Risk-taking Implications of Contingent Convertible Bond

Rogier Hanselaar[†] *Erasmus University Rotterdam*

Amiyatosh Purnanandam[‡] *University of Michigan*

Stefan Zeume [†‡] *University of Michigan*

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[†] Department of Finance, RSM, Erasmus University Rotterdam, hanselaar@rsm.nl .

[‡] Department of Finance, University of Michigan, amiyatos@umich.edu.

[‡†] Department of Finance, University of Michigan, zeume@umich.edu.

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Abstract

Contingent Convertible Bond (CoCo) has emerged as one of the most important security design solutions to improve the capital position of banks in the aftermath of the recent financial crisis. We show that the issuance of CoCo is associated with higher risk taking activities. Specifically, after the issuance of CoCo, issuing banks' loan portfolios become significantly more risky than those of similar non-issuers. These results highlight an important cost of CoCo securities: their ability to provide equity cushion to banks in bad states of the world is partly offset by the associated increase in risks on the asset side of the balance sheet. These findings have important implications for understanding the effect of security design on the riskiness of individual banks and the banking system as a whole.

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1. Introduction

Financial crisis of 2008-09 has reignited the debate on sound and effective management of the global banking system. The debate includes proposals to strengthen the balance sheets of banks, active monitoring of their activities, more accurate measurement and disclosure of risk, and better coordination among policymakers. Arguably, the most contentious issue in this debate has the amount and nature of equity capital a bank should hold. In terms of the nature of equity capital, Contingent Convertible Bond (or CoCo Bonds) has emerged as one of the most important security design solutions proposed by several academics and regulators. But this instrument has met with dramatically opposite enthusiasm across two sides of the Atlantic: no U.S. bank till date has issued CoCos, whereas European Banks issued over Euro 30 billion of CoCos only in 2014. Therefore, a clear understanding of the costs and benefits of this instruments, especially as it relates to the mitigation of risk in the banking sector, is needed both from an academic and policy-making perspective. Our paper sheds light on this issue by examining the effect of these instruments on the risk-taking behavior of banks on the asset side of their balance sheet, a topic that has escaped the attention of the empirical literature to the best of our knowledge.

Simply put, CoCo bonds are initially issued as bonds and they convert into equity (or are written off) when the issuing bank's equity value drops to a predetermined trigger point (see Flannery, 2014). Thus such bonds provide equity capital to banks in very crucial periods of financial distress, minimizing the risk of their failures. The key rationale for such security design is that by converting debt into equity or just writing it off, bank's capitalization ratio stays above the danger point, as a result both individual bank's default risk and the systemic risk come down. Thus CoCo bond investors take a haircut to ensure the bank's solvency, and the need for

government bailout is minimized. Motivated by these arguments, a number of regulatory authorities in Europe have allowed, often encouraged, their banks to issue part of their capital as CoCos.

The key advantage of CoCos, that it improves capital ratio in bad states of the world, is all related to the effect of CoCos on the liability side of the balance sheet. The effect of CoCos on a bank's leverage, and thus its financial risk, is straightforward; what is less understood is its effect on the risk taking incentives of banks on the asset side. Thus the risk decreasing benefit of CoCos implicitly assumes that CoCos issuance does not endogenously affect the risk-taking behavior of the bank on the asset side. Put differently, the key advantage of CoCo bonds is grounded in the assumption of separation of investments and financing decisions as in Modigliani and Miller world. This, however, is not obvious. CoCos can alter the manager-shareholder's preference for investment risks. One way to see this is to consider the incentive effects of CoCos in the context of classical literature on security design, specifically the incentive effects of regular convertible bonds. Green (1984) shows that convertible bonds can limit risk-taking behavior because shareholders are forced to share the gains of their risky bets with the convertible bondholders if the bet pays off. CoCos, on the other hand, mandatorily convert into equity only in the bad states of the word, i.e., when asset payoffs are low. Thus, one can think of CoCos as a "reverse" convertible bond. By engaging in high-risk activity, equity holders do not share any upside gains with the CoCo holders because the conversion only happens in low payoff states. At the same time, if the risk doses not payoff CoCos provide a guard against bankruptcy to the shareholders. In the presence of franchise value, such as rents that banks receive through subsidized deposit funding over time, concerns about bankruptcy and reorganization are likely to blunt the risk-increasing incentives. Replacing debt with CoCos

minimizes this threat and thus it may lead to higher risk as compared to banks funded with pure debt, holding fixed their equity-to-asset ratio.

A more nuanced discussion of the incentive effects of CoCos on risk-taking must take into account the specifics of trigger mechanism, conversion ratios, and other features of this complex security. Indeed, recent theoretical literature that considers these complex features more carefully has come to a mixed conclusion on the effect of CoCo on risk-taking behavior of the bank (for example, see Martynova and Perotti (2015), Chen et al. (2013) and others). For example, CoCo can even have a positive effect on the risk-taking behavior as shown by Martynova and Perotti (2015). There are two main forces in their model: one coming from reduction in leverage after conversion and the other from the shareholder-bondholder conflicts. The mechanical reduction in leverage upon the conversion results in a risk-reduction effect, whereas the other effect leads to an increase in risk. Similarly Chen et al. (2013) consider a range of realistic features of the CoCo such as trigger levels and conversion mechanism, and show that CoCos can increase risk-taking incentives for a range of parameters, for example if the trigger is not set too low. Thus these theoretical models suggest that the effect of CoCo on risk-taking behavior is an empirical issues; an issue we tackle in this paper.

We consider a large sample of European banks between 1999-2015 and collect information on all CoCo issuance by these banks over this time period; all CoCos in our sample have been issued during the period 2009-2015, i.e., after the financial crisis and after Basel Committee rules allowed these instruments to be counted as Additional Tier 1 or 2 capital. Our sample covers 95 coco bonds issued by 40 distinct banks across 10 countries. Since there is limited research on the motivations behind the issuance of CoCo, in our first test we examine the drivers of CoCo issuance decision. CoCo issuers are typically very large banks and have higher

leverage as compared to non-issuers. Thus, in our tests linking CoCo issuance to risk-taking, we are especially careful in separating the size and leverage effect from the effect of CoCo issuance. More important, we find that a key driver of CoCo issuance is the tax treatment of interest expense on this instrument. There is a lot of variation in the tax deductibility of interest expense on CoCo across countries in Europe. While some countries have allowed these expenses to be tax-deductible, others have not. Within the set of countries that have allowed such deductibility, the timing of their decision has varied. Thus we are able to assess the effect of this tax ruling on the bank's decision to issue CoCo. We collect data on precise year of legislation that allows for this deduction for every country in our sample, and find a strong positive effect of this regulation on CoCo issuance: banks issue more CoCos after the country of its domicile allows for this deduction. Further, this effect is stronger for banks that face higher tax rates, i.e., when the tax deductibility incentives are more likely to have a first order impact.

In our main tests, we use two simple but key measures of risk on the asset side: the proportion of impaired loans to total loans, and the proportion of loan loss reserves to the total loans of the bank. The first ratio directly measures the lending assets under default; the second measure is forward-looking in nature and captures the management's assessment of future default risk. We find a strong positive association between CoCo issuance and both these measures of risk-taking. In our main specification, we include both bank fixed effects and year fixed effects to isolate the effect of differences in bank's risk taking attitude and yearly changes in the macroeconomic conditions that may impact these measures. We find that in years after the issuance of CoCo bonds, banks have 1.854% higher impaired loans significant at the 1% level; the corresponding effect is relatively lower at 0.61% for loan loss reserves, but it is still statistically significant at the 1% level. Both these estimates are economically significant: the

sample median of impaired loans and loan loss reserve ratios are 1.63% and 0.91%, respectively. In all these regressions, we control for the equity-asset ratio of the firm, as measured by common equity to total asset ratio of the firm. Thus our estimates can be interpreted as the risk-taking effect of CoCos as compared to similar bank that instead finances itself with regular debt.

The set of CoCo issuer banks differ significantly from the non-issuers, especially in terms of firm size. In our next test, we construct a matched sample to study the difference in risk-taking across issuers and non-issuers while holding their assets and country of origin well matched. On this sample, we find that CoCo issuers have 1.97% higher impaired loans and 0.77% higher loan reserves compared to non-issuers. These numbers are comparable to the regression estimates we obtain with full sample. We estimate a series of carefully constructed matched sample analyses as robustness checks and obtain broadly similar results.

