HOUSE OF FINANCE

WORKING PAPER SERIES

Henning Hesse

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

SAFE Working Paper No. 212

Non-Technical Summary

This paper deals with the impact of write-down CoCo bonds on the risk-taking behavior of banks. The Basel III rules explicitly allow the write-down feature as a loss absorption mechanism for hybrid instruments in the high-quality "Additional Tier 1" capital category. This is despite the fact that the adverse impact of low conversion ratios on incentives is well-documented both in theoretical research, and in the policy debate on CoCo bonds. This paper is the first to document a price premium on write-down CoCo bonds, which is higher for write-down CoCo bonds from banks of lower quality. Thus, my empirical evidence is consistent with the theoretical prediction that write-down CoCo bonds introduce an agency conflict in the bank.

While the findings on the write-down CoCo bonds seem to discount the value of contingent capital, there is a silver lining in my findings. Opponents of CoCo capital point out the complexity of hybrid bonds, claiming that they are hard to price, and not believing in the merits of investor monitoring and market discipline. From the proponents of CoCo bonds, however, the two factors monitoring and market discipline are the ones that are mentioned when talking about advantages of contingent capital over equity. My findings are consistent with the concept of investor monitoring. This establishes the minimum requirements for market discipline through CoCo bonds to work.

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

Henning Hesse*

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 monitoring 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. The findings show that write-down CoCo bonds introduce a moral hazard problem in the banks. At the same time, they support the idea of CoCo investors acting as monitors, which is a prerequisite for a meaningful role of CoCo debt in banks' regulatory capital mix.

Keywords: CoCo bonds, contingent capital, endogenous risk, capital structure, incentives, monitoring

JEL: G18, G21, G32

* Goethe University Frankfurt and Research Center SAFE, Theodor-W.-Adorno-Platz 3, 60323 Frankfurt am Main, Germany. E-mail: henning.hesse@finance.uni-frankfurt.de

I would like to thank Stefan Avdjiev, Tobias Berg, Bilyana Bogdanova, Jannic Cutura, Jan-Pieter Krahnen, Marina Mukhamadieva, Alon Raviv, Mark Wahrenburg, Annika Weber, Fabian Wöbbeking, participants of the 77th Meeting of the American Finance Association (PhD Poster Session), the 34th Conference of the French Finance Association, the 22nd Spring Meeting of Young Economists, the ÖFG Workshop of the Research Group "Financial Crises", and seminar participants at Goethe University Frankfurt and Frankfurt School of Finance and Management. I gratefully acknowledge financial support from Deutsche Forschungsgemeinschaft (DFG).

1 Introduction

In 2011, an update of Basel III opened up the capital adequacy rules for Contingent Convertible (CoCo) bonds, including this newly arising capital class in banks' Tier 1 regulatory capital. This allowed banks to issue CoCo bonds in order to bolster their capital ratios, following the regulator's direction to create a more resilient banking sector by increasing individual banks' capital buffers. Since then, CoCo bond issues have surged: Globally, more than 500 billion US dollars of bank capital have been raised with the use of this hybrid security (Avdjiev et al., 2017). At the same time, the instrument is still subject to intense debate, both on CoCo capital's value relative to common equity capital, and on the question of the optimal CoCo bond design.

CoCo bonds are hybrid instruments, representing a debt claim which is automatically converted into equity or written off when bank capital falls short of pre-defined trigger level. The CoCo bond vs. common equity debate evolves around two main positions: On the one hand, proponents of CoCo capital argue that it is a valuable complement to equity capital, as the new capital class introduces an additional layer of Corporate Governance by creating a highly-exposed creditor class with additional incentives to monitor the bank (Liikanen Commission, 2012, p. 103). On the other hand, the opponents of CoCo capital forward the view that there is no benefit relative to common equity, as contingent capital can't do anything that equity couldn't, 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.

The second key theme in the CoCo capital debate is that of the optimal CoCo bond design. Policy discussions on CoCo bonds emphasize the role of CoCo conversion terms: In order to lower incentives for risk-shifting, CoCo bonds should dilute existing shareholders when converting into equity (Calomiris and Herring, 2013). However, the Basel Committee explicitly allows CoCo bonds to be issued with a write-down loss absorption mechanism, which wipes out the CoCo investors in a bank distress event rather than converting them into equity, resulting in a gain for the old shareholders instead of mandating their dilution. The write-down feature reverses Calomiris and Herring's (2013) argument, creating the potential for risk-shifting, as shareholders can offload losses on the investors in write-down CoCo bonds. The adverse effect of low conversion ratios and write-down CoCo bonds on incentives is also emphasized by a number of theoretical papers (see Hilscher and Raviv (2014), Berg and Kaserer (2015), Chan and van Wijnbergen (2016)). Still, in Europe, more than half of the CoCo bonds have been issued as write-down CoCo bonds, with a face value of 102 billion US dollars (Avdjiev et al., 2017).

