bank risk, as old shareholders stand to gain when hitting the trigger, benefiting from debt relief by writing down the liability from the CoCo bond. In Europe alone, more than half of the CoCo bonds have been issued as write-down CoCo bonds, with a face value of USD 102bn (Avdjiev et al., 2017).

The repercussions of write-down CoCo bonds for shareholder incentives have been discussed in a number of theoretical papers. Predominantly, this theoretical research associates the write-down feature with increased risk-taking incentives: Hilscher and Raviv (2014) show that in presence of write-down CoCo bonds, stock value increases with higher levels of asset risk, incentivizing higher bank risk taking. Berg and Kaserer (2015) illustrate the consequences of the write-down feature on incentives in bank crises: When the bank has its capital ratio close to the trigger, aligned managers rationally engage in excessive risk-taking, as shareholders stand to gain from both the upside and the downside. Similarly, Chan and van Wijnbergen (2016) find that the presence of write-down CoCo bonds increases risk-shifting incentives.[1] Evidently, these bank risk-taking considerations do matter for monitoring CoCo investors.

The combination of these two topics - that of CoCo investor monitoring, and that of perverse incentives from write-down CoCo bonds - raises the question on how CoCo investors perceive, and react to, the incentive risk from write-down CoCo bonds. Admati et al. (2013) mistrust the concept of CoCo bonds as being too complex, also with regards to the right valuation, implying that investors could miss contractual details in CoCo bonds, just like investors have missed other important characteristics of complex securities, like CDOs in the crisis. The Liikanen Commission (2012), on the other hand, has a more positive view in investors' abilities, trusting on their expertise in valuing CoCo bonds; this also implies a correct understanding and pricing of the write-down feature.

The question of whether CoCo investors should take the write-down feature into

[1] Martynova and Perotti's (2018) findings are a notable exception to the above results (see section 2.2)

account in their monitoring activities hinges on the question of whether or not banks are willing to distribute losses to debtholders in the first place. This is a core question surrounding the EU bail-in regulation. Vallée (2017) discusses that banks may in principle be inclined to protect CoCo investors from losses at all cost, trying to avoid a negative signal to the market. If this was the case, we would not expect to see a premium for the write-down feature. Yet, Vallée (2017) finds that pre-crisis hybrid bonds have been exposed to losses, thus making losses to post-crisis write-down CoCo bonds equally likely in future times of crisis.

In this paper, I investigate empirically the market prices of CoCo bonds, comparing the spread of subordinated bonds and CoCo bonds for both issuers of equity conversion and write-down CoCo bonds. Consistent with the theory on incentives, I am the first to document a yield premium for the write-down feature in market prices of European CoCo bonds, which lies at around 75 basis points, or around USD 0.8bn per year. This finding shows that CoCo investors are indeed aware of the risk-taking incentives derived from the CoCo design. Moreover, in my results I can show that the premium increases with existing moral hazard problems in the bank, both confirming that the premium derives from an incentive problem, and lending support to the view that CoCo investors are active bank monitors.

Ideally, the question of the incentives for banks with CoCo capital would be discussed with a sample of triggered CoCo bonds, since perverse incentives from the presence of CoCo bonds are strongest in times of distress. However, this is not possible given the youth of the CoCo market, and the lack of distress events. Instead, we can study the effect of investors anticipation of distress events, reflected in CoCo bond prices in normal times. In my analysis, I employ an innovative identification strategy to overcome potential problems of endogeneity. Rather than just looking at a cross section of CoCo bonds, checking whether the write-down feature is associated with higher yields, I add a control group of subordinated bonds, pricing the yield difference between subordinated and (write-down and non-write-down) CoCo bonds. This identification strategy, akin to a diff-in-diff, makes sure that I am pricing the risk of the CoCo *issue*, rather than that of the CoCo *issuer*.

For a number of reasons, my results are unlikely to be driven by sample selection. First of all, given my identification strategy, for my findings to be driven by sample selection, the selection would only have to affect the CoCo bonds, but not the subordinated bonds, which drastically decreases the number of settings where sample selection could play a role. Moreover, while banks may take their quality at the time of issuance into account, they have less control over their quality for a CoCo bond whose price I measure years after issuance, further mitigating sample selection concerns. Furthermore, given my finding that the write-down features carries a yield premium which is higher for "bad" banks, it is likely that the higher interest that potential write-down CoCo issuers have to pay deters them from issuing in the first place. In that regard, sample selection dictates that I probably underestimate the true effect. This is consistent with the findings of Goncharenko et al. (2017), who find that CoCo issuance is centered at high-quality banks, with the authors citing agency cost considerations as the motivation. To be sure, I conduct my own analysis of the issuance decision, looking how bank quality drives the choice of loss absorption mechanism (i.e. the choice of having a write-down feature or not). I do not find the choice to be associated with bank quality, rejecting the sample selection story.

The findings of my paper corroborate the view that CoCo investors are indeed active monitors of bank, enforcing market discipline. Given active monitoring, the notion that CoCo bonds could be a valuable instrument for bank capital increases is supported.

2 Motivation and Institutional Background

2.1 Market Discipline and the CoCo Bond versus Equity Debate

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 lively debate on which capital instruments should be allowed as regulatory capital. In this debate, one key aspect on the role of different capital instruments are the questions of investor monitoring, and market discipline.

Admati et al. (2013) advocate higher common equity as the prime tool to boost bank capital, citing its simplicity, and not seeing any advantage in having complicated CoCo bond securities in the pool of regulatory capital. In their view, CoCo bonds may cause problems in bank resolution, as regulators cannot design all contingencies of resolution ex ante, and there may be too little time to work on these problems when resolution becomes due. At the same time, Admati et al. (2013) are highly critical of the value of investor monitoring, citing the experience of the financial crisis of 2007-2008, where debt-holder monitoring proved to be ineffective in disciplining banks. [2]

In opposition of Admati et al.'s (2013) view, CoCo bonds have been endorsed as an alternative to equity buffers in banks by many scholars. Building on the original idea by Flannery (2005), its advocates find CoCo capital useful on the grounds that additionally to CoCo bonds providing an equity-like capital buffer, its investors are active monitors, which allows market discipline to work (Calomiris and Herring, 2013). The positive view on CoCo capital has also been endorsed by high-profile expert reports on the reform of the financial system after the crisis, such as the Liikanen Report (Liikanen Commission, 2012) and the Squam Lake Report (French et al., 2010).

[2] As to the motivations to issue CoCo bonds, Admati et al. (2013) identify the tax advantage of debt financing. The US case seems to support this view: In the USA, CoCo bonds are not tax privileged relative to equity. At the same time, the count of US CoCo bond issuances if at zero.

According to Flannery (2001), investor monitoring can reduce bank risk outside of default through market discipline: Other than through direct influence, i.e. through covenants (which are unavailable to CoCo investors), debtholders may punish risky banks with higher costs and lower availability of debt funding. Furthermore, price signals from the bond market, stemming from investor monitoring, can also be used by supervisors, who can choose to act on adverse information on bank health by constraining bank action. As CoCo bonds are very exposed to bank distress, one can expect that price signals develop early, potentially giving supervisors important additional information, and making CoCo bonds a valuable tool of market discipline.

At the core of the mechanism of market discipline is the correct pricing of CoCo bonds by investors. This can be 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 monitor, and equilibrium market prices will be risk-adjusted as a result of this monitoring. Thus, by studying the cross section of market prices, we can draw conclusions on the quality of CoCo investors' monitoring.