Recent theoretical literature has focused a lot of attention on how specific features of CoCos affect risk-taking incentives. In our final test, we investigate this issue by analyzing the effect of trigger levels and the type of conversion on the main effects we document. The trigger level of CoCos determines the threshold level of firm's equity ratio at which CoCos are either converted into equity or written off. We find no meaningful association between risk-taking incentives and the level of trigger. Similarly we find no meaningful association between risk-taking and the type of CoCo: whether it is of equity conversion variety or principal write-off variety. In summary, our results show that it is the act of issuing CoCo that matters for risk-taking behavior, its specific features do not matter.

There are two, not mutually exclusive, possible interpretations of our results: a selection effect where banks with (unobserved) riskier loans are more likely to issue CoCos, or a treatment effect where the risk-taking behavior changes in response to the CoCo issuance. Our result is

useful from policy perspective under either of these interpretations. It shows that CoCo issuance coincides with increases in risk-taking, and hence any policy that is aimed at increasing contingent equity capital through CoCos must take into account the concomitant increase in risk-taking. Said differently, the leverage-decreasing benefit of CoCos through the expected future increase in capitalization ratio is partly offset by a concomitant increase in asset risk.

To further isolate the effect of CoCo issuance on risk-taking behavior from the selection effect (i.e., banks with unobserved riskier loans are more likely to issue CoCos), we provide three arguments. As noted earlier, a key rationale for CoCo issuance has been the Basel regulations and tax treatment of interest on these instruments by the regulatory agencies of the country. While the Basel rulings broadly affected all countries in the sample at the same time, the timing of tax rulings – and hence the adoption of CoCos -- varied considerably across countries depending on their legislative processes. It is unlikely that such tax rulings are motivated by some unobserved anticipated shocks to the riskiness of the lending portfolio of CoCo issuing banks. Hence the underlying motivation behind the issuance of CoCo is consistent with the causal interpretation of our findings. Second, we investigate the timing of losses after CoCo issuance. The effect of CoCo issuance on loan default rates comes after a gap of two years from the issuance. While possible, it is relatively less likely that banks possess private information about the default rates two years in advance, minimizing the selection effects. Third, we find that relative to the non-issuers, CoCo issuing banks earn higher interest on their loans after the CoCo issuance as compared to before the issuance. This result shows that issuing banks are lending to riskier borrowers after the issuance of CoCo, a finding consistent with the treatment effect.

Our results have immediate implications for policy designs. While we do not address the optimality of CoCo issuance from the shareholders' perspective, the implication for regulation is

clear: CoCo issuance comes with higher risk-taking. Second, we also show that none of the main contract features such as trigger point or equity versus write-down CoCos mitigate this effect. Thus, purely from the perspective of risk-taking incentives, our study does not support the idea that CoCos with different features should be granted different status in the capital structure of a bank (e.g., treating them either as Additional Tier 1 or Tier 2 capital based on these features). Beyond the specific case of CoCo bonds, our study provides useful evidence for the broader security design literature. While the theoretical literature on the risk-taking incentive effects of security design is very rich, limited empirical research exists showing these interactions. One possible reason for this is the measure of investment risk itself. Measurement of risk-taking at the asset level is often hard outside of the banking industry, whereas in our setting we have two sensible measures of risk-taking at the loan level allowing us to relate the financial policy to asset risk more directly. In addition, there are very few empirical settings where a new class of security becomes popular with a number of firms in an industry, mainly due to regulatory reasons. Our setting provides such an empirical testing ground. Overall our results show that "reverse convertible bonds" come with higher risk taking incentives, and the precise contractual design feature seem to matter less.

Our paper relates to a growing literature in this area. Most closely related to our work is the paper by Vallee (2016) and Bolton et al. (2012), who study the pricing implications of CoCos. Bolton et al. (2012) show that after the issuance of CoCo, credit spread on senior debt comes down; however, there is no effect of CoCo on equity prices. These papers provide very useful assessment of the pricing implications. Our paper, on the other hand, is tackling a related but different question: the effect of CoCo on asset risk. To the best of our knowledge, our paper is the first one to document the effect of CoCo on risk-taking incentives on the asset side. Our

paper also provides inputs to a growing theoretical literature on the contractual design of CoCo bonds (see Sundaresan and Wang 2015, Pennacchi and Tchistyi 2016). These papers study the feasibility of different contractual features such as market or accounting based triggers for CoCo design. Our results suggest that we should also consider the possibility of endogenous changes in the riskiness of bank's assets while evaluating the efficacy of these features. The efficacy of market versus accounting based triggers is likely to be different when asset risk changes with the CoCo bond issuance as our results show. For example, if accounting ratios are slow to incorporate changes in asset risk as compared to market based ratios, then the triggers will vary in their effectiveness depending on whether they are accounting or market based. Overall, our results provide important inputs to both policy designs and future theoretical models in the area of security design in general.

The rest of the paper is as follows. Section 2 describes the data and the institutional setting. Section 3 describes the results, and Section 4 concludes the paper.

2. Institutional setting and Data

2.1 Institutional setting

In the aftermath of the financial crisis of 2008-09, regulators around the world have undertaken a number of policy measures to control individual and systemic bank failures. These measures affect several aspects of regulations ranging from strengthening the balance sheets of banks (e.g., capital requirements, liquidity coverage ratios) to limits on the scope of their activities (e.g., regulations on proprietary trading). Most of these regulations have been formulated under the broad umbrella of Basel III, the provisions of which have been adopted in varying degrees across different countries.

On the capital requirements side, Basel III accords attempt to improve both the quantity and the quality of capital available with banks. They redefine what constitutes capital and give a special role to CoCos in the capital buffers. Under Basel III, a bank needs to maintain 4.5% of total risk-weighted assets in common equity tier 1 capital, which consists of equity and retained earnings. Further, banks need to keep 6% of total risk-weighted assets in tier 1 capital, which consists of both common equity tier 1 capital and additional tier 1 (AT1) capital in the form of CoCos.[1] Thus, Basel III incentivizes the issuance of CoCos by making it an eligible security for the computation of Tier 1 capital ratio.

Details of the implementation of Basel III accord was left to the national regulators, and most developed and developing countries have adopted these measures at least in some degree. European regulators have in fact actively encouraged the issuance of CoCo by providing both broad regulatory support and fiscal incentives to issue CoCo. The fiscal incentive comes in the form of tax treatment of interest paid on CoCo before conversion. When the Basel III accords were agreed upon in 2011, some European governments already had fiscal incentives for CoCo issuance in place; others have introduced them since then. Since CoCos share some properties with equity and some with debt, there has been some ambiguity in the tax treatment of interest paid on coupon. Whether coupon payments on CoCos are tax deductible or not can have a substantial impact on the issuing bank's profits especially given the relatively high interest rates on these instruments. We collect information on whether and when a country issued definitive

[1] Additionally, 8% of total risk-weighted assets needs to be maintained in total capital, which consists of both tier 1 capital and tier 2 capital. Tier 2 capital is a mix of undisclosed reserves, revaluation reserves, general loan-loss reserves, hybrid instruments such as preferred shares or CoCo's, and subordinated term debt. Finally, on top of these minimum capital requirements, a bank needs to have a capital conservation buffer of 2.5% of risk-weighted assets. If capital levels fall below the level required by the capital conservation buffer, a bank can continue to operate as usual, but is not allowed to distribute capital (Basel Committee on Banking Supervision, 2011).

ruling on the tax deductibility of interest on CoCos. We provide details on this issue in the Appendix.

We obtain data for our study from various sources. Data on bank financials come from Bankscope. We take a number of steps, as described in Duprey and Lé, 2015 to clean the Bankscope data. These details are provided in the Appendix. From the entire Bankscope universe, we select all data between 2000 and 2015. We start our sample in 2000 in order to have a substantial time-series dimension. We do not include 2016 as Bankscope coverage for 2016 was poor as at the time of our data collection. We remove firms that are not banks, and drop supranational institutions. We exclude banks from countries other than the European Union, Switzerland and Norway, as CoCo issuance activity is concentrated in (western) Europe. We remove unconsolidated and non-relevant types of financial statements.

We obtain information on CoCo issuance from Bloomberg and select all available data up until the end of 2015. This dataset includes information on, amongst others, issue date, trigger level, trigger action, amount issued, currency, ISIN code, and firm ISIN code. We merge the full CoCo dataset with the bank financials using ISIN codes where available. The remaining unmatched CoCos we match by hand based on firm name wherever possible.