In this paper, I empirically investigate the write-down feature and its impact on CoCo bond prices. I do so by analyzing bond market prices of European CoCo bonds, comparing the yield spread between CoCo bonds and subordinated bonds, both for issuers of write-down CoCo bonds, and the alternative equity-conversion CoCo bonds, which dilute the old shareholders. 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 800 million US dollars 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 in the bank, both confirming that the premium derives from an incentive problem, and lending support to the view that CoCo investors are aware of that problem, proving to be active 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, I study the effect of investor 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 this control group and the (write-down and non-write-down) CoCo bonds. This identification strategy, akin to a diff-in-diff analysis, makes sure that I am pricing the risk of the CoCo *issue*, rather than that of the CoCo *issuer*.

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

My findings on the write-down premium and its link to bank incentives are robust to an alternative expected-losses explanation. In this alternative explanation, the write-down premium merely represents a compensation for higher expected losses: Ceteris paribus, both equity-conversion and write-down CoCo bonds are equivalent in the no-trigger-case; however, expected losses for write-down CoCo bonds are higher in default due to their higher loss given default. Thus, with exogenous risk, the write-down premium should linearly increase in the probability of default. However, I show that increases in expected losses fail to explain the write-down premium, while the write-down premium's link to moral hazard stands in light of this alternative explanation.

For a number of reasons, my results are unlikely to be driven by sample selection. First of all, given my identification strategy, for the 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 bank quality could play a role in the issue decision and the choice of the loss absorption mechanism, the link between bank quality and loss absorption mechanism breaks down over time, as a bond's contractual characteristics are fixed but bank quality is not, which further mitigates sample selection concerns. Furthermore, given my finding that the write-down feature carries a yield premium which is higher for low-quality banks, it is likely that the higher interest that these "bad-bank" 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. Additionally, in order to reinforce to these logical arguments against an upward sample selection bias, I conduct my own analysis of the issuance decision, looking how bank quality drives the choice of loss absorption mechanism in CoCo bond issues (i.e. the choice of having a write-down feature or not). I do not find the choice between the issue of write-down or equity-conversion CoCo bonds to be associated with bank quality, rejecting the sample selection story.

The findings of my paper support theoretical predictions that write-down CoCo bonds introduce risk-shifting incentives in the bank, leading to an additional agency conflict between old shareholders and CoCo bond investors. At the same time, they corroborate the view that CoCo investors are indeed active monitors, so that contingent capital fulfills the minimum requirements for market discipline to work.

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. These higher ratios should address the problems of debt overhang and risk-shifting, and ultimately reduce the probability for governments having to bail-out their banks. However, there is a lively debate on which capital instruments should be allowed to contribute to regulatory capital. In this debate, one key issue at stake is the role of investor monitoring and market discipline for the respective instruments.

Admati et al. (2013) advocate higher common equity as the prime tool to boost bank capital, citing its simplicity, and discounting the potential advantages from having CoCo bonds 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 resolve the problems which only emerge when resolution becomes due. Furthermore, they are highly critical of the merits of investor monitoring, citing the experience of the financial crisis of 2007-2008, where debt-holder monitoring proved to be ineffective in disciplining banks.[1]

In opposition to Admati et al.'s (2013) view, many scholars and bank regulators have endorsed CoCo bonds as an alternative to equity buffers in banks. Building on the original CoCo bond design by Flannery (2005), its advocates deem CoCo capital to be useful for providing a capital buffer, and for introducing CoCo bond investors as monitors, allowing for market discipline to work (Calomiris and Herring, 2013). In absence of any direct Governance tools, this view on contingent capital seems to endorse a wide view on market discipline beyond the enforcement tools of the investors. Rather, market discipline can work through the supervisor reacting to price signals from financial markets, who in turn can act by constraining bank action (Flannery, 2001). As CoCo bonds are highly exposed to bank distress, one can expect that price signals develop early, giving supervisors important additional information, and potentially making CoCo bonds a valuable tool of market discipline. 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 Squam Lake Report (French et al., 2010) and the Liikanen Report (Liikanen Commission, 2012).

[1]As to the motivations to issue CoCo bonds, Admati et al. (2013) refer to 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.

Against this backdrop, investors' risk-adjusted pricing of CoCo bonds builds the core of the various potential mechanisms of market discipline. This can be observed in 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

The balance sheet effects of a write-down CoCo bond are illustrated in Figure 1. In this example, the bank is hit by a loss. As a result, the write-down of the CoCo bond leaves the bank with a higher equity than before the loss. Since the CoCo investors are wiped out, all of the equity accrues to the old shareholders, leaving them better off than before the loss.

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 prior to the write-down of the CoCo bond: Hilscher and Raviv (2014) show that in presence of write-down CoCo bonds, the value of a bank's stock 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's capital ratio is close to the trigger, aligned managers rationally engage in excessive risk-taking, as shareholders stand to gain from both the upside and the downside. As Chan and van Wijnbergen (2016) emphasize, this problem is most prevalent with principal write-down CoCo bonds.[2]

Figure 2 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 2, 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: 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. 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.

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 2, Panel B).[3] Clearly, this agency conflict should be reflected in CoCo bond market prices.