As a result of these considerations, identifying drivers for CoCo prices is tantamount to finding evidence consistent with investor monitoring, which in turn establishes the necessary condition for market discipline to work. The findings of this paper on investor monitoring thus contributes to the discussion on whether alternative forms of regulatory capital are useful and appropriate in bolstering bank capital.

2.2 The Write-down Feature and Incentives

Incentives for risk-taking for owners and managers are a major driver for security prices of a bank. The influence of CoCo bonds on incentives are highlighted in Berg and Kaserer (2015), who explore the change of incentives which stems from the differences in CoCo conversion ratios when converting into equity in times of bank distress. They find that a typical CoCo bond increases incentives for risk-taking by relieving equity investors from losses in bank distress and putting it on CoCo investors instead. The link between CoCo design and incentives is as follows: The more conversion ratios are such that the issuer of the CoCo bond makes a gain upon a CoCo bond conversion, the more he will be inclined to increase bank risk, especially if the trigger ratio is close to the threshold. As Chan and van Wijnbergen (2016) emphasize, this problem is most prevalent with principal write-down CoCo bonds.

Figure 1 shows the payoff profiles of CoCo and equity investors, both for banks with write down and equity conversion CoCo bonds (Panels A and B, respectively). Note the jump in the payout profile of equity holders in presence of write-down CoCo bonds: Whenever a loss pushes the firm value below the equity threshold ratio, the payoff to the equity holder actually *increases due to the loss*, as the CoCo is written off (see Figure 1, Panel A). Thus, 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. As a result, (aligned) managers will rationally gamble for resurrection when close to the threshold, even if the expected value of the gamble is negative: 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 risks, creating a conflict of interest between shareholders and CoCo investors, and thus resulting in an agency cost. This is not the case for equity conversion CoCo bonds which convert at par (see Figure 1, Panel B).[3]

The adverse effect of low conversion ratios and write-down CoCo bonds on in incentives is emphasized in Hilscher and Raviv (2014), Berg and Kaserer (2015) or Chan and van Wijnbergen (2016). Other than the question of risk-shifting prior to conversion and the role of write-down CoCo bonds, Martynova and Perotti (2018) analyze the the risk

[3]In figure 1, the payoff profile of the shareholders in a bank with equity conversion CoCo bonds does not exhibit a jump. This, however, is only the case if conversion takes place at par, i.e. that CoCo investors do not make a loss upon conversion. In practice, equity conversion CoCo bonds are almost always designed in a way that conversion entails a gain for the old shareholders (Berg and Kaserer, 2015). Still, the problem is always smaller for equity conversion than for write-down CoCo bonds.

profile of the going-concern bank *after* the CoCo bonds have been triggered. In their findings, write-down CoCo bonds actually improve incentives post-triggering, inducing the bank not to choose inefficiently risky asset allocations. While certainly interesting, my focus is not on the risk profile after conversion, but before.[4]

2.3 Other Related Literature

Related theoretical literature on CoCo bonds deals with the relationship of CoCo bonds with straight debt, and with the design of the conversion trigger.

Koziol and Lawrenz (2012) analyze the influence of CoCo bonds on incentives outside the question of the write-down feature. In their model, CoCo debt undermines the disciplining effect of straight debt by postponing default. As a result, equity holders react to this effect by endogenously increasing bank asset risk.

With regards to the conversion trigger, there is a debate on whether it should target regulatory (accounting) or market ratios. Sundaresan and Wang (2015) reject the idea of a trigger based on accounting variables, as it prone to manipulation and, as a backward-looking variable, to delays. At the same time, they point out that market-based triggers suffer from multiple equilibria, in which both shareholders and CoCo holders have incentives to manipulate the stock price.[5] They advocate a market price trigger in combination with a conversion which does not transfer value between equity holders and CoCo investors, which is immune to that problem. Yet, Martynova and Perotti (2018) point all existing CoCo issues include a value transfer, and a conversion at par CoCo bond may be impossible to design in practice. Moreover, Glasserman and Nouri (2012) point out, actual CoCo bond issues all have accounting-based capital ratio triggers, for which reason they limit their CoCo bond asset-pricing exercise to CoCo bonds with accounting

[4]Martynova and Perotti's (2018) results stem from the effect that equity dilution has a *negative* effect on incentives. However, this result seems to be strongly driven by the timing of their model, in which the (old) managers decide on the entirety of post-trigger risk of the bank at the time before the triggering, s.t. the amount of old shareholders' equity left after dilution (or non-dilution in the case of write-down CoCo bonds), in absence of any (regulatory or new owners') action after the conversion.

[5]In contrast to that, Pennacchi and Tchistyi (2015) present a closed-form solution for CoCo bonds with market price trigger which doesn't suffer from multiple equilibria by introducing perpetual maturity.

triggers.

On the empirical side, notable work on CoCo capital has been done by Avdjiev et al. (2017), 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.[6] 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. (2017) who use a similar sample, and they also look at CoCo bonds' design features and their impact on 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.

2.4 Hypotheses

The above discussion suggests that write-down CoCo bonds are associated with excessive risk-taking incentives, higher than in the case of equity conversion CoCo bonds. The higher the gain is upon triggering of the CoCo bond, 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 perverse incentive).

My main analysis collects evidence of investor monitoring in CoCo bond 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 the complexity of CoCo bonds, investors are aware of the moral hazard risk which derives from the write-down feature.

[6] Additionally, Avdjiev et al. (2017) provide an excellent overview on both the regulatory treatment and requirements of CoCo bonds. More on these topics can also be found in Avdjiev et al. (2013).

To be precise, I do compare the spread between subordinated bonds, and either principal write-down CoCo bonds or equity conversion CoCo bonds of the same issuer. Clearly, in the case of write-down CoCo bonds, shareholder and CoCo holder incentives are not aligned, which burdens an agency cost on the CoCo holders. Thus, in the presence of monitoring CoCo investors, and with the mechanisms of market discipline at work, CoCo prices should be lower (the yield should be higher) for a write-down CoCo bond relative to an equity conversion CoCo bond.

This leads me to my first hypothesis:

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

Having established that CoCo bonds with a write-down feature indeed trade at a premium, it remains the question of what are the determinants of the size of the premium. The discussion and theoretical predictions on the agency cost of the write-down feature suggest that it is driven by concerns on risk-taking incentives and moral hazard.[7]

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 lack of such distress events, 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

[7] One alternative explanation for the source of the write-down premium is that it is simply a compensation for expected losses. The argument is as follows: In the "good state", i.e. the no-trigger-case, both write-down and equity conversion CoCo bonds are equivalent in that they represent fixed claims. However, in the "bad state", the write-down CoCo bond is worthless, while the equity conversion CoCo bond still has the equity value after conversion. Thus, if the triggering risk was exogenous, and equal for both kinds of CoCo bonds, the value of the write-down premium was solely determined by the product of loss given trigger of the equity conversion CoCo bond. If the loss given trigger was fixed, the write-down premium would be linear in bank risk. In a robustness test, I show that the write-down premium's link to moral hazard stands in light of this alternative explanation, see 5.

will exacerbate the problem from the skewed incentives from write-down CoCo bonds, as banks have lower incentives not to engage in opportunistic or risk-seeking behavior in the first place. One such driver for has been discussed Gropp and Vesala (2004), pointing to banks' charter values, proxied by the price to book ratio. 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 are hard to establish in a newly founded bank, and they cannot be bought on the market from an existing bank. At the same time, they contribute greatly to the bank's success in the form of higher future cash flows. As a consequence, a high charter value inhibits the risk of of opportunistic behavior, as there is more at stake for the owners of bank.