2.2 Descriptive statistics

Table 1 provides descriptive statistics on the issuance of CoCos in our sample. Panel A provides information on CoCo issuance for every country in our sample over the years. No CoCos were issued in our sample prior to 2009; subsequently there has been a steady increase in CoCo issuance with a considerable jump in the number of issues in 2012. Our analysis is at the bank level, since we are interested in the effect of CoCo issuance on bank's risk-taking on the asset side. Table B provides information on the number of first time issuers over time across

countries. There has been a steady increase in this number over time. More important, there is a rich coverage of first time CoCo issuers across countries and over time. In total, we have 40 distinct issuers in our sample. In our empirical analysis, we compare the riskiness of their lending portfolio before and after the issuance of CoCo with non-issuer banks.

Panel C shows the amount of CoCo issued: our sample banks have issued over Euro 85 billion through this form of finance. Thus, this security has provided a significant amount of capital to these banks during the sample period. Finally, in Panel D we provide some key information on the nature of CoCo issued by banks in our sample. Average (median) bank issued 2.41 (1) CoCos, raising Euro 2.1 billion (Euro 544 million) in proceeds. Out of this, on average 38% of CoCos are of the Equity Conversion type, whereas the remaining ones are either pure write-down CoCos or a mix of the two. Average trigger level, i.e., the level of capital ratio, is 5.8% as measured by the book value of Tier 1 capital ratio.

Table 2 provides information on relevant financial numbers of all banks in our sample, including the non-issuers. Based on the issuance dataset we collect, we create an indicator variable, CoCo Dummy, that takes a value of one for banks that have issued a CoCo at a given point in time. As expected, only a small percentage of sample banks have issued CoCo: about 1% of bank-year observations in the full sample comes from the issuers as reflected by the sample average of 0.99% for the CoCoDummy variable. Reflecting that very few banks have issued CoCos, the mean CoCo size, measured by amount issued divided by total assets, is very small—the bank with the largest CoCo amount issued has 2.7% in CoCos outstanding.

We use two measures of risk-taking for our analysis: the percentage of impaired loans in the total lending portfolio of the bank, and the percentage of loan loss reserves. Impaired loans measure loans that are already in distress, and they are defined as impaired loans divided by total

gross loans. Loan loss reserves is a relatively forward looking measure of default, as anticipated by bank managers. It is defined as loan loss reserves divided by total gross loans. The average value of these ratios are 2.7% and 1.48% for impaired loans and loan reserves, respectively. In Figure 1, we plot the yearly average of these variables. As can be seen from this figure, there is substantial time series variation in these numbers. In our empirical analysis, we are careful in separating out the yearly variation with the inclusion of year fixed effects in empirical models. The Table provides information on the asset size, leverage ratio (defined as one minus equity-to-asset ratio) and net interest margin of the bank (a proxy for bank's profitability). We use these variables as controls in our key regression specification to separate out the effect of common equity capitalization, profitability, and bank size on risk taking from the effect of CoCo issuance.

3. Main results

Determinants of CoCo Issuance: We begin our analysis by analyzing the key drivers of CoCo issuance decision. Clearly, these decisions are not random, and hence a better understanding of this decision allows us to interpret our main results – linking CoCos with risk-taking behavior – in proper context. In Table 3 we estimate a linear regression model with the number of CoCo issued during the year as the dependent variable. Our results are similar if we model this decision as a Poisson regression model, or when we replace the dependent variable by the amount of CoCos issued or by a binary variable that indicates whether a bank has issued a CoCo in a year or not.

In Model 1, we find that bank's size (as measured by log of assets) is a key driver of this decision: larger banks issue more CoCos. There is no reliable pattern in terms of difference in profitability and leverage ratio of the issuers and the non-issuers. In Model 2, we include an additional variable, called 'Fiscal Treatment Dummy', that equals one for bank-year

observations after which the bank's country of domicile allows tax-deductibility of interest on CoCos, and zero otherwise. This variable has a strong explanatory power: banks issue significantly more CoCos after receiving favorable tax treatment on interest paid on these securities. In Models 3 and 4, we progressively include bank and year fixed effects, and a clear pattern emerges from these estimation results: A key driver of CoCo issuance decision is the tax rulings of the country of domicile. With firm fixed effects, the effect of size on issuance decision disappears, which is not surprising given that relative size of a bank's asset base has not changed remarkably over the sample period. Bank's profitability from core operations, as measured by its net interest margin, does not play an important role in this decision, and a bit surprisingly, the bank's leverage ratio is only weakly related to this decision. For some specification we find that banks with higher leverage are less likely to issue CoCo, but the results are not consistent across model specifications.

In Model 5, we interact the 'Fiscal Treatment Dummy', with the tax rate of the bank during the previous year. This variable measures the likely impact of tax deductibility on the bank's incentive to issue CoCo at a bank-by-bank level. Banks with higher tax rates are more likely to benefit from the tax ruling that allows the tax deductibility of CoCo. Our results provide strong support for this conjecture. The interaction variable is one of the key variables that explains the issuance decision.

These results show that the most reliable determinant of CoCo issuance is the tax rulings and its likely impact on the bank. Large banks are more likely to issue CoCo, but profitability and leverage do not play big roles. We document these results for the first time in the literature to the best of our knowledge, and they are of independent interest. More important, they provide some interesting context to our main results linking CoCo to loan portfolio risk. To the extent

that tax related incentives are not systematically related to an individual issuing bank's unobserved risk-taking incentives, our results are likely to be causal. It is likely to be the case because the tax rulings are passed at the country level, often after lengthy socio-political negotiations. This provides some justification to the claim that the issuance of CoCo was not simply driven by changes in unobserved investment opportunity set of these banks.

Univariate analysis. We begin our analysis by proving some univariate results in Table 4. Panel A breaks all bank-year observations into two groups: CoCo=1 indicates bank-year observations for issuers after the issuance year; CoCo=0 are the remaining observations, i.e., they pool all observations for non-issuers and pre-issuance observations for issuers. Post-issuance issuing banks have 4.75% impaired loans compared to 2.68% for the remaining group. The difference of 2.07% across the two group is economically large, and statistically significant at 1%. A similar patter emerges for loan reserves ratio: 2.60% for the issuers post-issuance compared to 1.47% for the other group.

The Table also shows that there is a big difference in the average size of banks that issue CoCos compared to banks that do not, a result that we established in the previous section as well. To address this issue in a simple univariate setting, we split our sample into two parts, namely before and after the issuance of CoCo only for banks that eventually issued CoCo. On average, before the issuance CoCo issuing banks had impaired loans of 2.48%, which increased to 4.75% after the issuance. The difference of 2.27% is both economically and statistically significant. Similar pattern holds for loan loss reserves.

Regression Analysis. Table 5 provides formal regression estimation results, with impaired loans (Panel A) or loan loss reserves (Panel B) as the dependent variable. We provide estimation results for six models for both Panels: these models differ in terms of the variables

used in the model, inclusion of fixed effects, and the computation of standard errors. We focus on Columns (3) and (6) that include both year and firm fixed effects in the model, and compute standard errors clustered at the year level (Column 3) and bank level (Column 6). The key variable of interest of 'CoCo Dummy' that equals one for bank-years after the bank has issued CoCo, and zero otherwise. A clear theme emerges from this Table: after the CoCo issuance, bank's loan portfolio becomes riskier. Impaired loans increase by about 1.9%, whereas loan loss reserves go up by about 0.61%. These effects are statistically significant for all models, with slight differences in the level of significance depending on the modeling choice. Compared to the sample median of 1.63% for impaired loans and 0.91% for loan loss reserves, these estimates are large in economic terms as well. Thus, the analysis suggests an increase in risky lending after the issuance of CoCo. The use of firm fixed effect ensures that we are estimating the within-bank changes in these variables, whereas the inclusion of year fixed effects remove concern about yearly variation in aggregate economy and loan defaults.

In our next test, we analyze whether the amount of CoCo issuance matters for risk-taking conditional on the issuance of the CoCo. We conduct this test within the sample of CoCo issuers; if our previous results are driven by some inherent differences across the CoCo issuers and non-issuers in terms of their risk-taking decisions, then the estimation based solely on the issuer sub-sample should be able to address this concern. We now use the size of CoCo issuance (as a ratio of the bank's asset value) as the key explanatory variable, and estimate the regression model using both measures of risk-taking. Results are provided in Table 6, Panel A based on impaired loans as the measure of risk-taking, and Panel B based on loan loss reserves.