[2] Martynova and Perotti's (2018) findings are a notable exception to the above results. They analyze the the risk 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. Their 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.

[3] In Figure 2, 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.

2.3 Other Related Literature

Other than the above debates, there are still a number of further concerns with the design of CoCo bonds, and their impact on incentives, underlining the complexity of the subject matter and controversy surrounding CoCo bonds.

In addition to the discussion on conversion ratios, one important strand of theoretical research on CoCo design focuses on the trigger ratio. Here, the question is whether the trigger ratio should target regulatory (accounting) or market ratios. Sundaresan and Wang (2015) reject the idea of a trigger based on accounting variables, as it is prone to manipulation and 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.[4] 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, Glasserman and Nouri (2012) point out that actual CoCo bond issues all have accounting-based capital ratio triggers. Moreover, Martynova and Perotti (2018) emphasize all existing CoCo issues include a value transfer, and a conversion at par CoCo bond may be impossible to design in practice.

On a different note, additional research on CoCo bonds and incentives has been conducted by Koziol and Lawrenz (2012), who 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.

On the still very limited empirical front, notable work on CoCo capital has been done by Avdjiev et al. (2017), who conduct a comprehensive event study on the effect of CoCo capital on CDS spreads.[5] In their findings, the issuance of CoCo capital reduces CDS

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

[5] 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).

spreads, more so for equity-conversion than for write-down CoCo bonds.[6]

My paper is closest to Avdjiev et al. (2017) who use a similar sample, and who also look at CoCo bonds' design features and their impact on risk. However, while their study analyzes changes of the risk to senior debt holders at the time of the 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 incentives for excessive risk-taking relative to equity-conversion CoCo bonds. 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 (old shareholders are diluted, reducing the risk-taking 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 in spite of the complexity of CoCo bonds, investors take into account the moral hazard risk which arises from the write-down feature.

To be precise, I compare the spread between subordinated bonds, and either 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 bond investor incentives are not aligned, which burdens an agency cost on the CoCo bond investors. Thus, in the presence of monitoring CoCo investors, CoCo prices should be lower (the yield should be higher) for a write-down CoCo bond relative to an equity-conversion CoCo bond.

[6]On a related note, Ammann et al. (2017) 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.

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 on 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.

Ideally, this would be tested with banks in severe distress and their capital ratios close to the trigger. Here, we would test whether banks with write-down CoCo bonds indeed increase their risk or even create deliberate losses. However, given the lack of distress events involving CoCo bonds, 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 or risk-seeking behavior in the first place. One such driver for moral hazard has been discussed by 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 than 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 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 (CET1).[7] Additionally, I collect daily yield data (yield to first call (YTC)) starting from 01/10/2013 until 06/06/2017, one day before Banco Popular's bail-in.[8] 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 CET1 ratio from the contractual trigger 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. For the subordinated bonds, I

[7] The Additional Tier 1 requirement imposes that the trigger level for write-down or conversion has to be at least 5.125% of CET1, that the write-down or conversion has to create CET1 capital, that the CoCo bond is perpetual (i.e. has no maturity date), and that coupon payments may be skipped at the discretion of the issuer.

[8] In June 2017, the Spanish lender Banco Popular was put into resolution, and its entire junior debt was bailed-in, including its CoCo bonds. Coincidentally, my sample ends around the time of the bail-in - I cut it short to avoid any contamination by the events. My results are unchanged from the cut. In any case, Banco Popular is not included in my sample, as it does not fulfill my data requirements.

also collect the YTC and yield to maturity (YTM) where available. 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 only keep observations if I have both at least one CoCo bond and one subordinated bond by the same issuer in the same period. After dropping the missing values, this leaves me with 291 distinct securities from 21 different banks, 82 of which are CoCo bonds. Roughly half of the CoCo bond issues are write-down CoCo bonds (40 vs. 42 equity-conversion); of the issuers, 9 have issued only write-down CoCo bonds, 9 only equity-conversion CoCo bonds, and 3 have issued both.

The dependent variable in my regression is the individual security's yield. Given CoCo bonds perpetual maturity, I use the YTC for them. For subordinated bonds, I use the YTC wherever available, and the YTM whenever the YTC is missing, i.e. whenever there is no first call date. This follows Vallée's (2017) logic: The market expectation 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 damage 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. Table 1 displays detailed definitions of all the variables.

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 daily observations on security level, roughly two third of which are subordinated bonds, and one third

CoCo bonds. Panel C shows 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 *higher* 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.

4 Research Design

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 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 could 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 have to control for the issuers' characteristics.

We can easily accommodate bank characteristics in the regression analysis to the extend that they are observable. However, especially in the case of 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 I do not in my 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 identify the yield differentials between ordinary subordinated debt and CoCo debt. 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, which relates to the question of agency cost from my first hypothesis.

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). 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 10-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.

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 identification strategy 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, I 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 cannot be found in any other subsample.

In my second specification, I explore the drivers of the write-down premium. The specification is the same as above, other than including the interaction between the write-down dummy and and the bank's price-to-book ratio:

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

The price-to-book ratio in the interaction term 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 on the write-down feature.