This leads me to my second hypothesis:

(2) *The write-down premium, as compensation for an agency cost, increases with existing moral hazard problems in the bank. Thus, it is lower for banks with a high charter value (and vice versa).*

3 Data

To investigate the impact of the write-down feature on CoCo bond prices, I construct a data set which is based on all CoCo bond issues from banks from the European Economic Area (EEA) plus Switzerland since 2009, which I obtain from Bloomberg. This data set includes all bond-specific information which I am using in my analysis, including information on the trigger ratio, its level, and the loss absorption mechanism (equity conversion or write-down). In order to minimize the institutional differences between the various CoCo bonds, I do only keep Additional Tier 1 CoCo bonds with the trigger for loss absorption geared to the Common Equity Tier 1. Additionally, I collect daily yield data (yield to maturity, (YTM) and yield to first call, (YTC)) starting from Q3 2013 until 06/06/2017, one day before Banco Popular's bail-in. The CoCo bonds in my sample are denominated in USD, EUR, GBP and CHF, for which currencies I collect the long-term risk-free rate. For each CoCo bond, I calculate the distance to trigger by subtracting the actual Tier 1 ratio from the contractual threshold.

For the set of CoCo-issuing banks, I collect all subordinated bond issues from the same period belonging to the banks' Tier 2 capital category. I augment this combined data set with quarterly Common Equity Tier 1 ratios, and daily senior 10 year CDS spreads and price to book ratios, which I receive from SNL and Markit, and which I match with the banks in my sample by hand. I do only keep observations if I have both at least one CoCo bond and one subordinated bond by the same issuer in the same period. This leaves me with 291 securities from 21 different banks, 82 of which are CoCo bonds.

Using the YTM and YTC, I construct the yield for each bond as follows: Wherever available, I use the YTC as the security's yield. If the YTC is missing, i.e. whenever there is no first call date, I use the YTM as the security's yield instead. This follows Vallée's (2017) logic: Both CoCo bonds and subordinated bonds usually 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" for the issuer, at the price of a reputational loss vis-à-vis the investors (Vallée, 2017). As such, the market prices these bonds 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 about 15 years, i.e. the highest remaining life for a CoCo bond in my sample. Also, I drop all observations with a remaining life lower than half a year to avoid end-of-life yield problems. Finally, I winsorize my entire sample at the 5% level.

The summary statistics are shown in Table 2: Panel A shows the entire sample, Panel B compares subordinated bonds to CoCo bonds, and Panel C equity conversion to write-down CoCo bonds. The overall sample consists of more than 137,000 observations, roughly two third of which are subordinated bonds, and one third CoCo bonds. In Panel C, we can see that the CoCo bond observations are split almost equally in equity conversion and write-down CoCo bonds. The mean yield of an equity conversion CoCo bond is slightly *larger* than that of write-down CoCo bonds. Yet, write-down CoCo bonds seem to be of better quality (as seen in the issuer's average CDS spread and price to book ratio), and have a shorter remaining life.

In an additional analysis, I investigate the CoCo issuing behavior of European banks in order to find out whether the write-down premium may be driven by bank issuer's characteristics, i.e. by sample selection. Here, following Acharya and Steffen (2015), I look into a sample of EBA stress test banks of both CoCo issuers and non-issuers, and append it with listed banks from the Euro Stoxx Financials Index.[8]. The sample for this test covers 64 CoCo-issuing and non-issuing banks from 2011 to 2017, collecting all CoCo bond and equity issues of these banks in this period.

4 Empirical Strategy

The youth of the market for CoCo bonds poses some additional challenges for identification of the write-down premium. In an ideal setting, the price effect of the agency cost of conversion could be measured by randomly assigning the write-down feature to different issues. Yet, the actual characteristics of issues that we do observe in the market are deliberate choices by the issuing banks rather than random assignments. Moreover, the

[8]My main motivation to for including listed banks is to also include Swiss banks in my sample, which are not covered by the EBA.

factors which govern the banks' choice of CoCo bond characteristics could at the same time drive the CoCo prices independent of the CoCo features of interest. As a result, if we simply related CoCo bond prices with the write-down feature, these results would be biased. The measured difference could reflect the differences in the issuers' characteristics rather than the differences in the issues. To control for this bias, we will have to control for the issuers' characteristics.

We can easily accommodate bank characteristics in our regression analysis to the extend that they are observable. However, especially in a security as delicate as a CoCo bond, there is a large number of unobservable bank characteristics also driving the yields of the bonds, such as the issuer's reputation, or the investor's trust in the issuer. These characteristics would likely fluctuate between different banks, but remain stable for the duration of my sample for a given bank. Typically, we would control for these unobserved characteristics by incorporating bank fixed effects into the analysis. However, in a sample solely composed of (write-down and non-write-down) CoCo bonds, we cannot use bank fixed effects if we don't have both kind of CoCo bonds by every issuer (which we don't in our sample), as such an analysis will yield inconsistent estimates of the write-down feature.

Instead, my identification strategy rests on pooling my sample of CoCo bonds together with subordinated bonds of the same issuers. This allows me 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 write-down dummy, relating to the question of agency cost from my first hypothesis. The identification strategy is illustrated in figure 3: Each security is subject to a bank-specific base risk, captured by a bank fixed effect. Furthermore, every CoCo bond, regardless of the loss absorption mechanism, carries a CoCo premium, captured by a CoCo bond dummy. Finally, the write-down premium is captured by a write-down dummy.

As a result of my identification strategy, I measure the difference between the *spread* of a bank's subordinated debt and its CoCo debt, checking whether it is higher for write-down CoCo bonds than for equity conversion CoCo bonds. This is to ensure that unobserved bank characteristics potentially driving the yield of write-down CoCo bonds are already captured in the base risk dummy (bank fixed effect), and the write-down dummy only captures the additional yield introduced by the write-down feature.

My baseline empirical strategy looks as follows:

$$\begin{aligned} Yield_{i,t} = \beta_0 + \beta_1 * coco\ dummy_i + \beta_2 * write\ down\ dummy_i \\ + \gamma * X_{i,j,t} + FE_j + FE_t + \epsilon_{i,t} \end{aligned} \tag{1}$$

In equation 1, subscript i refers to the bond, j to the bank, and t to the period (day). The identification strategy is also illustrated in Figure 3. 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 write-down feature upon reaching the trigger ratio, and zero otherwise (i.e. zero 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, as they control for a wide range of time-variant, risk-related price drivers 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. As a CoCo bond-specific control, I use the distance to trigger. 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. For the subordinated debt, the distance to trigger is set to zero, as these securities are not subject to trigger risk. Furthermore, I control for the long-term market yields by including ten year government bond yields, with each security's currency mapped to its corresponding government bond 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 strategy including subordinated bonds 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.