We first provide the estimation result with CoCo dummy variable as the explanatory variable in this sample. Thus the estimated coefficient measures the effect of CoCo issuance on

bank's risk-taking using pre-issue years as the control observation. Thus, the effect of CoCo issuance in this model comes entirely from variation generated by the issuer sample, alleviating several sample selection issues that one may be concerned with when we compare issuer banks to the entire sample of banks.[2] Columns (1) – (3) provide the results, and show that CoCo issuance indeed is associated with higher risk-taking. Results are economically strong for both measures of risk-taking, and statistically strong for all models based on impaired loan losses. Results are strong for loan loss provisions as well, but the coefficient loses its significance when we use both year and firm fixed effects in the model. As we discuss below, once we exploit the variation in the extent of issuance, these results become significant as well. Overall, the results paint a clear picture: even within the sample of issuers, risk-taking goes up by significant amount after the CoCo issuance.

Columns (4) – (6) of both panels provide the main result of this table, linking the extent of CoCo issuance to risk taking. As the amount of CoCo increases, we observe significantly riskier loans. We focus on Column (6) -- the most stringent model – for discussions here. Based on impaired loans, we obtain an estimate of 0.962, which is significant at 5% level. In economic terms, the estimate suggests that one standard deviation increase in the amount of CoCo issuance results in 0.5 percentage points higher impaired loans. When we focus on loan loss reserves, we obtain a similar pattern. One standard deviation increase in CoCo amount is associated with an increase of 0.2 percentage points in loan loss reserves. The result is significant at 5% level. Among the control variables, we also obtain some interesting results. Banks with higher leverage have riskier loan portfolios, and banks with higher net interest margins have lower risk. The first result is consistent with risk-taking incentives generated by leverage; the

[2] This estimated strategy is analogous to the popular econometric approach that estimates the effect of some treatment by considering only the subjects that eventually get treated.

second result is consistent with the view that banks take higher risk as their profitability goes down. We cannot make precise conclusions on the relationship between profitability and risk-taking based on our study because we are unable to directly link the interest rates charged on loan portfolios for which we observe defaults. Further, our sample period witnessed some extraordinary measures on the monetary policy front in Europe that affected the net interest margin of different banks differently. We leave these investigations for future research.

Overall our results show that CoCo issuance coincides with higher risk taking and the higher the amount of CoCo issuance the higher is the risk-taking.

Matched sample evidence. We extend our analysis by conducting a matched sample test. The matched sample analysis complements the findings of regression analysis presented above, but it alleviates concerns that issuers and non-issuers are fundamentally different on observable dimensions such as bank size and country of domicile.

In the first matched sample exercise, for every issuing bank we find a non-issuing bank of similar size in the same country as the issuing bank. Thus we create a sample of bank-year observations where issuers and non-issuers are well matched on size and country dimensions. We estimate the regression model on this sub-sample, and present the results in Table 8. Our results remain similar. In second matched sample we find a matched bank of similar size in a different country, and report the results on this subsample in Table 7 as well. Issuing banks have significantly higher defaults in their loan portfolio as compared to the non-issuers in this sample as well. It is interesting to note that when we match banks in the same country, our estimates are lower in values compared to when we match them in different country. This is sensible as we expect some country level differences in risk-taking across banks.

Figure 2 presents our main results visually. We plot the difference in risk-taking of firms that issued a CoCo and matched firms around CoCo issuance. We find that risk taking measured by Impaired Loans (Panel A) and Loan Loss Reserves (Panel B) increases slightly in the year of CoCo issuance and the year thereafter, and increases considerably in year 2 after issuance.

Overall we find a consistent pattern with a series of tests in this paper: CoCo issuance and the amount of CoCo issued are associated with higher risk-taking on the lending side. Our results cannot be explained away by differences in size, equity-to-asset ratio, profitability, unobserved bank specific fixed effects, and yearly changes in default rates. Thus our results can be causal as long as any omitted variable of concern is captured by these control variables. More important, as we showed earlier, a key motivation for CoCo issuance is the regulation on tax treatment of coupon payments on these securities. It is reasonable to assume that these laws were not designed in response to some unobserved risk-taking incentives of the banks. Thus, given this underlying motivation, it is reasonable that our results are causal in nature, namely CoCo issuance affecting risk-taking.

Needless to say, our research design does not allow us to claim causality. If the results simply indicate a correlation, it is still an important and useful result to document. Under this interpretation, banks are issuing CoCo at the time when there are some unobserved changes in their risk-taking incentives. This suggests that policy designs that ignore concomitant increase in risk-taking can be problematic. In addition, theoretical models that study the design features of CoCo under the assumption of separation of investment and financing decisions can be limited. Thus, our results have important implications even without a clearly established causal link.

Cross-sectional evidence. We now investigate the impact of differences in CoCo design features on risk-taking incentives. A number of recent studies have argued that risk-taking incentives

change depending on these features: we evaluate these claims empirically in this part of the paper. We focus on two main features of the instrument: the trigger level and whether the CoCo converts into equity or is written off upon the trigger event. Based on the sample median of trigger value, we create a dummy variable, 'High Trigger', that equals one if the bank's CoCos are issued above the median, and zero otherwise. Using this variable as an additional explanatory variable, we estimate our baseline model for different specifications using impaired loans and loss reserves as dependent variables. Results are provided in Table 8, Panel A. Columns (1) and (2) use the entire sample, Columns (3) and (4) are based on matched sample, and Columns (5) and (6) are estimated with the sample of issuers only. Across the model specification, there is a consistent theme: though banks with lower trigger have riskier loan portfolios as evident by the negative sign of estimated coefficient on 'High Trigger' variable, the result is statistically insignificant.

In the next test, we break CoCo dummy into three groups: Only Equity Conversion, Only Write Down and Mixed CoCos and include these variables separately into the regression model. We fail to find any discernable pattern in risk-taking behavior across the type of CoCo issued. In other words, the effect of CoCo on risk taking behavior does not change by much in our sample.

Overall, the results show that it is the act of issuing CoCo and the amount of CoCo issued by the bank that is associated with riskier loan portfolios; the precise nature of the instrument does not seem to matter. This is an important result, as it shows that mere fine-tuning of the design of this security is unlikely to mitigate risk-taking effects of the instrument. The risk-taking effect is a first order implication of this security that transcends all forms of CoCo.

4. Conclusion

We document a positive link between CoCo issuance and riskiness of the bank's loan portfolios. CoCos have become a very important security for raising equity capital in Europe. The key benefits of CoCos – that they provide equity in bad states of the world – is based on a crucial assumption of the separation of financing and investment decision. Our paper shows that not to be the case: CoCo issuance and the amount of capital raised through CoCo issuance is associated with riskier investment decisions. Hence, at least partly, the leverage decreasing benefits of CoCo is offset by the increased riskiness of the banks on the asset side. Regulators around the world are still thinking about the costs and benefits of this security design. Our results provide important inputs to these policy debates.

Our study goes beyond the specifics of CoCo as a financing instrument; using this security design as an empirical setting we show that financing and investment decisions are intrinsically linked. Hence theoretical models that study the pricing of these instruments or study the optimality of such security design must seriously take into account the fact that asset risk is changing concomitantly with financing vehicles.

Finally, our study does not address whether the increase in risk at the bank level was optimal from the bank's shareholders' or manager's perspective. Our focus is simply on the risk taking aspect: an issue that bank regulators care about even if the increase in risk benefits the shareholders. Whether these instruments, and the increased risk-taking that come with them, are value enhancing for the shareholders of the firm has been left for future research work.

