CoCo Bond Issuance and Bank Funding Costs[1]

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Abstract

We conduct a first comprehensive empirical study of the bank contingent convertible (CoCo) issues market. Two main findings emerge from our study. First, the impact of CoCo issuance on CDS spreads is negative and statistically significant, indicating that CoCo issuance reduces banks' credit risk. The reduction in CDS spreads is much larger for mandatory conversion (MC) CoCos than for principal write-down (PWD) issues. The impact on CDS spreads for the "global systemically important bank" (GSIB) issuers tends to be considerably stronger in the lead-up to issuance than on and after the issue date. In contrast to CDS spreads, there is no significant impact on equity prices of CoCo issuers. Second, analysis of bank's securities pricing post CoCo issuance reveals that investors in CoCos view instruments as risky and place a significant likelihood on the possibility of conversion. Thus while CoCos provide capital buffer to banks, the effect on reducing risk-taking incentives is rather weak.

1 Introduction

The financial crisis of 2007-09 has revealed that bank equity-capital requirements were too low to provide any meaningful loss absorption capacity for banks to be able to survive even a moderate negative macro-economic shock. There has since been a sustained global drive to introduce significantly higher capital requirements. Part of banks' recapitalization effort has been through the issuance of contingent convertible bonds (CoCos), which provide banks with higher capital cushions in adverse contingencies by automatically converting debt liabilities into equity. These CoCo instruments are favored for the greater flexibility they offer in endowing banks with higher capital cushions when they are most needed. Issuance of CoCos has been encouraged by regulators in a number of jurisdictions and CoCos have been incorporated in regulatory capital requirements in some of these jurisdictions. This is still a relatively small market segment, but it has been growing rapidly in recent years. Between January of 2009 and September 2014 banks around the world have issued a total amount of $208 billion dollars in CoCos through 188 different issues. As a comparison, the asset quality review (AQR) of the largest European financial institutions undertaken by the European Central Bank in October 2014 revealed that out of a total of 92 billion Euros of new securities issues by the reviewed banks from July 2013 to August 2014, 32 billion Euros (or over one third) were through CoCo issues, and just under two thirds were through equity issues.

There has been a lively debate in academia and among policymakers on the pros and cons of CoCos in stabilizing the banking system. A key advantage of CoCos emphasized by early commentators on bank regulatory reform (in particular, Flannery, 2005, 2009, Raviv, 2004, Duffie, 2009, McDonald, 2010, Coffee, 2010, Pennacchi, Vermaelen and Wolff, 2010, and the Squam Lake Report, 2010) is that the conversion or write-down of CoCos is a quick and effective way of delevering a bank that has incurred losses and to put it back on a sounder financial footing. In other words, CoCos were seen as a simple way of *bailing in* a bank and of cutting through all the existing institutional complexities hindering bank debt restructuring on an ad-hoc basis in the midst of a crisis.

Skeptics of CoCos (most notably, Admati, DeMarzo, Hellwig and Pfleiderer, 2012) on the other hand have argued that CoCos are excessively complex and unlikely to provide adequate loss absorbing capacity to banks. The size of the losses that CoCos can absorb will either be too small or will expose investors in CoCos, who are assumed to be primarily fixed income investors, to large losses they are less equipped to manage than equity-holders. Moreover, Sundaresan and Wang (2010) have pointed out that the design of early CoCo proposals, with an equity price trigger for automatic conversion, has an important flaw, as the stock price trigger can give rise to so-called "death spirals," whereby the simple expectation that the price boundary will be crossed can be self-fulfilling and give rise to multiple equilibria. Concerns were also raised about the apparent lack of "natural buyers" of CoCos. Due to pricing complexities and the likely high correlation of trigger events with systemic events in the economy, CoCos represent a marginal asset class for most investors and investors' demand is highly sensitive to CoCos return performance.

Given the cumulative volume of issuance, a comprehensive empirical analysis of the growing CoCo market is called for. It can shed light on the above controversies and indicate which concerns have so far proved to be relevant and which have proved less important than feared by commentators. In addition, this empirical study will also begin to fill two gaps between the early theoretical analyses and the ongoing CoCo market development. First, while almost all the theoretical papers thus far have focused entirely on conversion-based CoCos, a majority (55%) of the CoCos by issuance-volume in our sample actually takes the form of principal writedowns to absorb losses. Even though principal writedown contracts have different incentive effects than equity-conversion contracts, they are treated equally by regulators. To the best of our knowledge, there are no theoretical analyses that compare the two conversion mechanisms. Second, none of the recently issued CoCos rely on stock-price based triggers widely discussed in the theoretical literature. All issues that qualify for Tier I and Tier II capital have an accounting-based rule trigger with discretion on conversion given to bank regulators. Furthermore, a deeper understanding of the CoCo market is all the more urgent in light of regulatory developments around bank resolution models based on single point of entry at the holding company level, which rely on total loss absorbancy capital resembling CoCos.

In our study we assemble the first comprehensive dataset on all the CoCo issues undertaken by banks from 2009 to early 2014 using information from Bloomberg, Dealogic and supplemental sources. Beyond providing an overview of the market, the issues, and the participants, our study seeks to address two central questions: First, how do CoCos issues affect bank funding cost? To address this question we analyze the financial market responses to new CoCo issues and the cross-sectional heterogeneity in the responses associated with differences in contractual designs and issuer characteristics. Second, we assess the position of CoCos relative to other debt and equity securities of the same bank, and use market prices to infer the market perception about the propensity of CoCos to be triggered and thus exposing CoCo investors to losses.

Applying a similar method to James (1987), who analyzes the effect of new loans on banks' stock price, we examine the effect on banks' CDS spreads and stock prices of the announcement of an upcoming CoCo issue. We find that CDS spreads (on non-CoCo senior unsecured debt) of the issuing banks fall significantly for a range of event windows (up to 21 days) around the issue date. The CDS market response is negative relative to the benchmark in three-quarters of the cases, consistent with the hypothesis that CoCo issuance increases bank loss absorbancy capacity. Moreover, the negative CDS spread changes are considerably larger for equity conversion CoCos than for principal write-down issues. Also, the impact of CoCo issuance on the CDS spreads for GSIBs tends to be considerably stronger in the lead-up to the issuance than on and after the issuance date. The exact opposite is true for non-GSIB CoCo issues. On the equity price side, the effects are more delicate and depend on CoCo contract design. In particular, the reaction of the equity price depends on whether issuing a CoCo is dilutive to current shareholders, which may be the case for only conversion-to-equity CoCos. Consistent with this hypothesis, we find that only conversion-to-equity CoCos, and in particular those with a high trigger, produce a negative pressure on the stock price. As for the principal-write-down contracts, we mostly obtain insignificant results which is not all that surprising in light of the predictions of the theoretical literature.

We also develop a simple analytical framework to derive empirical predictions about market perceptions on the propensity of CoCos to convert and absorb losses. In particular, we narrow down predictions about the sign of correlations between changes in CoCo prices and changes in the issuing bank's other security prices (equity, senior unsecured debt, subordinated debt, and CDS spreads on senior unsecured debt). We show that the sign of correlations depend on whether current shareholders will be wiped out or not upon conversion. The estimated correlations reveal that the pricing of CoCos and other bank securities is sometimes consistent with expectations that CoCos may convert and that investors may face losses upon conversion.

The closest study to ours is Vallee (2013), who focuses on hybrid bonds issued by European banks between 1998 and 2012, which have similar features to CoCos structured as reverse convertible bonds. He studies the effects of ex-post conversion of these hybrid bonds during the financial crisis of 2007-09 and finds that conversion had the intended effects predicted by CoCo theories. Contrary to Vallee (2013) our dataset consists entirely of post-crisis CoCos issued between 2009 and 2013, whose activation is triggered by a regulator or a mechanical trigger. The difference in the trigger mechanism leads to different signaling effects of CoCos issues to those for hybrid bond issues. Relatedly, the "event" in Vallee (2013) is the contingent debt relief achieved by bank's decision to exercise the non-call option of the first generation of hybrid instruments. The counterpart to this "event" in our dataset would be the activation of the loss-absorption mechanism for CoCos. However, no such event has yet taken place for the CoCos in our data set, and hence our study focuses on the ex ante effects of CoCo issuance.

The remainder of the paper is organized as follows. Section 2 provides the institutional background and describes the current state of CoCo issuance as well as the context of post-crisis policy debates around bank regulatory reform. Section 3.1 develops a simple analytical framework that formalizes how CoCo issuance affects banks' balance sheets and lay out the hypotheses as how the values of bank securities depends on bank's profits or losses. Section 4 presents the sample and reports the estimates of CDS and stock price responses to CoCos issuance and discusses the differential effects of CoCo contract features, followed by an empirical analysis of correlations between changes in CoCo prices and other bank securities prices depending on the likelihood of CoCos to convert. Finally, Section 5 discusses open questions about the future design of CoCos and offers concluding comments.

2 Institutional Background and Hypotheses

2.1 The CoCo market post financial crisis

The experience of the recent financial crisis illustrated that resolving banks during the crisis is complex and costly to taxpayers. It initiated several reforms that aim to enhance the loss-absorbing capacity of banks by imposing more stringent capital requirements and simplifying the resolution of banks in case of insolvency (eg. Basel III and TLAC). Banks can choose among different capital instruments to satisfy the requirements. Contingent convertible bonds (CoCos) is one of these choices.

CoCos are hybrid capital securities that absorb losses when the capital of the issuing bank falls below a certain level. CoCos are designed to provide a source of capital to the banks in distress when private investors are reluctant to supply external capital. CoCos can thus facilitate balance sheet repair or orderly resolution of the bank for bank management as well as supervisors. For banks, CoCos provide an additional and potentially cheaper source of funding compared to other sources. If CoCos are tied to management compensation, the instruments may also improve risk management incentives. For investors, CoCos offer an alternative higher yield exposure to bank's credit risk compared to other bank debt instruments.

CoCos have two defining characteristics: (i) a conversion mechanism that specifies how losses are absorbed; and (ii) a trigger that activates the conversion. As we mentioned in the Introduction there are two major classes of conversion mechanisms: conversion into common equity and a principal writedown. For conversion-into-equity CoCos, the conversion formula can be based on the equity price on the day when the CoCo converts or on a pre-specified formula of number of shares for each bond, or on some combination of the two. For principal writedown CoCos, the principal can be either fully or partially written off when the CoCo trigger is hit.

The trigger is often defined in terms of the ratio of common equity Tier 1 capital to risk-weighted assets. In principle, it can be based on either the book-value (accounting-value) or the market value, though in practice none of the existing issues relies purely on market valuations. The "point of non-viability trigger" (PONV) is usually at the discretion of the supervisors, that is, the loss absorption mechanism is not activated upon a specific and predetermined numerical value, but rather upon the supervisors' judgment about bank solvency and hence whether the trigger has been breached, leading to discretionary PONV triggers.

The pressure on banks to recapitalize following the financial crisis and the regulatory treatment of

CoCos are the main drivers of CoCo issuance. The current Basel III framework has two contingent capital components: (i) a PONV trigger requirement, which applies to all “Additional Tier 1” (AT1) and T2 instruments; and (ii) a “going concern” contingent capital requirement which applies only to AT1 instruments classified as debt liabilities (Graph 1).

[Insert Graph 1 here.]

As regulatory pressure on banks to boost their Tier 1 capital increased, the volume of CoCo issues has surged since the start of 2012 (Figure 1a).

[Insert Figure 1 here.]

Regulatory capital eligibility considerations are also crucial for the choice of maturity of a CoCo instrument. Under Basel III, all AT1 instruments must be perpetual and fixed maturity instruments qualify only as T2. Currently, over half of the instruments have no maturity date. For fixed-maturity instruments, most have a maturity of approximately 10 years. Moreover, for a CoCo to qualify as AT1, the trigger has to be at least 5.125% of risk-weighted assets. As market participants became more familiar with CoCo instruments, the share of CoCos with a trigger of at least 5.125% has been steadily increasing (Figure 1b). Needless to say, the interest servicing cost of a CoCo increases in the trigger level, to compensate investors for the higher probability of conversion.