Moreover, in my second specification, I explore the drivers of the write-down premium. The specification is the same as above, other than I include an interaction term:

$$\begin{aligned} Yield_{i,t} = \beta_0 + \beta_1 * coco\ dummy_i + \beta_2 * write\ down\ dummy_i \\ +\beta_3 * write\ down_i * PTB_{i,t} + \\ +\gamma * X_{i,j,t} + FE_j + FE_t + \epsilon_{i,t} \end{aligned} \tag{2}$$

The interaction term is the product of the write-down dummy and and the bank's price-to-book ratio. The price-to-book ratio serves as a proxy for the bank's charter value. As discussed above, a low charter value is a sign of existing moral hazard problems, reinforcing incentives for excessive risk-taking. As such, a low charter value should increase the premium on the write-down feature, while a high charter value relaxes the concerns on risk-taking incentives, thus lowering the premium of the write-down feature.

5 Results

Table 3 shows the yield premium of the write-down feature. It shows five different specifications, all of which show a statistically significant higher yield of write-down CoCo bonds relative to the subordinated bonds of the same issuer, than equity conversion CoCo bonds relative to the subordinated bonds of the respective issuer. The write-down feature's premium is between around 0.5 to 1.0 percentage points, depending on the specification.[9] After only including the CoCo and write-down dummies in column (1), adding bond-specific controls in column (2) and CDS as a bank risk control in column (3), I arrive at my uninteracted baseline model in column (4), which corresponds to equation 1.[10] All specifications show a significant increase of the yield from the write-down feature, supporting my first hypothesis. Finally in column (5), I include the interaction between the write-down feature and the bank's price to book ratio, our proxy for the bank's charter value. This specification represents my interacted baseline model (see equation 2). The interaction term is highly significant (both individually and jointly with the write-down dummy), suggesting that the write-down premium is not uniformly levied on all write-down CoCo bonds in the sample, but rather that it increases with low bank charter values. This finding supports my second hypothesis.

The findings in Table 3 lead us to the main results of my analysis: First of all, we find the expected yield premium of write-down CoCo bonds relative to equity conversion CoCo bonds. Moreover, this premium for the write-down feature is not the same for each write-down CoCo bond, but rather we have that it increases with existing moral hazard problems in the issuing bank.

Otherwise, we find the expected behavior for the control variables both in terms of signs, magnitudes and statistical significance. The only exception is the distance-to-trigger variable, which becomes insignificant in the interacted specification in column (5).

[9] Column (5) has a combined effect of the write-down dummy and the interaction term of around 0.75 percentage points at the mean of the price to book-ratio.

[10] My baseline model in column (4) is different to column (3) only in that it includes the price to book-ratio. While the ratio in itself doesn't have an effect, I leave it in the model as a benchmark for the interacted model.

This will be addressed in a robustness test. In what follows, the two regressions from columns (4) and (5) will serve as my (uninteracted and interacted) baseline regressions.

Given the result that the write-down premium is larger for banks with existing moral hazard problems, a natural question to ask is that of the performance of subsamples of CoCo bonds. This question is addressed in Table **??**, in which I split the sample of write-down CoCo bonds in two, only keeping the best observations (the half with the highest price to book ratio) in columns (1) and (2), and the worst ones in columns (3) and (4). [11] As expected, we find the highest price for the write-down feature in the sample of "bad" write-down CoCo bonds: The estimates for the write-down and the interaction in columns (3) and (4) are highly significant and larger than in the baseline regressions; the estimates of the features in the "good" sample are not statistically different from zero.[12] The latter finding is a surprise to some extent: While we do expect to find weaker effects in the "good" sample, we would still have expected them to be different from zero (unless we expect the risk of conversion of these issues to be zero). In an unreported regression, I repeat the analysis with quintile samples instead of splitting the sample in halves. I find the same result patterns there.

Finally, the discussion on the source of the write-down premium warrants an additional look at the link of the premium with bank risk. As discussed in chapter 2.4, the write-down premium could also be determined as a compensation for expected losses, rather than moral hazard concerns. This raises the question of which effect is the driver of the results. For that reason I introduce a second interaction term in the analysis, making

[11] I do not remove any subordinated or equity conversion CoCo bond observations.

[12] The F-Test on joint significance of the write-down dummy and the interaction has a p-value of 0.14.

sure that the link with moral hazard premium persists:

$$
\begin{aligned}
Yield_{i,t} = \beta_0 + \beta_1 * coco\ dummy_i + \beta_2 * write\ down\ dummy_i \\
+\beta_3 * write\ down_i * PTB_{i,t} + \\
+\beta_4 * write\ down_i * CDS_{i,t} + \\
+\gamma * X_{i,j,t} + FE_j + FE_t + \epsilon_{i,t}
\end{aligned}
\tag{3}
$$

In this specification, the CDS spreads are a proxy for the probability of default. Given zero risk, c.p. there should not be a difference between write-down and equity conversion CoCo bonds. As a result, the interaction between the write-down feature and the CDS should have a positive sign, as an increases in risk disproportionately increase the expected losses for write-down CoCo bonds. More precisely, the expected losses increase more steeply in the probability of default for write-down CoCo bonds than for equity conversion CoCo bonds, given the higher loss given default. As a result, the write-down premium should be larger for banks with higher risk. Equation 3 then inquires, whether the moral hazard interpretation of the write-down premium is intact after controlling for the increase in risk.

The results for this analysis following equation 3 are shown in Table 5. In column (1), I introduce the interaction of the CDS spread with the write-down premium into the baseline regression[13] Clearly, state pricing effects should be reflected in this interaction, as seen in column (1). Yet, when adding the baseline interaction (*write-down*bank charter value*), as in column (2), the state pricing effect loses significance, whereas the baseline interaction is consistently and strongly significant. This is also the case for the two alternative specifications with different fixed effects (columns (3) and (4)). Thus, when horse raced against the state pricing interaction, the moral hazard interaction term still retains statistical significance. This finding supports the view that the write-down premium is indeed a moral hazard premium, rather than a compensation for lower state

[13]For this interaction term, the CDS spread has been demeaned. This is facilitate the interpretation of the table, because otherwise the pure CDS effect would be "eaten up" by the interaction as they have the same signs.

prices.

Finally, Table 5 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 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.

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 Robustness

6.1 Alternative Specifications

In Table 6, I repeat the baseline regressions with a different set of fixed effects for both the uninteracted and interacted model. Whereas in my baseline specification, I use day and bank fixed effects, columns (1) and (2) of Table 6 repeat the analysis with quarter and bank fixed effects. Columns (3) and (4) employ bank-quarter fixed effects, and columns (5) and (6) use bank-day fixed effects. My interpretation remains unchanged: Regardless of whether I take out quarterly rather than daily variation, or whether I take out all bank-specific quarterly or even daily variation, I always find a positive and significant premium on write-down CoCo bonds, and I find that the write-down premium increases with lower charter values.

One potential concern towards my results may be that they are shaped by distressed markets. In early 2016, CoCo bonds were thrown into turmoil in fears over Europe's banking sector. At the same time, there were fears of the suspension of coupon payments for a number of issues. In Table 7, we make sure that our write-down premium is not only driven by these events, but continues to persist outside the window of market turmoil. Columns (1) and (2) only look at the sample before 2016, whereas columns (3) and (4) use only observations after the second quarter of 2016. The findings of my baseline specification are unchanged from these analyses: We still find a significant effect of the write-down premium and a link with moral hazard problems in the bank.

Finally, the Table 8 repeats the interacted analysis replacing the distance-to-trigger variable. This is to address the problem of an inbuilt link between the distance to trigger and the bank charter value, with the link presumably leading to insignificant results on the distance-to-trigger in the baseline interacted regression (see column (5) in Table 3).