Appendix 1: Tax Treatment by Country

Country	Position on tax deductibility	Date of clarification	Notes	Source
Austria	None	-	As of 1 Jan 2017, there has not been a general/official communication by the Austrian Ministry on the tax treatment of CoCo's, other than that securities need to be scrutinized on a case by case basis.	Correspondence Austrian Ministry of Finance
Belgium	In favor	10/2013	There has been a (favourable) ruling on the tax deductibility of CoCos: Voorafgaande beslissing nr. 2013.456 dd. 22.10.2013	Correspondence Belgium Ministry of Finance, and a ruling (http://ccff02.minfin.fgov.be/KMWeb/document.do?method=view&id=9d32787f-e465-431a-9391-f3cf5ff37721&documentLanguage=NL#findHighlighted)
Denmark	In favor	1/2004	A 2002 law allows for the counting of CoCos towards capital requirements. A 2004 law makes CoCos tax deductible.	Correspondence Danish Ministry of Finance
Germany	In favor	4/2014	A letter from the ministry of finance clarifies the (favourable) tax treatment of CoCos.	http://bihcapital.com/2014/05/germany-ministry-clears-tax-treatment-of-at1-capital/, https://bankenverband.de/newsroom/presse-infos/bankenverband-begruesst-entscheidung-zu-coco-bonds/, https://bankenverband.de/service/musterbedingungen-fuer-instrumente-kernkapital/
Netherlands	In favor	6/2014	Draft legislation making coupon payments on CoCos tax deductible is circulated in June 2014; the law is passed in October.	Correspondence Dutch Ministry of Finance (https://www.nrc.nl/nieuws/2015/11/03/de-bank-vraagt-de-minister-draait-a1405681)
Norway	In favor	-	Currently CoCo bonds are tax deductible in Norway, and within the ministry of finance they do not know of any law or ruling affecting the tax deductibility of CoCos	Correspondence Norwegian Central Bank and Norwegian Ministry of Finance
Spain	In favor	1985	Tax treatment follows accounting principles (Spanish GAAP), in which CoCos qualify as debt	Correspondence Spanish Ministry of Finance and Civil Service,

			and coupons are tax deductible.	(http://www.iflr.com/pdfs/regcapanalytics/Spains_favourable_AT1_tax_treatment_under_threat.pdf)
Sweden	In favor (until 1/2017)	-	CoCos qualified as debt under local accounting principles, and tax rules followed accounting rules. However, legislation has been passed that has removed the tax deductibility of CoCos per Jan 2017.	Correspondence Swedish Ministry of Finance
Switzerland	In favor	-	CoCo's are considered debt capital, and interest payments are deductible.	Correspondence Swiss Federal Department of Finance, http://www.taxand.com/taxands-take/news/improved-conditions-swiss-bond-issues
United Kingdom	In favor	7/2013	Draft legislation making coupon payments on CoCos tax deductible is circulated in July 2013; the law is passed in January 2014.	(https://www.sullcrom.com/Regulatory_Capital_Requirements, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265979/RCS_Regulations_TIIN_complete.pdf)

Appendix 2: Variable definitions

Variable name in paper	Description	Source
Impaired Loans/Gross Loans	Impaired loans divided by total gross loans.	Bankscope, SNL
Loan Loss Reserves/Gross Loans	Loan loss reserves divided by total gross loans.	Bankscope, SNL
CoCo Dummy	A dummy set equal to one if a firm has issued at least one CoCos in that year or in previous years.	Bloomberg
CoCo Amount	The amount of capital raised through CoCo issuance in a given year.	Bloomberg
Relative CoCo Size	Coco Amount Issued / Assets in %	Bloomberg
High Trigger	A dummy set equal to one if a bank has issued CoCos with above-median trigger on average.	Bloomberg
Only Equity Conversion CoCo	A dummy set equal to one if a bank has issued only CoCos that are converted to equity when triggered.	Bloomberg
Only Write Down CoCo	A dummy set equal to one if a bank has issued only CoCos that are written down when triggered.	Bloomberg
Mixed CoCos	A dummy set equal to one if a bank has issued CoCos of both equity conversion and write-off type.	Bloomberg
Assets	Total assets (in EUR). Regressions use the logarithm of one plus total assets (in EUR).	Bankscope, SNL
Leverage	One minus total equity divided by total assets.	Bankscope, SNL
Net Interest Margin	(Interest Income-Interest Expense)/Interest Income	Bankscope, SNL
Fiscal Treatment Dummy	A dummy set equal to one if coupon payments on CoCos can be deducted from taxable income in the country in which a bank is domiciled.	See Appendix 1

References

Adjiev, S., P. Bolton, W. Jiang, A. Kartasheva, and B. Bogdanova. 2015. CoCo Bond Issuance and Bank Funding Cost. Working Paper.

Chen, N., P. Glasserman, B. Nouri, and M. Pelger. 2013. CoCos, Bail-in, and Tail Risk. Office of Financial Research Working Paper.

Duprey, T. and M. Lé. 2015. Bankscope dataset: getting started. SSRN Working Paper.

Flannery, M. 2014. Contingent Capital Instruments for Large Financial Institutions: A Review of the Literature. *Annual Review of Financial Economics* 6: 225-240.

Green, R. 1984. Investment incentives, debt, and warrants. *Journal of Financial Economics* 13(1): 115-136.

Martynova, N. and E.C. Perotti. 2015. Convertible bonds and bank risk-taking. SSRN Working Paper.

Modigliani, F. and M. H. Miller. 1958. The cost of capital, corporation finance and the theory of investment. *The American Economic Review* 48(3): 261-297.

Pennacchi, G. and A. Tchistyi. 2016. 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(2): 881-920.

Vallee, B. 2016. Contingent Capital Trigger Effects: Evidence from Liability Management Exercises. HBS Working Paper.

Table 1 – Cocos Overview

This table provides summary statistics of CoCo issuances aggregated by country and year (Panels A-C) over the 2009-2015 period and by banks that issued at least one CoCo over the 2009-2015 period (Panel D). In Panel A, the variable of interest is the number of total CoCos issued by banks. In Panel B, the variable of interest is the number of banks that are first-time CoCo issuers. In Panel C, the variable of interest is the sum of CoCo issuance amounts in mn EUR. In Panel D, *Number of CoCos* denotes the number of CoCos issued by each CoCo-issuing bank, and *CoCo amount issued EUR mn* denotes the amount raised by each bank. *Write-down* and *Equity conversion* denote CoCos that are written off and converted into equity when triggered, respectively. Trigger level denotes the trigger levels employed by CoCo-issuing banks. Further variable descriptions are provided in the Appendix.

Panel A: Number of CoCos issues by country

	Before 2009	2009	2010	2011	2012	2013	2014	2015	Total
Austria	0	0	0	0	0	0	0	0	0
Belgium	0	0	0	0	0	0	1	0	1
Denmark	0	1	1	1	1	1	1	2	8
Germany	0	0	0	0	0	0	5	5	10
Netherlands	0	0	0	2	0	0	0	1	3
Norway	0	0	0	0	0	2	5	6	13
Spain	0	0	0	0	2	2	4	3	11
Sweden	0	0	0	0	0	0	5	5	10
Switzerland	0	0	0	1	7	4	3	7	22
United Kingdom	0	0	1	0	0	2	9	5	17
Total	**0**	**1**	**2**	**4**	**10**	**11**	**33**	**34**	**95**

Panel B: Number of distinct first-time CoCo issuers by country

	Before 2009	2009	2010	2011	2012	2013	2014	2015	Total
Austria	0	0	0	0	0	0	0	0	0
Belgium	0	0	0	0	0	0	1	0	1
Denmark	0	1	1	1	1	1	0	1	6
Germany	0	0	0	0	0	0	2	1	3
Netherlands	0	0	0	1	0	0	0	0	1
Norway	0	0	0	0	0	2	5	4	11
Spain	0	0	0	0	1	1	1	0	3
Sweden	0	0	0	0	0	0	2	2	4
Switzerland	0	0	0	1	1	1	0	1	4
United Kingdom	0	0	1	0	0	1	4	1	7
Total	**0**	**1**	**2**	**3**	**3**	**6**	**15**	**10**	**40**

Panel C: CoCo Issuance Amounts by country (in mn EUR)

	Before 2009	2009	2010	2011	2012	2013	2014	2015	Total
Austria	0	0	0	0	0	0	0	0	0
Belgium	0	0	0	0	0	0	1,948.3	0	1,948.3
Denmark	0	32.1	2.3	4.6	1.2	1.2	2.1	9.3	52.8
Germany	0	0	0	0	0	0	6,231.7	804.7	7,036.4
Netherlands	0	0	0	2,935.6	0	0	0	1,707.5	4,643.1
Norway	0	0	0	0	0	3.7	12.5	6.4	22.6
Spain	0	0	0	0	1,782.2	1,826.2	7,183.3	4,150.5	14,942.2
Sweden	0	0	0	0	0	0	3,217.3	2,279.7	5,496.9
Switzerland	0	0	0	1,449.2	12,041	3,997	3,999.5	5,419.1	26,905.8
UK	0	0	171.9	0	0	2865.2	11685.1	9259.6	23,981.8
Total	**0**	**32.1**	**174.2**	**4,389.4**	**13,824.4**	**8,693.1**	**34,279.8**	**23,636.7**	**85,029.7**

Panel D: Summary statistics for CoCos at the bank level

Variable	N	Mean	StDev	Min	P25	P50	P75	Max
Number of CoCos	39	2.41	2.26	1.00	1.00	1.00	3.00	12.00
CoCo Amount mn EUR	39	2,180.0	3,890.0	0.3	1.2	544.0	3,310.0	20,500.0
thereof Equity Conversion CoCos	39	1,320.0	2,970.0	0.0	0.0	0.0	660.0	13,300.0
Relative CoCo Size (%)	39	0.48	0.51	0.03	0.17	0.35	0.55	1.98
Trigger Level	39	5.80	1.16	3.73	5.13	5.13	7.00	10.28

Table 2 – Summary statistics

This table provides summary statistics of sample banks over the 1999-2015 period. All variables are defined in the Appendix. All continuous variables are winsorized at the 1% and 99% levels.