As we have already highlighted, the current equity-capital eligibility rules do not distinguish between CoCos with different loss absorption mechanisms. Even though in early years of the market mandatory conversion to equity (MC) CoCos dominated, the issuance of principal write-down (PWD) instruments picked up over time (Figure 1c). The growing demand by fixed-income investors for CoCos is a key factor that contributed to this trend. These investors are often restricted by mandate from investing in instruments that have a non-negligible possibility to convert to equity and PWD instruments do not fall under this restriction. In addition, PWD instruments involve less uncertainty about the payoff after the trigger is breached which may facilitate their pricing and risk management.

The geographical distribution of CoCo issuance mainly reflects the way Basel III regulations are applied and supplemented by national regulators. For example, in Switzerland the new regulatory regime requires Swiss banks to have 9% of risk-weighted assets in loss-absorbing instruments. Similar rules apply in Denmark. UK regulators also adopted loss absorbing capital requirements in 2012. One major jurisdiction where CoCos do not qualify for AT1 or AT2 capital is the US. Not surprisingly, approximately 80% of the CoCo issuance in our sample has been by European banks, primarily UK and Swiss institutions (Figure 1d).

To become a significant alternative source of bank capital CoCos need to build a solid investor base. Participation of institutional investors, asset managers, insurers and pension funds, is essential if any market depth, volume and liquidity is to be achieved. Unfortunately, information on the evolution of CoCo investors base is not systematically collected by supervisors and is rather scarce. According to market participants, the early CoCo issues were absorbed largely by retail and private bank investors in Asia and Europe, who were mostly motivated by search for yield in a low interest rate environment. In our dataset, a subsample of issues with a combined volume of $13 billion (primarily AT1 issues originated between April 2013 and March 2014) contains an institutional breakdown at the initial placement provided by Dealogic. In this subsample, private banks and retail investors were responsible for 52% of the total demand in the subsample. Asset management companies purchased another 27% of the volume. The remainder is split among hedge funds (9%), banks (3%) and insurers (3%).

Figure 2 provides the illustrations of the potential investor base by investor type and by geography for a selected subsample of AT1 instruments. These data reveal that a significant amount of CoCos were purchased by asset managers and hedge funds. It also indicates banks' holding of CoCos issued by other banks. However, these holdings are purely for intermediation purposes where banks act as underwriters and facilitate the initial placement of securities.[1] In terms of geographic distribution, investors from the UK, Europe, and the US are among the largest holders.

2.2 Policy debates and related literature

What role can CoCos play in strengthening financial stability? And, to what extent should bank regulations be structured around CoCos? As we have already hinted, there is no consensus yet on CoCos in either policy circles or academia. The main benefit of CoCos that has initially been put forward is that they are an effective way of facilitating restructuring of a distressed bank. But the effectiveness of CoCos to provide a reliable source of contingent capital depends on several considerations.

From the perspective of a bank and its managers and supervisors, CoCos additional layer of capital must offer sufficient loss absorption capacity and be activated on timely basis. Under Basel III framework, AT1 and Tier 2 CoCos would represent 1.5% and 2%, respectively, of bank's risk-weighted assets (RWA).[2] For AT1 instruments, the minimum trigger level is set at 5.125% of CET1 to RWA. In some jurisdictions (eg. Switzerland), national supervisors complement these minimum requirements with an additional layer of higher trigger CoCos. Clearly, the thicker is the layer of CoCos and the further the trigger is from PONV, the more likely it is that CoCos will ensure bank's balance-sheet repair on a going-concern basis.

Issuance of CoCos can impact bank's risk taking incentives. Following Flannery (2005), Calomiris

[1] Under Basel III banks are subject to a prohibitive capital charge to hold CoCos.

[2] As illustrated on Graph 1, the regulatory minimum capital requirements under Basel III framework are 4.5% ratio of CET1 to RWA, a Tier 1 capital ratio of 6%, and the total capital ratio of 8%.

and Herring (2011) propose designs that emphasize the potential of CoCos to encourage effective risk governance by banks and reduce regulatory forbearance risk. In their proposals, CoCos conversion to equity should be dilutive to preexisting equity holders and convert well before the bank faces insolvency and is excluded from access to capital markets. Martynova and Perotti (2012) investigate how different contract designs can have different impact on bank's risk-taking incentives. In practice, high trigger equity conversion instruments account for only 16% while over 55% of CoCos are principal write down. For principal write down instruments, high trigger could incentivise more risk-taking by banks by subordinating CoCo holders to equity holders. Admati et al. (2012) argue that CoCos with principal writedowns offer inadequate loss absorption which will either be too small or will excessively expose investors in CoCos. To some extent this effect can be mitigated by embedding CoCos in compensation of senior management, and by an overall disciplining effect of CoCo trigger events for bank's management. A wide variation of contract features of outstanding CoCo issues and the prevalence of principal write down CoCos raise a broader corporate governance question on whether managers or shareholder are responsible for bank's risk-taking.

Requiring banks to issue CoCos can affect bank's capital structure in that this can undermine calls for greater equity capital issuance (Admati et al. 2012). In more recent papers (notably Chen et al. (2013) and Albul et al. (2012)) researchers start to endogenize capital structure decisions when the bank is either required or has an option to issue CoCos along with the usual debt and equity instruments. Such analyses reveal that the equity holders can have a positive incentive to issue CoCos, and CoCos reduce the debt overhang problem. The reason is that the benefits of lower default risk accrue not only to bond holders but also to equity holders due to the lower cost of debt rollovers.

In the current regulatory environment, the issuance of CoCos is limited by the amount of capital that banks need to meet regulatory capital requirements and the leverage ratio. For example, according to market participants European banks were expected to issue up to 100 billion Euros of AT1-compliant CoCos in the next few years, with newly issued instruments typically replacing the Tier 1 capital instruments that no longer qualify under Basel III. Other regulatory changes, in particular TLAC requirements for GSIBs and MREL in the European Union, are likely to substitute the low trigger Tier 2 - compliant CoCos with statutory bail-in terms instruments (eg. bailinable bonds) for banks subject to these regulations.[3]

The next set of issues that can undermine the effectiveness of CoCos are related to the investor base. While in the current low-yield environment investors are eager to hold CoCos, the demand for CoCos can decrease in the environment of higher global interest rates and during the periods of higher volatility. In theory, the optimal risk sharing arrangement would require that risks associated with holding CoCos are transferred outside the financial system. As CoCos are unit beta type securities and the trigger events are likely to be associated with systemic events in the economy, CoCos represent a marginal asset class for most institutional investors, making these investors very sensitive to changes in the likelihood of trigger events. Another aspect of the investor base is that conversion to equity CoCos that received most favorable assessment in the academic literature can have limited market due to restrictions on equity holdings under the mandates of some institutional investors. The demand for CoCos from pension funds and insurance companies whose investment strategy is driven by asset-liability matching is curbed by the uncertain duration of securities. Finally, complexity and pricing uncertainty of CoCos (see below) reduce the suitability of this asset class for retail investors. Some jurisdictions, eg. the UK, imposed bans on marketing CoCos to retail investors.

[3] Total Loss Absorption Capacity (TLAC) is the minimum requirement for loss absorbing liabilities applied to GSIBs. Under current TLAC proposal, banks are required to hold at least additional 8% securities bailinable in resolution. The proposal aims to facilitate the resolution of entities in multiple jurisdictions.

Minimum Required Eligible Liabilities (MREL) applies to all European credit institutions and investment firms. Unlike TLAC which is based on a common Tier 1 standard, MREL is assessed individually per institution and it will take into account the recapitalization needs based on the institution's preferred resolution strategy.

CoCos are structured instruments with many embedded options and some degree of regulatory discretion which makes their pricing rather complex. While the market discipline approach (also reflected in Martynova and Perotti (2014)) favors a market-based trigger, Sundaresan and Wang (2010) have shown that the conversion design based on a stock price trigger can give rise to so-called "death spirals." That is, the simple expectation that the price boundary will be crossed can be self-fulfilling and give rise to multiple equilibria. Pennacchi et al (2011) propose a modification of CoCos that avoid the problem of market death spirals by providing shareholders an option to buy the shares from bondholders at the conversion price. Corcuera et al. (2014) suggest that the "death spiral" effect of market trigger CoCos is reduced if instead of conversion to equity CoCos cancel the coupon payments. In additional to spillover effects, pricing of CoCos can be complicated by other risks, in particular, coupon cancellation and the ultimate discretion of the supervisor to activate the trigger.

To foster financial stability, CoCos need to become a form of counter-cyclical equity buffer. This latter perspective on CoCos is underlined in Bolton and Samama (2012), who suggest that a design of CoCos as a true convertible bond (where the issuer has the option to convert) would at the same time mitigate the risk of a "death spiral", allow for a classical pricing approach using standard option pricing tools, and would offer the issuer a capital line of credit commitment. That is, a CoCo structured as a reverse convertible bond would be equivalent to giving the issuer a commitment to augment its equity capital at will at favorable terms in recessions, thus implementing a form of counter-cyclical equity buffer. While no bank issuer has to date adopted this CoCo design, the notion that CoCos could also be an alternative to equity issuance has gained prominence, especially given the difficult context European banks have faced in recent years in recapitalizing in the midst of a recession. In a closely related paper, Vallée (2013) has argued European banks' issues of hybrid debt before the crisis are similar to a reverse convertible bond, and, as he has shown, issuers took advantage of the attractive convertibility option in hybrid debt to convert these debt issues in the middle of the crisis of 2007-09 and thus partially recapitalize their stressed balance sheets.

Macroprudential regulation of banks relies on multiple regulatory tools, and thus CoCos cannot be considered in isolation from other capital requirements and liquidity regulations. With few exceptions, there is little guidance on the interaction among multiple regulatory tools. Zheng (2013) derives the optimal coutercyclical capital requirements. Walter and White (2015) show how tighter capital and liquidity regulation, and having an effective lender of the last resort, can improve the efficacy of bail-in policies.

In summary, if adequately designed, CoCos can improve banks' risk management ex-ante and support balance sheet repair or resolution ex-post. Yet it is important to recognize that the market reaction to trigger events and the sustainability of the investor base remain untested. The risks of CoCos exposures and the interaction of AT1 and Tier 2 capital requirements with other regulations need to be recognized and monitored.

3 Model and Hypotheses

3.1 A simple analytical framework

It is helpful to formulate a simple formal description of the balance sheet of a bank to determine how the issuance of CoCos strengthens the bank, and how different securities that the bank has issued are affected by the bank's operating profits or losses. Thus, consider the following simple balance sheet for a bank: At $t = 0$ the bank has assets in place A. These assets yield a profit π at $t = 1$ with probability $(1 - \theta)$ and a loss l with probability θ. Suppose also that the interest rate is $r > 0$. Under risk-neutral preferences (or probabilities) the ex-ante market and book value of assets is then:

$$\frac{A[1 + \pi - \theta(l + \pi)]}{1 + r}.$$

On the liability side, the bank may have senior debt with face value D, subordinated debt with face value B, CoCo bonds with face value C, which either convert into equity or involve a principal write-down of $(1 - \lambda)$ should the bank's equity capital ratio fall below a trigger $\tilde{\kappa}$.