Both the distance to trigger variable, defined as the CoCo Trigger Level minus the current Common Equity Tier 1 ratio (*book equity* to risk weighted assets), and the interaction between the write-down feature and the charter value, defined as the write-down dummy multiplied with the bank's market value of equity and the bank's *book value of equity*, are linked through the bank's book value of equity. Thus, in the interacted specification, the distance to trigger variable could be seen as a bad control in that it is specified simultaneously with the bank's charter value.

In order to address this potential criticism, the interacted regression is repeated with different controls than the distance to trigger in Table 8. In columns (1) to (3), I use the CoCo trigger level, i.e. the prespecified level of the common equity tier 1 ratio at which the CoCo bond's loss absorption mechanism is activated [14], instead of the distance-

[14] I.e. the level at which either a conversion of a write down takes place.

to-trigger. This measure of CoCo trigger risk is independent of the interaction term of interest; yet it is a noisier measure of the riskiness of the CoCo bond. The baseline results are unchanged for different sets of fixed effects, i.e. bank and day fixed effects (column 1), bank-quarter fixed effects (column 2), and bank-day fixed effects (column (3)).

In column (4), rather than just one CoCo bond dummy, I use dummies for high-trigger and low-trigger CoCo bonds while employing bank-day fixed effects. In column (5), I add the distance-to-trigger variable (which remains insignificant), and in column (6), I introduce an additional interaction dummy capturing the effect of the CET 1 ratio on CoCo bonds. My analysis is robust to these changes.

6.2 Sample Selection

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. Consistent with that argument, Goncharenko et al. (2017) find that CoCo bond issuers are high-quality banks.

While I do not think it is plausible that my results are driven by sample selection, I nevertheless explore this possibility, analyzing the differences between banks which issue equity, various forms of CoCo debt, and those which do not issue at all in sample of EBA stress test banks and listed Euro Stoxx Financials banks (see section 3). The results of this multinomial logit regression are presented in Table 9.

Columns (1) and (2) start by confirming the findings of Goncharenko et al. (2017), comparing CoCo bond issuers to non-issuers and equity issuers. As in their findings, the results confirm that banks issuing CoCo bonds are of higher quality than issuers of equity, both while controlling for country fixed effects (column (1)) and time fixed effects (column (2)).

In columns (3) and (4), and (5) and (6) I repeat the analysis, while distinguishing between equity conversion and write-down CoCo bonds. The results confirm the view that write-down CoCo bond issuers are not of a worse quality than equity conversion CoCo bond issuers - rather, I struggle to find any significant differences. This finding further supports my conjecture that the result on the write-down premium are not driven by sample selection.

7 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.

Finally, 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.

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A Appendix

Figure 1: One-Period Payoffs of Equity and CoCo Bonds

This chart shows CoCo investors' (left) and equity investors' (right) one-period payoffs, depending on the bank's asset value (firm value FV). Panel A (top) shows the payoffs with write-down CoCo bonds, and Panel B (bottom) shows the payoffs with equity conversion CoCo bonds as part of the bank's capital mix. For the equity conversion CoCo bonds, the conversion takes place at par, i.e. one euro of CoCo capital converts to one euro of equity capital. (C) stands for principal and interest of the CoCo bond promised to the investors if the firm value is such that the equity (CET1) is above the trigger threshold. B ("bond") stands for the the value of the senior debt's principal plus interest; if firm value is below B, neither junior claimant receives anything in either case. Note the jump in the payout profiles in the write-down case (Panel A).

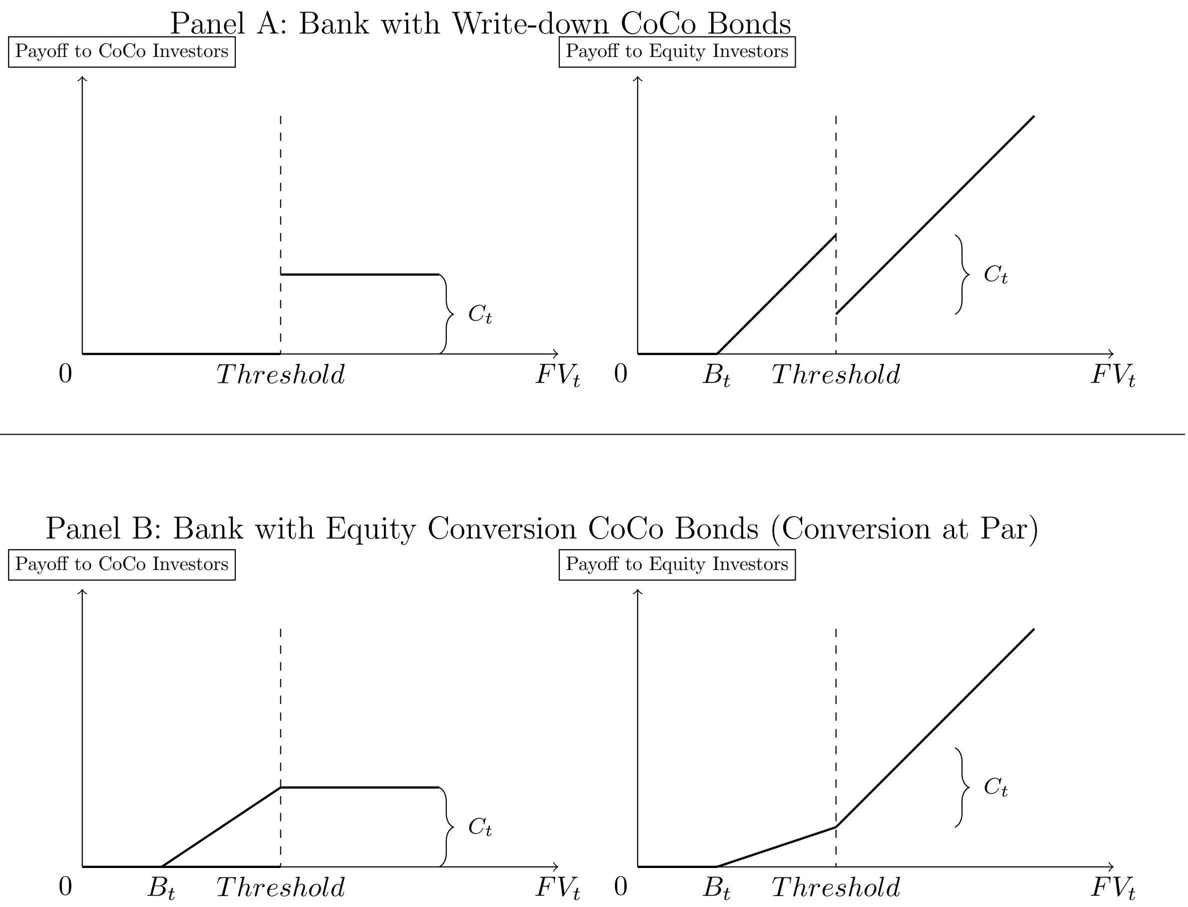

Figure 2: Balance Sheet Effects of a Write-down

This chart shows a write-down from a balance sheet perspective. The bank has just been hit by a loss of EUR 10m. On the left, the balance sheet is shown before accounting for the loss. Here, the CoCo bonds still are part of the balance sheet. On the right, the situation is shown after the loss. The loss has eaten up the entire equity, and triggered the write-down CoCo bond. Due to the write-down, the equity is actually higher after the loss. Since the CoCo capital has been written off, all of the equity on the right side is owned by the old shareholders, so they actually profited from the loss on the asset side.