Variable	Nobs	Mean	StDev	Min	P25	Median	P75	Max
CoCo Dummy	9,880	0.99%	9.91%	0.00%	0.00%	0.00%	0.00%	100.00%
Number of Cocos Issued	9,880	0.01	0.15	0.00	0.00	0.00	0.00	6.00
CoCo Amount (mn EUR)	9,879	8.6	194	-	-	-	-	11,800
Relative CoCo Size in %	9,880	0.01	0.08	-	-	-	-	2.71
Impaired Loans / Gross Loans in %	7,764	2.70	3.13	0.02	0.74	1.63	3.46	17.82
Loan Loss Reserves / Gross Loans in %	9,880	1.48	1.79	0.00	0.33	0.91	1.91	10.44
Assets (mn EUR)	9,880	20,100	130,000	49	201	417	1,280	2,220,000
Leverage in %	9,880	92.2	4.7	73.6	90.1	92.6	95.6	99.2
Net Interest Margin in %	9,873	2.1	0.9	0.4	1.5	2.0	2.6	5.9

Table 3 – Determinants of Coco issuance

This table provides the results of a panel analysis of CoCo issuance over the 1999 to 2015 period. The dependent variable is # *CoCo Issues*, the number of CoCos issued in a particular year. All controls are lagged by one year and defined in the Appendix. Fixed effects are included as indicated. All continuous variables are winsorized at the 1% and 99% levels. Standard errors are clustered at the year level. *t*-statistics are in parentheses; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	**(2)**	**(3)**	**(4)**	**(5)**
LN(1+Assets) (t-1)	0.017**	0.018**	0.028**	-0.030**	0.017**
	(2.16)	(2.22)	(2.61)	(-2.37)	(2.28)
Leverage (D/A) (t-1)	-0.000	-0.000	-0.001	-0.000	-0.000
	(-0.31)	(-0.18)	(-1.66)	(-0.46)	(-0.79)
Net interest margin (t-1)	-0.001	0.001	0.005	0.004	0.001
	(-1.07)	(0.78)	(0.96)	(0.78)	(0.54)
Fiscal treatment dummy		0.022**	0.114**	0.082**	
		(2.28)	(2.73)	(2.37)	
Fiscal treatment dummy x Tax rate (t-1)					0.025***
					(3.49)
N	8244	8244	8244	8244	8172
r2	0.038	0.042	0.179	0.190	0.053
#Firm FE			1447	1447	
Firm FE	No	No	Yes	Yes	No
Year FE	No	No	No	Yes	No

Table 4 – Univariate splits

This table compares characteristics of banks with and without outstanding CoCo(s) at the bank-year level over the 1999-2015 period. The first three columns present results for the full sample of banks, splitting by a Dummy variable that is equal to one if a bank as issued a CoCo. The last three columns present summary statistics for the set of banks that have issued at least one CoCo over the sample period, splitting such observations into those before and after the first CoCo issuance. All variables are defined in the Appendix. All continuous variables are winsorized at the 1% and 99% levels. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Panel A					
	Sample: All Banks			**Sample: CoCo Issuers**		
Variable	**CoCo=1**	**CoCo=0**	**Diff**	**Before**	**After**	**Diff**
Impaired Loans / Gross Loans (%)	4.75	2.68	2.07***	2.48	4.75	2.27***
Loan Loss Reserves / Gross Loans (%)	2.60	1.47	1.13***	1.66	2.60	0.95***
Assets (mn EUR)	324,000	17,000	307,000***	320,000	324,000	4,270
Leverage (%)	93.0	92.2	0.8*	94.2	93.0	-1.1***
Net Interest Margin (%)	2.0	2.1	-0.2**	1.9	2.0	0.1

Table 5 – CoCo issuances and risk-taking

This table provides the results of a panel analysis of measures of risk of banks over the 1999 to 2015 period. The dependent variable is *Impaired Loans/Gross Loans* in Panel A and *Loan Loss Reserves/Gross Loans* in Panel B. The control variable of interest is *CoCo Dummy*, a dummy variable set equal to one if a bank has issued at least one CoCo in a given year. Other controls are defined in the Appendix and included, along with fixed effects, as indicated. All continuous variables are winsorized at the 1% and 99% levels. Standard errors are clustered at the year level (Columns (1)-(3)) and bank level (Columns (4)-(6)), respectively. *t*-statistics are in parentheses; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Impaired Loans/Gross Loans

	(1)	(2)	(3)	(4)	(5)	(6)
CoCo Dummy	2.069***	2.446***	1.897***	2.069**	2.446***	1.897**
	(3.83)	(5.11)	(3.94)	(2.16)	(2.82)	(2.08)
LN(1+Assets)		-0.374	-1.866***		-0.374	-1.866***
		(-1.69)	(-4.02)		(-1.61)	(-4.01)
Leverage (D/A)		0.002***	0.003***		0.206***	0.276***
		(5.24)	(8.07)		(3.18)	(3.80)
Net Interest Margin		-0.007**	-0.003		-0.739***	-0.327
		(-2.66)	(-1.27)		(-2.60)	(-1.22)
N	7764	7764	7764	7764	7764	7764
r2_a	0.005	0.688	0.703	0.005	0.688	0.703
#Firm FE	-	1319	1319	-	1319	1319
Cluster	Year	Year	Year	Bank	Bank	Bank
Firm FE	No	Yes	Yes	No	Yes	Yes
Year FE	No	No	Yes	No	No	Yes

Panel B: Loan Loss Reserves/Gross Loans

	(1)	(2)	(3)	(4)	(5)	(6)
CoCo Dummy	1.135***	0.706***	0.610***	1.135**	0.706**	0.610*
	(3.00)	(4.12)	(4.77)	(2.06)	(2.07)	(1.74)
LN(1+Assets)		-0.316***	-0.561***		-0.316***	-0.561***
		(-6.81)	(-3.39)		(-3.51)	(-3.19)
Leverage (D/A)		0.007	0.010		0.007	0.010
		(0.94)	(1.33)		(0.79)	(1.01)
Net Interest Margin		0.054	0.037		0.054	0.037
		(0.62)	(0.44)		(0.64)	(0.42)
N	9880	9873	9873	9880	9873	9873
Adj. R2	0.004	0.726	0.734	0.004	0.726	0.734
#Firm FE	-	1448	1448	-	1448	1448
Cluster	Year	Year	Year	Bank	Bank	Bank
Firm FE	No	Yes	Yes	No	Yes	Yes
Year FE	No	No	Yes	No	No	Yes

Table 6 – CoCo issuances and risk-taking: Sample of CoCo issuers

This table replicates Tables 5 and 6 for the subset of sample firms that have issued a CoCo at least once over the 1999-2015 period. The dependent variable is *Impaired Loans/Gross Loans* in Panel A and *Loan Loss Reserves/Gross Loans* in Panel B. The control variable of interest in Columns (1)-(3) is *CoCo Dummy*, a dummy variable set equal to one if a bank has issued at least one CoCo in a given year. The control variable of interest in Columns (4)-(6) is *Relative CoCo Size*, the relative CoCo size (100*EUR issued/EUR assets). All continuous variables are winsorized at the 1% and 99% levels. *t*-statistics are in parentheses; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Impaired Loans/Gross Loans