3.1.1 CoCos never convert

Suppose to begin with that the bank is adequately capitalized, so that there will be no CoCo conversion upon the realization of loss:

$$\frac{A(1 - l) - L}{A(1 - l)} > \tilde{\kappa},$$

where $L = D + B + C$ denotes the total face value of the bank's liabilities and where the trigger $\tilde{\kappa}$ is greater than or equal to the minimum equity-capital requirement κ. In this case, the $t = 0$ market value of the various debt instruments is:

$$V_D = \frac{D}{1 + r}, \ V_B = \frac{B}{1 + r}, \text{ and } V_C = \frac{C}{1 + r}.$$

Following a loss, the bank has equity capital worth $E_{1l} = A(1 - l) - L$, and following a profit the bank has equity capital worth $E_{1\pi} = A(1 + \pi) - L$, so that at time $t = 0$ the equity value of the bank is given by:

$$V_E = \frac{1}{1 + r}[A[1 + \pi - \theta(l + \pi)] - L].$$

3.1.2 CoCos convert but equity holders are not wiped out

Consider second the case where the bank's equity capital ratio falls below $\tilde{\kappa}$ when the bank incurs a loss l, but equity still has strictly positive value following the loss, so that:

$$\tilde{\kappa} > \frac{E_{1l}}{A(1-l)} > 0.$$

Given that conversion is triggered following the realization of a loss, the post-conversion total equity value becomes:

$$E_{1c} = A(1-l) - (D+B),$$

if the CoCo is a conversion to equity instrument, and

$$E_{1pwd} = A(1-l) - (D+B+\lambda C),$$

if the CoCo is a principal write-down instrument. An important question around the conversion event is whether CoCo conversion into equity dilutes old shareholders. Suppose that after conversion CoCos represent a fraction $\alpha \in (0,1]$ of the bank's equity E_{1c}. Conversion, in effect, adds C to the equity buffer. If absolute priority is strictly enforced then we must have:

$$\alpha = \alpha_C \equiv \frac{C}{C+E}.$$

The only effect of conversion then is to relabel the fixed-income claim C as an equity claim. Thus, there is no dilution of old equity holders as long as $\alpha \leq \alpha_C$. If $\alpha < \alpha_C$ then equity-holders benefit from the conversion of CoCos, and CoCo-holders along with equity-holders are affected by the loss l. If, however,

$\alpha > \alpha_C$ then equity-holders are diluted as a result of the conversion. Interestingly, for principal write-down CoCos, when the CoCo is triggered equity-holders always benefit, as the value of their claim rises from the pre-trigger level $E_{1l} = A(1-l) - L$ to the post-trigger level $E_{1pwd} = A(1-l) - L + (1-\lambda)C$.

3.1.3 CoCos convert and equity holders are wiped out

Consider next the case where, as a result of the loss:

$$0 < \frac{A(1-l) - (D+B)}{A(1-l)} < \kappa,$$

and

$$\frac{A(1-l) - D}{A(1-l)} > \kappa.$$

In this case the old equity holders are completely wiped out. The CoCo holders become the sole equity holders, but their claim also gets disfigured as they are junior to the subordinated bondholders. For simplicity suppose that a "haircut" is imposed on subordinated bondholders such that: i) their bond claim going forward is reduced from B to $\hat{B}$, where $\hat{B}$ is given by

$$\frac{A(1-l) - D - \hat{B}}{A(1-l)} = \kappa,$$

and ii) they receive an equity stake γ such that

$$\gamma = \frac{(B - \hat{B})}{(B - \hat{B}) + E_1} = \frac{B - \hat{B}}{B - \hat{B} + \frac{A(1-l)-(D+B)}{A(1-l)}}.$$

Note that when there is credit risk not only for CoCos but also for subordinated debt, the latter claims, in effect, also become contingent claims. Also, in case the subordinated debt piece B is too small, or the bank has not issued any subordinated debt, then the senior unsecured debt D can also be disfigured. In this case, the CoCo holders, subordinated debt holders, and senior unsecured debt-holders jointly become the new equity-holders in the bank and the senior unsecured debt-holders incur a "haircut" $(D - \hat{D})$. The conditions for this case to obtain are:

$$0 < \frac{A(1-l) - D}{A(1-l)} < \kappa,$$

and

$$\frac{A(1-l) - \hat{D}}{A(1-l)} \geq \kappa.$$

Finally, if the subordinated (or senior unsecured) bond-holders have bought CDS protection and the haircut $(B - \hat{B})$ (or $(D - \hat{D})$) is not compensated through a debt-equity swap but by the CDS writer, then the 'spread' on the CDS is equal to:

$$s_B = \frac{1}{1+r} \frac{\theta(B - \hat{B})}{1-\theta}, \text{ for a CDS on subordinated debt, and}$$

$$s_D = \frac{1}{1+r} \frac{\theta(D - \hat{D})}{1-\theta}, \text{ for a CDS on senior unsecured debt.}$$

3.1.4 Correlation Predictions for CoCo, Equity, Bond and CDS Prices

We can use the formal description of the balance sheet above to derive predictions on the correlations between equity returns and the spreads[4] of CoCos, CDS, the bank's debt securities, and how these depend on the market's perceived risk of a CoCo being triggered.

1. When the bank's equity capital ratio is expected never to fall below the CoCo trigger $\tilde{\kappa} \geq \kappa$ the

[4]For each security, we consider the daily changes in the spread between the yield to maturity of a security and the corresponding government bond matched by currency and maturity.

market value of equity is:

$$V_E = \frac{1}{1+r}[A[1+\pi-\theta(l+\pi)]-L],$$

so that an increase in the probability of a loss θ negatively affects V_E by:

$$\frac{\partial V_E}{\partial \theta} = -\frac{1}{1+r}A(l+\pi).$$

Furthermore, if the increase in θ is associated with a decline in interest rates r (as a result, say, of counter-cyclical monetary policy) then simultaneously securities values V_i, $i = D, S, C$ increase, and therefore their yield to maturity, $\frac{1}{V_i} - 1$ decreases. Thus, in this case, a simple prediction is that changes in θ would result in a *positive correlation* between equity returns and CoCo spreads, and a *positive correlation* between CoCo and CDS spreads. As, in this case, the value of debt claims depends only on changes in interest rates, CoCo spreads and senior and subordinated debt spreads are also *positively correlated*.

2. These predictions on correlations extend to situations where the CoCo is triggered when the bank's equity capital ratio falls below $\tilde{\kappa}$ as a result of an operating loss, provided that the equity conversion results in the same equity value as the face value of the CoCo C, and provided that the subordinated debt and senior unsecured debt is expected not to be disfigured following conversion.

3. When the loss l, however, is so large that it disfigures the CoCo (but leaves subordinated debt untouched) then the correlation predictions change. First, the market value of equity at time $t = 0$ is now:

$$V_E = \frac{1}{1+r}(1-\theta)[A(1+\pi)-L],$$

so that:

$$\frac{\partial V_E}{\partial \theta} = -\frac{1}{1+r}[A(1+\pi) - L].$$

Second, the market value of the CoCo at $t = 0$ is now:

$$V_C = \frac{1}{1+r}[(1-\theta)C + \theta\kappa(1-\gamma)A(1-l)],$$

so that:

$$\frac{\partial V_C}{\partial \theta} = -\frac{1}{1+r}(C - \kappa(1-\gamma)A(1-l)).$$

(Note that we evaluate the marginal effect of θ against proportionally small changes in interest rates r, so that that the marginal effect with respect to r is negligible). Now changes in equity returns, subordinated and senior bond spreads are *negatively correlated* with CoCo spreads.

4. When the loss l is even larger, so that it not only disfigures the CoCo but also subordinated debt, then the correlation predictions are as follows:

   (a) As before:

   $$\frac{\partial V_E}{\partial \theta} = -\frac{1}{1+r}A[(1+\pi) - L],$$

   and

   $$\frac{\partial V_C}{\partial \theta} = -\frac{1}{1+r}(C - \kappa A(1-l)).$$

   (b) But,

   $$\frac{\partial V_B}{\partial \theta} = -\frac{1}{1+r}(B - \hat{B}),$$

and

$$\frac{\partial s}{\partial \theta} = \frac{1}{1+r}\frac{B-\hat{B}}{(1-\theta)^2}.$$

In words, a perceived increase in the probability of default lowers equity, CoCo, and subordinated debt returns. The same would be true for the price of senior unsecured debt if default also involves a loss given default for this more senior debt. Debt prices move inversely with spreads, so that the main theoretical prediction for this case regarding correlations in equity returns and debt spreads is that equity returns are *negatively correlated* with CoCo spreads, senior unsecured, subordinated debt, and CDS spreads when the market perceives that there is a positive credit risk associated with these instruments.

In summary, if we denote the changes in spreads of CoCos and debt as, respectively Δs_C, Δs_D, and Δs_S then the empirical predictions on the *sign of correlations* between changes in CoCo spreads and changes in banks' security prices, $Corr(\Delta s_C, \Delta V_E)$, $Corr(\Delta s_C, \Delta s_i)$ $i = D, S$, and $Corr(\Delta s_C, \Delta s)$ are as follows.

	Cases 1 and 2	Case 3	Case 4
$Corr(\Delta s_C, \Delta V_E)$	$+$	$-$	$-$
$Corr(\Delta s_C, \Delta s_i)$	$+$	$-$	$+$
$Corr(\Delta s_C, \Delta s_S)$	$+$	$-$	$+$
$Corr(\Delta s_C, \Delta s)$	$+$	$+$	$+$

For principal write-down CoCos the analysis is slightly different. Unlike for equity-conversion CoCos, when the bank incurs a loss and as a result breaks through the κ trigger, the holders of CoCos instead of getting C only receive λC, so that the ex ante value of the CoCo is now:

$$V_C = (1-\theta)C + \theta\lambda C,$$

and

$$\frac{\partial V_C}{\partial \theta} = -(1-\lambda)C.$$

The effect of the write-down is to increase the equity-capital buffer from:

$$\frac{A(1-l)-L}{A(1-l)},$$

to

$$\frac{A(1-l)-(D+B+\lambda C)}{A(1-l)}.$$

If

$$\frac{A(1-l)-(D+B+\lambda C)}{A(1-l)} > \kappa$$

then no further equity infusion is needed. In this case the value of equity is

$$E_{1pwd} = A(1-l) - (D+B+\lambda C)$$

after the loss, so that:

$$E = (1-\theta)[A(1+\pi)-(D+B+C)] + \theta[A(1-l)-(D+B+\lambda C)]$$

and

$$\frac{\partial V_E}{\partial \theta} = -A(l+\pi) + (1-\lambda)C.$$

It is plausible that $(1-\lambda)C < A(l+\pi)$, so that for this type of CoCo equity and CoCo prices are positively correlated.

3.2 Hypotheses and empirical motivations

Most of our empirical tests focus on the equity and credit market responses to the new CoCo issues. The impact of CoCo issuance on the probability of default of other (more senior) non-contingent debt claims of the same issuers is relatively straightforward. Although the issuing bank has to pay coupons on CoCos that are higher than those on non-CoCo debt, issuing CoCos should in theory lower the costs of other debt funding. Accordingly, we will mostly focus on credit default swap spreads to determine whether market perceptions are that CoCos strengthen an issuer's balance sheet, and to see whether these perceptions are stronger when the conversion trigger is higher or when conversion results in a debt write-down rather than an a debt-equity swap.

As for the effect on the issuer's stock price, that is more difficult to determine a priori. Applying Modigliani-Miller logic, adding more leverage should result in a lower stock price to compensate for the lower claims held by equity holders. On the other hand, signaling considerations may well lead to the opposite effect, if the announcement of a CoCo issue is understood by the market to mean that a new equity issue is less likely. Similarly, investors' narrow exclusive focus on earnings-per-share could artificially boost stock price if it is not understood that the increase in earnings per share is accompanied by a greater risk exposure. These mixed signals that CoCo issues could send to equity markets suggest that it is unlikely that CoCo issues will have a clear predictable effect on the issuer's stock price. However, the main CoCo design characteristics allow us to isolate the marginal impact sorted on the issuer's stock prices. More importantly, due to their different dilutive effects, the impact of issuing principal writedown CoCos on the stock price should be more positive (or less negative) than that of issuing CoCos that are convertible into equity.

In addition to assessing the overall effect of CoCo issuance, we analyze how it depends on contract characteristics. We estimate whether MC and PWD CoCos have differential effects on market assessments of banks' default risk. Although both instruments provide additional capital buffer, they differ in terms of the risk-taking incentives for current shareholders (and management). While an MC CoCo curbs risk taking incentives of current shareholders by introducing the possibility of equity dilution, PWD CoCos may have the opposite effect by shielding shareholders from bank insolvency. We also estimate the potential differential market reaction to other CoCo or issuer characteristics, including the trigger level, the CoCo issue size, and bank characteristics such as whether the bank has systemic importance status.

