The effect of different CoCo structures on the funding costs of a financial institution

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Abstract

Contingent Convertible bonds (CoCos) provide additional loss absorbing capital and are favored for their regulatory treatment. Despite strict requirements to qualify as Additional Tier 1 (AT1) or Tier 2 capital, there is still significant variation in the structure of CoCos that banks have issued. The eventual impact of additional loss absorbing capital and risk shifting incentives, resulting from the specific CoCo structure used, affects the default probability of the bank. Our study shows that the overall impact of CoCo issuance on the Credit Default Swap (CDS) spread is negative and significant. Indicating that the funding costs of financial institutions that issue CoCos decrease. The reduction in CDS spreads is stronger for AT1 CoCo structures, equity-conversion mechanisms and triggers at the regulatory minimum of 5,125% in terms of the Common Equity Tier 1 (CET1) capital ratio. The negative impact on CDS spreads is larger for Other Systemically Important Banks (O-SIBs), issuers with total assets below $1.500 billion and contributions to the Tier 1 capital ratio between 0,5% and 1% in terms of Risk Weighted Assets (RWA).

Keywords: Contingent Convertible bond, Additional Tier 1, conversion mechanism, trigger event, CRR, CRD-IV, event study, funding costs, financial institutions, too-big-to-fail, risk shifting incentives, Credit Default Swap, probability of default, dilution.

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Contents

Chapter 1

Introduction

Financial institutions are required to maintain capital buffers that can absorb losses in times of distress and preserve the bank as a *going-concern*. The financial crisis of 2008 revealed a lack of sufficient loss absorbing capital of large financial institutions and threatened their collapse. These *too-big-to-fail* banks had to be bailed out by national governments, to prevent widespread disruption of the financial system (Shull, 2010).

To avoid such bailouts in the future, the Basel Committee on Banking Supervision (BCBS) introduced higher capital requirements and increased the required loss absorbing capacity (BCBS, 2011). These increased capital requirements and the regulatory treatment of loss absorbing capital encouraged the issuance of new hybrid instruments. Designed to improve capital positions in times of distress and provide bail-in capital to recapitalize the bank on a going-concern basis. One of these hybrid instruments is the *Contingent Convertible bond* (CoCo) (Avdjiev *et al.*, 2013).

The imminent suspension of coupon payments on CoCos of Deutsche Bank in February 2016 revealed that CoCo investors misjudged the corresponding risks inherent in these products. Moreover, the $7 billion bailout of Monte dei Paschi in December 2016 is a recent example of insufficient loss absorbing capacity (Reuters, 2016).

CoCo structures and the incentives of financial institutions to issue them

CoCos automatically absorb losses via principal write-down or equity-conversion if a pre-specified trigger event occurs (Flannery, 2014). The structure of CoCos can be broken down by (i) a trigger event, (ii) a conversion mechanism, and (iii) lifecycle features. (i) Triggers activate the conversion mechanism. A trigger can be mechanical or discretionary. Mechanical triggers are based on market-values, book-values or a combination of these. Discretionary triggers can be activated by local regulators based on their judgment about the banks solvency prospects (Avdjiev *et al.*, 2013).

(ii) CoCos are converted into equity or written-down on the occurrence of a trigger event. The conversion rate to equity is specified in number of shares, the share price, or any other combination. The principal write-down can be partial or complete. A partial write-down can be temporary and a write-up might follow under strict conditions, or the holders of CoCos receive the remaining face value in cash (Avdjiev *et al.*, 2013).

(iii) Besides a trigger and a conversion mechanism, CoCos contain standard bond features like an initial maturity, call dates, coupon rate and coupon payment dates.

Different CoCo structures have been introduced in theory and practice. There is however no consensus between the BCBS and academics concerning effective CoCo structures (Flannery, 2009; French *et al.*, 2009; McDonald, 2010; Calomiris and Herring, 2013; Pennacchi, Vermaelen and Wolff, 2014).

The requirements for CoCos, to qualify as regulatory capital in the European Union (EU), are specified in the Capital Requirements Regulation (EP, 2013b, CRR). The CRR specifies that CoCos can qualify as Additional Tier 1 (AT1) or Tier 2 capital. One of the requirements to qualify as AT1 capital is the use of book-values to trigger conversion.

Academics state that book-value triggers substantially overestimate the true ability to absorb losses and that regulatory compliant CoCos would not have prevented the last crisis (Kuritzkes and Scott, 2009; Duffie, 2010; Admati *et al.*, 2010; Haldane, 2011; Calomiris and Herring, 2013).

Financial institutions are not eager to implement CoCo structures that deviate from the CRR, because compliance with capital requirements is their primary incentive to issue them (Avdjiev *et al.*, 2013). CoCos can to a certain extent substitute equity and issuing these hybrid instruments instead of equity provides several benefits (Calomiris and Herring, 2013). The main benefit is that CoCos are technically regarded as bonds, coupon payments can therefore be made from pre-tax earnings (Avdjiev *et al.*, 2013). Financial institutions hence prefer these less expensive capital instruments to minimize the cost of regulatory compliance (Flannery, 2014).

This preference is reflected by the growing popularity of CoCos in the last few years. Since the first CoCo issuance in 2009, 187 banks around the world have issued for more than $409 billion of CoCos through 467 different issues (Moody's, 2016a). All these CoCos are structured as AT1 or Tier 2 capital.

The effect of additional loss absorbing capital on default probabilities

There is however still significant variation in the types of CoCos that banks have issued and no consensus has yet emerged on the particular form that CoCos should take. Furthermore, the effect of different CoCo structures on the default probability of the issuer and total funding costs is still unclear.

Issuing CoCos can affect the default probability of the issuer in two ways. First, if CoCos work as they are supposed to and provide additional bail-in capital, they should make banks safer and reduce the default probability of the issuer (Flannery, 2014). Second, the structure of CoCos can reinforce risk taking incentives and therefore increase the default probability of the issuer (Chan and Wijnbergen, 2016).

A reduction in the default probability of the issuer results in a higher value of non-CoCo debt. The higher value is reflected by higher market prices of these debt instruments. The bank can replace these safer debt instruments and lower the total funding costs. The eventual impact on the default probability is expected to be reflected in the price of the Credit Default Swap (CDS) of the issuer. The price of a CDS decreases when the reference bond becomes less risky and can therefore serve as a proxy for the funding costs of financial institutions (Hull, 2006; Weistroffer *et al.*, 2009).

Main research question

Measuring the eventual impact of CoCo issuance on funding costs can provide valuable insights. Financial institutions can use these insights to optimise there funding costs, by issuing the specific CoCo structure that leads to regulatory compliance and the lowest total cost of funding. The main question of our research is therefore:

What is the effect of different CoCo structures on the funding costs of a financial institution?

Related research and academic contribution

Other studies already analysed the effect of CoCo issuance on the funding costs of the issuer. The closest related study is conducted by Avdjiev *et al.* (2015). They use the event study methodology to measure the impact of CoCo issuance on the CDS spread of the issuer. Their research is based on a sample of 72 CoCos issued in the first years after the introduction of the first CoCo in December 2009. Avdjiev *et al.* (2015) conclude that the impact of CoCo issuance on CDS spreads is negative and significant. Indicating that issuing CoCos reduces the default probability, and hence the funding costs of financial institutions.

The strong part of research by Avdjiev *et al.* (2015) is that differences in the contractual details and issuer characteristics are considered. Another strong part is a sensitivity analysis related to the time it takes to identify the complete market reaction of issuing a CoCo. However, some aspects of their methodology are weak and can be improved: (i) the specific conversion mechanism and associated dilution effects are not taken into account; (ii) they do not distinguish between AT1 and Tier 2 qualification; (iii) conclusions are based on a sample of 72 CoCos issued in the first years of the market rise; and (iv) in contrast to the claimed use of the risk-adjusted returns approach to measure the effect of CoCo issuance on CDS spreads, they actually implemented the market returns approach. Market sensitivities are therefore not taking into account.

Based on these shortcomings, the methodology of Avdjiev *et al.* (2015) can be improved upon a deeper analysis related to the contractual details of CoCos, using a representative sample, and implementing the risk-adjusted returns approach to measure the effect of CoCo issuance on the funding costs of financial institutions.

Approach

To provide a comprehensive answer to the main research question and contribute to existing literature, several aspects have to be identified and analysed. First, existing literature related to CoCo structures, regulation and the effect of CoCo issuance on funding costs is analysed and used as foundation for the qualitative and quantitative analysis of this research. Second, the specific research design and statistical tests used to measure the effect of CoCo issuance on the CDS spread of the issuer are described.

Third, the developments in the CoCo market are analysed based on Moody's (2016b) "CoCo Monitor Database", containing all the contractual details of 467 CoCos issued between December 2009 and April 2016. Fourth, the research design and relevant data are used to measure the effect of different CoCo structures and issuer characteristics on the CDS spread of the issuer.

Main findings

The result of our analysis is threefold, and includes: (i) the overall impact of CoCo issuance; (ii) the effect of different CoCo structures; and (iii) the effect of issuer characteristics on the funding costs of a financial institution.

(i) The results of the full CoCo sample show that the overall impact of CoCo issuance on the CDS spread of the issuer is negative and significant. Indicating that the total funding costs of financial institutions that issue CoCos decrease.

(ii) To analyse the effect of different CoCo structures, the full CoCo sample is broken down into sub-samples related to the regulatory tiering, conversion mechanism, trigger event, and coupon rate. Our main findings related to these different CoCo structures indicate that AT1 CoCo structures, equity-conversion mechanisms, and trigger levels at the regulatory minimum of 5,125% of the Common Equity Tier 1 (CET1) capital ratio are the most effective in reducing default probabilities, and hence the funding costs, of financial institutions.

(iii) To analyse the effect of issuer characteristics, the full CoCo sample is broken down into sub-samples related to the systemic importance, total assets at issuance, contribution to capital ratios, and region of the issuer. Our main findings related to these issuer characteristics indicate that the negative impact of CoCo issuance on default probabilities is the strongest for Other Systemically Important Banks (O-SIBs)[1], issuers with total assets below $1.500 billion, contributions to the Tier 1 ratio between 0,5% and 1% of Risk Weighted Assets (RWA), and issuers located in the Asia Pacific.

Structure of the remainder of this report

The remainder of this report is structured as follows. Chapter 2 provides an overview of all relevant CoCo structures, discusses regulatory and academic CoCo literature, and describes related research on the effect of CoCo issuance on funding costs. Chapter 3 presents the event study methodology used to measure the effect of CoCo issuance on the CDS spread of the issuer and introduces relevant statical tests to analyse the significance of this effect.

Chapter 4 performs a qualitative analysis on the current state of the CoCo market and contains a description of the data used as input for the quantitative analysis. Chapter 5 describes the results of the quantitative analysis on the effect of different CoCo structures and issuer characteristics on the funding costs of financial institutions. It also conducts a sensitivity analysis on the underlying assumptions of the specific research design used. Chapter 6 concludes, describes the limitations of our research and provides recommendations for further research.

[1] Banks that are not classified as Global Systemically Important Bank (G-SIB) are referred to as O-SIBs.

Chapter 2

Literature review

In this chapter the different perspectives on CoCo structures and the implications for funding costs are discussed. Section 2.1 starts with introducing the concept of CoCos and provides a framework for the discussion of regulation and the academic perspective on effective CoCo structures. Section 2.2 then explains the incentive to issue CoCos, created by new capital requirements, and the role of regulatory treatment on the structure of CoCos currently implemented in the market.

Section 2.3 describes the initial concept of CoCos and the academic perspective on effective CoCo structures. Section 2.4 identifies the theoretical relation between CoCo issuance and funding costs. Section 2.5 explains the concept of event studies, the method used for the quantitative analysis. Section 2.6 concludes with summarizing related research and describes the contributions of our research.

2.1 Structure of CoCos

CoCos automatically absorb losses via principal write-down or equity-conversion if a pre-specified trigger event occurs. CoCos can therefore absorb losses while the bank is still a going-concern, whereas standard bonds can not be used to absorb losses until the underlying financial institution has defaulted (gone-concern) (Flannery, 2014).

The structure of CoCos can be broken down by (i) a trigger event; (ii) a conversion mechanism; and (iii) lifecycle features (Avdjiev *et al.*, 2013). The specific combination of these characteristics is tailored to achieve the individual objective of the issuing financial institution (Chen *et al.*, 2013).

Different CoCo structure have been introduced in theory and practice. The common objective is always to provide loss absorbing capital in times of distress and prevent insolvency (Flannery, 2014). The structure of CoCos is crucial to achieve this objective. CoCos have the potential to enhance financial stability and can affect the funding costs of financial institutions (Chen *et al.*, 2013).

Figure 2.1 provides an overview of the main CoCo structures that have been introduced in theory and practice. The following sections describe the trigger event (Section 2.1.1), conversion mechanism (Section 2.1.2) and lifecycle features (Section 2.1.3), and discusses their pros and cons.

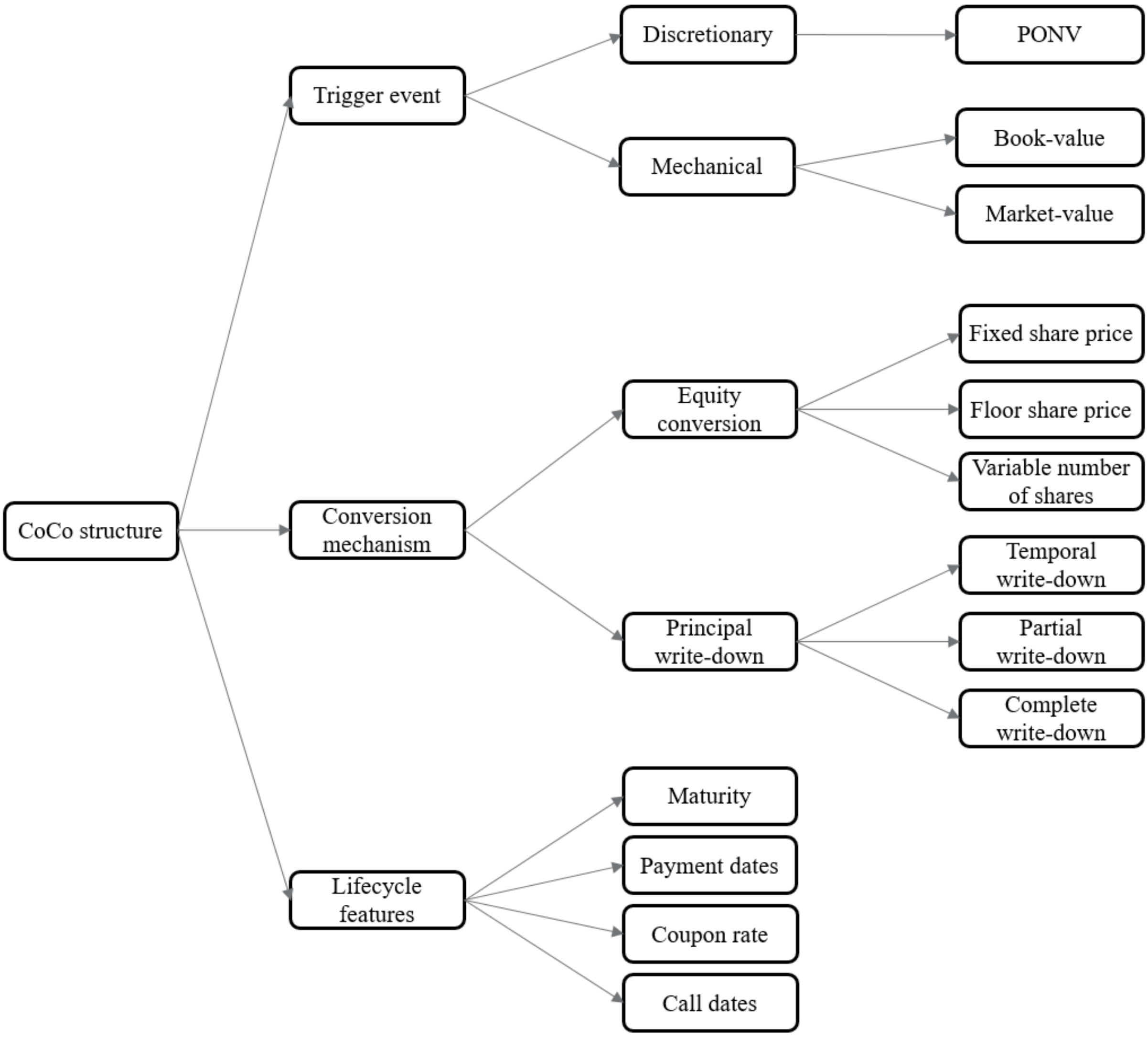

FIGURE 2.1: Overview of CoCo structures broken down by a trigger event, conversion mechanism and lifecycle features. Extension on Graph 1 of Avdjiev *et al.* (2013).

2.1.1 Trigger event

The definition of the trigger is the most important design feature of CoCos. It is the point at which the conversion mechanism is activated. A trigger can be mechanical, discretionary or both. Mechanical triggers are defined numerically in terms of book-values, market-values, or a combination of these (Avdjiev *et al.*, 2013).

The effectiveness of triggers is strongly related to the transparency of the underlying values. Non-transparent and infrequent publication of underlying values leads to uncertainty and therefore reduces the effectiveness (Calomiris and Herring, 2013).

Book-value triggers are typically set in terms of the CET1 capital ratio. The frequency at which this ratio is publicly disclosed and the accuracy of internal calculations are not transparent. Furthermore, the regulator and the behaviour of management can influence the book-value trigger. Which is not predictable and makes it difficult to quantify the probability of conversion (Calomiris and Herring, 2013). Pennacchi, Vermaelen and Wolff (2014), Flannery (2014), and Giacomini and Flannery (2015) therefore state that book-value triggers are not effective.

Market-value triggers are defined in terms of a publicly-traded underlying, like the share price of the issuer or a specific index. They have the potential to be effective, to prevent balance sheet manipulations, and are not subject to regulatory judgement (Avdjiev *et al.*, 2013). Flannery (2005), French *et al.* (2009), McDonald (2010), Calomiris and Herring (2013), Pennacchi, Vermaelen and Wolff (2014), and Bulow and Klemperer (2015) therefore prefer market-value triggers. The design of market-value triggers is however not without difficulties and might result in adverse incentives (Kashyap, Rajan and Stein, 2008; Flannery, 2009; McDonald, 2010). These and other issues are addressed by multiple design proposals as pointed out in Section 2.3.

A discretionary or point of non-viability (PONV) trigger can be activated by local resolution authorities, based on their judgment about the banks solvency prospects (EBA, 2016b). This power of the regulator to trigger conversion of CoCos is an important source of uncertainty for investors (Avdjiev *et al.*, 2013). Especially because the regulator does not require the PONV to be included contractually to activate the loss absorption mechanism (EP, 2013b, Article 45).

2.1.2 Conversion mechanism

CoCos absorb losses by converting the debt liability into equity, or by suffering a principal write-down. The conversion rate to equity is specified based on: a fixed share price, the share price at the moment of conversion (including a floor price), a variable number of shares (including a maximum number), or any other pre-arranged mechanism (Avdjiev *et al.*, 2013).

The principal write-down can be partial or complete. A partial write-down means that a pre-specified percentage of the principal amount is written-down. The remaining principal can continue to exist under the same conditions, or the holders of CoCos receive the remaining face value in cash (Flannery, 2014). Another possibility is that the write-down is temporary, meaning that CoCos can regain their initial principal amount. This write-up is only possible under strict conditions (EP, 2013b).