	(1) CoCo Dummy	**(2)** CoCo Dummy	**(3)** CoCo Dummy	**(4)** Relative CoCo Size	**(5)** Relative CoCo Size	**(6)** Relative CoCo Size
CoCo Dummy	2.270***	2.437***	1.333**	1.402***	2.108***	0.962**
	(5.26)	(6.51)	(2.47)	(2.85)	(4.98)	(2.17)
LN(1+Assets)		0.176	-1.335*		0.804*	-1.360*
		(0.36)	(-1.79)		(1.67)	(-1.83)
Leverage (D/A)		0.772***	0.913***		0.737***	0.958***
		(5.91)	(6.92)		(5.52)	(7.30)
Net Interest Margin		-1.624***	-2.739***		-1.415***	-2.707***
		(-3.94)	(-6.49)		(-3.38)	(-6.42)
N	416	416	416	416	416	416
r2_a	0.060	0.523	0.584	0.017	0.502	0.583
#Firm FE		37	37		37	37
Firm FE	No	Yes	Yes	No	Yes	Yes
Year FE	No	No	Yes	No	No	Yes

Panel B: Loan Loss Reserves/Gross Loans

	(1)	(2)	(3)	(4)	(5)	(6)
	CoCo Dummy	CoCo Dummy	CoCo Dummy	Relative CoCo Size	Relative CoCo Size	Relative CoCo Size
CoCo Dummy	0.946***	0.840***	0.181	0.294	0.826***	0.363**
	(4.04)	(6.27)	(0.94)	(1.05)	(5.24)	(2.21)
LN(1+Assets)		-0.399**	-0.654**		-0.190	-0.632**
		(-2.28)	(-2.53)		(-1.14)	(-2.45)
Leverage (D/A)		0.313***	0.372***		0.316***	0.380***
		(7.29)	(8.68)		(7.23)	(9.01)
Net Interest Margin		-0.051	-0.367**		0.018	-0.373***
		(-0.35)	(-2.54)		(0.12)	(-2.60)
N	473	473	473	473	473	473
Adj. R2	0.031	0.787	0.816	0.000	0.781	0.817
#Firm FE		39	39		39	39
Firm FE	No	Yes	Yes	No	Yes	Yes
Year FE	No	No	Yes	No	No	Yes

Table 7 – Robustness

This table provides the results of robustness tests for a panel analysis of measures of risk of banks over the 1999 to 2015 period. The dependent variable is *Impaired Loans/Gross Loans* in Columns (1)-(2) and *Loan Loss Reserves/Gross Loans* in Columns (3)-(4). In Columns (1) and (3), the sample is restricted to banks that have issued a CoCo over the sample period and banks that have never issued a CoCo that are matched to CoCo issuers by same headquarter country and by size a year before CoCo issuance. In Columns (2) and (4), the sample is restricted to banks that have issued a CoCo over the sample period and banks that have never issued a CoCo and that are matched as before except that control firms are restricted to banks from different headquarter countries. The control variable of interest is *CoCo Dummy*, a dummy variable set equal to one if a bank has issued at least one CoCo in a given year. Other controls are defined in the Appendix and included as indicated. All continuous variables are winsorized at the 1% and 99% levels. Standard errors are clustered at the year level. *t*-statistics are in parentheses; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	**(2)**	**(3)**	**(4)**
LHS	**Impaired Loans/Gross Loans**	**Impaired Loans/Gross Loans**	**Loan Loss Reserve/Gross Loans**	**Loan Loss Reserve/Gross Loans**
Sample	**Matched Same Country**	**Matched Different Country**	**Matched Same Country**	**Matched Different Country**
CoCo Dummy	1.718***	3.031***	0.859***	1.439***
	(3.32)	(7.99)	(3.38)	(7.30)
LN(1+Assets)	0.206***	0.146***	0.227***	0.169***
	(6.67)	(3.65)	(12.72)	(13.74)
Leverage(D/A)	0.001	-0.000	-0.001***	-0.001***
	(1.14)	(-0.80)	(-4.62)	(-4.31)
Net interest margin	0.011**	0.008**	0.012***	0.009***
	(2.32)	(2.38)	(7.51)	(8.49)
N	769	680	910	806
Adj. R2	0.074	0.066	0.381	0.214
Firm FE	No	No	No	No
Year FE	No	No	No	No

Table 8 – CoCo Characteristics

This table provides the results of a panel analysis of measures of bank risk taking over the 1999 to 2015 period. The set-up follows exactly that of Table 5 (Columns (1) and (5)), as well as the robustness tests provided in Table 6 and 7. In Panel A, the *CoCo Dummy* is additionally interacted with *High Trigger*, a Dummy variable that is set equal to one if a bank's CoCos are issued with above-median trigger level on average. In Panel B, the CoCo Dummy is split into banks that only ever issued Equity Conversion CoCos, banks that only ever issued Write Down CoCos, and banks that issued at least one CoCo of each type. Other controls are defined in the Appendix and included as indicated. All continuous variables are winsorized at the 1% and 99% levels. Standard errors are clustered at the year level. *t*-statistics are in parentheses; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Trigger levels

LHS: Impaired Loans

Sample	(1) All	(2) All	(3) Matched Same Country	(4) Matched Different Country	(5) CoCo Issuers	(6) CoCo Issuers
CoCo Dummy	2.364*	2.459**	2.859**	2.547*	3.056***	1.786***
	(1.89)	(2.16)	(2.24)	(1.97)	(5.23)	(2.77)
High Trigger	-1.354	-0.884	-1.403	-1.449	-0.942	-0.738
	(-0.80)	(-0.59)	(-0.81)	(-0.82)	(-1.27)	(-1.28)
LN(1+Assets)	0.179***	-1.868***	0.194***	0.155***	-0.003	-1.376*
	(3.04)	(-4.02)	(6.37)	(3.78)	(-0.04)	(-1.85)
Leverage (D/A)	-0.034	0.275***	0.057	-0.007	0.314***	0.892***
	(-1.38)	(8.23)	(1.08)	(-0.17)	(2.67)	(6.72)
Net Interest Margin	1.044**	-0.332	1.013**	0.731**	1.577***	-2.797***
	(2.77)	(-1.29)	(2.41)	(2.33)	(7.10)	(-6.60)
N	7764	7764	769	680	416	416
Adj. R2	0.101	0.703	0.103	0.059	0.172	0.585
# Firm FE		1319				37
Firm FE	No	Yes	No	No	No	Yes
Year FE	No	Yes	No	No	No	Yes

LHS: Loan Loss Reserves

Sample	(1) All	(2) All	(3) Matched Same Country	(4) Matched Different Country	(5) CoCo Issuers	(6) CoCo Issuers
CoCo Dummy	1.124*	0.736*	1.067*	1.053*	1.282***	0.208
	(1.97)	(2.06)	(2.04)	(1.92)	(5.16)	(0.94)
High Trigger	-1.018	-0.211	-0.773	-0.892	-0.575*	-0.051
	(-1.60)	(-0.42)	(-1.32)	(-1.46)	(-1.80)	(-0.25)
LN(1+Assets)	0.186***	-0.562***	0.227***	0.174***	0.085**	-0.656**
	(9.68)	(-3.38)	(12.77)	(14.25)	(2.55)	(-2.53)
Leverage (D/A)	-0.042***	0.010	-0.129***	-0.054***	0.112**	0.371***
	(-8.25)	(1.33)	(-4.63)	(-3.65)	(2.36)	(8.57)
Net Interest Margin	0.728***	0.036	1.210***	0.924***	1.575***	-0.370**
	(11.70)	(0.43)	(7.86)	(8.73)	(15.84)	(-2.55)
N	9873	9873	910	806	473	473
Adj. R2	0.208	0.734	0.387	0.205	0.446	0.815
# Firm FE		1448				39
Firm FE	No	Yes	No	No	No	Yes
Year FE	No	Yes	No	No	No	Yes

Panel B: Equity Conversion vs. Write-down CoCos

LHS: Impaired Loans

Sample	(1) All	(2) All	(3) Matched Same Country	(4) Matched Different Country	(5) CoCo Issuers	(6) CoCo Issuers
Only Equity Conversion CoCo	1.919***	2.939***	2.309***	2.010***	2.966***	2.172***
	(3.02)	(4.82)	(3.67)	(3.19)	(4.27)	(3.09)
Only Write Down CoCo	1.533**	1.504***	2.045***	1.642**	2.417***	0.346
	(2.36)	(3.00)	(3.03)	(2.40)	(4.47)	(0.54)
Mixed CoCos	1.231**	1.066	1.702***	1.479**	2.116**	2.361**
	(2.29)	(1.31)	(3.41)	(2.86)	(2.29)	(2.45)
LN(1+Assets)	0.177***	-1.891***	0.181***	0.145***	-0.020	-1.621**
	(3.02)	(-4.03)	(6.18)	(3.56)	(-0.26)	(-2.15)
Leverage (D/A)	-0.000	0.003***	0.001	-0.000	0.334***	1.013***
	(-1.36)	(8.10)	(1.24)	(-0.09)	(2.85)	(7.48)
Net Interest Margin	0.010**	-0.003	0.010**	0.007**	1.610***	-2.838***
	(2.77)	(-1.26)	(2.40)	(2.31)	(7.24)	(-6.73)
N	7764	7764	769	680	416	416
Adj. R2	0.100	0.704	0.098	0.053	0.168	0.591
# Firm FE		1319				37
Firm FE	No	Yes	No	No	No	Yes
Year FE	No	Yes	No	No	No	Yes