5 Results

Table 3 shows the yield premium of the write-down feature. The table contains five different specifications, all of which show a significantly higher yield of write-down CoCo bonds than equity-conversion CoCo bonds. The write-down feature's premium is economically significant, ranging from about 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 specification in column (4), which corresponds to equation 1.[10] Finally, in column (5), I include the interaction between the write-down feature and the bank's price-to-book ratio, as my 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

[9] In column (5), the combined effect of the write-down dummy and the interaction term is 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.

bonds in the sample, but rather that it increases with low bank charter values.

Table 3 reports two key results of my analysis, and fully supports my two hypotheses. First of all, and as expected, I find the yield premium of write-down CoCo bonds relative to equity-conversion CoCo bonds. Moreover, this premium for the write-down feature is not constant for each write-down CoCo bond, but rather it increases with existing moral hazard problems in the issuing bank, representing a compensation for an agency cost.

Otherwise, I find the expected behavior for the control variables both in terms of signs and magnitudes, as well as statistical significance. The only exception is the distance-to-trigger variable, which becomes insignificant in the interacted specification in column (5). This is addressed in a robustness test in section 6.1. In what follows, the model specifications from columns (4) and (5) are referred to as the (uninteracted and interacted) baseline regressions.

In Table 4, I repeat the baseline regressions with a different set of fixed effects for both the uninteracted and interacted model. This is to test for robustness of the results for differently timed industry-wide, and for bank-specific shocks. Whereas in my baseline specification, I use day and bank fixed effects, columns (1) and (2) of Table 4 repeat the analysis with quarter and bank fixed effects, testing whether the results are robust to market fluctuations on a quarterly rather than a daily level. Next, I employ bank-specific time fixed effects, which account for shocks on a bank level that potentially could drive the results. Specifically, columns (3) and (4) employ bank by quarter fixed effects, and columns (5) and (6) use bank by day fixed effects. The interpretation of the results remains unchanged: Regardless of whether I take out quarterly rather than daily variation, or whether I take out all bank-specific variation per quarter or even per day, 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.

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 5, in which I split the sample of write-down CoCo bonds, only keeping the "good" observations (the upper half in terms of the price-to-book ratio) in columns (1) and (2), and respectively the "bad" ones in columns (3) and (4). As expected, I find the highest price for the write-down feature in the sample of "bad" write-down CoCo bonds: The estimates for the write-down dummy and the baseline interaction term 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.[11] The latter finding is a surprise to some extent: While we 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). Still, the larger effects for "bad" banks is fully in line with my expectations on the write-down premium, and its link to moral hazard in banks. In an unreported regression, I repeat the analysis with quintile samples instead of splitting the sample in halves, finding the same result patterns.

6 Robustness

6.1 Alternative Specifications

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, with market uncertainty over possible regulatory suspensions of coupon payments on some CoCo bonds. In Table 6, I 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) restrict the sample to the period before 2016, whereas columns (3) and (4) use only observations after the second quarter of 2016. The findings of my baseline specification are unchanged in these analyses: I still find a significant effect of the write-down premium, and an increase of the premium with low bank charter values.

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

Furthermore, Table 7 repeats the interacted analysis by replacing the distance-to-trigger variable with alternative controls for the trigger risk. 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).

The distance-to-trigger variable and the interaction between charter value and write-down dummy are linked through the bank's book value of equity, implying a mechanistic correlation between the two variables.[12] Potentially, this leads to high error variances and imprecise parameter estimates. Thus, in the baseline interacted specification, the distance-to-trigger variable could prove to be a bad control that is specified simultaneously with a parameter of interest.

In order to address this potential criticism, in Table 7, the interacted regression is repeated with controls for the trigger risk other than the distance-to-trigger variable. In columns (1) to (3), I use the CoCo trigger level instead of the distance-to-trigger, i.e. I use the prespecified threshold level of the CET1 ratio at which either a conversion of a write-down takes place. 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, as it only contains information on the contractual level of the trigger ratio, and not on the actual level. The baseline results are unchanged for different sets of fixed effects, i.e. bank and day fixed effects (column 1), bank by quarter fixed effects (column 2), and bank by day fixed effects (column (3)). In columns (4) to (6), I use dummies for high-trigger and low-trigger CoCo bonds, while applying the same sets of fixed effects as in the three previous regressions. High-trigger and low-trigger CoCo bonds are defined to have a trigger level of 7% of CET1 and 5.125%, respectively[13]. All my results on the write-down premium and its relation to the bank charter value are robust to these changes.

[12]The CET1 ratio has the book equity in numerator, while the price-to-book ratio has it in the denominator. See Table 1 for the full definitions.

[13]There are no other trigger levels than these two in my sample.

6.2 Expected Losses

Table 8 contains a 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 is weakly larger than zero; 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 manner as the test for agency costs, 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 bond, as payoffs would only be determined by the default-free state. Consequently, the write-down premium should then increase with bank risk. My specification for this test is as follows:

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

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. Yet, with a higher loss given default, write-down CoCo bonds' premium should increase in the probability of default. As a result, the interaction between the write-down feature and the CDS should have a positive sign, as an increase in risk disproportionately increases 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 in a default state. 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 expected losses.