CoCo investors are better off when the equity-conversion price is low, because this will result in more shares when the conversion takes place. Current shareholders on the other hand prefer a high conversion price, such that there will be as little dilution as possible (Chan and Wijnbergen, 2016).

It is essential that the issuer of an equity-conversion CoCo has listed shares. Financial institutions that do not have listed shares can use the principal write-down mechanism as an alternative way to absorb losses (Avdjiev *et al.*, 2013). Some listed financial institutions still prefer principal write-down mechanisms to absorb losses. The main reason is that conversion will not dilute strategic shareholders and jeopardise their majority. In addition, some investors are not allowed to own shares and therefore only accept principal write-down mechanisms, because these conversions will never lead to owning shares (Spiegeleer and Schoutens, 2014).

Both conversion mechanisms are subject to several concerns. Conversion of a partial write-down CoCo, that pays the remaining part in cash, will decrease the liquidity positions of the bank that is already in distress (Avdjiev *et al.*, 2013). Conversion to equity can potentially lead to dilution of existing shareholders. But the possibility of dilution increases the incentive for shareholders to avoid a trigger event in the first place (Chan and Wijnbergen, 2016).

2.1.3 Lifecycle features

Lifecycle features specify the maturity, call dates, coupon rate and coupon payment dates. CoCos behave like standard bonds under normal circumstances. Hence, investors pay a principal amount at the starting date and receive coupon payments at pre-specified dates. The principal amount is redeemed at maturity, or at a predefined call date and price (Spiegeleer and Schoutens, 2014).

CoCos behave differently in times of distress. Unlike standard bonds, coupon payments can be cancelled and the principal amount can be converted on the occurrence of a trigger event (Flannery, 2014). Since the introduction of CoCos in 2009, none of the mechanical triggers have been hit and all coupons are payed.

2.2 Regulatory treatment of CoCos

The primary function of capital is to provide loss absorbing capacity in times of distress and preserve the financial institution as a going-concern. The financial crisis of 2008 revealed a lack of sufficient loss absorbing capital of large financial institutions and threatened their collapse. These too-big-to-fail banks had to be bailed out by national governments to prevent widespread disruption of the financial system (Shull, 2010; Melaschenko and Reynolds, 2013).

Regulators responded with reforms and a global drive to introduce higher capital requirements, structure the resolution process, and increase the loss absorbing capacity of financial institutions. The overall objective of these reforms is to create more financial stability and a shock resistant financial system, because this is a precondition for sustainable economic growth and prosperity (BCBS, 2011).

2.2.1 Regulatory framework

The BCBS agreed upon the final version of Basel III in 2011. A global regulatory framework intended to strengthen capital requirements. The European Parliament (EP) implemented this in the Capital Requirements Directive (EP, 2013a, CRD-IV) and Capital Requirements Regulation (EP, 2013b, CRR). These publications specify the increased capital requirements and additional buffers for financial institutions in the EU. Among these new requirements are strict conditions concerning the admission of

CoCos as AT1 capital (Section 2.2.3). Not satisfying these conditions results in a Tier 2 qualification (EP, 2013b).

In 2014 the EP introduced the Bank Recovery and Resolution Directive (EP, 2014, BRRD) to impede insolvency of financial institutions, increase the long term financial stability, and prevent the use of taxpayer's money for future bail-outs. The BRRD provides the European Banking Authority (EBA) with a set of rules and a framework including a bail-in tool, which ensures that shareholders and creditors bear the cost of bank failure. BRRD also requires the implementation of additional loss-absorbing buffers under the so-called "Minimum Requirement for own funds and Eligible Liabilities" (MREL), that will be phased in between 2016 and 2020. Banks that satisfy the MREL are entitled to the Single Resolution Fund (SRF) in case of a resolution (EBA, 2015).

In the same year the Financial Stability Board (FSB) published the "Adequacy of loss-absorbing capacity of global systemically important banks in resolution" (FSB, 2014). This publication introduces a new standard concerning "Total Loss Absorbing Capacity" (TLAC) for G-SIBs. TLAC requirements intend to provide confidence that G-SIBs have sufficient capital to absorb losses and create a level playing field internationally (FSB, 2014).

MREL and TLAC are closely related, both set requirements for additional equity capital and bail-in debt instruments. The main difference is that MREL requirements apply to all banks active in the EU and TLAC requirements only apply to G-SIBs active in the EU. This means that G-SIBs active in the EU have to comply with both MREL and TLAC requirements (EBA, 2015; FSB, 2014).

2.2.2 Current and upcoming capital requirements

The main incentive for financial institutions to issue CoCos is the new capital requirements that have become applicable since January 2014. These requirements are expressed in several capital categories. The CRR contains a detailed description of what types of equity and liabilities can be used in each category (EP, 2013b).

The two main categories are Tier 1 and Tier 2. The Tier 1 category consists of non-maturing capital without restrictions to absorb losses on a going-concern basis, and do not have any obligations related to payments. It represents the core capital and consists of the sum of the CET1 capital and AT1 capital of a financial institution. The Tier 2 category consists of supplementary capital that can only absorb losses during a gone-concern phase. As a result, Tier 2 capital can only be subject to absorb losses if all the Tier 1 capital has been bailed-in. The Total Capital of the bank is then the sum of Tier 1 and Tier 2 capital.

All capital requirements are expressed as a percentage of RWA. RWA is a financial institutions assets or off balance-sheet exposures, weighted according to their risk. Different asset classes therefore have different risk weights associated with them. The BCBS prefers this approach, because it provides a standardised measure to compare banks, off-balance sheet exposures are taken into account, and low-risk liquid-assets are encouraged.

Figure 2.2 shows the minimum impact of the Basel III capital requirements and the maximum impact for G-SIBs as of January 2019, including the potential for AT1 and Tier 2 CoCos to satisfy these requirements. The following sections explain these requirements and the implementation of Basel III, MREL and TLAC in more detail.

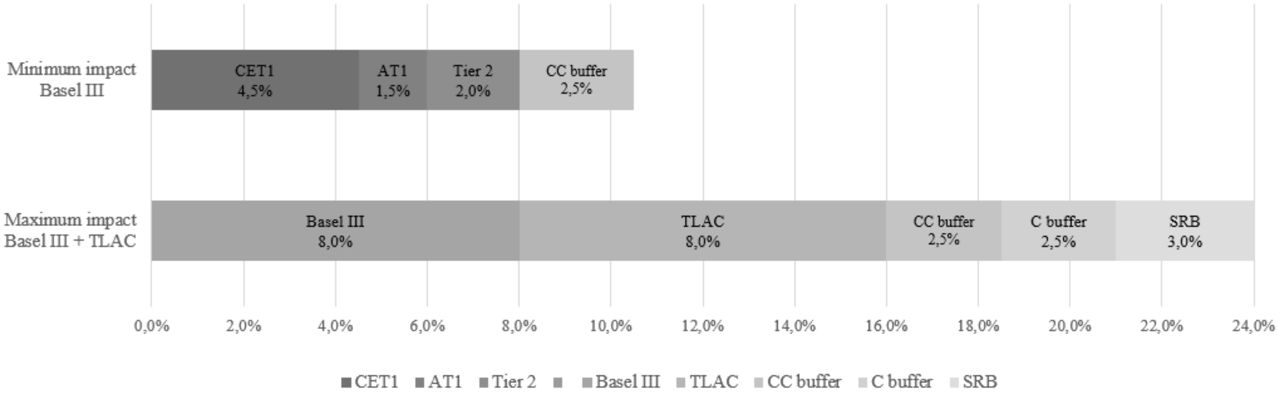

FIGURE 2.2: Upper bar shows the minimum impact of capital requirements under Basel III as of January 2019, broken down by the eligible capital categories. Lower bar shows the maximum impact of Basel III and TLAC requirements for G-SIBs as of January 2019.

Implementation of Basel III in the EU

The minimum requirements of own funds for financial institutions specified by the CRR are: (i) a CET1 capital ratio of 4,5%; (ii) a Tier 1 capital ratio of 6%; and (iii) a Total Capital ratio of 8% (EP, 2013b, Article 92). Equation 2.1, 2.2 and 2.3 show the exact calculations including the minimum requirements:

$$\text{CET1 ratio} = \frac{\text{CET1}}{\text{RWA}} \geq 4,5\%; \tag{2.1}$$

$$\text{Tier 1 ratio} = \frac{\text{CET1 + AT1}}{\text{RWA}} \geq 6\%; \tag{2.2}$$

$$\text{Total Capital ratio} = \frac{\text{Total Capital}}{\text{RWA}} = \frac{\text{CET1 + AT1 + Tier 2}}{\text{RWA}} \geq 8\%. \tag{2.3}$$

Observe that all capital requirements can be met with CET1 capital. This option is however not optimal, because issuing new shares to generate Tier 1 capital is more expensive than issuing CoCos and additional equity lowers the Return-on-Equity (RoE) ratio. The main reason that equity is more expensive than CoCos is that CoCos are technically regarded as bonds in the majority of European countries. Coupon payments can therefore be made from pretax earnings and enhance the bank's tax shield (Avdjiev *et al.*, 2013). In addition, the underwriting cost of issuing equity is far higher than those of issuing a CoCo, due to information and managerial agency problems (Calomiris and Herring, 2013).

CoCos can qualify as AT1 or Tier 2 capital. Financial institutions therefore prefer these less expensive capital instruments to minimize the cost of regulatory compliance. The optimal size of each category is limited by the capital requirements introduced in the Basel III framework. Following Equation 2.1 and 2.2, the potential for AT1 CoCos to contribute to the Tier 1 ratio is 1,5% of RWA. From Equation 2.3 it can be observed that the potential for Tier 2 CoCos to contribute to the Total Capital ratio is 2% of RWA.

The CRD-IV describes three additional capital buffers that a financial institution is required to maintain (EP, 2013a, Article 128). All these buffer requirements are expressed as a percentage of RWA and must be met with CET1 capital:

1. All banks must maintain a Capital Conservation (CC) buffer of 2,5%. This requirement will be phased in between January 2016 and January 2019;

2. Local authorities can impose an institution-specific Countercyclical (C) capital buffer of 0 - 2,5% based on country specific credit exposures;

3. The national supervisor can implement a Systemic Risk Buffer (SRB) of 0 - 3% (EP, 2013a, Article 129-137).

The minimum impact of the Basel III framework requires financial institutions to maintain a Total Capital ratio plus Conservation buffer of 10,5%. In some jurisdictions this minimum is far higher resulting from institution-specific buffer requirements, though.

MREL & TLAC

The focus of Minimum Requirements for own funds and Eligible Liabilities is on increasing loss absorbing capacity and resolvability of financial institutions during the gone-concern phase (EBA, 2015). National resolution authorities have to determine institution-specific MREL based on the risk-profile of all banks active in the EU. Both equity and bail-in capital can be used to satisfy the imposed requirement. No resolution authority has made a decision setting MREL for any institution as of July 2016, the exact impact of MREL is therefore still unclear (EBA, 2016a).

Total Loss Absorbing Capacity sets requirements for G-SIBs concerning the available bail-in capital to cope with unexpected losses. From January 2019, the minimum TLAC requirement for G-SIBs is 16% of RWA and steadily increase to 18% in 2028. The capital held for Basel III requirements also counts for TLAC requirements, except for the additional buffer provisions. TLAC should consist of capital instruments that can be written down or converted into equity in case of resolution. AT1 and Tier 2 CoCos perfectly satisfy this condition and therefore have a huge potential to satisfy upcoming TLAC requirements (FSB, 2015b).

2.2.3 Conditions and implications of AT1 qualification

As introduced in Section 2.2, the CRR contains strict conditions for the admission of CoCos as AT1 capital. Not satisfying these conditions results in a Tier 2 qualification. A detailed description of the conditions for AT1 capital can be found in Article 52 of the CRR (EP, 2013b). The main conditions are:

1. Coupon payments are non-cumulative and paid out of Available Distributable Items (ADI). Coupon payments can be cancelled on the discretion of the regulator or the issuer, and this does not constitute an event of default (EP, 2013b, Article 52.l);

2. The trigger event has to be specified in terms of the CET1 capital ratio (Equation 2.1), with a minimum trigger level of 5,125%. Moreover, regulators can force conversion at the PONV based on their judgment about the banks solvency prospects (EP, 2013b, Article 45, 54.1a);

3. Rank below Tier 2 instruments in the event of insolvency of the institution. Are not secured, subject to a guarantee, or any arrangement that enhances the seniority of the claim (EP, 2013b, Article 52.d-f);

4. The maturity must be perpetual and not contain incentives to be redeemed at its call dates. The first call date must be at least five years after issuance (EP, 2013b, Article 52.i), and the option to call may be exercised at the sole discretion of the issuer (EP, 2013b, Article 52.g).

These conditions limit the possibilities for financial institutions to freely design their AT1 CoCos and have several implications for the resulting risk profiles. Investors in AT1 CoCos are exposed to the risks resulting from these conditions and therefore require an adequate coupon rate to compensate for these risks. This high coupon rate affects the total funding costs of financial institutions.

The first condition emphasizes that the issuer has no obligation to any AT1 payments and that AT1 coupons are paid out of the ADI. Skipping coupon payments will damage the reputation and market access of the issuer. Financial institutions will hence never voluntarily skip coupon payments (Chan and Wijnbergen, 2014).

However, if a financial institution does not meet the additional buffer requirements as described in Section 2.2.2, the calculated Maximum Distributable Amount (MDA) restricts several capital distributions. All payments on CET1 capital, dividends, bonuses and AT1 instruments are limited by this MDA (EP, 2013a, Article 141). Moreover, missed coupon payments are permanently lost and do not constitute an event of default. AT1 CoCo holders are therefore exposed to coupon cancellation risk.

The second condition requires the use of the CET1 capital ratio to trigger conversion and empowers the regulator to force conversion at the PONV. Section 2.1.1 already mentioned that book-value triggers lack transparency and the PONV trigger leads to uncertainty for investors (Calomiris and Herring, 2013). The regulatory requirement to trigger the loss absorbing mechanism therefore exposes CoCo holders to uncertain and non-transparent bail-in risk.

The last condition prohibits the presence of coupon step-ups if the CoCo is not redeemed at its call dates. The issuer might therefore have an incentive to skip the call dates if the replacement cost result in higher funding costs (Spiegeleer and Schoutens, 2014). The absence of incentives to redeem CoCos at its call dates results in extension risk for CoCo investors.

Additional risk exposures for CoCo holders are price fluctuations and interest rate changes, just like standard bonds.

2.3 Academic perspective on effective CoCo structures

The regulator dictates strict conditions for CoCos to qualify as AT1 capital, including the requirement to trigger conversion based on the CET1 capital ratio. Academics distance themselves from this book-value trigger, because regulatory capital ratios substantially over-state the true ability to absorb losses and would not have prevented the use of taxpayer's money during the last crisis (Giacomini and Flannery, 2015).

Haldane (2011) shows that regulatory capital ratios failed to forecast the financial crisis of 2008. None of the banks that had to be bailed-out during the crisis had regulatory capital ratios that would have triggered CoCo conversion. On the contrary, by selling profitable activities banks even increased their capital ratios in the period before they had to be bailed-out.[1]

Hence, if these financial institutions had issued going-concern CoCos with regulatory capital triggers, conversion would have failed when it was needed most (Pennacchi, Vermaelen and Wolff, 2014). Market value triggers on the other hand clearly indicated the financial distress and would have led to conversion (Haldane, 2011; Admati *et al.*, 2010; Pennacchi, Vermaelen and Wolff, 2014). Academics therefore prefer the use of market value triggers in their design proposals (Flannery, 2009; French *et al.*, 2009; McDonald, 2010; Calomiris and Herring, 2013; Pennacchi, Vermaelen and Wolff, 2014; Flannery, 2014).

2.3.1 Initial design proposals

Three years before the financial crisis of 2008, Flannery (2005) introduced the first characteristics of a hybrid security that automatically converts from debt into equity when a bank's share price falls below a pre-specified threshold. It was designed to keep banking firms adequately capitalized and absorb losses prior to the point of insolvency, without involving depositors, counter parties or taxpayers. A specific proposal

[1] Kuritzkes and Scott (2009) state that five large financial institutions reported Tier 1 capital ratios between 12% and 16% at the quarter-end before they had to be bailed-out in 2008. Citigroup reported a Tier 1 capital ratio of 11,8% in December 2008, the corresponding market value was only 1% of total assets (Duffie, 2010).

for the design of CoCos is provided in a successive paper by Flannery (2009), where the conversion of debt into equity is automatically triggered when the market-value of the issuer falls below a pre-specified level. An overview of other proposals following the concept of Flannery can be found in Appendix B.

Most of the trigger mechanisms of these early proposals are based on the share price of the issuer. The majority of authors recognize that conversion to equity can potentially lead to dilution, incentives for price manipulation, and death spirals (Flannery, 2009; Kashyap, Rajan and Stein, 2008; McDonald, 2010; French *et al.*, 2009).

Initial shareholders are diluted by the conversion of CoCos if the value of shares resulting from the conversion is higher than the face value of the CoCo. The conversion will not lead to dilution if CoCos contain a principal write-down mechanism, or the conversion to equity does not transfer value from shareholders to CoCo holders (Chan and Wijnbergen, 2016).

2.3.2 Advanced theoretical CoCo structures

The introduction of CoCos resulted in an extensive discussion on the optimal CoCo structure and potential issues that can diminish its effectiveness. The problems recognised in these initial proposals are addressed by three specific CoCo structures proposed by Calomiris and Herring (2013), Pennacchi, Vermaelen and Wolff (2014), and Bulow and Klemperer (2015).

Regulators are not willing to acknowledge these non-compliant CoCos structures as AT1 capital. Unfortunately, none of these advanced theoretical CoCo structures have therefore currently been implemented in practice. The details of these proposals can be found in Appendix B.

2.4 Funding costs of financial institutions and CoCo issuance

The enhanced capital requirements for financial institutions are described in Section 2.2. The resulting impact of these requirements, on cost of funding, is much debated these days. Increasing the amount of equity, assuming the same required returns on debt and equity, will lead to higher total costs of equity. However, additional equity changes the required return on both debt and equity, because the additional equity makes both debt and equity less risky.

Modigliani and Miller (1958) state that the total cost of debt and equity is not affected by the specific funding mix used to increase capital levels. Increasing the share of equity leads to lower cost of both debt and equity.

The extent to which the statement of Modigliani and Miller (1958) apply to banks is debated. According to an impact study on the post crisis Basel reforms by Oliver Wyman (2016), the funding cost of banks increased by 60 to 84 basis points (bps).[2]

[2]This estimate depends on the specific region and does not include the upcoming MREL and TLAC requirements. Increasing the funding costs of $10 billion of debt with 10 bps increases the annual funding cost with $10 million.

Another explanation for the increased funding cost is the perception of the market that financial institutions are more risky, resulting in higher required returns.

The Modigliani and Miller (1958) theorem is therefore not a good description of the situation facing banks in the coming years. Given the relative unattractiveness of debt and equity in the post crisis years, the theorem is unlikely to apply and neither equity nor longterm debt will be cheap. As a result, increasing the amount of available loss absorbing capital will result in additional funding costs. Additional funding costs have a negative impact on profitability (Oliver Wyman, 2016).