To offer unmitigated loss absorption capacity without also creating unintended risks, CoCo investors need to understand the risks and be ready to absorb the losses should the trigger be breached. As the market for CoCos grows, so do the warnings that investors may underestimate the risk that their investment can be lost upon conversion. An increasing number of market participants claim that the demand for CoCos is driven by search for yield during the post-crisis accommodative monetary policy and the low returns of the fixed income market. To assess these claims we explore market perceptions of conversion risk of CoCos by empirically testing the CoCo correlations with equity prices and non-CoCo debt spreads from the analytical framework in Section 3.1.

4 Empirical Analysis

4.1 Data

Our data set covers $208 billion worth of CoCo issues in advanced and emerging economies between January of 2009 and September 2014. Our sample consists exclusively of CoCos issued by banks (it excludes CoCos issued by insurance companies and other non-bank financial institutions). Data are obtained from Bloomberg and Dealogic. Figure 1 presents an overview of the market from 2009 to 2014 and Table 1 presents more detailed summary statistics. There are 187 distinct CoCo instruments in our sample, which have been issued by 68 banks. The size of the average CoCo issue is approximately $1.1 billion, but there is a lot of variation in the size of issues. CoCo issuance has been dominated by European banks, which account for roughly 86% of the total CoCo volume in our sample (Table 1). Among individual national banking systems, UK banks ($43 billion) and Swiss banks ($29 billion) have issued the highest volume of CoCos. Outside of Europe, the most active issuers of CoCos have been Brazilian banks ($14 billion) and Australian banks ($9 billion).

[Insert Table 1 here.]

For each CoCo instrument we observe the main contractual characteristics, loss absorption mechanisms, and the trigger level. Furthermore, we observe the maturity of the instrument, the issuance volume, the issuance currency, and whether an instrument is classified as AT1 or T2 capital. We also have information on the issue date, maturity date, price and yield at issuance, coupon, amount issued, amount outstanding, rating by the three major credit rating agencies S&P, Moody's, and Fitch (if available), payment rank classification (subordinated debt, preferred equity, etc.), PONV trigger inclusion and coupon tax deductibility. The summary statistics are in Table 1. For a subset of our sample we also have a breakdown of primary market buyers by geographical location and institution type. In addition to initial contract characteristics, for each CoCo instrument we have daily data (closing prices) for YTM, YTC, and G-spread.

In order to facilitate the comparison of CoCo yields with those of other debt instruments, we have found (where possible) subordinated and senior unsecured bonds matches (of the same issuer) for each CoCo instrument in our sample. We have two sets of criteria for selecting the bond matches for the CoCos – one set of criteria were used for calculating the spread at issuance and another set for the matches used to calculate the YTM spreads. In the former case, the match was determined based on (in order of importance): (i) the issuance date and (ii) the maturity at issuance. In the latter case, the match was determined based on (again in order of importance): (i) the remaining maturity and (ii) the coupon rate. In both cases, the matching subordinated and senior unsecured bonds must be issued by the same bank and be denominated in the same currency as the CoCo instrument.

Finally, for each bank that has issued at least one CoCo instrument, we have daily (closing) data on equity prices and on CDS spreads (for senior unsecured debt) and annual data on: Total Assets, Risk-weighted Assets, Regulatory Tier 1 capital and Total Regulatory Capital.

4.2 CoCo issuance and bank default risk

4.2.1 Empirical set-up

The issuance of a CoCo has two effects on a bank's balance sheet. First, it reduces the probability of default by providing an additional layer of loss-absorbing capital at the time of financial distress. This effect is most relevant for banks' debt-holders and is expected to be reflected in lower CDS spreads. Second, issuing a CoCo affects the risk-taking incentives of the bank's management. Greater risk-taking incentives can increase the probability of default and thus adversely affect debt holders. We therefore measure the impact of issuing CoCos on the CDS spreads and equity prices of issuing banks by employing the methodology of James (1987).[5] We test to what extent CoCo issuance changes an issuing bank's default risk, given that both loss-absorbency and incentive effects are at work. In addition, we analyze how the effect of CoCo issuance depends on the CoCo's main contract features, including the conversion mechanism (MC or PWD) and the trigger level, as well as bank's characteristics such as size and GSIB status. The main advantage of applying James methodology in our study is that it is capable to accomodate for the limited sample size and the limited information available prior and post issuance. It allows us to extract information from a limited sample by underweighting noise.

Unlike for the typical event study, the "event date", when all relevant information is simultaneously announced to all market participants at a clearly defined point in time, is not well-defined and the optimal length of the event window to identify the full impact of a CoCo issue is not obvious either. There is no single point in time at which an upcoming CoCo issue is publically announced. Instead, information about a typical upcoming CoCo issue spreads among market participants in a diffusion-like process. According to market participants and regulators, the information about the intention of a bank to issue a CoCo is revealed to a small group of potential buyers over the course of two weeks prior to the date of the issuance. As the book is being built, the information is also likely to diffuse to a wider set of investors and get incorporated in equity prices and CDS spreads prior to the actual announcement. Still, the issue date often reveals additional value-relevant information, such as the over-subscription status of the issue.

Hence, we consider three event windows: the full 21-day (from $t-15$ to $t+5$), the pre-issuance 15-day ($t-15$ to $t-1$), and the post-issuance 6-day (t to $t+5$), all defined relative to the issue date (t) of the CoCo instrument (as recorded on Bloomberg). In addition to letting us examine the sensitivity

[5] Appendix A contains a detailed description of the estimation methodology.

of our results to different event-window specifications, varying the size of the announcement window also allows us to evaluate how quickly information about CoCo issuance is incorporated in market prices. The market is usually informed about the new CoCo issuance about one week prior to the issue date, but new critical and value-relevant information keeps coming after the announcement. Such information includes the subscription status of the new issues. Therefore, we adopt a 21-day window centered on the CoCo issuance date to calculate the cumulative abnormal returns (CARs), taking into account that information revelation is a diffusion process starting days before the issue date.

In our benchmark estimation, we consider CoCos issued by banks from all advanced economies with the exception of the euro area periphery (Greece, Ireland, Italy, Portugal and Spain). We exclude CoCos issued by banks from the euro area periphery due to the high uncertainty surrounding many of these issues. Also, their CDS spreads and equity prices tend to be much more volatile than those of banks from the core of the euro zone and other parts of the developed world. Including these issues in our benchmark sample may therefore distort the estimates of the impact of CoCo issuance on CDS spreads and equity prices.

4.2.2 Evidence from credit default swaps

We begin by estimating the change in issuers' CDS spreads around CoCo issuance dates. Table 2 reports the results. Panel A shows that the overall impact of a CoCo issue on the CDS spread on the senior unsecured debt of the issuing bank is negative. The z-value for the cumulative change vis-a-vis the benchmark during the 21-day window is negative and statistically significant (at the 1% level). The economic significance is also meaningful – the average prediction error for the full sample is equal to approximately 8 bps. This implies that if the compression in CDS spreads is fully passed through to senior unsecured debt yields, issuing CoCos reduces the annual interest costs associated with each

\$10 billion of (non-CoCo) bank debt by \$8 million. The second statistic we examine is the proportion of negative prediction errors. It has a value of 75% and is statistically significant at the 1% level (according to the Wilcoxon signed ranks statistic).

[Insert Table 2 here.]

An inspection of the results for the other two event windows (reported in Panels B and C in Table 2) that we examine reveals that most of the compression in CDS spreads tends to happen in the period leading up to the issue date, as opposed to on or after the CoCo issuance date. And the change is gradual during this time period. This evidence suggests that the market mostly digested the news of CoCo issuance before the actual issue date even if there is no clear "event date" for the information release.

We next break down the full sample into subsamples sorted by the most important CoCo contracting terms and issuer characteristics. Our first sorting variable is the loss absorption mechanism (mandatory conversion or principal write-down). The results reported in Table 2 reveal that CoCo contract terms significantly affect issuer default risk. The impact of mandatory conversion (MC) CoCos on CDS spreads tends to be considerably more negative than the impact of principal write-down (PWD) CoCos. For the 21-day event window, the z-value for the MC CoCos is negative and statistically significant (at the 1% level), whereas the z-value for the PWD CoCos is not statistically significant even at the 10% level. Similarly, the proportion of negative prediction errors for MC CoCos (90%, significant at the 1% level) is considerably higher than that for PWD CoCos (65%, significant at the 5% level).

The difference in impact of issuing MC or PWD CoCos points to the potential importance of the conversion mechanism for banks' risk-taking incentives. Conversion to equity increases the cost of risk taking for current shareholders and management due to equity dilution. In contrast, no such costs are imposed by PWD CoCos. In fact, PWD CoCos may increase risk taking incentives by shareholders, as the downside risk is now shared with CoCo investors. Our estimation results suggest that MC contracts could be more effective at reducing banks' risk and cost of funding. This has important policy implications as the current regulatory treatment of CoCos does not distinguish between the two conversion features.

The second sorting variable is the trigger level (above or below 6%). It is not entirely surprising that the impact is stronger for higher-trigger CoCos. We further interact the trigger sorting with the loss-absorption mechanism and find that CoCos that convert to equity when the bank is still a going concern rather than close to insolvency appear to have the strongest impact on banks' funding costs. For all event windows, the z-values for the MC higher-trigger CoCos is negative and significant at the 1% (21-day window) or 5% (15-day and 6-day windows) levels. As for the PWD CoCos, the level of the trigger does not seem to matter and is insignificant, except for the CoCos with PWD and a low trigger (15-day window, 5% significant). The latter result points to the benefits of PWD CoCos in absorbing losses when the bank's equity capital is extremely low. However, the effectiveness of PWD CoCos in curbing banks' risk taking seems to be limited.

The third set of sorting variables assesses whether the CDS price reaction depends on the amount of CoCos issued (scaled by the risk-weighted assets of the issuing bank), the overall size of the issuing bank (proxied by the US dollar value of its total assets) and whether the issuer is designated as a Global Systemically Important Bank (GSIB)[6]. Our results suggest that issuing CoCos tends to have a statistically significant negative impact on the CDS spreads of both GSIB and non-GSIB issuers. The z-score for GSIBs (-2.75, p-value of 0.6%) is slightly larger in absolute value and marginally more

[6] For the latter data split, we use the latest GSIBs list issued by the Financial Stability Board (FSB, 2013).

significant than the respective score for non-GSIBs (-2.45, p-value of 1.4%). However, this is largely due to the fact that the former group contains considerably more observations than the latter (49 versus 23, respectively) and that CDS spreads of GSIBs tend to be considerably less volatile than those of non-GSIBs. In fact, the average prediction error for non-GSIBs is more negative than that for GSIBs (9 bps versus 7 bps, respectively). In addition, the proportion of negative prediction errors for non-GSIBs is 87%, whereas that for GSIBs is only 68% (both are statistically significant at the 1% level). This result could be interpreted as evidence that the credit-risk channel of CoCo issuance is more pronounced for smaller banks than for larger banks, whose senior debt-holders may be perceived as benefitting from an implicit government guarantee.

Interestingly, the impact of CoCo issuance on CDS spreads for GSIBs tends to be considerably stronger in the lead-up to issuance (between t-15 and t-1) than on and after the issuance date (between t and t+5). The exact opposite is true for non-GSIBs. There are several possible explanations for this finding. First, information about the upcoming CoCo issuance is more efficiently incorporated into the CDS spread of GSIBs than into those of non-GSIBs (since the former tend to be more liquid and covered by more analysts than the latter). Second, once an upcoming CoCo issuance is announced, the probability of a successful placement is higher for GSIBs than for non-GSIBs. As a consequence, the CDS spread of non-GSIBs would tend to decline only once the CoCo issuance has gone through successfully.