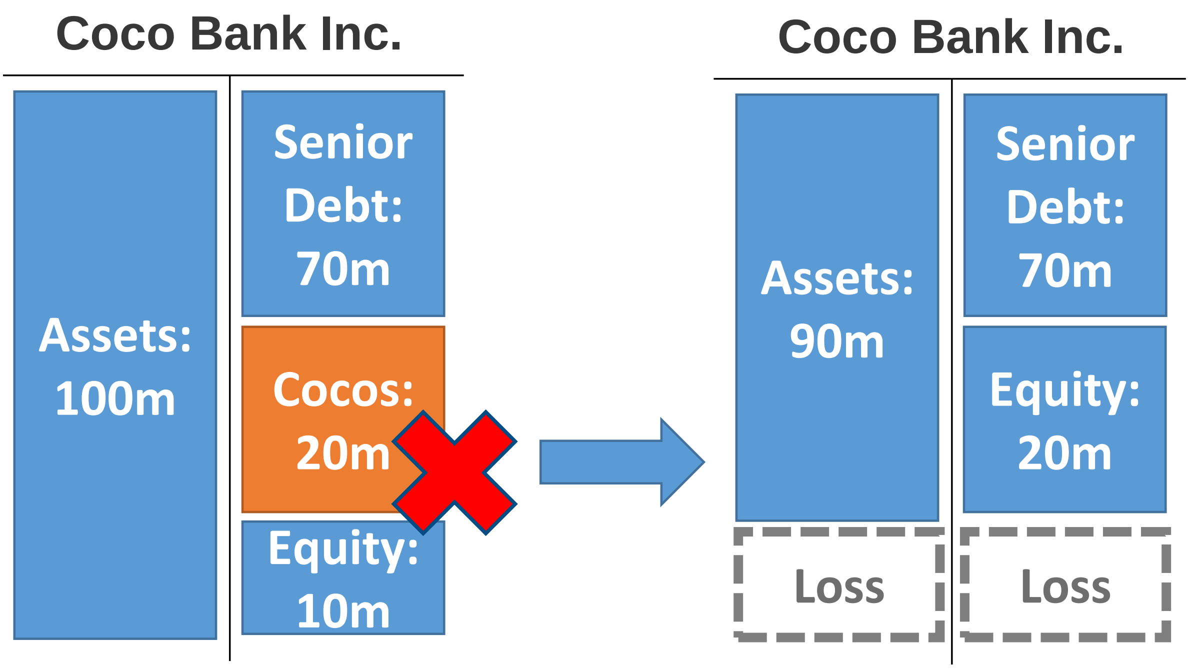

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Figure 3: Identification of the Write-down Premium

This chart illustrates the identification strategy. Each bank in my sample has both a subordinated bond, and either an equity conversion or a write-down CoCo bond. The bank fixed effect, gauged from the subordinated bond and the CoCo bonds, contains the base risk; the CoCo premium is the premium for CoCo bonds regardless of loss absorption mechanism, whereas the write-down premium is added for write-down CoCo bonds. In the second part of the analysis, the write-down premium is not fixed, but is allowed to vary with the charter value of the bank (not illustrated).

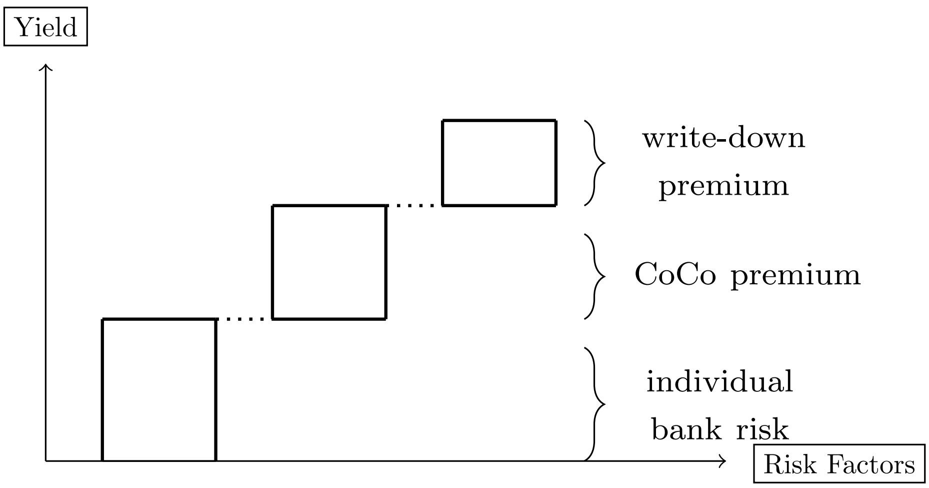

Table 1: Variable Definitions

Name	Definition
log(Remaining life)	Natural logarithm of the remaining time until first possible call date by the issuer of the bond, i.e. the earliest date of redemption, at the time of the observation, in years. If there is no first call date, it is the time to maturity instead
Yield	Yield to the earliest date of redemption, i.e. yield to first call if available, and yield to maturity otherwise, in percent
CoCo Dummy	Indicator variable which is equal to 1 for Contingent Convertible Bonds (i.e. bonds with a principal loss absorption either through conversion to equity of write-down, as defined in Basel III), and zero else
Write-down Dummy	Indicator variable which is equal to 1 for CoCo bonds with a write-down feature as loss absorption mechanism, and zero else
Tier 1 ratio	Common Equity Tier 1 (CET1) as a percentage of Risk-weighted assets (RWA)
Trigger Level	Contractual level of the CET1 ratio at which the CoCo bond's loss absorption is activated (i.e. equity conversion or write-down), in percentage points. Zero for ordinary subordinated bonds
Distance-to-trigger	Difference between the CET1 ratio and the contractual trigger level of the CoCo bond, in percentage points. Zero for ordinary subordinated bonds
Safe yield	10 year government bond yield for the respective currency (USD, EUR, CHF and GBP), in percent. For EUR denominated bonds, the German government bond yields are used
CDS	Bank's senior CDS spreads for senior debt with MM ("Modified-Modified") restructuring clause, in basis points
Price-to-book (P/B)	Bank's market value of equity divided by the book value of equity
Dummy Low Tr.	Indicator variable which is equal to 1 for Contingent Convertible Bonds with a contractual CET1 ratio trigger level of 5.125%, and zero else
Dummy High Tr.	Indicator variable which is equal to 1 for Contingent Convertible Bonds with a contractual CET1 ratio trigger level of 7%, and zero else

Table 2: Summary statistics

Panel A: Entire Sample (n=136,955)				
	Mean	Std. Dev.	Min.	Max.
yield_	4.153	2.304	0.561	10.079
time_to_call	5.979	2.922	0.501	15.381
distance_to_trigger_	1.925	3.1	0	10.075
safe_yield	1.055	0.88	-0.511	2.704
CDS_	129.39	37.289	80.75	211.82
price_to_book_	78.519	31.166	21.558	302.23