Financial institutions are therefore eager to minimize the impact of new regulation and look for instruments to minimize the total costs of regulatory compliance. CoCos are perfectly suited to fulfill this role and if CoCos work as they supposed to, they can reduce the probability of default. Issuing CoCos can therefore reduce the risk of non-CoCo debt holders of the issuer. Hence, replacing this safer debt instruments can potentially lead to lower funding costs (Avdjiev *et al.*, 2015).

The eventual impact on funding costs can be influenced by the specific structure of CoCos and issuer characteristics. Measuring the effect of issuing these CoCos on funding costs can provide valuable insights. Financial institutions can use these insights to optimise their funding costs by issuing the specific CoCo structure that leads to regulatory compliance and the lowest total cost of funding.

2.4.1 Default probabilities and risk shifting incentives

Issuing properly designed CoCos provides additional loss absorbing capital that moves the financial institution further away from the default barrier (Flannery, 2014). The reduction in probability of default results in a higher value of debt instruments. The rollover cost of non-CoCo debt will therefore decrease, resulting in lower funding costs (Avdjiev *et al.*, 2015).

Chen *et al.* (2013) and Albul *et al.* (2015) analysed the effect of capital structure decisions when a financial institution is required or has an option to issue CoCos along with the usual debt and equity instruments. The analysis of Chen *et al.* (2013) revealed that equity holders can have a positive incentive to issue CoCos. The reason is that the benefits of lower default risk accrue not only to debt holders but also to equity holders, due to lower cost of debt rollovers. The increased tax shield further decreases funding costs, resulting in more available capital for equity holders.

Hilscher and Raviv (2014) state that financial institutions that issue going-concern CoCos have lower default probabilities than those that issue gone-concern subordinated debt. Issuing additional equity has the same effect on the default probability as going-concern CoCos. However, financial institutions avoid additional equity because equity is more expensive than debt and lowers the RoE ratio.

Even after suffering substantial losses there are still issues that prevent financial institutions from recapitalizing themselves with new equity. The main reasons for this are risk shifting incentives, the debt overhang problem[3], and the possibility of a government bailout (Admati *et al.*, 2010; Giacomini and Flannery, 2015).

Appropriate choice of CoCo parameters can entirely eliminate or reduce the debt overhang problem (Chen *et al.*, 2013), possibility of a government bailout (Albul *et al.*, 2015), and risk shifting incentives (Hilscher and Raviv, 2014). Designing a feasible CoCo will require trade-offs among multiple goals, though. A realistic CoCo cannot satisfy all the potential goals perfectly (Flannery, 2014).

Risk shifting incentives arise from the wealth transfers that shareholders will receive upon CoCo conversion. Greater risk taking incentives can increase the probability of default and thus decrease the value of debt instruments. Chan and Wijnbergen (2016) analysed the effect of CoCo structures on risk shifting incentives. They showed that CoCos with principal write-down and non-dilutive equity-conversion mechanisms contain incentives to increase risk taking. Dilutive CoCos do not lead to undesired risk taking incentives. The structure of CoCos, and the conversion mechanism in particular, can therefor have a substantial effect on ex-ante risk shifting incentives (Calomiris and Herring, 2013).

2.4.2 Reflection in CDS spread

Two effects of issuing CoCos on default probabilities are described in the previous section. The first is that additional loss absorbing capital resulting from CoCo issuance reduces the probability of default. The second is that the structure of CoCos can reinforce the tendency to increase risk taking and therefore increase the default probability. Debt holders of the issuer are affected by the eventual change in the default probability and this is expected to be reflected in the CDS of the issuer.

A CDS is a derivative contract that provides protection against default of a bond. The buyer of this protection makes payments to the seller. If the reference bond defaults, the buyer of the CDS receives a payout related to the face value of the bond.

The price of a CDS increases when the reference bond becomes more risky (higher default probability) and can therefore be used to gauge investors perception of the bank's credit risk.[4] The CDS can therefore serve as a proxy for the funding cost of financial institutions (Hull, 2006; Weistroffer *et al.*, 2009; Beau *et al.*, 2014).

CDS contracts are regularly traded, the value fluctuates based on the increasing or decreasing probability that a reference entity will default. Bond holders that provide funding to financial institutions are more likely to be fully repaid when the issuer is more resilient to shocks. More resilient financial institutions should therefore tend to face lower funding costs and sellers of protection on bonds of these safer issuers will demand lower premiums.

[3]The debt overhang problem emerges if a bank has an investment opportunity with a positive Net Present Value (NPV), but existing debt holders are expected to claim positive cash flows resulting from this opportunity. This renders the NPV negative and shareholders will therefore be reluctant to invest.

[4]The price of a CDS is referred to as its *spread*, and is denominated in basis points, or one-hundredths of a percentage point. A bank's CDS spread of 150 bp, or 1,50%, means that the insurance of €100,- debt of this bank costs €1,50 per year.

Measuring the effect of CoCo issuance on the CDS spread of the issuer can provide insights in the effect on funding costs of financial institutions. The event study methodology is a good method to structure this quantitative analysis.

2.5 Event study

An event study is a statistical research method to examine the impact of an economic event on the value of an individual security. It is a popular and widely accepted method to asses the information content of an event, especially in the field of economics and finance (MacKinlay, 1997).

The event study method distinguishes between two time periods, an event-window and an estimation period. The event-window is the period in which the market incorporated all relevant news related to a specific event. The estimation period is the period prior to the event-window. Based on this estimation period, the method estimates what the *normal return* of the affected security should be during the event-window. Thereafter, the method deducts this *normal return* from the *observed return* to determine the *abnormal return* attributed to the event. The resulting abnormal returns can then be aggregated in different groups and statistically tested to determine the significance of the event (Henderson, 1990).

2.5.1 Estimating normal returns

The approach used to estimate the normal returns during the event-window is an important part of the event study methodology. There are several approaches to do this. Some common approaches are (i) mean returns, (ii) market returns, and (iii) risk-adjusted returns.

- The mean returns approach assumes that the normal return of a security during the event-window is the same as the average return during the estimation period.
- The market returns approach assumes that the normal return of a security during the event-window is equal to the return of the market in that period.
- The risk-adjusted returns approach uses a regression model to predict expected returns. Abnormal returns are then defined to be the difference between the returns observed and those predicted by the regression model (Henderson, 1990).

Risk-adjusted returns is the most popular approach for event studies and outperforms the mean returns and market returns approach (Cable and Holland, 1999). Henderson (1990) provides an overview of the regression models used in the risk-adjusted returns approach.

It is important to recognize that regression models are based on several statistical assumptions related to the residuals. Specifically, regression models assume that residuals are normally distributed with a mean of zero, have a constant variance, not serially correlated, not correlated with explanatory variables, and there is no correlation between residuals for different firms (Henderson, 1990).

2.5.2 Underlying assumptions of event study methodology

McWilliams and Siegel (1997) indicate that the usefulness of the event study technique depends heavily on a set of rather strong assumptions. If these assumptions are violated, the empirical results may be biased, and the resulting conclusions imprecise.

The three assumptions are: (i) an efficient market; (ii) an unanticipated event; and (iii) no confounding events.

- The Efficient Market Hypothesis (EMH) implies that price changes are only caused by the occurrence of new, credible information. If the EMH holds, security prices should completely and immediately represent all available information (Malkiel and Fama, 1970).
- An unanticipated event means that the market did not receive information before the event-date. This event-date is a clearly defined point in time on which all relevant information is simultaneously announced to the market.
- Confounding events that might affect the results need to be excluded.

2.6 Related research

There are two related studies that analysed the effect of the announcement of an upcoming CoCo issuance on the CDS spread of the issuer.[5] The paper of Avdjiev *et al.* (2013) shortly mentions the effect of new information on the price of CoCos with different characteristics. They do however not relate their conclusions to funding costs or CDS spreads.

The closest related study has been conducted by Avdjiev *et al.* (2015). They analysed the effect of CoCo issuance on funding costs using the event study methodology. Their research is based on a sample of 72 CoCos issued in the first years after the introduction of the first CoCo in December 2009.

Avdjiev *et al.* (2015) conclude that the impact of CoCo issuance on CDS spreads is negative and significant. Indicating that issuing CoCos reduces the default probabilities, and hence the funding costs of financial institutions. In addition, they analysed the effect of different CoCo design characteristics and aspects of the issuer.

The strong part of related research by Avdjiev *et al.* (2015) is that differences in the contractual details and issuer characteristics are taken into account. Another strong part is a sensitivity analysis related to the time it takes to identify the complete market reaction. Table 2.1 summarizes their main findings.

[5] Both studies are conducted by employees of the Bank of International Settlements (BIS), the views expressed are however those of the authors and do not necessarily reflect those of the BIS.

TABLE 2.1: Main findings of related research.

This table summarizes the results of the research conducted by Avdjiev *et al.* (2015). The first column shows the characteristics used to analyse the effect of CoCo issuance. The second column shows the estimated effect on funding costs.

Characteristic	**Effect on funding costs**
Conversion mechanism	The reduction of funding costs is larger for CoCos with equity-conversion mechanisms than for principal write-down mechanisms. They allocate this effect to the importance of the conversion mechanism on risk shifting incentives, where principal write-down mechanisms are assumed to increase risk taking of the issuer.
Trigger level	Trigger levels above 6% have a higher impact on the reduction of funding costs than trigger levels below 6%. This is explained by the earlier conversion of higher trigger CoCos, that keep the bank further away from insolvency.
Systemic importance	CoCo issuance reduces funding costs for both G-SIBs and O-SIBs.
Issuer size	The reduction in funding cost is stronger for larger banks (based on total assets).
Issue amount	Smaller issue amounts in terms of percentage of RWA results in higher reductions of funding costs compared to larger issue amounts.

The lack of related research by Avdjiev *et al.* (2015) is that the authors only distinguish between equity-conversion and principal write-down mechanisms. Not taking into account the difference between partial, complete and temporary write down, and the conversion rate to equity. The specific design of the conversion mechanism is an important factor because this can contain incentives to increase risk taking (Chan and Wijnbergen, 2016).

In addition, Avdjiev *et al.* (2015) do not distinguish between AT1 and Tier 2 qualification. AT1 CoCos convert on a going-concern bases, Tier 2 CoCos can only convert on a gone-concern basis. The difference between these qualifications is therefore expected to be reflected in the eventual impact on default probabilities (Flannery, 2014).

Moreover, the resulting conclusions of Avdjiev *et al.* (2015) are based on a sample of 72 CoCos issued in the first years of the market rise. This sample is therefore not a good representation of the current CoCo market and the results can not be generalized.

The main point of discussion is the method used to determine the normal returns during the event-window. Avdjiev *et al.* (2015) claim that the methodology of James (1987) is used. In contrast to the risk-adjusted returns approach used by James, they actually implemented the market returns approach. As indicated before, the market returns approach assumes that the normal return during the event-window is equal to the return of the market. The risk-adjusted returns approach is the preferred method for the estimation of normal returns (Cable and Holland, 1999).

Based on the shortcomings identified above, the methodology of Avdjiev *et al.* (2015) can be improved upon a deeper analysis related to the contractual details of CoCos, using a representative sample of the current CoCo market, and implementing the risk-adjusted returns approach to estimate normal returns. Chapter 3 explains how the event study methodology is applied for our research.

Chapter 3

Methodology

This chapter introduces the specific research design used to measure the effect of CoCo issuance on the CDS of the issuer and test the statistical significance of this effect.

Section 3.1 first explains the approach used to measure the effect of CoCo issuance on the CDS spread using the event study methodology. Including the time periods (Section 3.1.1), underlying assumptions (Section 3.1.2), estimation of normal returns (Section 3.1.3), and determination of abnormal returns (Section 3.1.4).

Section 3.2 then describes the statistical tests used to evaluate the significance of the abnormal returns and to determine the sensitivity of the research design.

3.1 Research design

We use event study methodology to measure the market reaction of CoCo issuance and the cross-sectional heterogeneity in the responses associated with differences in CoCo design characteristics, and specific aspects of the issuer. Here the event of interest is the announcement and issuance of CoCos. The related market reaction of this event is measured by the corresponding change in the CDS spread of the issuer.

This means that the net effect of additional loss absorbing capital and risk shifting incentives on the default probability of the issuer is expected to be reflected at the credit market and can be measured by the change in the CDS spread of the issuer. Where the eventual change in the CDS spread is used as a proxy for the funding costs of financial institutions.

3.1.1 Time periods

The event study methodology depends on two time periods, an estimation period and an event-window. The estimation period, used to estimate the normal returns, consists of daily returns during the 120 trading days prior to the event-window. MacKinlay (1997) showed that 120 trading days is optimal for an event study based on daily returns.

The event-window is the period in which the market incorporated all relevant news related to a specific event. This event is a clearly defined time interval in which all relevant information is incorporated by the market.

Figure 3.1 is a graphical representation of the estimation period and the event-window.

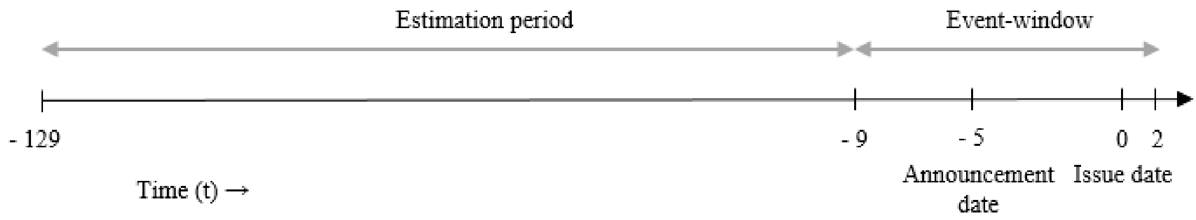

FIGURE 3.1: Timeline of the estimation period and event-window in business days, including announcement date and issue date.

For CoCo issuance there is no single point in time on which all relevant information is publicly announced. Avdjiev *et al.* (2015) describe it as a diffusion process, where the information about the intention of a bank to issue a CoCo is revealed to a small group of investors. As the book is being built, the news diffuses and gets incorporated in the CDS of the issuer prior to the actual issue date. The first market response is therefore expected to take place before the announcement date. Based on the analysis of Avdjiev *et al.* (2015), we assume that the first market response takes place four days before the official announcement.

Right after the actual issue date, relevant information about the over-subscription and successful placement is revealed. Based on the analysis of Avdjiev *et al.* (2015), we assume that all relevant information about over-subscription and successful placement is revealed two days after the issue date.

This results in an event-window of multiple days that incorporates the complete market response prior to the announcement date and after the issue date. The issue date of each CoCo is defined as $t = 0$ and the announcement date is five trading days before the issuance at $t = -5$. The boundaries of the event-window have to be set in such a way that the complete market reaction related to the CoCo issuance is incorporated in the event-window. The start of the event-window is therefore set at $t = -9$ and the end is set at $t = 2$. This results in an event-window of twelve days $[t = -9, t = 2]$. The sensitivity of these assumptions on our results is analysed in Chapter 5.

3.1.2 Underlying assumptions

Section 2.5.2 discussed the three underlying assumptions of the event study methodology. Below I explain how our research design satisfies these assumptions.

- The first is the EMH assumption. This assumption is expected to hold sufficiently to attribute the changes in the CDS spreads to new information related to CoCo issuance. Instead of other price sensitive information released at an earlier stage (Malkiel and Fama, 1970).

- The second assumption is that the event is unanticipated. This assumption can only be satisfied if the market did not receive relevant information before the event-date. For CoCo issuance there is no specific date. Dyckman *et al.* (1984) find that the assumption of unanticipated events is satisfied when the window is chosen large enough to contain the release of all relevant information. As explained in Section 3.1.1, we choose the event-window such that this is satisfied.

- The last assumption states that their should be no confounding events. McWilliams and Siegel (1997) find that the assumption of non-confounding events is satisfied when these event are excluded. We exclude events that might be influenced by confounding events to satisfy this assumption.

3.1.3 Estimating normal returns

A critical part of the event study methodology is estimating normal returns. As indicated in Section 2.6, the risk-adjusted returns approach is used to do this. The risk-adjusted returns approach uses a regression model to estimate normal returns for each individual CDS spread during the event-window. The regression model used in this research design is the market model (Henderson, 1990).

The market model estimates the alpha (α) and beta (β) of each individual CDS spread with respect to the market through an Ordinary Least Squares (OLS) regression over the estimation period. The resulting alpha and beta are then used to calculate the normal returns during the event-window. The results of OLS regression models are often similar to those of the more advanced regression models (Brown and Warner, 1985). This is because the more sophisticated models are often not able to reduce the variance of the abnormal returns (MacKinlay, 1997).

The changes in CDS spreads and market index are calculated using logarithmic returns. Logarithmic or continuously compounded returns are used because these conform better to the normality assumptions underlying regression (Fama, 1973).

The normal return for each security *i* at day *t* is estimated by the market model:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t}, \tag{3.1}$$

where:

$R_{i,t}$ = change in the CDS spread of security *i* at day *t*;
t = during the estimation period: $-129 \leq t \leq -10$;
α_i = alpha, a stable component of security *i*;
β_i = beta, the market sensitivity of security *i*;
$R_{m,t}$ = change of the corresponding market index *m* at day *t*;
$\varepsilon_{i,t}$ = error term with $E(\varepsilon_{i,t} = 0)$ and $var(\varepsilon_{i,t}) = \sigma_\varepsilon^2$.

3.1.4 Abnormal returns

Abnormal returns are defined to be the difference between the actual returns observed during the event-window and the normal returns estimated by the regression model.

The abnormal return is used as a direct measure of the influence of CoCo issuance on the CDS spread (MacKinlay, 1997). It follows from the market model that the Abnormal Return (AR) for security *i* at time *t* is calculated as:

$$AR_{i,t} = R_{i,t} - (\alpha_i + \beta_i R_{m,t}), \tag{3.2}$$

The abnormal returns are calculated during the event-window ($-9 \leq t \leq 2$). Where α_i (alpha) and β_i (beta) are estimated by an OLS regression. The market return during the event-window is given and the change in CDS spread for security *i* at time *t* is observed.

Market returns as alternative for risk-adjusted returns approach

Besides the risk-adjusted returns approach, the market returns approach is used to estimate abnormal returns. This second method is used to compare the result of the risk-adjusted returns approach used our research, with the results of the market returns approach used in related research of Avdjiev *et al.* (2015). This comparison provides insights in the extent to which the data sample and research design affects the results.

The market returns approach assumes that the normal return of a security during the event-window ($-9 \leq t \leq 2$) is equal to the return of the market. Resulting in a prediction error that can be used as a proxy for the abnormal returns. The prediction error of a security *i* at day *t* is defined as:

$$PE_{i,t} = R_{i,t} - R_{m,t}, \tag{3.3}$$

The market returns approach in Equation 3.3 is equal to the risk-adjusted returns approach in Equation 3.2, assuming an α (alpha) of zero and a β (beta) of one.

Cumulative abnormal returns

The Cumulative Abnormal Return (CAR) of security *i* between T_1 and T_2, is the sum of all abnormal returns of security *i* between T_1 and T_2:

$$CAR_{i,(T_1,T_2)} = \sum_{t=T_1}^{T_2} AR_{i,t}, \tag{3.4}$$

where:

$T_1 =$ start of the event-window, $(t = -9)$;
$T_2 =$ end of the event-window, $(t = 2)$.

Now, the Cumulative Average Abnormal Return (CAAR) of N CoCos between T_1 and T_2 is obtained by averaging the abnormal returns across all CoCos in the sample:

$$CAAR_{(T_1,T_2)} = \frac{1}{N}\sum_{i=1}^{N} CAR_{i,(T_1,T_2)}, \tag{3.5}$$

where:

$N =$ the number of CoCos in the sample.