Consistent with the effects of the GSIB status, our results show that the impact is also stronger for larger banks. Using three breakdowns for issuer size: median, $500 billion and $1,000 billion, the results consistently show that the effect is stronger for issuers of larger size. Interestingly, regarding the sensitivity of the results to the size of CoCo issues relative to the risk-weighted assets of a bank, the effect is stronger when CoCo issues are smaller, suggesting that the issuance announcement may also have a "signalling" effect on the tightness of the capital constraint of the issuer.

Figure 3 depicts the main results in Table 2 by plotting the cumulative abnormal returns (CARs) on the issuing banks' CDS spreads for a 21-day window, which starts 10 business days before the CoCo issuance date and ends 10 business days after the CoCo issuance date. The $CARs$ are calculated based on the daily changes in the CDS spreads of both the issuers (subscript i) and the market (subscript m). For each issuer i and date t (where $t = -10, ..., 0, ... + 10$ is index for trading days where day 0 is the CoCo issuance date) the abnormal return is $AR_{i,t} = \Delta CDS_{i,t} - \Delta CDS_{m,t}$. The figures plot the average cumulative abnormal returns $CAR_\tau = \sum_{t=-10}^{\tau} \left(\frac{1}{n_t} \sum_{i=1}^{n_t} AR_{i,t} \right)$ for $\tau = -10, ..., +10$, where n_t is the number of CoCo issues (with non-missing return data) on date t.

[Insert Figure 3 here.]

The pattern in CARs during the time window echo the ones obtained previously using the James (1987) methodology. More specifically, the CARs for the CDS spreads of CoCo issuers are steadily moving into negative territory throughout the event window, reaching -6 bps by t+8 (Figure 3a). Furthermore, consistent with the results reported above, the CARs for the CDS spreads of MC CoCo issuers are considerably more negative than the CARs for the CDS spreads of PWD CoCo issuers. The former CARs decline in a monotone fashion on both sides of the issuance date and reach -9 bps eight business days after the issuance date (Figure 3b). In contrast, the latter CARs follow their initial decline with a recovery towards zero around the issuance date, before falling to -4 bps shortly before the end of the event window (Figure 3c).

4.2.3 Evidence of equity price changes

The effect of CoCo issuance on equity prices is more delicate and is highly sensitive to the terms of the CoCo contract, in particular on whether CoCos will be diluting at conversion. Table 3 reports the results using the same methodology as in Table 2, replacing CDS spreads with stock returns. The benchmark regional indices (for Europe, Asia excluding Japan, Australia and Latin America) are calculated using the respective DataStream regional equity indices.

All of the z-scores and most of the Wilcoxon signed rank statistics are not statistically significant, though most of the significant coefficients point to a negative effect on stock price. This set of results is not surprising in light of the predictions of the theoretical literature. First, a CoCo issue could be seen as a negative signal about the bank's balance sheet (even if it is less negative than an equity issue). Second, the CoCo may be seen by investors as having too low a trigger to have any credible risk of being converted. A CoCo issue would then just be seen as more leverage, with an ambiguous effect on stock price. Furthermore, the CoCo issue could dilute existing equity-holders upon conversion (for those CoCos that are seen as having a credible risk of conversion). Consistent with this latter hypothesis, we indeed find that only MC, and not PWD, CoCo issues have a negative effect on the equity price (significant at the 5% level), and even more so when the trigger is high, increasing the risk of dilution (significant at the 1% level). In contrast, the equity market response to PWD CoCos with high trigger is significantly positive (at the 5% level), as equity holders will benefit from an automated delevering when the bank is still a distance from insolvency. Another possibility is that the market may interpret a CoCo issue as a concession by regulators, giving more breathing space to banks by letting them issue CoCos in lieu of equity. That could also have a positive effect on stock price. In addition, the market may be learning slowly about this new financial product. All in all, corporate finance theory suggests that the stock price effect of CoCo issues could be either positive or negative, so we should not expect to see a clear effect in the data.

[Insert Table 3 here.]

4.3 Investors' assessment of the risk of conversion

Section 3.1.4 provides an analytical framework to assess investors' perceptions about the risk that CoCos may convert to equity or be written down. We estimate pairwise correlations between the daily changes in the CoCo bond spreads and the daily changes in subordinated debt spreads, the CDS spread (on senior unsecured debt) and the equity return of the same issuer. Table 4 reports the results. The empirical correlations reveal that investors place a significant probability that CoCos will convert or that there will be a loss at conversion on CoCos and subordinated debt. The signs of correlations are coherent with the analytical predictions in case 4, where the equity capital ratio is expected to fall below the trigger level and the loss is large enough so that it disfigures the CoCo and subordinated debt. As predicted by the analysis in this case, the correlation between the changes in CoCo spreads and equity returns is negative, while the correlations between the changes in spreads of CoCo and senior unsecured debt, subordinated debt and CDS prices are all positive.

[Insert Table 4 here.]

The results show that CoCo instruments are perceived by investors as risky instruments with a non-negligible likelihood of conversion. This implies that the incentive and the capital buffer effects of CoCos are not sufficiently strong to drive the CDS spread to zero and eliminate the credit risk in subordinated debt. The reaction of CDS spreads to CoCo issuance is indeed negative, as depicted on Figure 3. Figure 4, plotting the level of CDS spreads during the event window, further shows that the CDS spreads remain significant post CoCo issuance (126 bps). In other words, they reflect positive credit risk, which is inconsistent with the CoCo price movements (correlations) if there were no expectation of conversion. Thus, while CoCos are able to provide additional capital buffer, the current market prices/spreads reveal both that the disciplining effect of CoCo issuance on bank risk-taking incentives and the expected ex post loss absorption is assessed by the market to be rather weak.

These results also shed some light on some commentators' suggestions that the demand for CoCos is driven by an irrational search for yield. Though we cannot directly address the question whether investors' demand for CoCos is "excessive", the analysis of CoCo pricing shows that investors are aware of the risks in CoCo instruments. Their decisions to invest do not appear to arise from a complete disregard of the risk that CoCo instruments may convert, but rather from a rational decision to take on more risk, probably due to the absence of better risk-return profile alternatives.

[Insert Table 4 here.]

5 Conclusion

We put together and analyze the first comprehensive data set of contingent convertible instruments (CoCos) issued by banks after the financial crisis. In addition to reporting basic stylized facts about this market, we conduct preliminary tests analyzing the impact of CoCo issuance on bank CDS spreads and equity prices. We find that the effect of CoCo issuance on bank funding costs depends crucially on CoCos contract features and bank characteristics. In particular, issuing conversion-to-equity CoCos has a negative impact on issuer's CDS spreads, while issuing CoCos with a principal-write-down has less of an impact. Importantly, in spite of this differential effect and the differences in incentives of the two CoCo contract designs, there is no distinction in their regulatory treatment. As for the reaction of equity prices, CoCo issuance has no clear overall effect, in line with the predictions of corporate finance theory.

The assessment of pricing of banks' securities post CoCo issuance shows that investors place a significant likelihood that CoCos will convert and the loss will be sufficiently high to disfigure not only CoCos but also subordinated debt. Thus market participants view CoCos as risky investments with a strong possibility of conversion. Although CoCos provide additional capital buffers to issuing banks, as reflected in the lower CDS spreads, their effect on overall loss-absorbency and risk-taking incentives is rather weak.

We have explored only a subset of issues concerning the effects of CoCos on issuing banks' cost of capital. An important open question for the immediate future concerns the investor clientele of CoCos. We only have sketchy information on the buy side and cannot determine which investors of CoCos are mainly chasing yields and are attracted by the higher remuneration of the bonds without adequate consideration for the risks they may be exposed to. Second, CoCos enhance the stability of issuing banks and the banking system at large mainly if the holders of CoCos are non-bank investors. To the extent that CoCos are held by banks, all that is achieved is a transfer of risk from the issuing bank to the investor bank, so that no net risk reduction in the banking system has been achieved. It is therefore also important to know what fraction of the CoCo market is purely a risk transfer within the banking system.

Another question of immediate importance is what is the right fraction of CoCo issues for a typical bank issuer? Have banks been too conservative in their issues of CoCos? Have they held back due to the unfavorable regulatory or tax treatment of CoCos? Have they issued CoCos only to be in strict compliance with capital regulations? Or on the contrary, have some of the larger issuers of CoCos built up excessively large CoCo liabilities? Going forward, other important questions that remain to be answered are what differentiates banks that have decided to issue CoCos and those that have not. Are banks that issue CoCos more financially sophisticated? Or are these primarily issuers that are running out of recapitalization options?

6 Appendix A: Methodology

We calculate the following regional indices – Europe, Asia excluding Japan, Australia and Latin America. The regional financial equity index is calculated using the DataStream regional equity indices. The CDS indices are calculated using the equally weighted iTraxx Senior Financials constituents, which have been augmented with additional liquid bank names. The construction of indices aims to build a market portfolio that is congruent with the profile of banks issuing CoCos. These are relatively large financial institutions with a substantial share of interregional and international activities.

The prediction error of a security for bank j at day t is defined as

$$PE_{jt} = R_{jt} - R_{mt},$$

where R_{jt} is the return on equity or a change in the CDS spread on day t and R_{mt} is the corresponding return on equity or CDS index. The prediction error is used as a proxy for the abnormal returns during the event window.

The average prediction error at date t (APE_t) is obtained by averaging the prediction errors across all CoCo issues in the sample,

$$APE_t = \frac{1}{N} \sum_{j=1}^{N} PE_{jt},$$

where N is the number of banks in the sample.

Tests of statistical significance of the average prediction errors are based on standardized prediction errors that account for the number of days in the estimation period and the length of the event window. The standardized prediction error for bank j when the event window lasts T days and the control window is M days is defined as

$$SPE_j = \sum_{t=-(T-1)}^{0} \frac{PE_{jt}}{S_j},$$

where

$$S_j = \left[TV_j^2 \left[1 + \frac{1}{M} + \frac{(R_{mt} - R_m)^2}{\sum_{i=1}^{M}(R_{mi} - R_m)} \right] \right]^{\frac{1}{2}}$$

and V_j^2 and R_m are the residual variance for firm j and the mean market return over the control window, respectively.

The average standardized prediction error on date t is

$$ASPE_t = \frac{1}{N} \sum_{j=1}^{N} SPE_{jt}.$$

Assuming the individual prediction errors are independent across banks (this may be a strong assumption for our sample as bank's decision to issue a CoCo depends on a common regulatory treatment of CoCos) and the average prediction errors are equal to zero, the Z statistics

$$Z = \sqrt{N}(ASPE_t)$$

is distributed $N(0, 1)$.