Panel B: Sub Debt vs. CoCo Bonds				
	Sub Debt (n=95,926)		CoCo Bonds (n=41,029)	
	Mean	Std. Dev.	Mean	Std. Dev.
yield_	2.960	1.417	6.942	1.387
time_to_call	5.985	3.038	5.966	2.628
distance_to_trigger_	0	0	6.521	1.603
safe_yield	0.861	0.813	1.513	0.864
CDS_	133.373	37.812	120.079	34.276
price_to_book_	76.137	29.781	84.088	33.533

Panel C: Equity Conversion vs. Write-down CoCo Bonds				
	Eq. Conversion (n=20,684)		Write-down (n=20,345)	
	Mean	Std. Dev.	Mean	Std. Dev.
yield_	7.074	1.448	6.806	1.309
time_to_call	6.455	2.468	5.468	2.691
distance_to_trigger_	7.139	1.574	5.884	1.365
safe_yield	1.461	0.901	1.566	0.821
CDS_	124.697	37.235	115.384	30.266
price_to_book_	76.150	34.208	92.158	30.803

Table 3: Write-down Premium: Baseline Regression

This table presents OLS regressions with fixed effects for the write-down premium on security prices. The dependent variable is the securities' yield (yield to first call, or, if unavailable, yield to maturity). All dependent variables are explained in the appendix. The sample consists of CoCo bonds and subordinated bonds by CoCo issuers from 2013 to 2017. Standard errors are adjusted for heteroskedasticity and clustering on a bond level. The p-values are in parentheses.

	(1)	(2)	(3)	(4)	(5)
CoCo Dummy	3.447***	4.097***	3.945***	3.945***	3.338***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Write-down Dummy	0.963***	0.496**	0.468**	0.468**	1.401***
	(0.000)	(0.024)	(0.037)	(0.037)	(0.000)
Write-down*P/B					-0.0134***
					(0.000)
Distance-to-trigger		-0.120**	-0.0971**	-0.0971**	0.0000555
		(0.012)	(0.040)	(0.040)	(0.999)
log(Remaining Life)		1.220***	1.237***	1.237***	1.242***
		(0.000)	(0.000)	(0.000)	(0.000)
Safe Yield		0.823***	0.831***	0.831***	0.825***
		(0.000)	(0.000)	(0.000)	(0.000)
CDS			0.0109***	0.0109***	0.0114***
			(0.000)	(0.000)	(0.000)
Price-to-Book				-0.000137	0.00219
				(0.958)	(0.441)
Bank FE	YES	YES	YES	YES	YES
Day FE	YES	YES	YES	YES	YES
N	136,955	134,430	134,430	134,430	134,430
adj. R^2	0.749	0.873	0.879	0.879	0.882

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

Table 4: The Write-down Premium and Charter Value

This table presents OLS regressions with fixed effects for the write-down premium on security prices for write-down CoCo bonds with high and low moral hazard problems. The dependent variable is the securities yield (yield to first call, or, if unavailable, yield to maturity). All dependent variables are explained in the appendix. The sample consists of CoCo bonds and subordinated bonds by CoCo issuers from 2013 to 2017. The "Good" Subsample contains only write-down CoCo bonds with price-to-book ratio above the mean, and the "Bad" Subsample with price-to-book below the mean. Standard errors are adjusted for heteroskedasticity and clustering on a bond level. The p-values are in parentheses.

	"Good" Subsample		"Bad" Subsample	
	(1)	(2)	(3)	(4)
CoCo Dummy	3.389***	3.077***	3.802***	3.794***
	(0.000)	(0.000)	(0.000)	(0.000)
Write-down Dummy	0.0630	0.680	0.748***	3.083***
	(0.798)	(0.104)	(0.002)	(0.000)
Write-down*P/B		-0.00708**		-0.0434***
		(0.048)		(0.000)
Distance-to-trigger	-0.0108	0.0395	-0.0772	-0.0774
	(0.827)	(0.548)	(0.186)	(0.176)
log(Remaining Life)	1.286***	1.283***	1.259***	1.259***
	(0.000)	(0.000)	(0.000)	(0.000)
Safe Yield	0.842***	0.841***	0.863***	0.864***
	(0.000)	(0.000)	(0.000)	(0.000)
CDS	0.0101***	0.0103***	0.0115***	0.0108***
	(0.000)	(0.000)	(0.000)	(0.000)
Price-to-Book	-0.00143	-0.000539	0.00127	0.000887
	(0.537)	(0.825)	(0.672)	(0.747)
Bank FE	YES	YES	YES	YES
Day FE	YES	YES	YES	YES
N	124,326	124,326	124,539	124,539
adj. R^2	0.863	0.863	0.876	0.880

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

Table 5: Alternative Regressions: Expected Losses

This table presents OLS regressions with fixed effects on the driver of the write-down premium, testing the "moral hazard story" against the alternative "expected losses story". The dependent variable is the securities yield (yield to first call, or, if unavailable, yield to maturity). All dependent variables are explained in the appendix. In the "expected losses story", the write-down premium is simply the result of lower payoffs of a write-down CoCo bond when triggered, and not because of changes in the shareholders' incentives. The sample consists of CoCo bonds and subordinated bonds by CoCo issuers from 2013 to 2017. Standard errors are adjusted for heteroskedasticity and clustering on a bond level. The p-values are in parentheses.

	(1)	(2)	(3)	(4)
CoCo Dummy	3.762***	3.367***	3.358***	3.200***
	(0.000)	(0.000)	(0.000)	(0.000)
Write-down Dummy	0.486**	1.195***	1.203***	1.362***
	(0.037)	(0.000)	(0.000)	(0.000)
Write-down*P/B		-0.0103***	-0.0104***	-0.0127***
		(0.001)	(0.001)	(0.001)
Write-down*CDS	0.00805***	0.00492	0.00477	0.00504
	(0.003)	(0.117)	(0.125)	(0.109)
Distance-to-trigger	-0.0693	-0.00544	-0.00268	0.0275
	(0.141)	(0.922)	(0.961)	(0.710)
log(Remaining Life)	1.223***	1.232***	1.243***	1.206***
	(0.000)	(0.000)	(0.000)	(0.000)
Safe Yield	0.840***	0.832***	0.814***	0.830***
	(0.000)	(0.000)	(0.000)	(0.000)
CDS	0.00915***	0.0102***	0.0112***	
	(0.000)	(0.000)	(0.000)	
Price-to-Book	-0.000712	0.00130	-0.000310	
	(0.765)	(0.616)	(0.892)	
Bank FE	YES	YES	YES	NO
Day FE	YES	YES	NO	NO
Quarter FE	NO	NO	YES	NO
Bank-day FE	NO	NO	NO	YES
N	134,430	134,430	134,431	134,352
adj. R^2	0.882	0.883	0.881	0.887