The CAAR is used to visualise the development of the Cumulative Average Abnormal Return during the event-window.

3.2 Statistical testing of abnormal returns

Based on the estimated market reactions, the results are tested on there statistical significance. This can be done using parametric or non-parametric tests. Parametric tests assume that the abnormal returns of individual securities are normally distributed, whereas non-parametric tests do not rely on such assumptions. Parametric tests are therefore more sensitive for outliers than non-parametric tests. Complementing a parametric test with a non-parametric test can verify that the resulting conclusions are not due to such outliers (Henderson, 1990).

To analyse the influence of the normality assumption on the result of our research, we use both a parametric (standardised cross-sectional) and a non-parametric (Wilcoxon signed-rank) test. Where the results of the non-parametric test are not affected by potential outliers. The following sections introduce both tests.

3.2.1 Standardised cross-sectional test

The first test statistic performed is the standardised cross-sectional test used in related event studies (James, 1987; Henderson, 1990; MacKinlay, 1997). This test of statistical significance of the abnormal returns is based on standardised abnormal returns. It accounts for the number of days in the estimation period, the length of the event-window, and is robust to the variance induced by the events (Henderson, 1990).

The Standardised Abnormal Return (SAR) for security *i* is the sum of all abnormal returns during the event-window, corrected by the the standard error of the abnormal returns. Where the event-window lasts T days, and the estimation period is M days.

The SAR is defined as:

$$SAR_i = \frac{1}{S_i} \cdot \sum_{t=T_1}^{T_2} AR_{i,t}, \tag{3.6}$$

where S_i is the standard error of the sum of estimated abnormal returns for security *i*. This factor corrects for the number of days in the event-window and the difference in market variation during the estimation period compared to market variations during the event-window (Patell, 1976).[1] S_i is defined as:

$$S_i = \left[T \cdot V_i^2 \left[1 + \frac{1}{M} + \frac{(R_{m,T} - (T \cdot R_m))^2}{\sum_{j=1}^{M} (R_{mj} - R_m)^2} \right] \right]^{\frac{1}{2}} \tag{3.7}$$

where:

T = number of days in the event-window;
V_i^2 = residual variance of security i during estimation period;
M = number of days in the estimation period;
$R_{m,T}$ = market return over the event-window;
R_m = mean market return over the estimation period;
$R_{m,j}$ = market return at day j during the estimation period.

The Average Standardised Abnormal Return (ASAR) is:

$$ASAR = \frac{1}{N} \sum_{i=1}^{N} SAR_i, \tag{3.8}$$

assuming the individual abnormal returns are independent across the securities, the Z-statistic can be computed:

$$Z = \sqrt{N} \cdot ASAR \tag{3.9}$$

where:

$Z =$ is distributed $N(0,1)$.

In this parametric test, a null-hypothesis is formulated that states that the mean of the standardised abnormal returns in the sample is equal to zero $(H_0 : \mu = 0)$. The alternate hypothesis states that the mean of the standardised abnormal returns in the sample is not equal to zero $(H_1 : \mu \neq 0)$. The critical values to reject the null-hypothesis of this two-sided test depend on the significance level.

Independent sample t-test

To determine whether there is a significant difference between the market reactions to different CoCo structures, the effects are compared using an independent sample t-test. An independent sample t-test is used to test the significance of the difference between the mean of the standardised abnormal returns of different groups, resulting from cross-sectional comparisons. The test statistic is formulated as:

$$T = \frac{\overline{Y_1} - \overline{Y_2}}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}} \tag{3.10}$$

where:

[1] The $\sqrt{T}$ normalizes SAR to a standard deviation of 1 (Patell, 1976).

$\overline{Y_i}$ = mean of sample i;
s_i^2 = variance of sample i;
N_i = sample size of sample i.

For this test, a null-hypothesis is formulated that states that the means of both groups are equal ($H_0 : \mu_1 = \mu_2$). The alternate hypothesis states that the means of the groups are not equal ($H_1 : \mu_1 \neq \mu_2$). The critical values to reject the null-hypothesis of this two-sided test depend on the significance level.

3.2.2 Wilcoxon signed-rank test

The Wilcoxon signed-rank test is a non-parametric statistical test used to analyse whether the difference between two measurements is significant, without assuming that the sample is normally distributed. The steps for the test procedure are:

1. Calculate the absolute difference of all observations $|x_2 - x_1|$ and determine the sign of the difference $(x_2 - x_1)$.
2. Exclude observations where $|x_2 - x_1| = 0$.
3. Order the observations from smallest absolute difference to largest absolute difference and rank them. Equal observations receive the average of the ranks they span.
4. Calculate the test statistic, Z:

$$Z = \frac{\sum_{i=1}^{N_r}(S_i \cdot R_i)}{\sqrt{\frac{N_r(N_r+1)(2N_r+1)}{6}}} \tag{3.11}$$

where:

N_r = sample size excluding observation where: $|x_2 - x_1| = 0$;
S_i = sign of the difference $(x_2 - x_1)$;
R_i = rank of the observation.

In this Wilcoxon signed-rank test, a null-hypothesis is formulated that states that the difference between the measurements follows a symmetric distribution around zero (H_0 : the median difference is zero). The alternate hypothesis states that the difference between the measurements does not follow a symmetric distribution around zero (H_1 : the median difference is not zero). The critical values to reject the null-hypothesis of this two-sided test depend on the significance level.

Chapter 4

Data description

This chapter provides an overview of the data used for this research. Section 4.1 starts with a description of the current state of the CoCo market. This qualitative analysis is based on Moody's (2016b) "CoCo Monitor Database", containing detailed information about the contractual details of 467 CoCos. These characteristics are used in the cross-sectional analysis to identify its influence on abnormal returns.

Section 4.2 describes how the data related to the market index and the individual CDS spreads of the issuers is obtained. This data forms the bases for the quantitative analysis as described in Chapter 3.

4.1 Developments in the CoCo market

Lloyds Banking Group plc issued the first CoCo in December 2009. Since then the market has grown dramatically, banks around the world have issued more than $409 billion of CoCos as of April 2016. This total amount is composed of 467 distinct CoCos, issued by 187 financial institutions, in 38 jurisdictions.

Financial institutions have favored CoCos in the recent years for their ability to absorb losses and compliance with capital requirements. Investors, in turn, have been attracted by the relatively high yields of CoCos in a low interest rate environment.

All issued CoCos contain a specific structure that includes a conversion mechanism, trigger event and lifecycle features. Financial institutions structured 58% of the CoCos to qualify as AT1 capital, the remaining 42% is designed to qualify as Tier 2 capital.

4.1.1 Principal write-down vs. equity-conversion

The regulator imposed no restrictions concerning the two conversion mechanisms of AT1 and Tier 2 CoCos. This freedom is reflected in the market where both conversion mechanisms are used. However, financial institutions and investors seem to prefer principal write-down (54,5%) over equity-conversion (45,5%).

Figure 4.1 shows the growth of the total volume of CoCo issuance between December 2009 and April 2016, broken down by conversion mechanism.

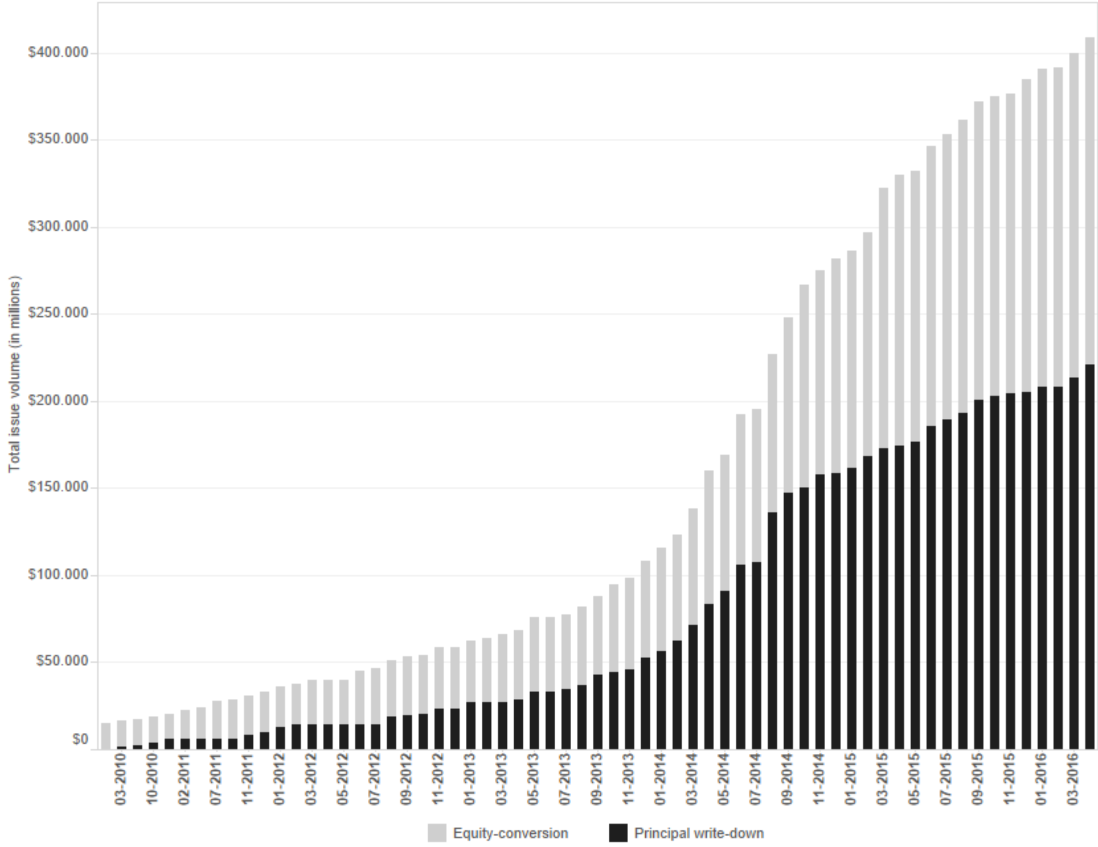

FIGURE 4.1: Growth of total issue volume in the CoCo market between December 2009 and April 2016, broken down by principal write-down and equity-conversion.

There are four possible explanations for the preference of banks to structure CoCos using the principal write-down mechanism: (i) financial institutions without listed shares have no choice, they can only use the principal write-down mechanism; (ii) equity-conversion can potentially dilute shareholders, where the principal write-down mechanism does not jeopardise their majority; (iii) institutional investors can be restricted from investing in instruments that have a possibility to convert to equity, principal write-down therefore attracts a broader group of investors; and (iv) the pay-off resulting from a trigger event involves less uncertainty for principal write-down mechanisms.

Both mechanisms can be broken down further into the exact conversion procedures specified in the contracts. The principal write-down mechanism is specified by a partial (48%) or complete (52%) write-down. Where the partial write-down can be temporary (97%) and a write-up might follow under strict conditions, or the holders of CoCos receive the remaining face value in cash (3%). The conversion rate to equity is specified based on a fixed share price (25%), the share price at the moment of conversion including a floor price (28%), a variable number of shares including a maximum (39%), or any other pre-arranged mechanism (8%). These conversion mechanisms do not lead to a value of shares that is higher than the face value of CoCos. According to the definition of Chan and Wijnbergen (2016), these CoCos are therefore non-dilutive.

4.1.2 Trigger event

The conversion mechanism of CoCos can be activated by a mechanical trigger based on the CET1 capital ratio, a discretionary trigger at the PONV, or both. The EP implemented the regulatory framework introduced by the BCBS in the CRR and CRD-IV, these requirements apply to all members of the EU since January 2014 (EP, 2013b; EP, 2013a). Regulators in other regions made less progress implementing the Basel III framework or use a different interpretation of these requirements. This is reflected by the trigger mechanisms included in the contracts of AT1 and Tier 2 CoCos.

Figure 4.2 presents the composition of AT1 and Tier 2 CoCos, broken down by trigger mechanisms as specified in the contractual details.

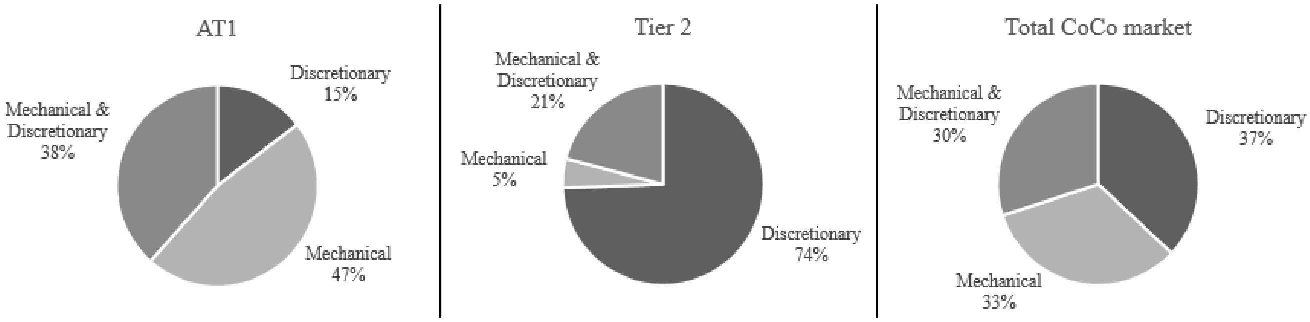

FIGURE 4.2: Trigger mechanism of AT1, Tier 2 and total CoCo market as a percentage of total issue volume in the corresponding capital category.

The majority (85%) of AT1 CoCo contracts contain a mechanical (47%) or mechanical & discretionary (38%) trigger. The residual 15% of the AT1 CoCos contain no mechanical trigger, but these are merely outside the EU. Only 26% of Tier 2 CoCos contain a mechanical trigger. Moreover, financial institutions use CET1 trigger levels between 2% and 8,25%. The minimum trigger level for AT1 CoCos in the EU is 5,125%.

Figure 4.3 shows that 99,5% of all AT1 CoCos are at or above this level.

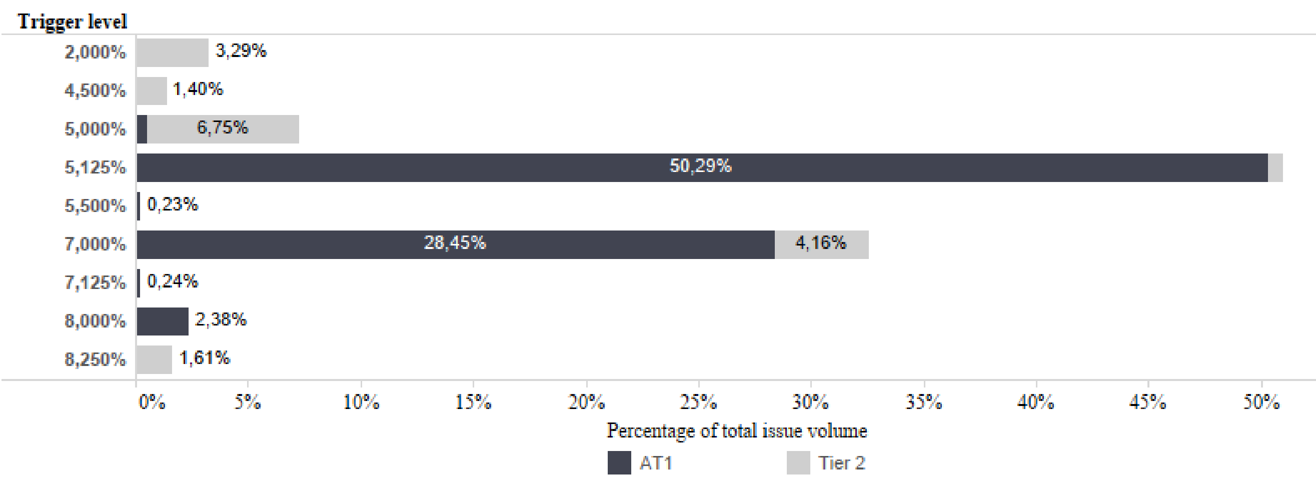

FIGURE 4.3: CET1 trigger level of AT1 and Tier 2 CoCos, as a percentage of total issue volume.

Most Tier 2 CoCos contain trigger levels below the minimum set by the EP. Especially Switzerland (5% trigger) and Russia (2% trigger) are responsible for these deviating Tier 2 trigger levels. Approximately 49% of the AT1 CoCos have trigger levels above the minimum of 5,125%, this means that financial institutions voluntarily increased the probability of conversion.

4.1.3 Lifecycle features

The lifecycle features of CoCos specify information about initial maturity, first call date and coupon rate. The initial maturity of 96% of AT1 CoCos is perpetual, which is one of the requirements specified by the EP. Only financial institutions in Spain deviate from the maturity requirement. However, a closer look reveals that these non-perpetual AT1 CoCos are issued before the implementation of the Basel III framework in 2014. None of the Tier 2 CoCos have a perpetual maturity.

Both, AT1 and Tier 2 CoCos contain call dates on which the issuer can redeem the CoCo at a predefined price and time. The effective maturity will therefore not by definition be perpetual. There are however eleven AT1 CoCos without a call date, this means that these CoCos will continue to exist until the occurrence of a trigger event.

Coupon rates of AT1 CoCos range from 2,5% to 20,8%, with a median of 6%. Tier 2 CoCos contain less risk and the required compensation is therefore expected to result in lower coupon rates. This is reflected by the range of 0,6% to 18%, with a median of 4,9%. Figure 4.4 show the distribution of coupon rates of AT1 and Tier 2 CoCos in a boxplot.

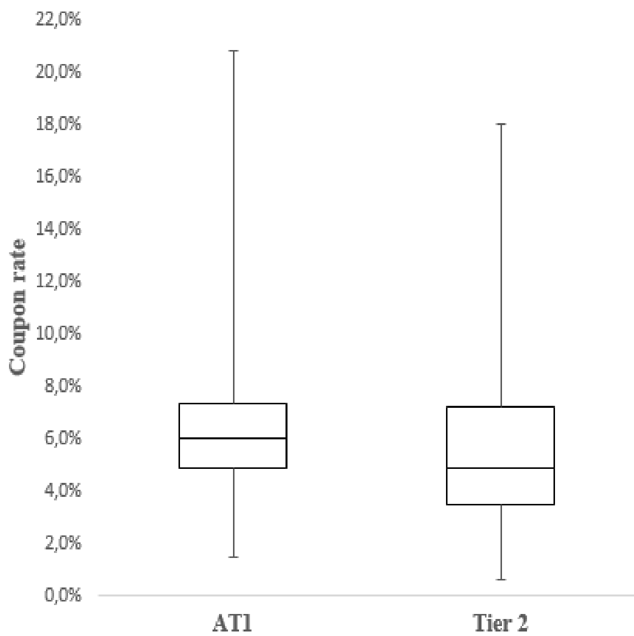

FIGURE 4.4: Distribution of coupon rates of AT1 and Tier 2 CoCos.

4.1.4 Global distribution

The rise of this new market is mainly driven by European and Asian banks, they accounted for 47% and 43% of historical CoCo issuance respectively. Especially large banks located in these regions are responsible for these CoCo issuances. This is probably strongly related to the progress of regulators in implementing Basel III and the tax deductibility of coupon payments (Moody's, 2016a). Coupon payments on CoCos are not tax deductible in US, no CoCos have therefore been issued by banks located there (Moody's, 2016b).