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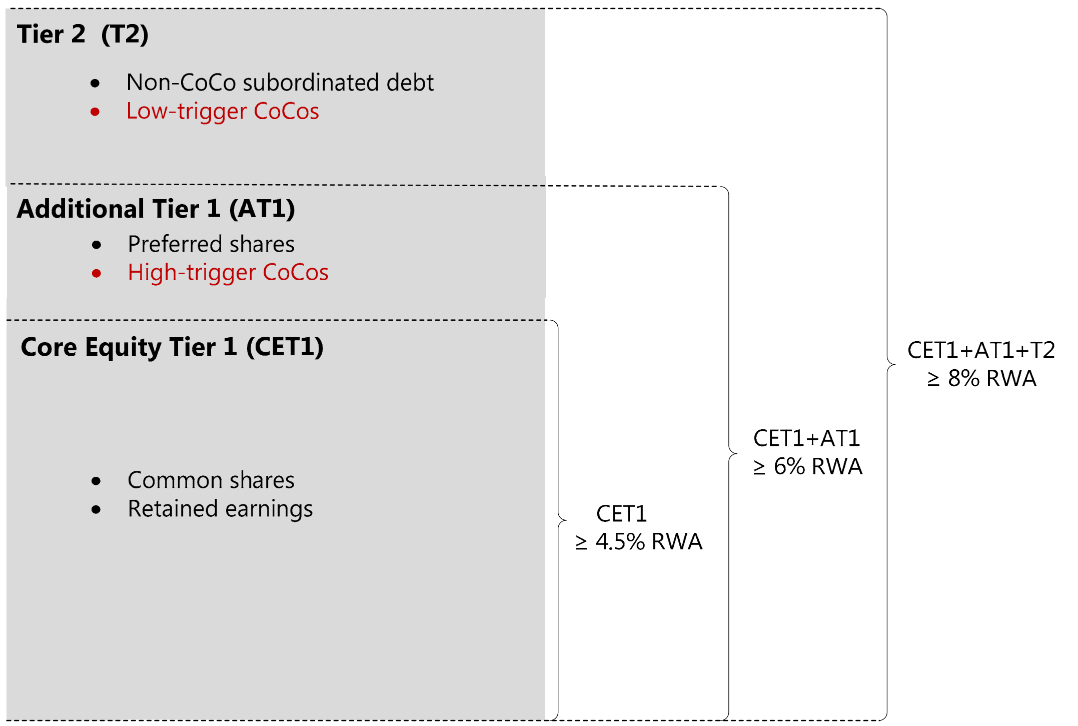
Graph 1.CoCos position in Basel III capital requirements

The graph is an illustration of the position of CoCo instruments under Basel III requirements. The list of instruments in this graph is not exhaustive and is included solely for illustrative purposes. For a complete list of instruments and associated criteria for inclusion in each of the three capital buckets, see BCBS (2011). The above shares of RWA represent the bare minimum capital requirements and do not account for any add-ons, such as the capital conservation buffer, the countercyclical buffer and the SIFI surcharge.



1

Figure 1. Overview of CoCo Bond Issuance: Trends and Compositions

The four charts in Figure 1 present the trends and compositions of CoCo bonds issuance from the post-financial crisis era of 2009 to 2014. The information source is Bloomberg Dealogic. Figure 1a shows the time series of dollar amount of all CoCo issues, broken down by CoCos which qualify for Additional Tier 1 (AT1) and those only to Tier 2 capital. For a CoCo to qualify as AT1, the trigger has to be at least 5.125% of risk-weighted assets. Figure 1b presents the same time series except breaking down all issuances by their loss absorption mechanisms: A "principal write-down" CoCo's principal can be either fully or partially written off when the trigger is hit; A "conversion-to-equity" CoCo is converted into equity when triggered where the conversion formula can be based on the equity price on the day of conversion or on a pre-specified formula of number of shares for each bond, or on some combination of the two. Figure 1c shows the composition of CoCo issues during the sample period by nationality of the issuers. Finally, Figure 1d plots the time series of the percentage of CoCos with trigger greater than 5.125% (and hence qualify as AT1).

Figure 1a. CoCo issuance by regulatory capital classification (in million dollars)

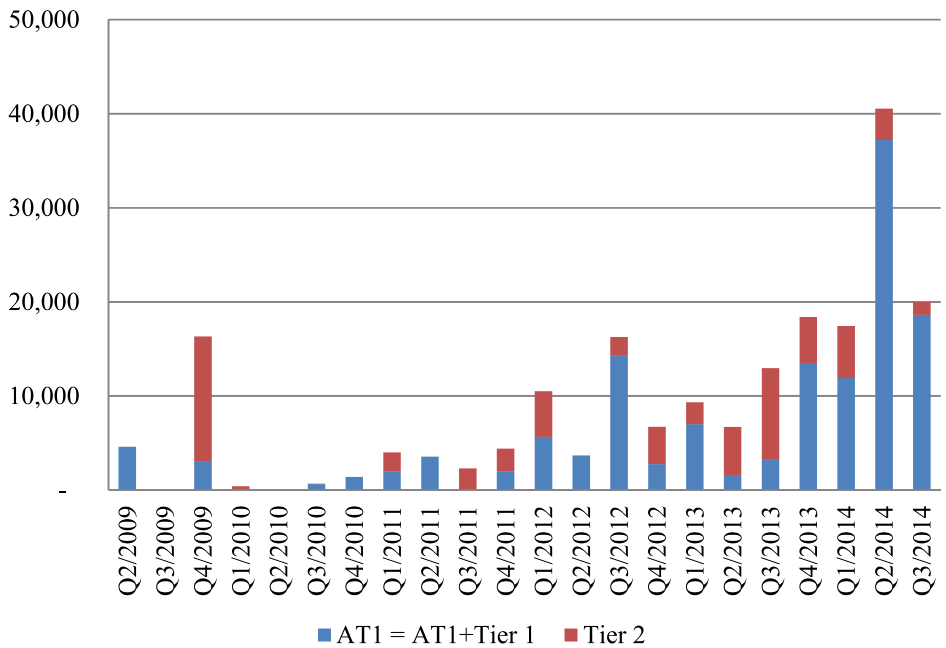


Figure 1b. Percentage of CoCos with a trigger greater or equal to 5.125%

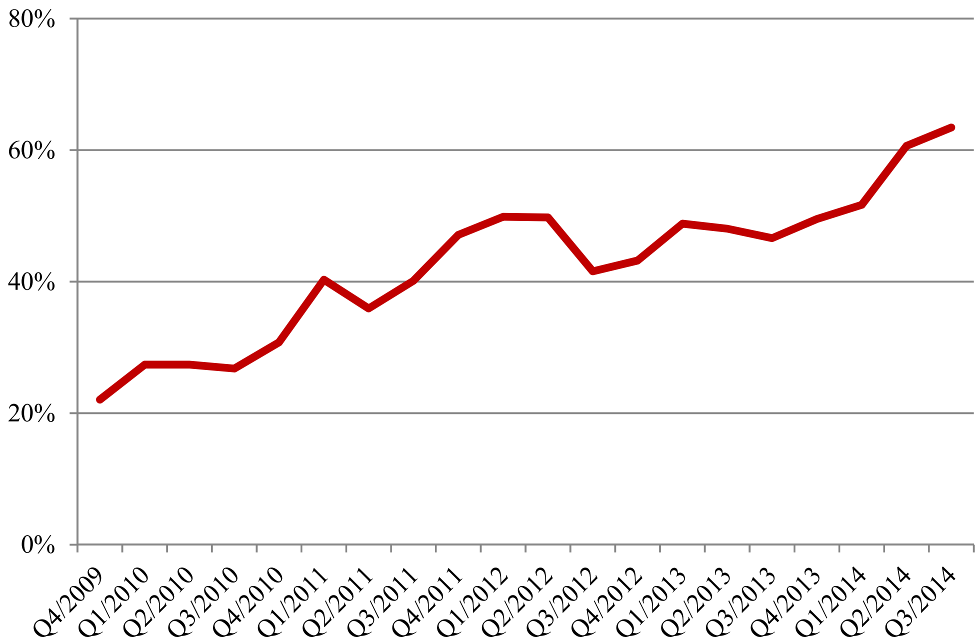


Figure 1c. CoCo issuance by loss absorption mechanism (in million dollars)

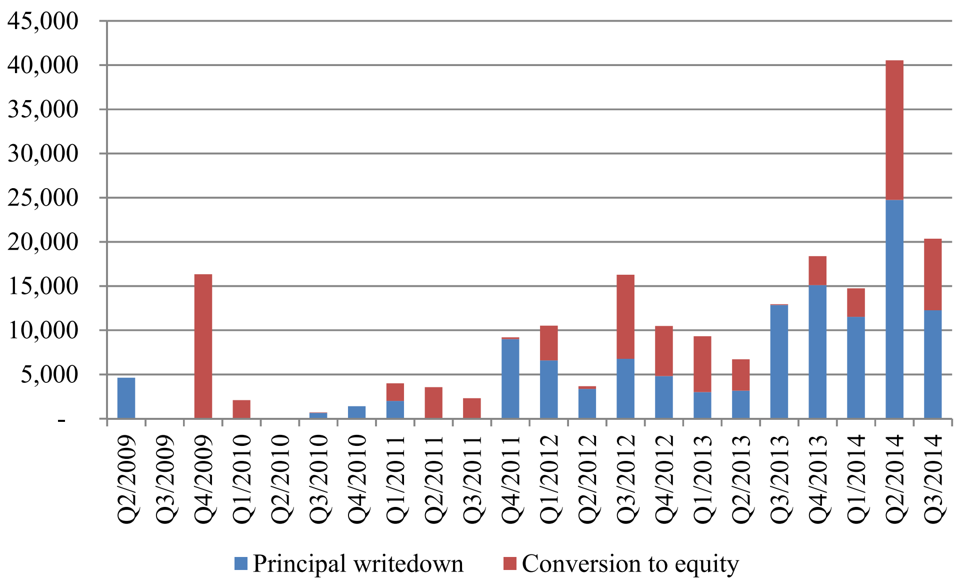


Figure 1d. CoCo issuance by nationality of issuer (in billion dollars)

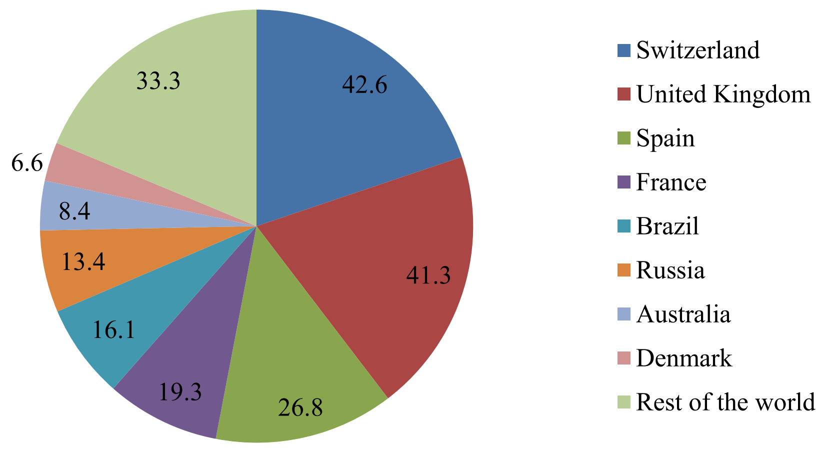


Figure 2. Distribution of Primary Market CoCo Bond Investors

For a selected subsample of CoCo bonds (primarily Additional Tier 1 issues originated between April 2013 and March 2014) for which information is available, Figure 2 plots the distribution of the investors in the primary market. The issues are marked by their issuance dates, issuers, and the currencies. Figure 2a presents distribution by investor type while Figure 2b presents that by region.