The results for this analysis following equation 3 are shown in Table 8. In column (1), I introduce the state pricing interaction (*write-down**CDS*) into the baseline regression, which captures the effect of higher expected losses on the write-down premium.[14] As explained above, state pricing effects should be reflected in this interaction. This is what we seem to observe in column (1). Yet, when adding the baseline interaction (*write-down**bank charter value*), as in column (2), the interaction capturing expected losses loses significance, whereas the baseline interaction (which captures moral hazard) 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 interaction on expected losses, 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 mere compensation for higher expected losses.

To sum up, the previous results are robust to the inclusion of a compensation for expected losses. As previously found, a lower agency cost additionally decreases yields for write-down bonds relative to the other securities, whereas higher risk does not explain increases in the write-down premium. This further supports the idea that investors demand a write-down premium as compensation for the agency costs resulting from the CoCo bond design.

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

6.3 Sample Selection

The identification strategy, which includes subordinated debt securities as control group, corroborates the internal validity of the analysis. Moreover, the research design makes it less likely that the results are driven by sample selection, as it 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. As a result, sample selection could only influence the results in the unlikely case that it leads to higher yields on the write-down CoCo bonds, but not on the subordinated bonds. Moreover, 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. This argument is consistent with the findings by Goncharenko et al. (2017) that CoCo bond issuers in general are high-quality banks, underlining that this high-risk instrument is issued by banks with a lower risk, and thus a lower cost of doing so.

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. 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.[15] 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. The results of this multinomial logit regression are presented in Table 9.

Columns (1) and (2) start by confirming the results of Goncharenko et al. (2017), comparing CoCo bond issuers to non-issuers and equity issuers. As in their findings, my

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

results show 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 at all. While being small-scale due to the econometric constraints of a multinomial logit, the analysis and its results further support my conjecture that the findings 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 merits have been subject to fierce discussions.

In this paper, I contribute to these discussions by shedding light on one important risk feature of outstanding CoCo issues, and on investors' appreciation of this feature: 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 write-down feature. In addition, my findings show that investors indeed price the agency cost introduced by that feature. These results are robust to a number of changes in the specification and alternative explanations, including the timing of the sample, bank-specific shocks, an alternative expected-losses explanation, and sample selection.

My empirical findings have important policy implications: While they are useful for expanding the capital buffer of a bank, write-down CoCo bonds run counter of the regulators' intentions to make the financial system more resilient and less risky, by introducing incentives for risk-shifting for banks which are most pronounced in times of bank distress. Thus, from a regulator's perspective who aims at containing risk in the banking sector during crises, equity-conversion CoCo bonds with conversion at par at clearly preferable. On a positive note towards CoCo bonds, given the premium on the write-down feature, regulators can rely on CoCo investors to not only monitor the bank itself, but also to take into account incentive effects arising from the bank's capital structure, potentially producing timely and meaningful price signals. Thus, the paper indeed supports the view that CoCo investors do provide monitoring, as they distinguish between different qualities of CoCo designs as well as issuing banks. While this finding does not necessarily imply that CoCo capital is at par with equity capital in terms of quality, it backs the proponents of CoCo by showing that CoCo capital fulfills the minimum requirements for market discipline to work.

Moreover, my results show that issuers have to pay a price for a write-down feature 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 the benefits that issuers derive from the write-down feature.

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 do not have CoCo bonds as a part of their capital mix. Especially when we see further 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.

References

Acharya, V. V. and S. Steffen (2015): "The greatest carry trade ever? Understanding eurozone bank risks," *Journal of Financial Economics*, 115, 215 – 236.

Admati, A. R., P. M. DeMarzo, M. F. Hellwig, and P. Pfleiderer (2013): "Fallacies, Irrelevant Facts, and Myths in the Discussion of Capital Regulation: Why Bank Equity is Not Socially Expensive," *Working Paper*.

Ammann, M., K. Blickle, and C. Ehmann (2017): "Announcement Effects of Contingent Convertible Securities: Evidence from the Global Banking Industry," *European Financial Management*, 23, 127–152.

Avdjiev, S., B. Bogdanova, P. Bolton, W. Jiang, and A. Kartasheva (2017): "CoCo issuance and bank fragility," *BIS Working Papers*.

Avdjiev, S., A. Kartasheva, and B. Bogdanova (2013): "CoCos: a primer," *BIS Quarterly Review*.

Berg, T. and C. Kaserer (2015): "Does contingent capital induce excessive risk-taking?" *Journal of Financial Intermediation*, 24, 356–385.

Calomiris, C. W. and R. J. Herring (2013): "How to Design a Contingent Convertible Debt Requirement That Helps Solve Our Too-Big-to-Fail Problem," *Journal of Applied Corporate Finance*, 25, 39–62.

Chan, S. and S. van Wijnbergen (2016): "Coco Design, Risk Shifting Incentives and Capital Regulation," *C.E.P.R. Discussion Papers*.