Table 4.1 gives an overview of the fifteen banks with the largest total issue volumes, including their systemic classification.

TABLE 4.1: Top 15 financial institutions based on total issue volumes.

This table reports the fifteen financial institutions with the highest total CoCo issue volumes between December 2009 and April 2016. The first and second column specify the region and jurisdiction of the issuer. The third column indicates the issuer and its systemic importance (G-SIB or O-SIB). The last column shows the total issued amount in millions.

Region	**Jurisdiction**	**Issuer & Systemic importance**	**Total amount**
Asia Pacific	Australia	Commonwealth Bank of Australia (O)	$ 9.607
		Westpac Banking Corporation (O)	$ 7.764
		Australia and New Zealand Banking Grp. (O)	$ 7.343
	China	Bank of China Limited (G)	$ 18.916
		Agricultural Bank of China Limited (G)	$ 17.858
		Industrial & Commercial Bank of China (G)	$ 10.865
		Bank of Communications Co. (O)	$ 8.833
Europe - Euro Area	Netherlands	Rabobank Nederland (O)	$ 8.825
	France	Credit Agricole S.A. (G)	$ 7.467
		Societe Generale (G)	$ 7.124
Europe - Non-Euro Area	Switzerland	Credit Suisse Group AG (G)	$ 18.298
		UBS AG (G)	$ 12.308
	United Kingdom	Lloyds Banking Group plc (O)	$ 15.076
		Barclays Plc (G)	$ 8.788
North America	Canada	Royal Bank of Canada (O)	$ 7.512

There are however some concerns related to the inherent risks of CoCos, resulting in a (temporary) slow down of the CoCo market. Moody's (2016a) expects the global issuance of CoCos in 2016 to be 30% less than the $105 billion issued in 2015. This forecasted $75 billion is well below the $174 billion peak in 2014. See Table 4.2 for a detailed description of developments in issue volume per region.

TABLE 4.2: Developments in CoCo issue volume per region.

This table reports the total issued amount of CoCos between December 2009 and April 2016. The amounts are specified in millions per region, per year. The contribution of each region is expressed as a percentage of the total issue volume in the corresponding year. The last column shows the total CoCo issue volume in millions per region and the total contribution of each region to the global issue volume.

	Year								
Region	2009	2010	2011	2012	2013	2014	2015	YTD 2016	**Total**
Asia Pacific			$3.749	$4.859	$13.183	$90.899	$51.840	$9.154	$173.684
			25,4%	19,0%	26,8%	52,2%	49,5%	38,6%	42,5%
Europe EU		$3.707	$9.002	$4.949	$9.434	$26.751	$14.197	$6.672	$74.712
		100%	61,0%	19,3%	19,2%	15,4%	13,6%	28,1%	18,3%
Europe Non-EU	$14.849		$2.000	$13.928	$22.135	$35.572	$26.758	$2.300	$115.967
	100%		13,6%	54,4%	44,9%	20,4%	25,6%	9,7%	28,3%
Latin America				$1.750	$2.000	$8.295			$12.045
				6,8%	4,1%	4,8%			3,0%
Middle East & Africa				$127	$2.505	$4.341	$3.460	$332	$10.765
				0,5%	5,1%	2,5%	3,3%	1,4%	2,6%
North America						$8.193	$8.429	$5.270	$21.891
						4,7%	8,1%	22,2%	5,4%
Grand Total	$14.849	$3.707	$14.751	$25.612	$49.257	$174.051	$104.684	$23.728	$409.064

The collapse of CoCo issuance in 2016 is the result of uncertainty around the exact specifications of the MDA and concerns related to the risk of coupon cancellation. Especially fears that large losses recorded by Deutsche Bank could force it to suspend coupon payments to holders of AT1 CoCos. This caused uncertainty among investors about the point at which coupons might be suspended. Prices of existing CoCos decreased 10% on average, with a maximum of 20% for the Deutsche Bank CoCos (Moody's, 2016a). This led to the suspension or withdraw of issuance plans, because the required coupon rate in the current market was not attractive.

Several European banks have returned to the market after the announcement that the European Commission is working on proposals to mitigate the mandatory consequence of a bank breaching its capital buffers (Bloomberg , 2016). This proposal makes dividends and bonuses subordinated to coupon payments on AT1 CoCos. Hence decreasing the probability of insufficient MDA for AT1 coupon payments and increasing the attractiveness for investors.

4.2 Individual CDSs & market index

The event study methodology introduced in Chapter 3 relies on two important data sources. The first is individual CDSs to measure the impact of CoCo issuance. The second is a corresponding market index to calculate market returns used as a benchmark for the measurement of abnormal returns.

For 235 of the 467 CoCos, the CDS is liquid and available. These CDSs are obtained from Bloomberg and Datastream. The CDS used to measure the impact of the CoCo issuance is the CDS on five year senior debt.[1] This is a default insurance on senior debt of the issuer and compensates the buyer if a pre-specified credit event occurs. For the remaining CoCos the CDS is illiquid around the issue date, or not available in Bloomberg and Datastream. A list of International Securitie Identification Numbers (ISIN) for all CoCos used in the quantitative analysis can be found in Appendix C.

All the 235 CoCos in the sample have been issued in Europe or Asia Pacific. A specific market index is selected for each region. The iTraxx Senior-Financials CDS index best represents the European benchmark. This index comprises 30 equally weighted CDSs of investment grade financial institutions operating in Europe. The Asia Pacific market is divided in an Asian part and an Australian part. The Asian market benchmark used is the iTraxx Asia CDS index. Consisting of 40 equally weighted investment grade Asian entities. The Australian market benchmark used is the iTraxx Australia CDS index. Consisting of 25 equally weighted investment grade Australian entities.

Market iTraxx indices roll every six moths in March & September. This "roll" means that the underlying of the index is changed to the new series where companies are added or dropped depending on their ratings, cost of protection and ease of trading. Rolling over to the new series results in a change in the price of the iTraxx indices (Hull, 2006; Bloomberg, 2015).

An overview of all entities included (on July 27, 2016) in the iTraxx Senior-Financials CDS index, iTraxx Asia CDS index, and iTraxx Australia CDS index can be found in Appendix D.

4.3 Summary statistics of CoCos included in this research

The insights on the contractual details and the current developments in the CoCo market are provided in Section 4.1. These insights are used in the cross-sectional analysis to identify its influence on abnormal returns. As indicated in Section 4.2, the sample size is reduced to 235 CoCos, due to illiquid or unavailable CDSs. Table 4.3 provides the summary statistics of the 235 CoCos included in the sample, related to all the discussed characteristics. For some CoCo characteristics there is no specific information available, these missing items are grouped and reported for each characteristic.

As mentioned before, AT1 CoCos absorb losses on a going-concern basis and can therefore provide an additional layer of protection for other liability classes and prevent insolvency. Tier 2 CoCos provide less protection for other liability classes, because they can only absorb losses on a gone-concern basis. This difference is expected to be reflected in the analysis of abnormal returns and the table therefore distinguishes between AT1 and Tier 2 CoCos.

[1]The CDS on five year senior debt is the most widely available for banks in the sample and therefore preferred above CDS on subordinated debt.

TABLE 4.3: Summary statistics of CoCos included in the sample.

This table summarizes the characteristic of the CoCos included in the sample. The table distinguishes between AT1 and Tier 2 CoCos and reports for each characteristic: the number of issuance in the sub-sample (N), the percentage of each characteristic in the sub-sample (%), and the the total issue amount in the sub-sample in millions of dollars ($).

		AT1			**Tier 2**		
Characteristic		**N**	**%**	**$**	**N**	**%**	**$**
Total		137	100	166.666	98	100	88.763
Conversion mechanism	**Equity-conversion**	62	45,3	89.785	23	23,5	30.893
	Fixed price	20	32,3	41.154	1	4,3	14.849
	Floor price	21	33,9	28.089	3	13,0	4.258
	Variable number of shares	14	22,6	15.703	19	82,6	11.787
	(missing)	7	11,3	4.840	-	-	-
	Principal write-down	75	54,7	74.880	75	76,5	57.869
	Partial permanent	1	1,3	2.250	3	4,0	3.491
	Temporary	35	46,6	40.891	-	-	-
	Permanent	30	40,0	28.145	48	64,0	47.618
	(missing)	9	12,0	5.594	24	32,0	6.760
Trigger event	**Mechanical**	118	86,1	152.102	28	28,6	47.557
	$< 5,125\%$	-	-	-	20	71,4	35.608
	$5,125\%$	64	54,2	81.661	-	-	-
	$> 5,125\%$	54	45,8	70.441	8	28,6	11.949
	Discretionary	19	13,9	14.563	70	71,4	41.205
Coupon rate	$< 5\%$	27	19,7	19.512	58	59,6	34.086
	$\geq 5\%, < 10\%$	103	75,2	144.256	34	33,7	38.146
	$\geq 10\%$	4	2,9	1.473	3	3,1	504
	(missing)	3	2,2	1.424	3	3,1	16.026
Systemic importance	G-SIB	61	44,5	88.469	28	28,6	36.604
	O-SIB	76	55,5	78.197	70	71,4	52.158
	(as of 3-11-2015)						
Total assets at issuance	<**Median** ($746 bln)	60	43,8	48.172	58	59,2	29.155
	$\geq$ **Median**	77	56,2	118.494	40	40,8	59.608
	< **$1.500 bln**	97	70,8	104.138	74	75,5	66.566
	$\geq$ **$1.500 bln**	40	29,2	62.528	24	24,5	22.197
Contribution to ratios	$< 0,5\%$	87	63,5	100.034	64	63,3	41.121
	$\geq 0,5\%, < 1\%$	34	24,8	49.814	15	15,3	18.502
	$\geq 1\%$	12	8,8	14.344	7	7,1	9.688
	(missing)	4	2,9	2.474	12	12,2	19.452
Region	**Asia pacific**	46	33,6	43.860	68	69,4	40.923
	Europe	91	66,4	122.806	30	30,6	47.840
	Euro area	47	51,6	61.794	4	13,3	5.128
	Non-Euro area	44	48,4	61.012	26	86,7	42.712

Chapter 5

Results

The methodology as described in Chapter 3 and the data as introduced in Chapter 4 are used to perform the quantitative analysis of our research. This chapter contains the results of our analysis and describes the effect of different CoCo structures and issuer characteristics on the funding costs of financial institutions.

Section 5.1 starts with describing the overall impact of CoCo issuance on funding costs of financial institutions and Section 5.1.1 explains the difference between the results of the risk-adjusted returns and market returns model.

The full CoCo sample is then broken down into sub-samples to test the cross-sectional heterogeneity in the responses associated with different CoCo structures and issuer characteristics. Section 5.2 describes the specific effect of different CoCo structures and Section 5.3 does the same for issuer characteristics.

Section 5.4 concludes with a sensitivity analysis related to the underlying assumptions of the risk-adjusted returns and market returns model.

5.1 Overall impact of CoCo issuance on funding costs

We estimate the abnormal returns of CoCo issuance using the risk-adjusted returns and the market returns model. The results of both models are reported in Table 5.1 and indicate that the overall impact of CoCo issuance on the CDS spread of the issuer is negative. The economic relevance of lower CDS spreads is that this theoretically results in lower funding costs. The negative impact is statistically significant at the 5% level for the risk-adjusted returns and at the 1% level for the market returns model.

TABLE 5.1: Effect of CoCo issuance on the funding costs of financial institutions.

This table reports the results of the quantitative analysis on the effect of CoCo issuance on funding costs. N indicates the number of CoCos in the sample. The SAR, Z-value and P-value are reported for the risk-adjusted and market returns model. In addition, for the risk-adjusted model the table reports the average alpha (α) and beta (β) for the full CoCo sample. Resulting from the regression as in Equation 3.1: $R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t}$. The *, **, and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively.

		Risk-adjusted returns model					Market returns model		
	N	α	β	**SAR**	**Z-value**	**P-value**	**SAR**	**Z-value**	**P-value**
All CoCos	235	-0,001	0,331	-33,14	-2,16	0,031**	-52,01	-3,39	0,001***

Figure 5.1 is a graphical representation of the CAAR of the full CoCo sample for both models, showing a gradual decrease of the CAAR over the event-window.

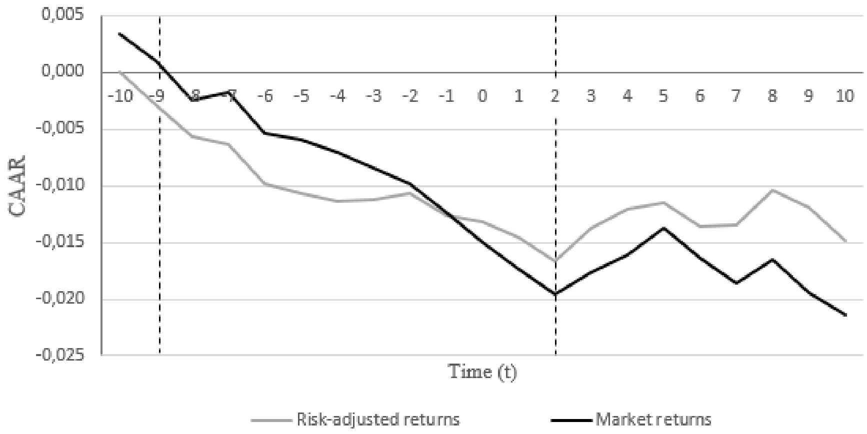

FIGURE 5.1: CAAR of the risk-adjusted returns and market returns model for the full CoCo sample over time. The vertically dotted lines indicate the start and end of the event-window.

The average abnormal return of the risk-adjusted returns and the market returns model for the full sample are equal to 3 and 5 bps, respectively. These abnormal returns are measured using the CDSs on senior unsecured debt of the issuers. If the decrease in CDS spreads is fully passed on to the yields on the corresponding senior unsecured debt, the bank can reduce the total funding costs.

The reduction in funding costs can be achieved by replacing or rolling-over senior unsecured and other debt, where the replaced debt instruments require lower coupon rates and therefore decrease the total cost of funding. Decreasing the annual interest rate of $10 billion of non-CoCo debt with 1 bp reduces the annual interest cost with $1 million.

5.1.1 Difference between risk-adjusted and market returns model

Figure 5.2 shows the same CAAR of both models as in Figure 5.1, including the market movement. Where the market movement is the cumulative average daily change of the market, of the full CoCo sample, over the event-window.[1]

The difference between the risk-adjusted returns and market returns model can be explained by the sensitivity of individual CDS spreads for these market movements:

- Equation 3.2 can be transformed to the market returns model by assumes that alpha (α) is zero and beta (β) is one. Meaning that abnormal returns are calculated by subtracting the complete market movements from the movements of individual CDS spreads.

- The risk-adjusted model estimates alpha and beta for each individual CoCo issuance. Abnormal returns are then calculated based on these estimates.

[1]The market movements line does not indicate that the negative impact of CoCo issuance on the CDS spread is the result of specific market circumstance or the timing of CoCo issuance.

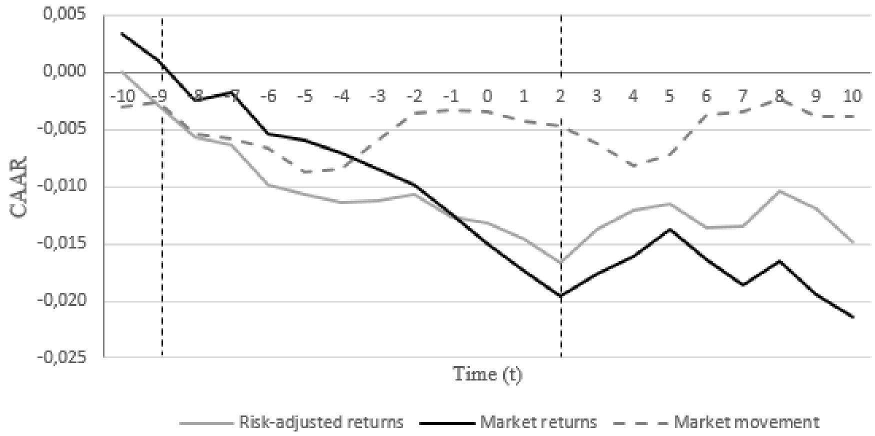

FIGURE 5.2: CAAR of the risk-adjusted returns and market returns model for the full CoCo sample over time, including the cumulative average market movement. The vertically dotted lines indicate the start and end of the event-window.

It follows from Equation 3.2 that the risk-adjusted returns model is affected by alpha and beta, where:

- Alpha is subtracted from the daily change of the individual CDS. Positive (negative) alpha reduces (increases) the daily change of the individual CDS and therefore reduces (increases) the abnormal return.
- Beta is multiplied by the market movement and then subtracted from the daily change of the individual CDS. If the market movement is negative (positive) and beta is one, the daily change of the individual CDS is increased (decreased) by the complete market movement. Resulting in a lower (higher) abnormal return.

The estimated alpha and beta of the risk-adjusted model for the full CoCo sample are -0,001 and 0,331, respectively.[2] Taking into account these factors and the negative cumulative average market movement over the event-window results in a less negative CAAR of the risk-adjusted returns model at $t = 2$.

The difference between the development of the CAAR of the risk-adjusted returns and the market returns model can be explained by the variance in the cumulative average market movement (alpha and beta are constant over the event-window).

5.2 The effect of different CoCo structures on funding costs

To analyse the effect of different CoCo structures, the full CoCo sample is broken down into sub-samples sorted by specific contractual details. The results of this analysis are reported in Table 5.2. The following sections explain the specific effect related to the conversion mechanism (Section 5.2.1), trigger event (Section 5.2.2), coupon rate (Section 5.2.3) and regulatory tiering (Section 5.2.4) used to structure CoCos.

[2]The average beta, of the full CoCo sample is expected to be equal to one. The average beta of the full CoCo sample and all the sub-samples is between 0,164 and 0,587. The iTraxx CDS indexes used as benchmark are therefore not a good representation of the market. Section 6.2 discuses this limitation.

TABLE 5.2: Effect of different CoCo structures on the funding costs of financial institutions.

This table reports the results of the quantitative analysis on the effect of different CoCo structures on the funding costs of financial institutions. The analysis distinguishes between several CoCo structure characteristics: conversion mechanism, trigger event, coupon rate and regulatory tiering. Missing values are grouped for each characteristic. N indicates the number of CoCos in the sub-sample. The SAR, Z-value and P-value are reported for the risk-adjusted and market returns model. In addition, for the risk-adjusted model the table reports the average alpha (α) and beta (β) for each sub-sample. Resulting from the regression as in Equation 3.1: $R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t}$. The R-squared for each sub-sample can be found in Appendix E. The *, **, and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively.