Figure 2a. Distribution by investor type

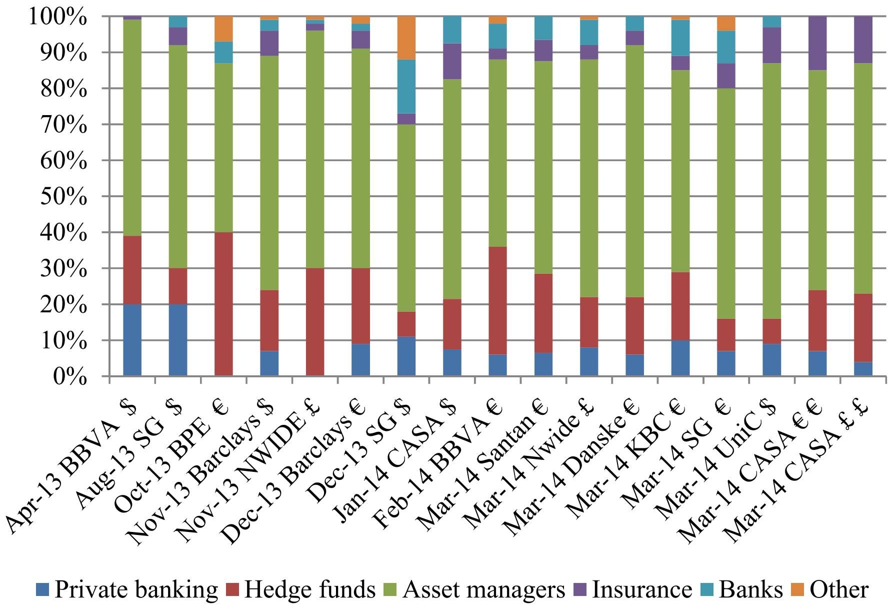


Figure 2b. Distribution by region

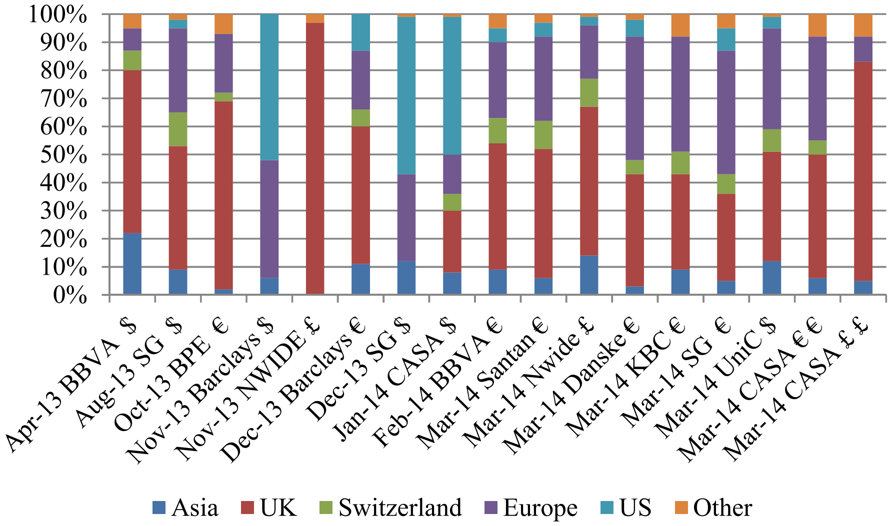


Figure 3. Credit Default Swap (CDS) Spread Changes around CoCo Bond Issuance

This figure plots the cumulative abnormal changes (in basis points) in the CDS spreads of the issuers of the CoCo bonds from t-10 to t+10 days where t is the date of issuance as recorded on Bloomberg. The benchmark regional indices (for Europe, Asia excluding Japan, Australia and Latin America) are calculated as equally weighted averages of the iTraxx Senior Financials constituents and additional liquid bank names from the same region. Figure 3a shows the CDS spreads for the full sample including 72 CoCos issued by banks from all advanced economies with the exception of the euro area periphery (Greece, Ireland, Italy, Portugal and Spain). Figures 3b and 3c plot the same graphs for subsamples of 29 CoCos using mandatory conversion to equity and 43 CoCos using principal write-down as loss absorption mechanisms, respectively.

Figure 3a. Full sample

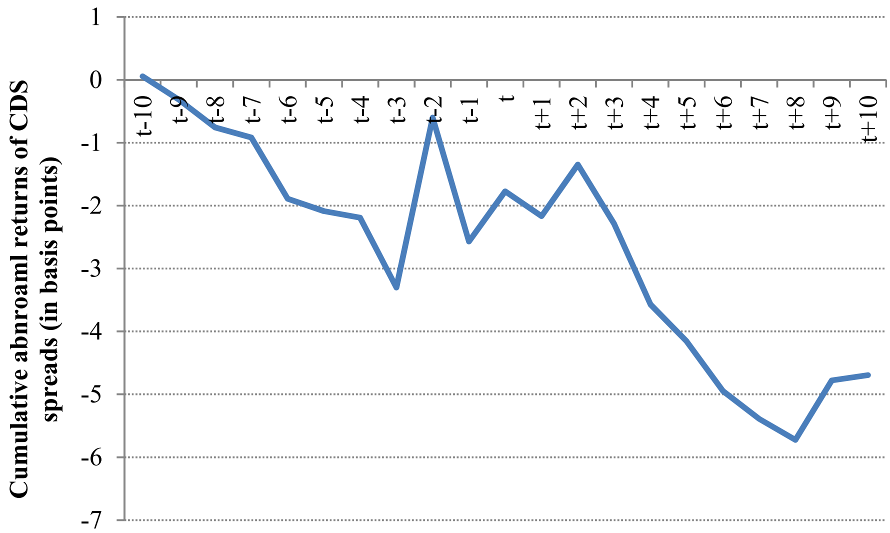


Figure 3b. Subsample of mandatory conversion-to-equity CoCos

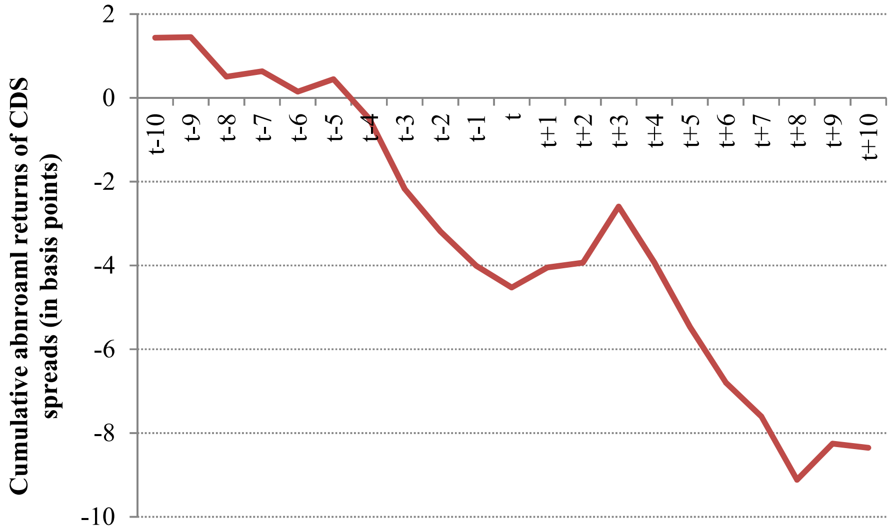


Figure 3c. Subsample of principal write-down CoCos

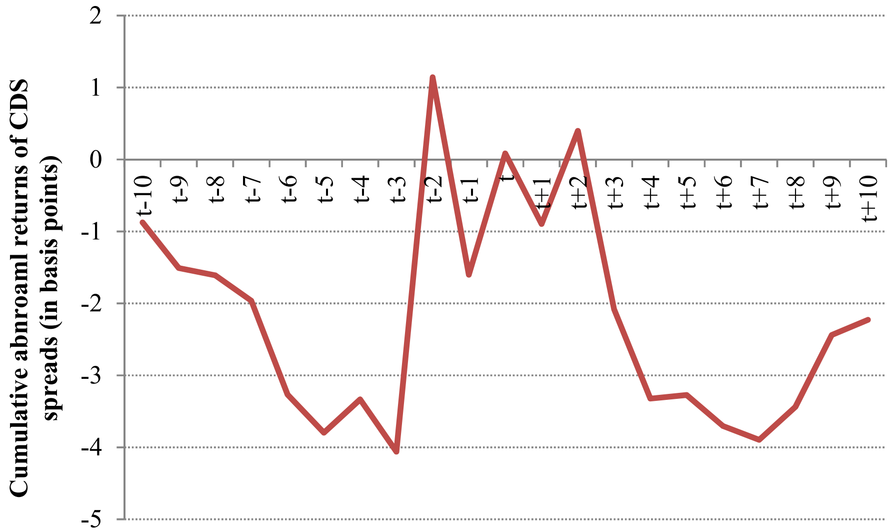


Figure 4. Credit Default Swap (CDS) Spreads around CoCo Bond Issuance

This figure plots the level of CDS spreads of the issuers of 72 CoCo bonds from t-10 to t+10 days where t is the date of issuance as recorded on Bloomberg. The benchmark regional indices (for Europe, Asia excluding Japan, Australia and Latin America) are calculated as equally weighted averages of the iTraxx Senior Financials constituents and additional liquid bank names from the same region. The sample include CoCos issued by banks from all advanced economies with the exception of the euro area periphery (Greece, Ireland, Italy, Portugal and Spain).

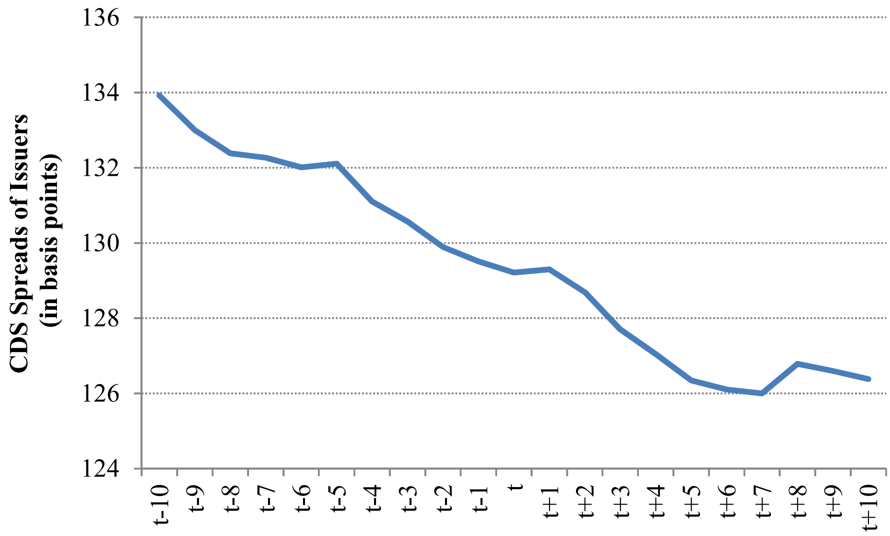


Table 1. Summary Statistics of CoCo Issues 2009-2014

This table reports the number of issues and issued amount of different categories of CoCo bonds from September 2009 to March 2015, classified by loss absorption mechanism, trigger level, denomination currency, regulatory classifications, and maturity at issuance.

	Issued amount (in US$ million)	% of total issuance	Number of issues
Total	207,761	100%	187
Loss absorption mechanism			
Principal writedown	112,436	55.2	97
Mandatory conversion	91,209	44.8	88
Trigger, in %			
< 4.5	8,930	4.3	17
4.5 – 6	113,832	54.8	110
≥ 6	56,757	27.3	37
No numerical trigger	28,243	13.6	23
Currency			
USD	106,106	51.1	82
EUR	56,118	27.0	42
Other	17,044	8.2	28
Regulatory classification	28,494	13.7	35
Additional tier 1			
Tier 2	133,426	67.9	95
Original maturity, in years	63,003	32.1	83
< 5			
5 – 10	18,290	9.0	8
≥ 10	31,037	15.3	32
Perpetual	36,957	18.2	56

Table 2. Impact of CoCo Issuance on Issuer CDS Spreads

This table reports the normalized abnormal CDS spread changes of CoCo issuers of the full and various subsamples of CoCo bonds during the three event windows: the full 21-day (from t-15 to t+5), the pre-issuance 15-day (t-15 to t-1), and the post-issuance 6-day (t to t+5), all defined relative to the issue date (t) of the CoCo instrument (as recorded on Bloomberg). The benchmark regional indices (for Europe, Asia excluding Japan, Australia and Latin America) are calculated as equally weighted averages of the iTraxx Senior Financials constituents and additional liquid bank names from the same region. The sample includes CoCos issued by banks from all advanced economies with the exception of the euro area periphery (Greece, Ireland, Italy, Portugal and Spain). "Z–value" is defined as $Z = \sqrt{N}\,(ASPE)$, where *ASPE* is the average standardized prediction error and *N* is the sample size, following James (1987). "Proportion negative" is the proportion of negative prediction errors, where the null equals 0.5. The test statistic is a Wilcoxon signed rank statistic. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