Flannery, M. (2001): "The Faces of Market Discipline," *Journal of Financial Services Research*, 20, 107–119.

——— (2005): "No Pain, No Gain? Effecting Market Discipline Via "Reverse Convertible Debentures"," 171–196.

French, K. R., M. N. Baily, J. Y. Campbell, J. H. Cochrane, D. W. Diamond, D. Duffie, A. K. Kashyap, F. S. Mishkin, R. G. Rajan, D. S. Scharfstein, R. J. Shiller, H. S. Shin, M. J. Slaughter, J. C. Stein, and R. M. Stulz (2010): *The Squam Lake Report: Fixing the Financial System*, Princeton University Press.

Glasserman, P. and B. Nouri (2012): "Contingent Capital with a Capital-Ratio Trigger," *Management Science*, 58, 1816–1833.

Goncharenko, R., S. Ongena, and A. Rauf (2017): "The Agency of CoCo: Why Do Banks Issue Contingent Convertible Bonds?" *CFS Working Paper*.

Gropp, R. and J. Vesala (2004): "Deposit Insurance, Moral Hazard and Market Monitoring," *Review of Finance*, 8, 571–602.

Hilscher, J. and A. Raviv (2014): "Bank stability and market discipline: The effect of contingent capital on risk taking and default probability," *Journal of Corporate Finance*, 29, 542–560.

Koziol, C. and J. Lawrenz (2012): "Contingent convertibles. Solving or seeding the next banking crisis?" *Journal of Banking & Finance*, 36, 90–104.

Liikanen Commission (2012): *High-level Expert Group on Reforming the Structure of the EU Banking Sector: Final Report*, European Commission.

Martynova, N. and E. Perotti (2018): "Convertible bonds and bank risk-taking," *Journal of Financial Intermediation.*

Pennacchi, G. and A. Tchistyi (2015): "A Reexamination of Contingent Convertibles with Stock Price Triggers," *Working Paper.*

Sundaresan, S. and Z. Wang (2015): "On the design of contingent capital with a market trigger," *The Journal of Finance*, 70, 881–920.

Vallée, B. (2017): "Contingent Capital Trigger Effects: Evidence from Liability Management Exercises," *Working Paper.*

Figure 1: 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 are still 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 profit from the loss on the asset side. The result for equity-conversion CoCo bonds looks the same, other than the equity in the post-conversion bank being (partly) owned by the CoCo investors, with the share of the ownership depending on conversion ratios (not illustrated).

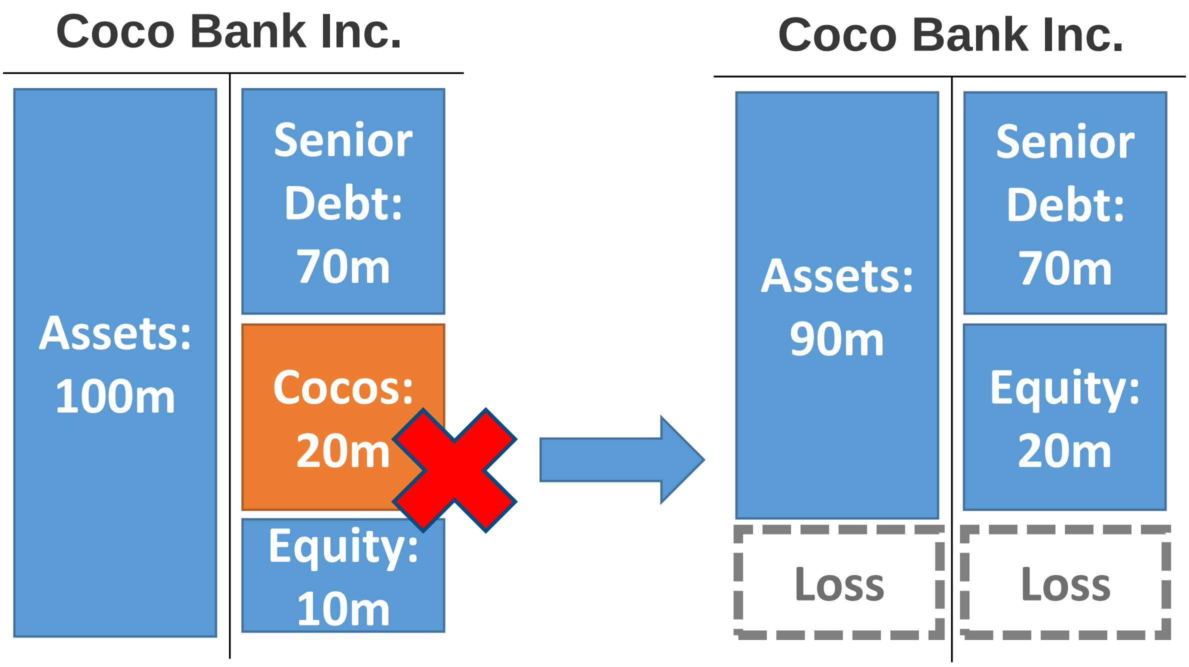
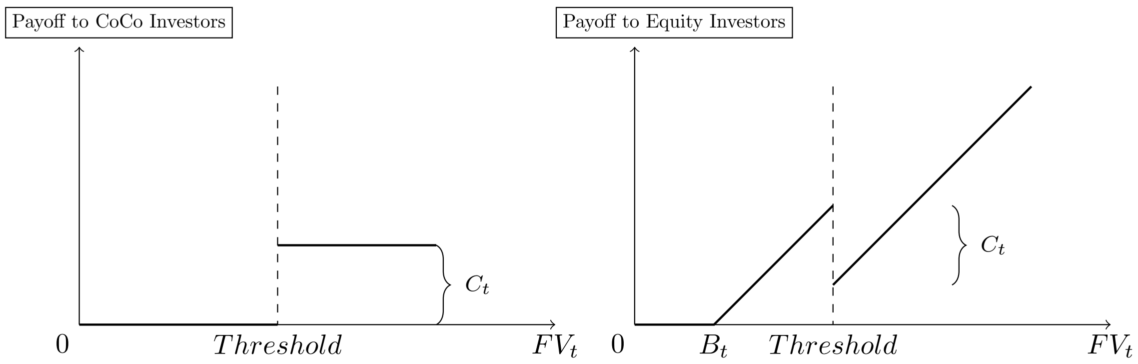