			Risk-adjusted returns model					Market returns model		
Characteristic		**N**	α	β	**SAR**	**Z-value**	**P-value**	**SAR**	**Z-value**	**P-value**
All CoCos		235	-0,001	0,331	-33,14	-2,16	0,031**	-52,01	-3,39	0,001***
Conversion mechanism	**Equity-conversion**	85	0,000	0,347	-19,46	-2,11	0,035**	-29,00	-3,15	0,001***
	Fixed price	21	-0,001	0,587	-6,60	-1,44	0,150	-7,69	-1,68	0,093*
	Floor price	24	0,000	0,445	-4,81	-0,98	0,326	-8,78	-1,79	0,073*
	Variable number of shares	33	0,000	0,164	-4,60	-0,80	0,423	-10,27	-1,79	0,074*
	(missing)	7								
	Principal write-down	150	0,000	0,321	-13,68	-1,12	0,264	-23,01	-1,88	0,060*
	Partial permanent	4	-0,001	0,297	-0,72	-0,36	0,718	-0,98	-0,49	0,624
	Temporary	35	-0,001	0,518	-2,09	-0,35	0,724	-7,79	-1,32	0,188
	Permanent	78	0,000	0,256	-9,03	-1,02	0,307	-13,70	-1,55	0,121
	(missing)	33								
Trigger event	**Mechanical**	146	-0,001	0,401	-16,94	-1,40	0,161	-35,21	-2,91	0,004***
	$< 5,125\%$	20	-0,001	0,427	3,14	0,70	0,483	3,32	0,74	0,458
	$5,125\%$	64	-0,001	0,348	-10,93	-1,37	0,172	-23,65	-2,96	0,003***
	$> 5,125\%$	62	-0,001	0,469	-9,14	-1,16	0,246	-14,88	-1,89	0,059*
	Discretionary	89	0,000	0,200	-16,20	-1,72	0,086*	-16,80	-1,78	0,075*
Coupon rate	$< 5\%$	85	0,000	0,193	-10,99	-1,19	0,233	-19,29	-2,09	0,036**
	$\geq 5\%, < 10\%$	135	0,000	0,436	-22,92	-1,97	0,048**	-33,60	-2,89	0,004***
	$\geq 10\%$	7	-0,003	0,143	0,65	0,24	0,807	-1,32	-0,50	0,618
	(missing)	8								
Tier	**AT1**	137	-0,001	0,371	-22,08	-1,89	0,059*	-40,02	-3,42	0,001***
	Tier 2	98	0,000	0,274	-11,06	-1,12	0,264	-11,99	-1,21	0,226

The results of the independent sample t-test can be found in Appendix F

5.2.1 Conversion mechanism

The results reported in Table 5.2 show that the specific conversion mechanism used significantly affects the default probability of the issuer. The risk-adjusted model indicates that the impact of equity-conversion CoCo structures on CDS spreads is more negative than the impact of principal write-down CoCo structures. The negative impact of equity-conversion mechanisms is statistically significant at the 5% level. For principal write-down mechanisms the impact is not significant. The result of the independent sample t-test indicates that the difference between equity-conversion and principal write-down CoCo structures is not significant (Appendix F).

The market returns model identifies the same effect of the specific conversion mechanism on CDS spreads. The negative impact of equity-conversion mechanisms is however considerably stronger and significant at the 1% level. For principal write-down mechanisms the negative impact is significant at the 10% level. The result of the independent sample t-test indicates that the difference between equity-conversion and principal write-down CoCo structures is significant at the 10% level.

The development of the CAAR of equity-conversion and principal write-down mechanisms, for both models, are shown in Figure 5.3. The CAAR of the market returns model shows that there is a clear difference between the equity-conversion and principal write-down mechanism.

For the risk-adjusted model, the CAAR (at $t = 2$) of the principal write-down mechanism is less negative than the CAAR of the equity-conversion mechanism. Taking a closer look at the development of the CAARs of this model reveals that the difference between both mechanisms is less explicit.

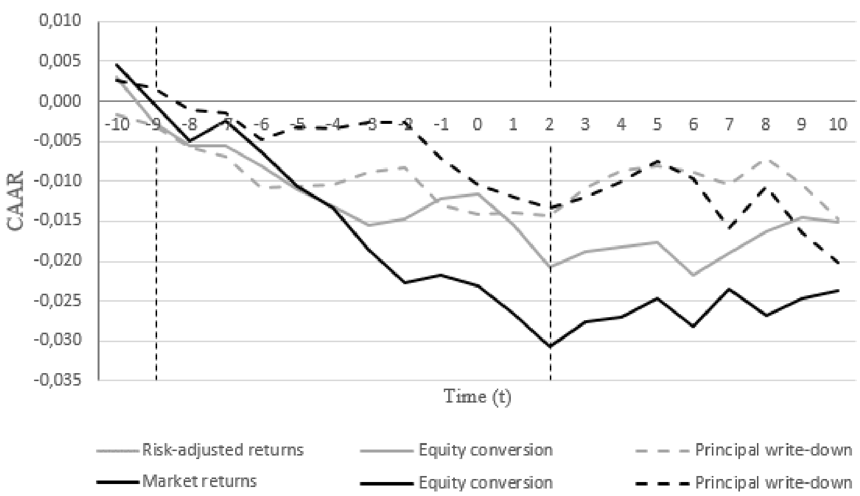

FIGURE 5.3: CAAR of the risk-adjusted returns and market returns model over time, broken down by conversion mechanism. The vertically dotted lines indicate the start and end of the event-window.

The difference between the impact of equity-conversion and principal write-down can be explained by the analysis of Chan and Wijnbergen (2016). They showed that CoCos with principal write-down and non-dilutive equity-conversion mechanisms contain incentives for shareholders to increase risk taking. Avdjiev *et al.* (2015) state that the risk shifting incentives attributed to CoCos with principal write-down mechanisms can increase the probability of default and therefore explain the less negative impact on CDS spreads. As indicated in Section 2.6, a deeper analysis of the specific conversion mechanism is required to verify this explanation.

Specific conversion mechanism

The equity-conversion mechanism is specified in terms of a fixed share price, the share price at the moment of conversion (including a floor price), or a variable number of shares (including a maximum number of shares). Taking a closer look at these mechanisms reveals that none of the equity-conversion CoCos will lead to a value transfer from shareholders to CoCo holders (Section 2.3.1; Section 4.1.1), because the share price of the issuer, on the occurrence of a trigger event, will be below the fixed and floor price specified in the contractual details.[3]

According to Chan and Wijnbergen (2016), a value transfer creates incentives for shareholders to prevent a trigger event and describe this as dilution effects. None of the analysed CoCo structures contains a conversion mechanism that leads to a value transfer from shareholders to CoCo holders. The difference between the impact of equity-conversion and principal write-down is therefore not the result of dilution effects as described by Chan and Wijnbergen (2016).

The simple fact that conversion to equity leads to additional shares and therefore reduces the stake of initial shareholders might explain the observed effect of issuing equity-conversion CoCos instead of principal write-down CoCos.

Principal write-down CoCo structures are specified in terms of a permanent write-down, temporary write-down or partial permanent write-down. None of these structures has a significant negative impact on the default probability of the issuer.

Main findings related to the conversion mechanism

Based on these results we concluded, with 95% confidence, that the CDS spread of financial institutions that issue a CoCo with an equity-conversion mechanism will decrease. We can also concluded that CoCos containing equity-conversion mechanisms are more effective than principal write-down mechanisms in reducing the probability of default and funding costs of financial institutions. This result is however only significant for the market returns model, at the 10% level.

The EP (2013b, CRR) does currently not distinguish between the two conversion mechanisms and financial institutions/investors seem to prefer principal write-down (54,5%) over equity-conversion (45,5%) (Section 4.1.1). Indicating that the results of our analysis could potentially be used to optimise the structure of future CoCo issues and reduce the total cost of funding.

[3] The variable number of shares including a maximum number is basically the same as the share price at the moment of conversion including a floor price. Both mechanisms limit the number of shares resulting from conversion.

5.2.2 Trigger event

Zooming in to the trigger event used to structure CoCos reveals that the results of the risk-adjusted returns and market returns model are contradicting (Table 5.2).

The results of the risk-adjusted model indicate that the impact of issuing CoCos with a discretionary trigger is more negative than the impact of CoCos with a mechanical trigger. The impact of CoCo structures with a discretionary trigger is negative and significant at the 10% level. For mechanical triggers the negative impact on CDS spreads is not significant. The result of the independent sample t-test indicates that the difference between discretionary and mechanical triggers is not significant.

The market returns model on the other hand shows that the impact of issuing CoCos with a mechanical trigger, on CDS spreads, is more negative than the impact of issuing CoCos with a discretionary trigger. The negative impact of CoCos with mechanical triggers is statistically significant at the 1% level. For CoCo structures with a discretionary trigger the impact is negative and significant at the 10% level. The result of the independent sample t-test indicates that the difference between discretionary and mechanical triggers is not significant (Appendix F).

Explanation for the difference between the two models

The difference between the risk-adjusted and market returns model can be explained by the sensitivity of individual CDS spreads for market movements. The alpha and beta of the market returns model are always zero and one, respectively. For the risk-adjusted model the estimated alpha en beta are:

- Average alpha of mechanical and discretionary triggers is -0,001 and 0,000, respectively. The negative alpha of mechanical triggers increases the abnormal return, resulting in a less negative impact of CoCo issuance.
- Average beta of mechanical triggers is 0,401 and for discretionary triggers 0,200. The higher beta of mechanical triggers means that the individual CDSs of CoCos containing these triggers are more sensitive for market movements.

The combination of these factors and the market movements during the event-window are responsible for the difference between both models. An important difference between mechanical and discretionary triggers is that Tier 2 CoCos are not required to contain a mechanical trigger. The trigger level of Tier 2 CoCos is therefore not bounded by regulatory requirements and might blur the results. Taking a closer look at the effect of different trigger levels is therefore interesting.

Mechanical trigger level

The mechanical trigger level is specified in terms of the CET1 ratio. Figure 5.4 shows the development of the CAAR for different trigger levels.

The risk-adjusted model does not provide significant results for any trigger level.

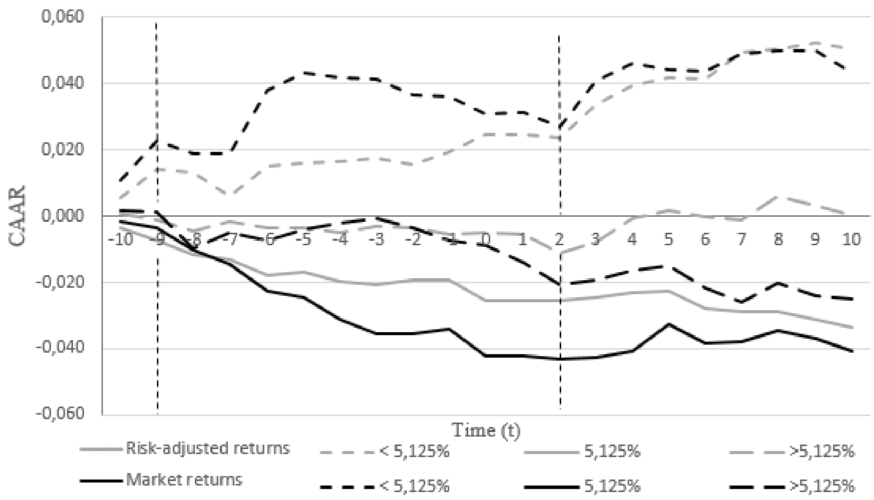

FIGURE 5.4: CAAR of the risk-adjusted and market returns model over time, broken down by trigger levels. The vertically dotted lines indicate the start and end of the event-window.

The result of the market returns model is significant at the 1% level for trigger levels at the regulatory minimum (= 5,125%). The negative impact of trigger levels above the regulatory minimum (> 5,125%) is significant at the 5% level. The impact of trigger levels below the regulatory minimum (< 5,125%) is positive and not significant.

Its interesting to see that the impact of CoCos with trigger levels above the regulatory minimum (> 5,125%) on CDS spreads is less negative than CoCos with trigger levels at the regulatory minimum (= 5,125%). The result of the independent sample t-test indicates that the difference between the regulatory minimum and higher trigger levels is not significant (Appendix F).

The difference between regulatory minimum and lower trigger levels is significant at 10% and 1% level for the risk-adjusted and market returns model, respectively. The difference between trigger levels above the regulatory minimum and trigger levels below this minimum is significant at 5% for the risk-adjusted and market returns model.

Interpretation of the results

Higher trigger levels indicate that the loss absorbing mechanism is activated at an earlier stage and these CoCos are therefore expected to have more impact on the reduction of default probabilities (J.P. Morgan, 2014; Avdjiev *et al.*, 2015). The analysed market response associated with the issuance of these high trigger CoCos does however contradict this expectation. The difference between the regulatory minimum and higher trigger levels is not significant, but the less negative impact of higher trigger levels is counterintuitive.

The financial institutions in this sub-sample, that issued AT1 CoCos with trigger levels above the regulatory minimum, are located in Europe and is dominated by: The United Kingdom (35%), The Netherlands (13%), Sweden (11%) and Switzerland (13%). Another relevant aspect of this sub-sample is that 65% the issuers is classified as G-SIB. See Section 5.3.1 for the effect of systemic classification on default probabilities.

Issuing CoCos with CET1 triggers below the regulatory minimum (<5,125%) has a positive impact on CDS spreads. Indicating that financial institutions that issued these CoCos increased their default probabilities. These results are not significant, but can be explained by the specific composition of the sub-sample.

All these CoCos (20) are structured as Tier 2 instruments and are not required to have a mechanical trigger (Section 2.2.3). The positive impact on CDSs is therefore more likely to be the result of country specific circumstances or the regulatory tiering. As indicated in Section 4.1.2, especially Russia (12) and Switzerland (7) use mechanical trigger levels below 5,125% to structure their Tier 2 CoCos. For this specific situation the Russian Tier 2 CoCos are responsible for the positive impact on CDSs.

Removing CoCos with mechanical triggers below the regulatory minimum from the sub-sample of mechanical triggers changes the result of both models. Now, the impact of issuing CoCos with mechanical triggers on CDS spreads is more negative than the impact of discretionary triggers. The impact of CoCo structures with mechanical triggers is negative and significant at the 10% and 1% level for the risk-adjusted returns and market returns model, respectively.

Main findings related to the trigger event and trigger level

Our results indicate, with 90% confidence, that the CDS spread of financial institutions that issue CoCos with a discretionary trigger event decreases. We can also concluded, with 90% confidence, that the CDS spread of financial institutions that issue CoCos with a mechanical trigger event, and trigger levels at or above the regulatory minimum, decreases. Based on our analysis of the specific trigger level we conclude, with 99% confidence for the market returns model, that the regulatory minimum of 5,125% reduces the probability of default and funding costs of the issuer.

The regulatory minimum of 5,125% is the most effective in reducing default probabilities. 49% of AT1 CoCos have trigger levels above this minimum (Section 4.1.2). Financial institutions could therefore take advantage of our result by structuring future CoCos with trigger levels of 5,125% and optimise the effect on total funding costs.

5.2.3 Coupon rate

Coupon rates at issuance indicate the return required by CoCo investors. High coupon rates compensate for high risks. The results of the risk-adjusted model, as reported in Table 5.2, show that the impact of coupon rates between 5% and 10% on CDS spreads is more negative than coupon rates below 5%. Issuing CoCos with coupon rates above 10% has a positive impact on the CDS spreads. The negative impact of coupon rates between 5% and 10% is statistically significant at the 5% level. The results of the independent sample t-test indicate that the difference between different coupon rates is not significant (Appendix F).

The market returns model indicates the same impact for coupon rates between 5% and 10% (1% significance level). For coupon rates below 5% the negative impact is significant at the 5% level. The results of the independent sample t-test indicate that the difference between different coupon rates is not significant.

Figure 5.5 shows the development of the CAAR for different coupon rates. Its interesting to see that the CAAR of CoCos with a coupon rate above 10% is very volatile during the event-window. The sub-sample of CoCos with a coupon rate of 10% consists of seven distinct CoCos and is therefore to small for general conclusions.

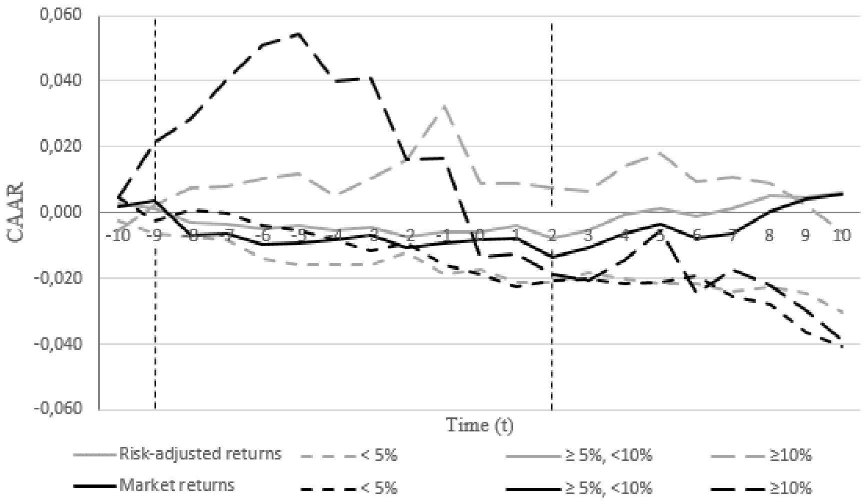

FIGURE 5.5: CAAR of the risk-adjusted and market returns model over time, broken down by coupon rates. The vertically dotted lines indicate the start and end of the event-window.

AT1 CoCo investors are exposed to more and other risks than Tier 2 CoCo investors (Section 2.2.3). Coupon rates of AT1 CoCos are therefore generally higher than coupon rates of Tier 2 CoCos (Section 4.1.3). Another factor that blurs the results is the risk free rate. The risk free rate is included in all coupon rates, but is not constant over time and can deviate for geographical locations. Individual financial institutions can not influence this risk free rate and have to accept the required return of the market. The impact of different coupon rates on the probability of default of the issuer can therefore better be explained by the regulatory tiering of CoCos.

Main findings related to the coupon rate

Based on these results we concluded, with 95% confidence, that the CDS spread of financial institutions that issue a CoCo with coupon rates between 5% and 10% will decrease.

5.2.4 Regulatory tiering

The last sorting variable used to explain the effect of different CoCo structures is the regulatory tiering (AT1 or Tier 2), the results are reported in Table 5.2. The results of the risk-adjusted model indicate that the impact of issuing AT1 CoCos on the CDS spread of the issuer is more negative than issuing Tier 2 CoCos. The negative impact of issuing AT1 CoCos is statistically significant at the 10% level. For Tier 2 CoCos the negative impact is not significant. The result of the independent sample t-test indicates that the difference between AT1 and Tier 2 CoCos is not significant (Appendix F).

The results of the market returns model indicate a higher significance (1% level) of the negative impact of AT1 CoCos. For Tier 2 CoCos the negative impact is not significant. The result of the independent sample t-test indicates that the difference between AT1 and Tier 2 CoCos is not significant.

Figure 5.6 shows the development of the CAAR of AT1 and Tier 2 CoCo structures. For both models, the CAAR of AT1 CoCos gradually decreases during the event-window.

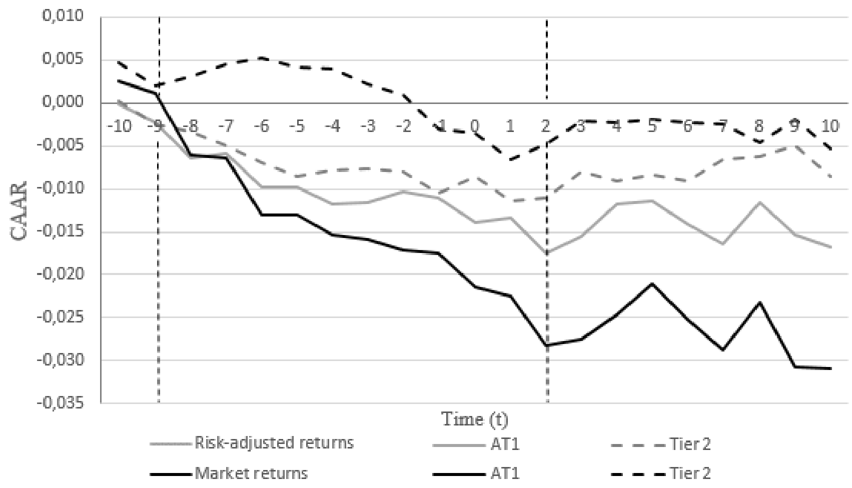

FIGURE 5.6: CAAR of the risk-adjusted and the market returns model over time, broken down by regulatory tiering. The vertically dotted lines indicate the start and end of the event-window.