		Z–value	P–value	Proportion negative	Wilcoxon test p–value	Sample size
Panel A. 21–day window (–15, 5)						
All CoCos		-3.66^{***}	0.00	0.75^{***}	0.00	72
CoCo Issue size	< median	-2.71^{***}	0.01	0.78^{***}	0.00	41
(Amt issued/ RWA)	≥ median	-2.46^{**}	0.01	0.71^{***}	0.00	31
Issuer size	< median	-1.87^{*}	0.06	0.71^{***}	0.01	24
(=total assets)	≥ median	-3.16^{***}	0.00	0.77^{***}	0.00	48
Issuer size	< $500bn	–1.08	0.28	0.78^{*}	0.07	9
(=total assets)	≥ $500bn	-3.50^{***}	0.00	0.75^{***}	0.00	63
Issuer size	< $1,000bn	-2.16^{**}	0.03	0.70^{***}	0.00	30
(=total assets)	≥ $1,000bn	-2.96^{***}	0.00	0.79^{***}	0.00	42
Issuer	GSIB	-2.75^{***}	0.01	0.69^{***}	0.00	49
	no GSIB	-2.45^{***}	0.01	0.87^{***}	0.00	23
Loss absorption	PWD	–1.51	0.13	0.65^{**}	0.02	43
	MC	-3.92^{***}	0.00	0.90^{***}	0.00	29
Trigger	< 6%	-2.06^{**}	0.04	0.73^{***}	0.00	40
	≥ 6%	-2.93^{***}	0.00	0.79^{***}	0.00	29
PWD and trigger	<6%	–1.27	0.20	0.65^{*}	0.07	31
	≥ 6%	–0.81	0.42	0.67	0.23	12
MC and trigger	<6%	-1.99^{**}	0.05	1.00^{***}	0.00	9
	≥ 6%	-3.15^{***}	0.00	0.88^{***}	0.00	17
Panel B. 15–day window (–15, –1)						
All CoCos		-3.99^{***}	0.00	0.75^{***}	0.00	72
CoCo Issue size	< median	-3.18^{***}	0.00	0.76^{***}	0.00	41
(Amt issued/ RWA)	≥ median	-2.42^{***}	0.02	0.74^{***}	0.00	31
Issuer size	< median	-2.25^{**}	0.02	0.67^{***}	0.00	24
(=total assets)	≥ median	-3.30^{***}	0.00	0.79^{***}	0.00	48
Issuer size	< $500bn	–0.67	0.50	0.56	0.16	9
(=total assets)	≥ $500bn	-4.01^{***}	0.00	0.78^{***}	0.00	63
Issuer size	< $1,000bn	-2.29^{**}	0.02	0.67^{***}	0.00	30
(=total assets)	≥ $1,000bn	-3.29^{***}	0.00	0.81^{***}	0.00	42
Issuer	GSIB	-3.53^{***}	0.00	0.71^{***}	0.00	49
	no GSIB	-1.90^{*}	0.06	0.83^{***}	0.00	23
Loss absorption	PWD	-2.66^{***}	0.01	0.67^{***}	0.00	43
	MC	-3.04^{***}	0.00	0.86^{***}	0.00	29
Trigger	< 6%	-2.83^{***}	0.00	0.70^{***}	0.00	40
	≥ 6%	-2.67^{***}	0.01	0.83^{***}	0.00	29

		Z–value	P–value	Proportion negative	Wilcoxon test p–value	Sample size
PWD and trigger	<6%	–2.39**	0.02	0.68***	0.00	31
	≥ 6%	–1.20	0.23	0.67	0.15	12
MC and trigger	<6%	–1.54	0.12	0.78**	0.03	9
	≥ 6%	–2.48**	0.01	0.94***	0.00	17
Panel C. 6–day window (0,5)						
All CoCos		–0.53	0.60	0.64	0.14	72
CoCo Issue size	< median	–0.03	0.97	0.59	0.74	41
(Amt issued/ RWA)	≥ median	–0.77	0.44	0.71*	0.06	31
Issuer size	< median	0.05	0.96	0.50	0.80	24
(=total assets)	≥ median	–0.69	0.49	0.71**	0.04	48
Issuer size	< $500bn	–0.96	0.34	0.89*	0.07	9
(=total assets)	≥ $500bn	–0.21	0.84	0.60	0.34	63
Issuer size	< $1,000bn	–0.42	0.68	0.57	0.67	30
(=total assets)	≥ $1,000bn	–0.34	0.73	0.69	0.15	42
Issuer	GSIB	0.44	0.66	0.59	0.66	49
	no GSIB	–1.58	0.11	0.74**	0.03	23
Loss absorption	PWD	1.39	0.17	0.56	0.45	43
	MC	–2.53**	0.01	0.76***	0.00	29
Trigger	< 6%	0.62	0.54	0.63	0.87	40
	≥ 6%	–1.26	0.21	0.66*	0.06	29
PWD and trigger	<6%	1.40	0.16	0.58	0.58	31
	≥ 6%	0.38	0.70	0.50	0.46	12
MC and trigger	<6%	–1.29	0.20	0.78	0.20	9
	≥ 6%	–1.97*	0.05	0.76**	0.01	17

Table 3. Impact of CoCo Issuance on Issuer Equity Prices

This table reports the normalized abnormal equity returns of CoCo issuers of the full and the various subsamples of CoCo bonds during the three event windows: the full 21-day (from t-15 to t+5), the pre-issuance 15-day (t-15 to t-1), and the post-issuance 6-day (t to t+5), all defined relative to the issue date (t) of the CoCo instrument (as recorded on Bloomberg). The benchmark regional indices (for Europe, Asia excluding Japan, Australia and Latin America) are calculated using the respective DataStream regional equity indices. The sample includes CoCos issued by banks from all advanced economies with the exception of the euro area periphery (Greece, Ireland, Italy, Portugal and Spain). "Z–value" is defined as $Z = \sqrt{N}\ (ASPE)$, where *ASPE* is the average standardized prediction error and *N* is the sample size, following James (1987). "Proportion negative" is the proportion of negative prediction errors, where the null equals 0.5. The test statistic is a Wilcoxon signed rank statistic. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

		Z–value	P–value	Proportion negative	Wilcoxon test p–value	Sample size
Panel A. 21–day window (–15, 5)						
All CoCos		–1.50	0.13	0.63	0.14	76
CoCo Issue size	< median	0.04	0.97	0.53	0.94	40
(Amt issued/ RWA)	≥ median	–2.07**	0.04	0.76***	0.02	33
Issuer size	< median	1.76*	0.08	0.46*	0.10	26
(=total assets)	≥ median	–2.81***	0.00	0.71***	0.01	48
Issuer size	< $500bn	–0.41	0.68	0.64	0.70	14
(=total assets)	≥ $500bn	–1.16	0.25	0.62	0.25	60
Issuer size	< $1,000bn	0.96	0.34	0.56	0.43	32
(=total assets)	≥ $1,000bn	–2.47**	0.01	0.67**	0.02	42
Issuer	GSIB	–0.49	0.62	0.63	0.42	49
	no GSIB	–1.86*	0.06	0.63	0.23	27
Loss absorption	PWD	–0.15	0.88	0.63	0.71	46
	MC	–2.21**	0.03	0.63*	0.06	30
Trigger	< 6%	–0.88	0.38	0.65	0.37	46
	≥ 6%	–0.99	0.32	0.59	0.41	27
PWD and trigger	<6%	–1.15	0.25	0.70	0.28	37
	≥ 6%	2.00**	0.05	0.33	0.16	9
MC and trigger	<6%	0.33	0.74	0.44	0.65	9
	≥ 6%	–2.62***	0.01	0.72**	0.03	18
Panel B. 15–day window (–15, –1)						
All CoCos		–0.49	0.62	0.53	0.80	76
CoCo Issue size	< median	0.98	0.33	0.43	0.19	40
(Amt issued/ RWA)	≥ median	–1.44	0.15	0.67	0.10	33
Issuer size	< median	1.86*	0.06	0.38*	0.07	26
(=total assets)	≥ median	–1.66*	0.10	0.60	0.14	48
Issuer size	< $500bn	–0.34	0.73	0.50	0.70	14
(=total assets)	≥ $500bn	–0.09	0.93	0.53	0.93	60
Issuer size	< $1,000bn	1.20	0.23	0.47	0.25	32
(=total assets)	≥ $1,000bn	–1.35	0.18	0.57	0.28	42
Issuer	GSIB	0.47	0.64	0.53	0.59	49
	no GSIB	–1.45	0.15	0.52	0.30	27
Loss absorption	PWD	0.39	0.69	0.52	0.70	46
	MC	–1.27	0.21	0.53	0.36	30
Trigger	< 6%	0.02	0.98	0.52	0.88	46
	≥ 6%	–0.59	0.56	0.52	0.67	27
PWD and trigger	<6%	–0.50	0.62	0.59	0.62	37
	≥ 6%	1.90*	0.06	0.22*	0.07	9

		Z–value	P–value	Proportion negative	Wilcoxon test p–value	Sample size
MC and trigger	<6%	1.05	0.29	0.22	0.16	9
	≥ 6%	–2.06**	0.04	0.67	0.13	18
Panel C. 6–day window(0, 5)						
All CoCos		–2.04**	0.04	0.59***	0.01	76
CoCo Issue size	< median	–1.48	0.14	0.55*	0.08	40
(Amt issued/ RWA)	≥ median	–1.59	0.11	0.67***	0.00	33
Issuer size	< median	0.34	0.73	0.46	0.85	26
(=total assets)	≥ median	–2.64***	0.01	0.67***	0.00	48
Issuer size	< $500bn	–0.24	0.81	0.50	0.57	14
(=total assets)	≥ $500bn	–2.03**	0.04	0.62***	0.01	60
Issuer size	< $1,000bn	–0.10	0.92	0.50	0.74	32
(=total assets)	≥ $1,000bn	–2.47**	0.01	0.67***	0.00	42
Issuer	GSIB	–1.66*	0.10	0.59**	0.03	49
	no GSIB	–1.18	0.24	0.59*	0.08	27
Loss absorption	PWD	–0.90	0.37	0.52	0.26	46
	MC	–2.13**	0.03	0.70***	0.00	30
Trigger	< 6%	–1.68*	0.09	0.57**	0.04	46
	≥ 6%	–0.93	0.35	0.59	0.11	27
PWD and trigger	<6%	–1.36	0.17	0.54	0.12	37
	≥ 6%	0.74	0.46	0.44	0.41	9
MC and trigger	<6%	–1.04	0.30	0.67*	0.07	9
	≥ 6%	–1.66*	0.10	0.67***	0.01	18

Table 4. Correlation between CoCo Bonds and Other Securities

This table reports the summary statistics of the pairwise correlation coefficients between Coco Spread (i.e., the daily changes in the spread between the yield to maturity (YTM) of a CoCo bond and a corresponding government bond (matched by currency and maturity)) and the following return/spread measures: (1) Equity return, expressed in percentage changes at the daily level. (2) Senior unsecured spread, which is the daily changes in the spread between the YTM of a senior unsecured bond and a corresponding government bond (matched by currency and maturity). (3) Subordinated spread, which is the daily change in the spread between the YTM of a non-CoCo subordinated bond and a corresponding government bond (matched by currency and maturity). (4) CDS spread, which is expressed as daily changes. The numerical numbers in the parenthesis indicate the four scenarios modeled in Section 3.1.4: (1) The bank's equity capital ratio is expected never to fall below the CoCo trigger. (2) The CoCo is triggered, but the equity obtained following conversion has the same value as the face value of the CoCo. (3) The CoCo is triggered and disfigured but was sufficient to absorb loss (i.e., the subordinated debt is not disfigured). (4) The CoCo is triggered and disfigured and the CoCo was not sufficient to absorb loss (i.e., the subordinated debt is disfigured).

	Mean	Median	Min	Max	No of observations
CoCo spread – **Equity** return	–0.25 (3&4)	–0.22	–0.57	0.11	67
CoCo spread – **Senior unsecured** spread	0.45 (1&4)	0.58	–0.65	0.96	34
CoCo spread – **Subordinate** spread	0.53 (1&4)	0.54	–0.62	0.98	37
CoCo spread – **CDS** spread	0.36 (all)	0.30	–0.03	0.85	74