Figure 2: One-Period Payoffs of Equity and CoCo Bonds

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).

Panel A: Bank with Write-down CoCo Bonds



Panel B: Bank with Equity-Conversion CoCo Bonds (Conversion at Par)

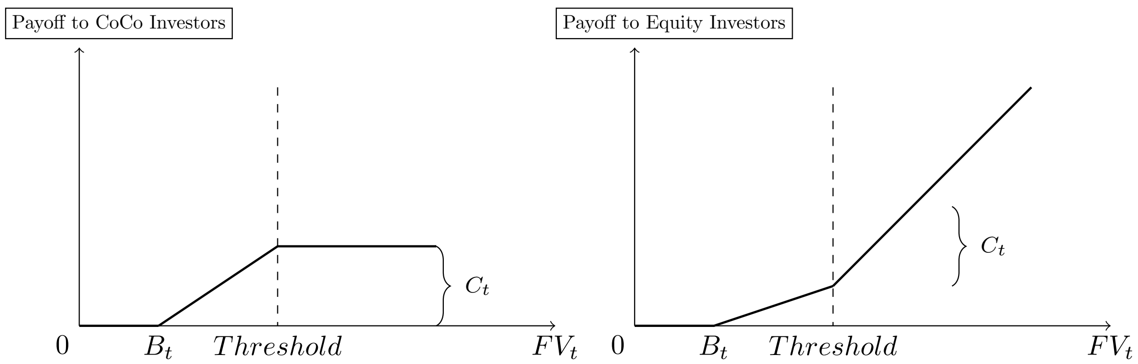


Figure 3: Identification of the Write-down Premium

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).

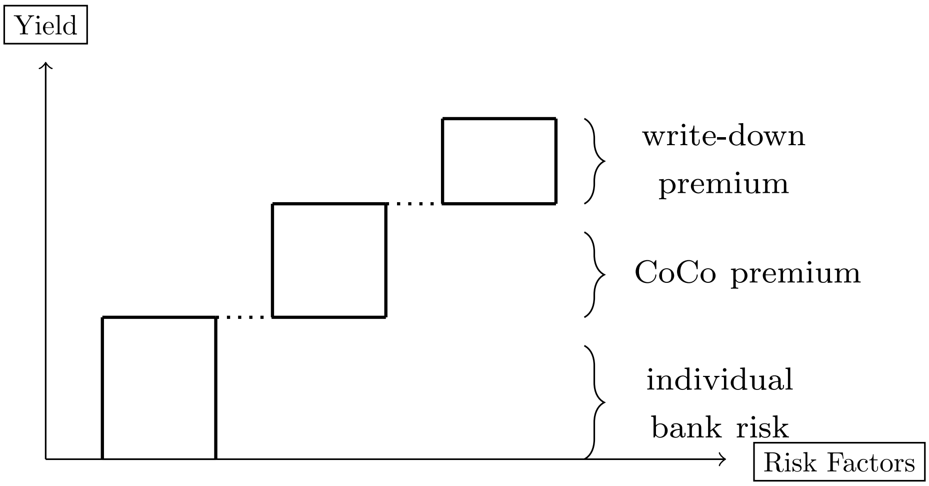


Table 1: Variable Definitions

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
Remaining Life	5.979	2.922	0.501	15.381
Distance-to-tr.	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
Remaining Life	5.985	3.038	5.966	2.628
Distance-to-tr.	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
Remaining Life	6.455	2.468	5.468	2.691
Distance-to-tr.	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 security's yield (yield to first call, or, if unavailable, yield to maturity). All independent 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 at the 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: 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 security's yield (yield to first call, or, if unavailable, yield to maturity). All independent 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 at the bond level. The p-values are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
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 5: 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 security's yield (yield to first call, or, if unavailable, yield to maturity). All independent 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 at the 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 6: 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 security's yield (yield to first call, or, if unavailable, yield to maturity). All independent 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 starts in Q3 2016 and lasts until the end of the overall sample (2017). Standard errors are adjusted for heteroskedasticity and clustering at the bond level. The p-values are in parentheses.