AT1 and Tier 2 CoCos both provide additional loss absorbing capital. As indicated in Section 2.2.3, AT1 CoCos have to comply with strict requirements set by the EP (2013b, CRR). One of these requirements is that the regulator can cancel coupon payments of AT1 CoCos, without constituting a default event. Tier 2 CoCos do not contain these restrictions on coupon payments.

Another aspect of AT1 CoCos is that they can be converted or written-down on a going-concern basis. Tier 2 CoCo can only be converted or written-down on a gone-concern basis. Issuing AT1 CoCos therefore contains additional options to preserve the bank as a going-concern, resulting in a higher reduction in default probabilities.

Market movements during the event-window

The impact of issuing AT1 CoCos is more negative than issuing Tier 2 CoCos. If financial institutions have different incentives for issuing AT1 and Tier 2 CoCos, the difference could be explained by the timing of issuance. Figure 5.7 shows the cumulative average market movement of AT1 and Tier 2 CoCos. Neither of these lines shows a cumulative average decrease of the market. The result of the independent sample t-test indicates that the difference between the cumulative average market movement of AT1 and Tier 2 CoCos is not significant. The difference between AT1 and Tier 2 CoCos can therefore not be attributed to different market conditions.

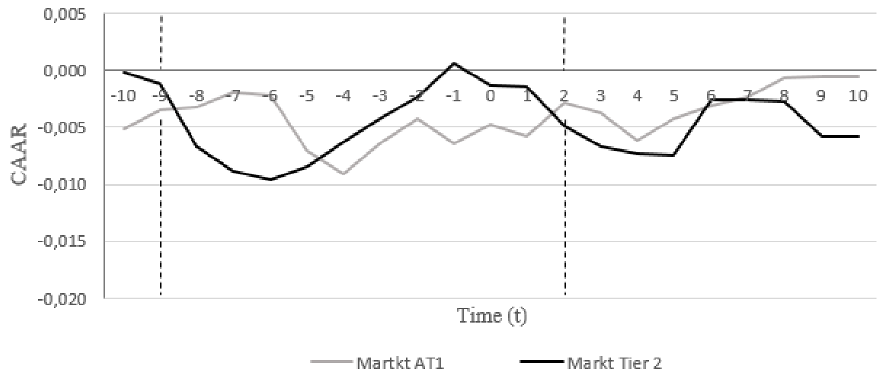

FIGURE 5.7: Cumulative average market movement of AT1 and Tier 2 CoCos. The vertically dotted lines indicate the start and end of the event-window.

Main findings related to the regulatory tiering

Based on these results we concluded, with 90% confidence, that the CDS spread of financial institutions that issue an AT1 CoCo will decrease. AT1 CoCo structures are more effective (not significant) than Tier 2 CoCos in reducing the probability of default of financial institutions. Under the current capital requirements, specified by the EP (2013b, CRR), there is a potential for both CoCo structures. The CoCo structure that optimises the total funding costs depends on the specific situation of the issuer related to earlier issued CoCos and the amount of debt funding used.

If a financial institution already issued AT1 CoCos with a total value of more than 1,5% of RWA, it could still be optimal to issue an AT1 instead of a Tier 2 CoCo. Considering that the effect of issuing AT1 CoCos on default probabilities can compensate the higher coupon rate of AT1 CoCos. The on average higher coupon rates of AT1 CoCos can be compensated by high amounts of debt funding. Decreasing the required coupon rates of a large amount of debt can compensates for the higher coupon rate of AT1 CoCos.

5.3 The effect of CoCo issuer characteristics on funding costs

In this section we analyse the effect of CoCo issuer characteristics on funding costs. The full CoCo sample is broken down into sub-samples to test the cross-sectional heterogeneity in responses associated with different issuer characteristics. The results of this analysis are reported in Table 5.3.

The following sections explain the specific effect related to the systemic importance (Section 5.3.1), total assets at issuance (Section 5.3.2), contribution to capital ratios (Section 5.3.3) and region (Section 5.3.4) of the issuer.

TABLE 5.3: Effect of different issuer characteristics on the funding costs of financial institutions.

This table reports the results of the quantitative analysis on the effect of CoCo issuer characteristics on the funding costs of financial institutions. The analysis distinguishes between several CoCo issuer characteristics: systemic importance, total assets at issuance, contribution to capital ratios and region. Missing values are grouped for each characteristic. N indicates the number of CoCos in the sub-sample. The SAR, Z-value and P-value are reported for the risk-adjusted and market returns model. In addition, for the risk-adjusted model the table reports the average alpha (α) and beta (β) for each sub-sample. Resulting from the regression as in Equation 3.1: $R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t}$. The R-squared for each sub-sample can be found in Appendix E. The *, **, and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively.

			Risk-adjusted returns model					**Market returns model**		
	Characteristic	**N**	α	β	**SAR**	**Z-value**	**P-value**	**SAR**	**Z-value**	**P-value**
	All CoCos	235	-0,001	0,331	-33,14	-2,16	0,031**	-52,01	-3,39	0,001***
Systemic importance	**G-SIB**	89	-0,001	0,439	-10,83	-1,15	0,251	-16,67	-1,77	0,077*
	AT1	61	-0,001	0,468	-8,89	-1,14	0,255	-14,20	-1,82	0,069*
	Tier 2	28	-0,001	0,378	-1,95	-0,37	0,713	-2,47	-0,47	0,641
	O-SIB	146	0,000	0,264	-22,31	-1,85	0,065*	-35,34	-2,93	0,003***
	AT1	76	-0,001	0,294	-13,19	-1,51	0,130	-25,82	-2,96	0,003***
	Tier 2	70	0,000	0,232	-9,12	-1,09	0,276	-9,52	-1,14	0,255
Total assets at issuance	**<Median ($746 bln)**	116	0,000	0,218	-21,70	-2,01	0,044**	-32,85	-3,05	0,002***
	$\geq$ Median	119	-0,001	0,449	-11,44	-1,05	0,294	-19,16	-1,76	0,079*
	$<$ $1.500 bln	171	0,000	0,304	-30,56	-2,34	0,019**	-43,87	-3,35	0,001***
	$\geq$ $1.500 bln	64	-0,001	0,401	-2,58	-0,32	0,747	-8,14	-1,02	0,309
Contribution to ratios AT1 & Tier 2	**Tier 1 capital ratio**	**AT1**								
	$< 0,5\%$	88	-0,001	0,438	-8,24	-0,88	0,380	-22,03	-2,35	0,019**
	$\geq 0,5\%, < 1\%$	33	0,000	0,313	-11,36	-1,98	0,048**	-14,06	-2,45	0,014**
	$\geq 1\%$	12	-0,001	0,438	-3,25	-0,94	0,348	-4,99	-1,44	0,150
	(missing)	4								
	Total Capital ratio	**Tier 2**								
	$< 0,5\%$	64	0,000	0,238	-9,62	-1,20	0,229	-9,10	-1,14	0,255
	$\geq 0,5\%, < 1\%$	15	0,000	0,265	-3,77	-0,97	0,330	-5,21	-1,35	0,178
	$\geq 1\%$	7	0,000	0,250	-0,25	-0,10	0,924	0,62	0,24	0,814
	(missing)	12								
Region	**Asia Pacific**	114	0,000	0,184	-18,89	-1,77	0,077*	-31,42	-2,94	0,003***
	Europe	121	-0,001	0,475	-14,25	-1,30	0,195	-20,59	-1,87	0,061*
	Euro area	51	-0,001	0,516	-5,03	-0,70	0,481	-12,76	-1,79	0,074*
	Non-Euro area	70	-0,001	0,435	-9,22	-1,10	0,271	-7,83	-0,94	0,349

The results of the independent sample t-test can be found in Appendix F

5.3.1 Systemic importance

The first sorting variable to analyse the effect of CoCo issuer characteristics on funding costs is the systemic importance.[4] The results reported in Table 5.3, indicate that the systemic classification of financial institutions considerably affects the default probability of CoCo issuers.

The risk-adjusted returns model shows that the impact of O-SIBs that issue CoCos on CDS spreads is more negative than the impact of G-SIBs that issue CoCos. The negative impact of O-SIBs that issue CoCos is statistically significant at the 10% level. The negative impact of G-SIBs that issue CoCos is not significant. The result of the independent sample t-test indicates that the difference between G-SIBs and O-SIBs that issue CoCos is not significant (Appendix F).

The results of the market returns model indicate the same effect. The impact of O-SIBs that issue CoCos on CDS spreads is significant at the 1% level. The negative impact of G-SIBs that issue CoCos is significant at the 10% level. The result of the independent sample t-test indicates that the difference between G-SIBs and O-SIBs that issue CoCos is not significant.

The development of the CAAR for the risk-adjusted and market returns model are shown in Figure 5.8. The CAAR of O-SIBs gradually decreases over the event-window. For G-SIBs the CAAR is more volatile during and after the event-window.

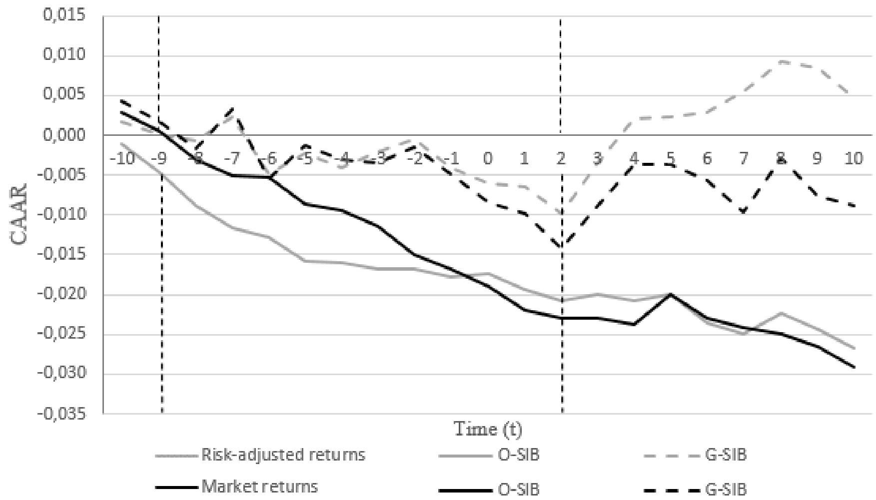

FIGURE 5.8: CAAR of the risk-adjusted and the market returns model over time, broken down by systemic importance (G-SIBs and O-SIBs). The vertically dotted lines indicate the start and end of the event-window.

Avdjiev *et al.* (2015) showed that CoCo issuance reduces funding costs for G-SIBs and O-SIBs. The results of the risk-adjusted and market returns model indicate that the default probability of O-SIBs that issue CoCos decline more than the default probability of G-SIBs that issue CoCos. This can be explained by the market perception that G-SIBs are still too-big-to-fail and if in distress will receive government support.

[4]This split is based on the latest G-SIBs list issued by the FSB (2015a).

The implicit government guarantee is incorporated in the CDS spread and default probability of G-SIBs. The effect of additional loss absorbing capital provided by the issuance of CoCos therefore has less impact on G-SIBs.

Zooming in to the regulatory tiering of CoCos issued by G-SIBs and O-SIBs shows that mainly AT1 CoCos are responsible for the negative impact on CDS spreads. The results of the risk-adjusted returns model indicate that the impact of issuing AT1 CoCos is more negative for both systemic classifications. Neither of the sub-samples shows significant results.

The results of the market returns model indicate the same effect. The impact of O-SIBs that issue AT1 CoCos on CDS spreads is significant at the 1% level. The negative impact of G-SIBs that issue AT1 CoCos is significant at the 10% level. The impact of O-SIBs and G-SIBs that issue Tier 2 CoCos is not significant.

Main findings related to the systemic importance

Based on these results we concluded, with 90% confidence, that the CDS spread of O-SIBs that issued a CoCo, decreased.

The systemic classification of financial institutions is based on the methodology imposed by the BCBS (2016). Factors that are taken in into account are: size, cross-jurisdictional activity, interconnectedness, substitutability and complexity. The next section zooms in to the specific effect of the size of the issuer in terms of total assets.

5.3.2 Size of issuer in terms of total assets

Total assets of the issuer is the second variable to analyse the effect of CoCo issuer characteristics on funding costs. The full CoCo sample is split based on the median ($746 billion) of total assets at issuance. The results of the risk-adjusted and market returns model are reported in Table 5.3.

The results show that the size of the issuer, in terms of total assets at issuance, influences the effect on CDS spreads. The impact on CDS spreads is more negative for issuers with total assets below the median than the impact of issuers with total assets above the median. The negative impact of issuers below the median is statistically significant at the 5% and 1% level for the risk-adjusted and market returns model, respectively. The negative impact of issuers with total assets above the median is only significant for the market returns model (at 10% level).

The results of the independent sample t-test indicate that the difference between financial institution that issue CoCos with total assets below and above the median is not significant (Appendix F).

Increasing the total assets threshold

Using a total assets threshold of $1.500 billion instead of the median emphasizes the difference between small and large financial institutions in terms of total assets.

The impact on CDS spreads is more negative for issuers with total assets below \$1.500 billion than the impact of issuers with total assets above \$1.500 billion. The negative impact of issuers with total assets below \$1.500 billion is statistically significant at the 5% and 1% level for the risk-adjusted and market returns model, respectively. The negative impact of issuers with total assets above \$1.500 billion is not significant.

The results of the independent sample t-test indicate that the difference between financial institution that issue CoCos with total assets below and above the \$1.500 billion is not significant.

Figure 5.9 shows the development of the CAAR, of the risk-adjusted and market returns model, for financial institutions that issued CoCos with total assets above and below \$1.500 billion.

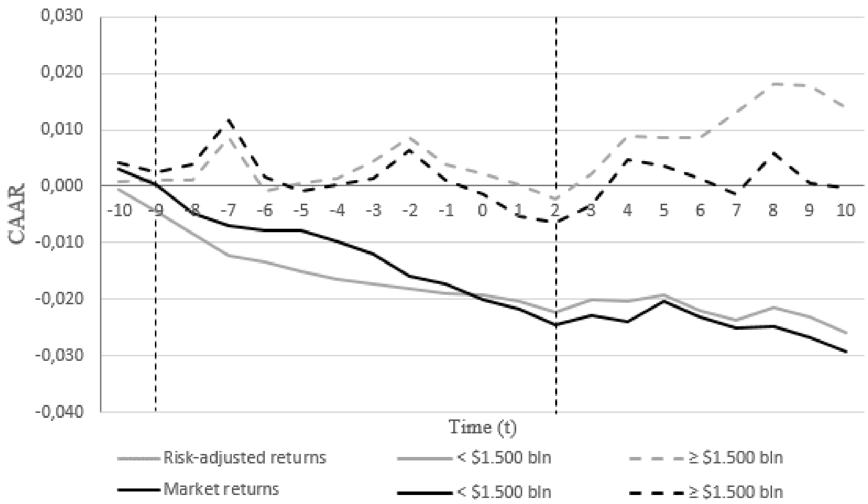

FIGURE 5.9: CAAR of the risk-adjusted and market returns model over time, broken down by total assets at issuance. The threshold used is \$1.500 billion. The vertically dotted lines indicate the start and end of the event-window.

The CAAR of CoCo issuers with total assets below \$1.500 billion gradually decreases over the event-window. For CoCo issuers with total assets above \$1.500 billion the CAAR does not substantially decrease over the event-window and even increases between $t = 2$ and $t = 10$.

Related research of Avdjiev *et al.* (2015) showed that the effect of CoCo issuance on default probabilities is stronger for larger financial institutions. Our research indicate opposite effects. For both the median and \$1.500 billion threshold of total assets, the negative impact on default probabilities is stronger for smaller financial institutions.

Main findings related to the size of the issuer in terms of total assets

Based on these results we concluded, with 95% confidence, that the CDS spread of financial institutions that issue a CoCo and has less than \$1.500 billion of total assets, decreases.

Our analysis suggests that large financial institutions, in terms of total assets, that issue CoCos are considered as too-big-to-fail. The effect of additional loss absorbing capital therefore has less impact on the default probability of these banks.

5.3.3 Contribution to capital ratios

The third sorting variable used to analyse the effect of CoCo issuer characteristics on funding costs is the contribution to capital ratios. This analysis takes into account both the regulatory tiering of CoCos and the size of the issuer.

Issuing AT1 CoCos results in an increase of the Tier 1 ratio. Issuing Tier 2 CoCos results in an increase of the Total Capital ratio. The increase of the Tier 1 and Total Capital ratio depend on the issue amount of the CoCo and the size of the issuer in terms of RWA. The results of this analysis are reported in Table 5.3.

None of the results related to the contribution of Tier 2 CoCos to the Total Capital ratio are significant and will therefore not be discussed.

Contribution to Tier 1 ratio

The impact of issuing AT1 CoCos is more negative for contributions to the Tier 1 ratio between 0,5% and 1%, than for contribution below 0,5% and above 1%. The negative impact of the contribution to the Tier 1 ratio between 0,5% and 1% is statistically significant at the 5% level for the risk-adjusted returns and market returns model. The negative impact of other Tier 1 contributions are not significant.

The results of the independent sample t-test indicate that the difference between Tier 1 ratio contributions below 0,5% and between 0,5% and 1% is significant at the 10% level for both models. Other differences are not significant (Appendix F).

Figure 5.10 shows the development of the CAAR, of the risk-adjusted and market returns model, for different Tier 1 contributions of AT1 CoCos.

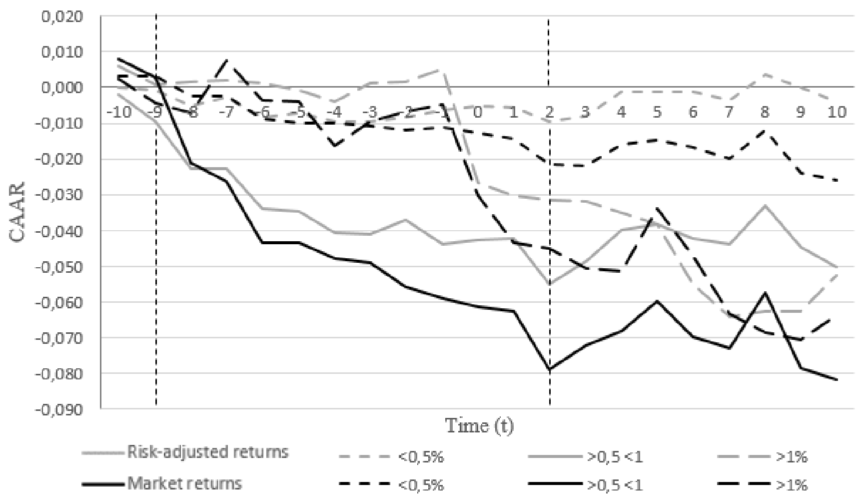

FIGURE 5.10: CAAR of the risk-adjusted and market returns model over time, broken down by contributions to the Tier 1 capital ratio. The vertically dotted lines indicate the start and end of the event-window.