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

Table 6: Baseline Regressions with Alternative Fixed Effects

This table presents the baseline OLS regressions with fixed effects for the write-down premium on security prices with alternative fixed effects. The dependent variable is the securities' yield (yield to first call, or, if unavailable, yield to maturity). All dependent variables are explained in the appendix. The sample consists of CoCo bonds and subordinated bonds by CoCo issuers from 2013 to 2017. Standard errors are adjusted for heteroskedasticity and clustering on a bond level. The p-values are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
	yield_	yield_	yield_	yield_	yield_	yield_
CoCo Dummy	3.938***	3.330***	3.959***	3.172***	3.941***	3.142***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Write-down Dum.	0.466**	1.402***	0.475**	1.555***	0.472**	1.571***
	(0.036)	(0.000)	(0.029)	(0.000)	(0.041)	(0.000)
Write-down*P/B		-0.0134***		-0.0155***		-0.0158***
		(0.000)		(0.000)		(0.000)
Distance-to-tr.	-0.0948**	0.00249	-0.0919*	0.0340	-0.0903	0.0377
	(0.042)	(0.963)	(0.089)	(0.612)	(0.115)	(0.597)
log(Remaining L.)	1.248***	1.252***	1.219***	1.223***	1.212***	1.216***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Safe Yield	0.814***	0.808***	0.813***	0.807***	0.830***	0.824***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CDS	0.0118***	0.0122***	0.0109***	0.0110***	0.0213***	0.0210***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Price-to-Book	-0.0018	0.00054	-0.0010***	-0.0073***	0.0044	0.0060**
	(0.441)	(0.830)	(0.000)	(0.000)	(0.119)	(0.028)
Bank FE	YES	YES	NO	NO	NO	NO
Quarter FE	YES	YES	NO	NO	NO	NO
Bank-Quarter FE	NO	NO	YES	YES	NO	NO
Bank-Day FE	NO	NO	NO	NO	YES	YES
N	134,431	134,431	134,431	134,431	134,352	134,352
adj. R^2	0.877	0.881	0.889	0.893	0.882	0.887

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

Table 7: The Write-down Premium in Different Periods

This table presents OLS regressions with fixed effects for the write-down premium on security prices. The dependent variable is the securities' yield (yield to first call, or, if unavailable, yield to maturity). All dependent variables are explained in the appendix. The sample consists of CoCo bonds and subordinated bonds by CoCo issuers in two different subsamples: The "early" subsample starts with the overall sample (2013), and ends in 12/2015; the "late" subsample is from Q2 2016 to the end of the overall sample (2017). Standard errors are adjusted for heteroskedasticity and clustering on a bond level. The p-values are in parentheses.

	"Early" Subsample		"Late" Subsample	
	(1)	(2)	(3)	(4)
CoCo Dummy	3.147***	2.869***	4.075***	3.081***
	(0.000)	(0.000)	(0.000)	(0.000)
Write-down Dummy	0.485*	1.107***	0.506**	1.560***
	(0.053)	(0.000)	(0.017)	(0.000)
Write-down*P/B		-0.00804***		-0.0161***
		(0.002)		(0.000)
Distance-to-trigger	-0.0596	-0.0149	-0.0863	0.0695
	(0.212)	(0.776)	(0.175)	(0.390)
log(Remaining Life)	1.369***	1.377***	1.189***	1.178***
	(0.000)	(0.000)	(0.000)	(0.000)
Safe Yield	0.875***	0.872***	0.817***	0.811***
	(0.000)	(0.000)	(0.000)	(0.000)
CDS	0.00384**	0.00426***	0.0140***	0.0142***
	(0.010)	(0.004)	(0.000)	(0.000)
Price-to-Book	-0.00269	-0.000704	0.000705	0.00261
	(0.352)	(0.815)	(0.853)	(0.510)
Bank FE	YES	YES	YES	YES
Day FE	YES	YES	YES	YES
N	53,065	53,065	62,484	62,484
adj. R^2	0.903	0.904	0.884	0.888

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

Table 8: Baseline Regressions with Different Control Variables for the Trigger Level

This table presents OLS regressions with fixed effects for the write-down premium on security prices. The dependent variable is the securities' yield (yield to first call, or, if unavailable, yield to maturity). Baseline controls are the same as in Table 3. All dependent variables are explained in the appendix. The sample consists of CoCo bonds and subordinated bonds by CoCo issuers from 2013 to 2017. Standard errors are adjusted for heteroskedasticity and clustering on a bond level. The p-values are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
CoCo Dummy	4.845***	4.369***	4.279***			
	(0.001)	(0.001)	(0.002)			
Dummy Low Tr.				3.591***	3.477***	7.709***
				(0.000)	(0.000)	(0.006)
Dummy High Tr.				3.340***	3.191***	8.783***
				(0.000)	(0.000)	(0.008)
Write-down Dum.	0.982*	1.150**	1.188**	1.188**	1.264**	1.055*
	(0.059)	(0.017)	(0.021)	(0.021)	(0.018)	(0.086)
Write-down*P/B	-0.012***	-0.013***	-0.013***	-0.013***	-0.014***	-0.013***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)
Trigger Level	-0.231	-0.147	-0.134			
	(0.247)	(0.422)	(0.490)			
Distance-to-tr.					0.0188	0.829*
					(0.796)	(0.082)
Tier 1 Ratio	-0.113**					
	(0.015)					
Tier 1*CoCo Dum.						-0.806*
						(0.088)
Baseline Controls	YES	YES	YES	YES	YES	YES
Bank FE	YES	NO	NO	NO	NO	NO
Day FE	YES	NO	NO	NO	NO	NO
Bank-Quarter FE	NO	YES	NO	NO	NO	NO
Bank-Day FE	NO	NO	YES	YES	YES	YES
N	131,463	135,251	135,175	135,175	134,352	131,388
adj. R^2	0.884	0.893	0.887	0.887	0.887	0.888

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

Table 9: Sample Selection Test: The Issue Decision

This table presents multinomial regressions on the issue decision for CoCo bonds. The sample consists of yearly observations from 2011 to 2017 on the probability that banks issued a specific instrument. The coefficients refer to the benchmarks on top, representing the effect of a change in the explanatory variable on the change of log of the odds ratio between alternative and benchmark. This allows for a direct qualitative interpretation of the effects: E.g., the first coefficient on the upper left (-0.188) tells us that an increase in the Tier 1 ratio of a bank significantly decreases the probability of the alternative (no issue at all), thus increasing the probability of the benchmark (CoCo bond issue). Note the different benchmarks in the columns, and the different alternatives in the rows. The p-values are in parentheses.

Benchmark:	**Any CoCo Issue**		**Write-down CoCo Issue**		**Write-down CoCo Issue**	
	(1)	(2)	(3)	(4)	(5)	(6)
Alternative: No Issue vs. Benchmark						
Tier 1 ratio$_{t-1}$	-0.188**	-0.0197	-0.180*	-0.0381	-0.155*	-0.00669
	(0.010)	(0.679)	(0.052)	(0.526)	(0.094)	(0.914)
Price-to-book$_{t-1}$	-0.00414	-0.00357	-0.00759**	-0.00724**	-0.00700*	-0.00556*
	(0.178)	(0.166)	(0.041)	(0.015)	(0.056)	(0.061)
Alternative: Equity Issue vs. Benchmark						
Tier 1 ratio$_{t-1}$	-0.468***	-0.227***			-0.431***	-0.213**
	(0.000)	(0.002)			(0.000)	(0.013)
Price-to-book$_{t-1}$	-0.0129**	-0.0180***			-0.0165***	-0.0202***
	(0.015)	(0.000)			(0.005)	(0.000)
Alternative: Equity Conversion CoCo Issue vs. Benchmark						
Tier 1 ratio$_{t-1}$			0.139	0.0341	0.129	0.0334
			(0.291)	(0.656)	(0.329)	(0.672)
Price-to-book$_{t-1}$			-0.0110	-0.00444	-0.0121*	-0.00482
			(0.118)	(0.280)	(0.090)	(0.253)
Country FE	YES	NO	YES	NO	YES	NO
Time FE	NO	YES	NO	YES	NO	YES
N	376	376	376	376	376	376

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