	"Early" Subsample		"Late" Subsample	
	(1)	(2)	(3)	(4)
CoCo Dummy	3.147***	2.869***	3.903***	2.918***
	(0.000)	(0.000)	(0.000)	(0.000)
Write-down Dummy	0.485*	1.107***	0.497**	1.575***
	(0.053)	(0.000)	(0.016)	(0.000)
Write-down*P/B		-0.00804***		-0.0162***
		(0.002)		(0.000)
Distance-to-trigger	-0.0596	-0.0149	-0.0717	0.0820
	(0.212)	(0.776)	(0.259)	(0.299)
log(Remaining Life)	1.369***	1.377***	1.200***	1.189***
	(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***	0.0138***	0.0138***
	(0.010)	(0.004)	(0.000)	(0.000)
Price-to-Book	-0.00269	-0.000704	-0.000102	0.00177
	(0.352)	(0.815)	(0.980)	(0.660)
Bank FE	YES	YES	YES	YES
Day FE	YES	YES	YES	YES
N	53,065	53,065	57,556	57,556
adj. R^2	0.903	0.904	0.885	0.889

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

Table 7: 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 security's yield (yield to first call, or, if unavailable, yield to maturity). Baseline controls are the same as in Table 3. All independent 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 at the bond level. The p-values are in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
CoCo Dummy	4.641***	4.369***	4.279***			
	(0.001)	(0.001)	(0.002)			
Trigger Level	-0.195	-0.147	-0.134			
	(0.315)	(0.422)	(0.490)			
Dummy Low Tr.				3.642***	3.617***	3.591***
				(0.000)	(0.000)	(0.000)
Dummy High Tr.				3.277***	3.342***	3.340***
				(0.000)	(0.000)	(0.000)
Write-down Dum.	0.967*	1.150**	1.188**	0.967*	1.150**	1.188**
	(0.061)	(0.017)	(0.021)	(0.061)	(0.017)	(0.021)
Write-down*P/B	-0.011***	-0.013***	-0.013***	-0.011***	-0.013***	-0.013***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Baseline Controls	YES	YES	YES	YES	YES	YES
Bank FE	YES	NO	NO	YES	NO	NO
Day FE	YES	NO	NO	YES	NO	NO
Bank-Quarter FE	NO	YES	NO	NO	YES	NO
Bank-Day FE	NO	NO	YES	NO	NO	YES
N	135,250	135,251	135,175	135,250	135,251	135,175
adj. R^2	0.883	0.893	0.887	0.883	0.893	0.887

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

Table 8: Alternative Regressions: Expected Losses

This table presents OLS regressions with fixed effects, exploring the driver of the write-down premium, testing the "moral hazard story" against the alternative "expected losses story". The dependent variable is the security's yield (yield to first call, or, if unavailable, yield to maturity). All independent 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 at the 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 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

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

Recent Issues

No. 211	Thomas Mosk	Bargaining with a Bank
No. 210	Darien Huang, Christian Schlag, Ivan Shaliastovich, Julian Thimme	Volatility-of-Volatility Risk
No. 209	Eren Gürer, Alfons J. Weichenrieder	Pro-rich Inflation in Europe: Implications for the Measurement of Inequality
No. 208	Roberto Casarin, Michele Costola, Erdem Yenerdag	Financial Bridges and Network Communities
No. 207	Claes Bäckman, Tobin Hanspal	The Geography of Alternative Work
No. 206	Loriana Pelizzon, Anjan Thakor, Calebe de Roure	P2P Lending versus Banks: Cream Skimming or Bottom Fishing?
No. 205	Horst Entorf, Jia Hou	Financial Education for the Disadvantaged? A Review
No. 204	Loriana Pelizzon, Matteo Sottocornola	The Impact of Monetary Policy Interventions on the Insurance Industry
No. 203	Florian Hett, Felix Schmidt	Pushing Through or Slacking Off? Heterogeneity in the Reaction to Rank Feedback
No. 202	Tobias H. Tröger	Germany's Reluctance to Regulate Related Party Transactions
No. 201	Dirk Krueger, Alexander Ludwig	Optimal Taxes in the OLG Model with Uninsurable Idiosyncratic Income Risk
No. 200	Nils Grevenbrock, Max Groneck, Alexander Ludwig, Alexander Zimper	Cognition, Optimism and the Formation of Age-Dependent Survival Beliefs
No. 199	Tobias H. Tröger	Regulation of Crowdfunding in Germany
No. 198	Henning Hesse, Boris Hofmann, James Weber	The Macroeconomic Effect of Asset Purchases Revisited
No. 197	Benjamin Clapham, Peter Gomber, Martin Haferkorn, Paul Jentsch, Sven Panz	Circuit Breakers – A Survey among International Trading Venues