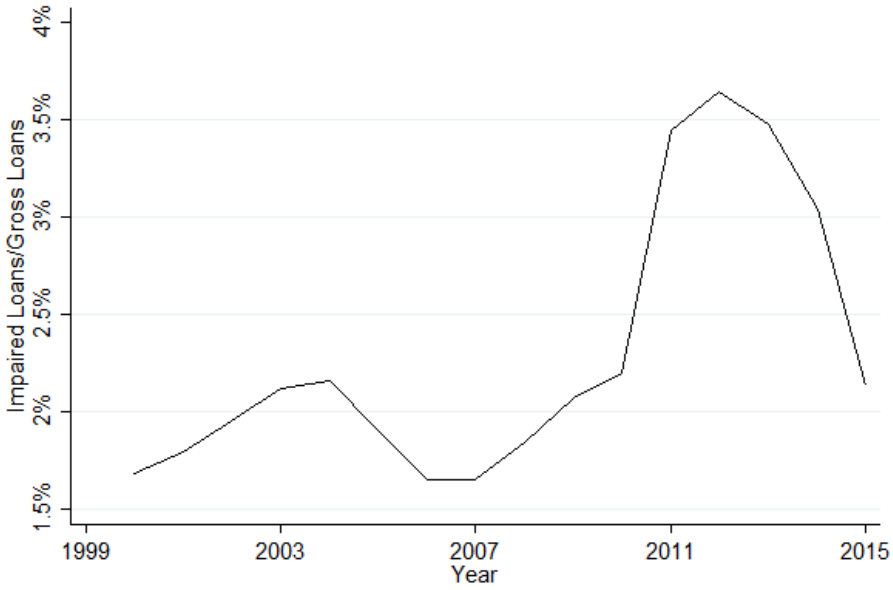
LHS: Loan Loss Reserves

Sample	(1) All	(2) All	(3) Matched Same Country	(4) Matched Different Country	(5) CoCo Issuers	(6) CoCo Issuers
Only Equity Conversion CoCo	0.071	1.070***	0.288	0.146	0.689**	0.815***
	(0.28)	(4.82)	(1.04)	(0.58)	(2.15)	(3.23)
Only Write Down CoCo	0.956*	0.587***	0.996**	0.925*	1.313***	-0.111
	(1.90)	(3.17)	(2.29)	(1.98)	(5.76)	(-0.50)
Mixed CoCos	-0.017	-0.418	-0.093	-0.066	0.191	-0.160
	(-0.10)	(-1.43)	(-0.62)	(-0.46)	(0.45)	(-0.45)
LN(1+Assets)	0.187***	-0.567***	0.231***	0.178***	0.091***	-0.817***
	(9.68)	(-3.44)	(13.71)	(12.00)	(2.72)	(-3.16)
Leverage (D/A)	-0.000***	0.000	-0.001***	-0.001***	0.122**	0.395***
	(-8.15)	(1.32)	(-4.71)	(-3.30)	(2.58)	(9.10)
Net Interest Margin	0.007***	0.000	0.012***	0.009***	1.616***	-0.391***
	(11.61)	(0.46)	(7.61)	(8.26)	(16.23)	(-2.73)
N	9873	9873	910	806	473	473
Adj. R2	0.208	0.735	0.387	0.203	0.449	0.821
# Firm FE		1448				39
Firm FE	No	Yes	No	No	No	Yes
Year FE	No	Yes	No	No	No	Yes

Figure 1: Key Measures of Risk Taking over time

This figure shows average measures of bank risk taking over the sample period. Measures of bank risk taking are *Impaired Loans/Gross Loans* (Panel A) and *Loan Loss Reserves/Gross Loans* (Panel B).

Panel A: Impaired Loans/Gross Loans



Panel B: Loan Loss Reserves/Gross Loans

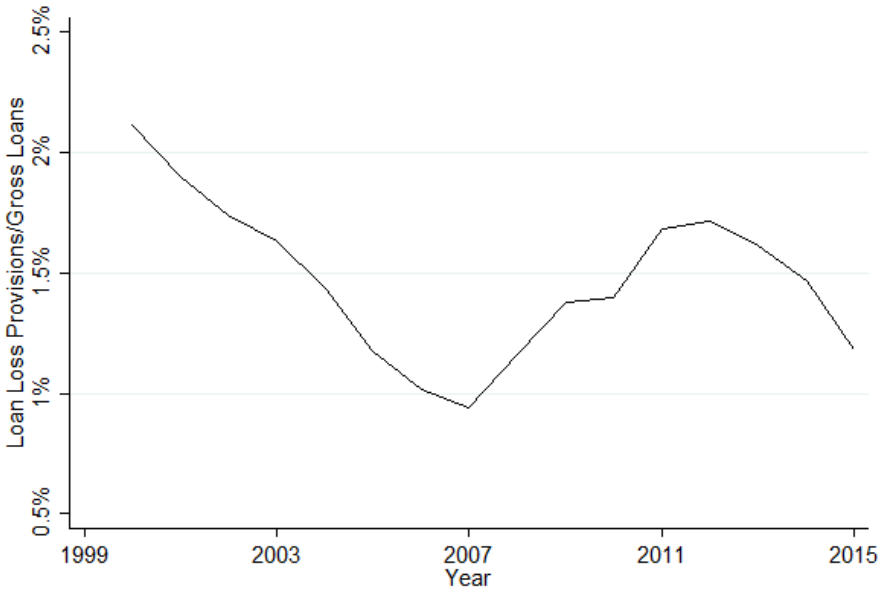
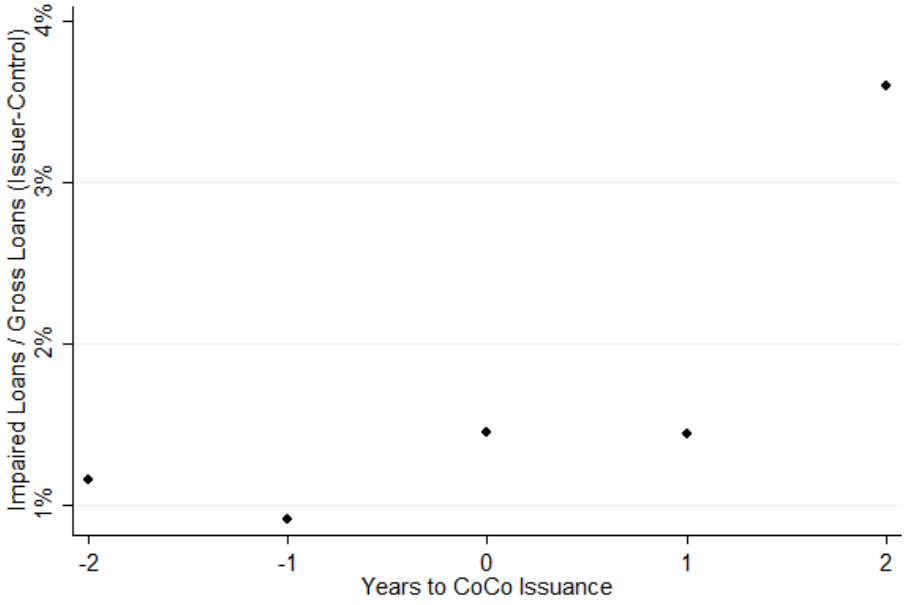


Figure 2: Key Measures of Risk Taking around CoCo Issuance

This figure shows average measures of bank risk taking around CoCo issuance for treated and control firms. Measures of bank risk taking are *Impaired Loans/Gross Loans* (Panel A) and *Loan Loss Reserves/Gross Loans* (Panel B). The graph shows the difference between risk taking of banks that have issued a CoCo over the sample period and those that have not.

Panel A: Impaired Loans/Gross Loans



Panel B: Loan Loss Reserves/Gross Loans