The CAAR of the risk-adjusted and market returns model show a gradual decrease for CoCos that contribute between 0,5% and 1% to the Tier 1 capital ratio. The CAAR for contributions below 0,5% does not show a clear decrease over, or after, the event-window. This can be explained by the minor impact of these contributions.

The decrease in the CAAR for contributions above 1% appears to be delayed until $t = -1$. A possible explanation for this delay is doubts related to the successful placement of such large CoCo issues.

Related research of Avdjiev *et al.* (2015) did not find different effects related to the contribution level of CoCos.

Main findings related to the contribution to capital ratios

Based on these results we concluded, with 95% confidence, that the CDS spread of financial institutions that issue an AT1 CoCo, with a contribution to the Tier 1 ratio between 0,5% and 1%, decreases.

We can also concluded, with 90% confidence, that AT1 CoCos that contribute between 0,5% and 1% to the Tier 1 ratio are more effective in reducing the default probability of the issuer than contributions below 0,5%.

5.3.4 Region of the issuer

The last soring variable used to analyse the effect of CoCo issuer characteristics on funding costs is the region of the issuer. The results of the risk-adjusted and market returns model indicate that the region of the issuer influences the effect on CDS spreads. The full CoCo sample contains CoCos issued in the Asia Pacific and Europe. The European issuers can be broken down in issuers located in the Euro area and issuers located in the non-Euro area.

The results, as reported in Table 5.3, indicate that the impact is more negative for issuer located in the Asia Pacific than for issuers located in Europe.

The negative impact of Asia Pacific issuers is statistically significant at the 10% and 1% level for the risk-adjusted and market returns model, respectively. The negative impact of European issuers located in the Euro area is only significant for the market returns model (at 10% level). The result of the independent sample t-test indicates that the difference between regions is not significant (Appendix F).

Figure 5.11 shows the development of the CAAR for issuers located in the Asia Pacific, the Euro area and issuers located in the non-Euro area.

The development of the CAAR of European CoCo issuers located in the non-Euro area can be explained by the composition of the sub-sample. The non-Euro area includes financial institutions located in: The United Kingdom (33%), Switzerland (33%), Russia (19%), Sweden (10%), Denmark (3%) and Norway (3%).

The Tier 2 CoCos issued by financial institutions located in Russia have a positive effect on CDS spreads (Section 5.2.2). In addition, 72% of the CoCos issued in the non-Euro area (excluding Russia) are issued by G-SIBs.

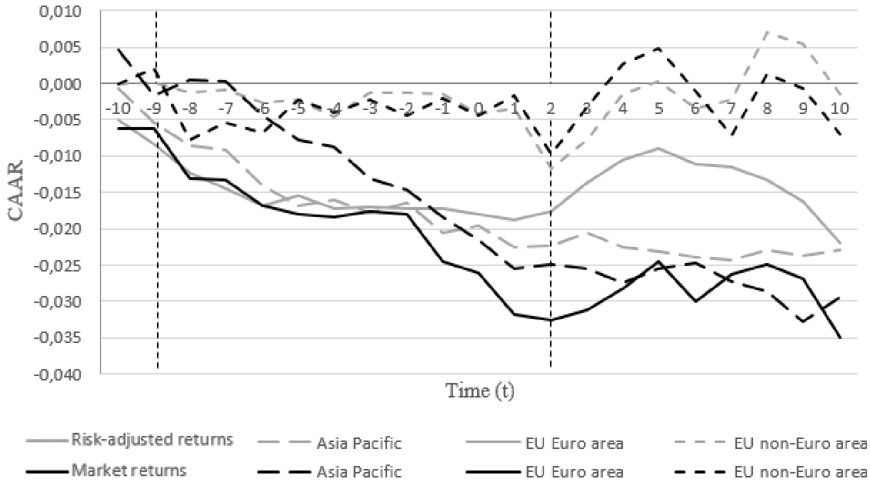

FIGURE 5.11: CAAR of the risk-adjusted and market returns model over time, broken down by the region of the issuer. The vertically dotted lines indicate the start and end of the event-window.

Main findings related to the region of the issuer

Based on these results we concluded, with 90% confidence, that the CDS spread of CoCo issuers located in the Asia Pacific will decrease. For CoCo issuers located in Europe the decrease in CDS spreads is only significant for the market returns model (90% confidence).

5.4 Sensitivity analysis

Our results of the risk-adjusted returns and market returns model are subject to underlying assumptions related to the event-window, the estimation period and normality of abnormal returns. The impact of these underlying assumptions on our results is examined by means of a sensitivity analysis.

5.4.1 Event-window and estimation period

We use an event-window of twelve days to analyse the effect of CoCo issuance on the funding costs of financial institutions. We assume that the first market response of CoCo issuance takes place four days before the official announcement at $t = -9$ and all relevant information is incorporated two days after issuance at $t = 2$.

The difference between the risk-adjusted returns and market returns model can be explained by the alpha and beta estimate. Alpha and beta for the risk-adjusted returns model are estimated by Equation 3.1. We use an estimation period of 120 trading days and assume that this period is optimal to estimate alpha and beta.

Start of the event-window

The sensitivity of our results is analysed by changing the start of the event-window to $t = -11$, $t = -10$, $t = -8$, or $t = -7$. The results of these start dates are reported in Appendix G. This analysis is performed for the risk-adjusted returns (Table G.1 and Table G.3) and the market returns model (Table G.2 and Table G.4). For both models we observe that our results are more stable for larger sample sizes and the P-value of smaller sample sizes is more volatile.

The results of the risk-adjusted returns model related to the overall impact of CoCo issuance on the CDS spread of the issuer are significant at the 5% level for start dates between $t = -11$ and $t = -9$. We observe the same impact on significance levels for equity-conversion mechanisms, coupon rates between 5% and 10%, AT1 CoCos, O-SIBs, issuers with total assets below \$1.500 billion, contributions to the Tier 1 capital ratio between 0,5% and 1%, and issuers located in the Asia Pacific.

The results of the market returns model related to the overall impact of CoCo issuance on the CDS spread of the issuer are significant at the 1% level for start dates between $t = -11$ and $t = -8$. We observe the same impact on significance levels for equity-conversion mechanisms, trigger levels at 5,125% of the CET1 ratio, coupon rates between 5% and 10%, AT1 CoCos, O-SIBs, issuers with total assets below the median or below \$1.500 billion, contributions to the Tier 1 capital ratio between 0,5% and 1%, and issuers located in the Asia Pacific.

Based on the sensitivity analysis regarding the start of the event-window, we conclude that an earlier start of the event-window ($t = -11$ and $t = -10$) results in a stronger negative impact on default probabilities. A later start of the event-window ($t = -7$) results in a less negative impact on default probabilities.

End of the event-window

The sensitivity of our results is also analysed by changing the end date of the event-window to $t = 0$, $t = 1$, $t = 3$, or $t = 4$. The results of these end dates are reported in Appendix G. This analysis is performed for the risk-adjusted returns (Table G.5 and Table G.7) and the market returns model (Table G.6 and Table G.8). We observe that our results are more stable for larger sample sizes and the P-value of smaller sample sizes is more volatile.

The results of the risk-adjusted returns model related to the overall impact of CoCo issuance on the CDS spread of the issuer are significant at the 10% level for end dates between $t = 0$ and $t = 3$.

Our results for trigger levels at 5,125% of the CET1 ratio, coupon rates between 5% and 10% and AT1 CoCos are not significant if we change the end date to $t = 0$, $t = 1$, $t = 3$ or $t = 4$. For equity-conversion mechanisms, O-SIBs, issuers with total assets below the median or below \$1.500 billion, contributions to the Tier 1 capital ratio between 0,5% and 1%, and issuers located in the Asia Pacific we observe that the impact is significant at the 5% or 10% level for end dates between $t = 1$ and $t = 4$.

The results of the market returns model related to the overall impact of CoCo issuance on the CDS spread of the issuer are significant at the 1% level for end dates between $t = 0$ and $t = 4$. We observe the same impact on significance levels for equity-conversion mechanisms, trigger levels at 5,125% of the CET1 ratio, coupon rates between 5% and 10%, AT1 CoCos, O-SIBs, issuers with total assets below the median or below $1.500 billion, contributions to the Tier 1 capital ratio between 0,5% and 1%, and issuers located in the Asia Pacific (significance levels of 1% or 5%).

Based on the sensitivity analysis regarding the end of the event-window, we conclude that our results are stable for end dates between $t = 0$ and $t = 3$. $t = 4$ as end date of the event-window results in a less negative impact on default probabilities.

Beta estimates

For each CoCo issuance we estimate beta during the estimation period. The average beta estimate of the full CoCo sample and all the sub-samples is between 0,164 and 0,587. To analyse the sensitivity of our beta estimate we change the estimation period to 110 and 130 trading days.

An estimation period of 110 trading days results in an average beta estimate between 0,161 and 0,589. An estimation period of 130 trading days results in an average beta estimate between 0,159 and 0,585.

Based on these results we conclude that the impact of changing the number of trading days in the estimation period is limited. In Section 6.2 we further discuss the beta estimates.

5.4.2 Normality assumption

The statistical significance of our results is tested using the standardised cross-sectional test. This parametric test assumes that the abnormal returns of individual CoCos are normally distributed.

To analyse the influence of the normality assumption on the result of our research, we use both a parametric and a non-parametric test. The Wilcoxon signed-rank test is a non-parametric statistical test used to analyse whether the difference between two measurements is significant, without assuming that the sample is normally distributed. The results of the Wilcoxon signed-rank test are reported in Appendix G Table G.9.

Based on the results of the Wilcoxon signed-rank test, we conclude that the normality assumption used in the standardised cross-sectional test does not significantly influence our results. We do observe that the results of both tests are more stable for larger sample sizes.

Chapter 6

Conclusion

In the previous chapters we (i) analysed literature related to CoCo structures, regulation and the effect of CoCo issuance on funding costs; (ii) performed a qualitative analysis on developments and trends in the CoCo market, between December 2009 and April 2016; and (iii) performed a quantitative analysis on the effect of different CoCo structures and issuer characteristics on the CDS spread of the issuer.

All the foregoing is required to answer our main research question:

What is the effect of different CoCo structures on the funding costs of a financial institution?

The answer to this question is threefold, and includes: (i) the overall impact of CoCo issuance; (ii) the effect of different CoCo structures; and (iii) the effect of issuer characteristics on the funding costs of a financial institution (Section 6.1).

Our research design, used to perform the quantitative analysis, contains several assumptions and limitations. In Section 6.2, we describe these limitations and provide recommendations for further research.

6.1 Conclusion

The overall impact of CoCo issuance on the CDS spread of the issuer is negative and significant. Indicating that the default probability of financial institutions that issue a CoCo decreases.

The average decrease of the CDS spread for the full CoCo sample is equal to 4 bps. If the decrease in the CDS spread is fully passed on to the yields on the corresponding debt, the bank can reduce the total funding costs. The reduction in funding costs can be achieved by rolling-over existing debt instruments, where the replaced debt instruments require lower coupon rates. Decreasing the annual interest rate of $10 billion of non-CoCo debt with 1 bp reduces the annual interest cost, and hence the funding costs, with $1 million.

The decrease in default probabilities is highly dependent on the specific CoCo structure used and characteristics of the issuer. In the sections below we describe the main findings of our research regarding these CoCo structures and issuer characteristics.

CoCo structures

Our analysis regarding the effect of different CoCo structures distinguishes between (i) conversion mechanisms; (ii) trigger events; (iii) coupon rates; and (iv) regulatory tiering. We conclude that the effect of CoCo issuance on the funding costs of a financial institution is highly dependent on the specific CoCo structure used.

Our main findings for each of these CoCo structure characteristics indicate that equity-conversion mechanisms, trigger levels at the regulatory minimum of 5,125% of the CET1 capital ratio, coupon rates between 5% and 10% and AT1 CoCo structures are the most effective in reducing default probabilities.

CoCos containing equity-conversion mechanisms are more effective than principal write-down mechanisms in reducing the funding costs of financial institutions. Based on our analysis regarding the specific conversion mechanism used, we conclude that none of the analysed CoCo structures contain a conversion mechanism that leads to a value transfer from shareholders to CoCo holders. The difference between the impact of equity-conversion and principal write-down is therefore not the result of dilution effects as described by Chan and Wijnbergen (2016). The simple fact that conversion to equity leads to additional shares and therefore reduces the stake of initial shareholders might explain the observed effect of issuing equity-conversion CoCos instead of principal write-down CoCos.

CoCos containing mechanical triggers are more effective than discretionary triggers in reducing the funding costs of financial institutions. Moreover, trigger levels at the regulatory minimum of 5,125% of the CET1 capital ratio are the most effective. The lower impact of trigger levels above the regulatory minimum is counter-intuitive, because higher trigger levels indicate that the loss absorbing mechanism is activated at an earlier stage.

Coupon rates between 5% and 10% are more effective than lower or higher coupon rates in reducing the funding costs of financial institutions. The ability of financial institutions to influence the required coupon rate is however limited and depends on several other factors.

AT1 CoCos are more effective than Tier 2 CoCos in reducing the funding costs of financial institutions. We explain this effect by the fundamental difference between these CoCo structures on default probabilities. AT1 CoCos contain additional options to preserve the bank as a going-concern, Tier 2 CoCos can only absorb losses on a gone-concern basis.

Our findings regarding the effect of different CoCo structures are different from those of Avdjiev *et al.* (2015). We do not attribute the stronger negative impact of equity-conversion mechanisms to dilution effects and our results indicate that the impact of CET1 triggers at the regulatory minimum of 5,125% is stronger than trigger levels above this minimum.

Issuer characteristics

Our analysis regarding the effect of issuer characteristics distinguishes between (i) systemic importance; (ii) total assets at issuance; (iii) contribution to capital ratios; and (iv) region of the issuer. We conclude that the effect of CoCo issuance on funding costs is highly dependent on the characteristics of the issuer.

Our main findings for each of these issuer characteristics indicate that the negative impact of CoCo issuance on default probabilities is the strongest for O-SIBs, issuers with total assets below $1.500 billion, contributions to the Tier 1 capital ratio between 0,5% and 1% of RWA, and issuers located in the Asia Pacific or EU Euro area.

The funding costs of O-SIBs that issue CoCos decline more than the funding costs of G-SIBs that issue CoCos, and the decline is primarily caused by AT1 CoCos. This may be explained by the market perception that G-SIBs are still too-big-to-fail and will receive government support to prevent wide spread disruption of the financial system. Additional loss absorbing capital therefore has less impact on G-SIBs.

The reduction in funding costs is stronger for issuers with total assets below $1.500 billion than for issuers with total assets above this threshold. Dividing the sample based on total assets instead of systemic importance emphasizes the difference between small and large financial institutions.

The funding cost of issuers that issue an AT1 CoCo decline more if the contribution to the Tier 1 capital ratio is between 0,5% and 1% of RWA, than for contributions below 0,5% and above 1% of RWA.

The reduction in funding costs is stronger for issuers located in the Asia Pacific and EU Euro area than for issuers located in the EU non-Euro area.

Our findings regarding the effect of different issuer characteristics are different from those of Avdjiev *et al.* (2015). We showed that the impact of CoCo issuance on funding cost is stronger for O-SIBs, where Avdjiev *et al.* (2015) concluded that the funding cost of both G-SIBs and O-SIBs decreased. In addition, we showed that for both the median and $1.500 billion threshold of total assets at issuance, the negative impact on default probabilities is stronger for smaller banks. Related research by Avdjiev *et al.* (2015) showed that the effect is stronger for larger financial institutions.

6.2 Limitations & recommendations for further research

Here we outline the limitations of our research and a number of recommendations for further research. The main limitations of our research are the sample size of subsamples, low average beta estimates, and the proportion of explained variance.

Our recommendations for further research are the use of a larger CoCo sample, determine the difference between CoCo issuance and issuance of other debt instruments on funding costs, and the extend to which CoCos are fitted for their purpose.

Limitations

Our quantitative analysis is based on a sample of 235 CoCos issued between December 2009 and April 2016. For each cross-sectional test we split-up the full CoCo sample in smaller sub-samples. Smaller sample sizes limit the significance and strength of our conclusions. Another limitation for all of our conclusions regarding sub-samples is that we assume that all other relevant aspects of the samples are equal (Ceteris paribus).

Our research design relies on two data sources. The first is an individual CDS to measure the impact of CoCo issuance. The second is a corresponding market index to calculate market returns, used as a benchmark for the measurement of abnormal returns. As noted in Section 5.1, the average beta of the full CoCo sample and all the sub-samples is between 0,164 and 0,587. We expected an average beta of one.

There are two possible explanations that may explain the low average beta. Firstly, the iTraxx CDS indexes used as benchmark are not good representations of the market. The average beta of European issuers is 0,474 (Table 5.3). For Issuers located in the Asia Pacific the average beta is 0,184 (Table 5.3). The iTraxx CDS index used as benchmark for the European market comprises 30 investment grade financial institutions (Appendix D). The Asian and Australian benchmark comprise 40 and 25 investment grade entities, not financial institutions (Appendix D).

Secondly, the beta for each individual CoCo issuance is estimated by the regression as in Equation 3.1. Two important variables in this equation are the daily change in the CDS spread of the issuer and the daily change of the corresponding market index. The market index is considerably more liquid than the CDS spread of the issuer. Beta represents the market sensitivity of each individual CDS spread, the different liquidity levels may therefore explain the low average beta estimates. If we use weekly returns instead of daily returns, the liquidity problem may be solved. Weekly returns is however not a good alternative, because the corresponding market response is a matter of days and not weeks.

R-squared is the proportion of explained variance in the dependent variable that can be predicted from the independent variable. The R-squared for all of our results can be found in Appendix E. Just as for the beta estimate, the average R-squared is low. The average R-squared for the full CoCo sample and all the sub-samples is between 0,106 and 0,456. The average R-squared for the full CoCo sample is equal to 0,228. This implies that 22,8% of the variability between daily changes of the market and daily changes of the individual CDS spread has been accounted for. The remaining 77,2% variability is still unaccounted for, and is not explained by the independent variable.

Recommendations for further research

We think that the CoCo market is still immature and the size of the CoCo market will increase due to stricter capital requirements, because issuing regulatory compliant

CoCos decreases the funding costs.

Financial institutions will continue with issuing many different CoCo structures. If there is a larger CoCo sample available, our research can be improved by larger sub-samples for each of the cross-sectional comparisons. This could provide additional insights in the optimal CoCo structure for financial institutions with different characteristics.

An important question is the extend to which the reduction in funding cost, resulting from CoCo issuance, can be achieved by issuing other debt instruments? What is the effect of issuing subordinated debt on the funding costs of financial institutions? What are the pros and cons of issuing other debt instruments instead of AT1 or Tier 2 CoCos?

Another important question is the extent to which CoCos are fitted for their purpose. Will they provide sufficient additional loss absorbing capital to prevent insolvency? Are the regulatory CoCo trigger requirements able to prevent the next crisis? Or should regulators listen to the arguments of Flannery (2009), Kuritzkes and Scott (2009), Duffie (2010), Admati *et al.* (2010), Haldane (2011), Calomiris and Herring (2013), and Pennacchi, Vermaelen and Wolff (2014)?

Going forward, other important questions that remain to be answered are what is the difference between financial institutions that have issued CoCos and those that have not? What is the optimal proportion of AT1 and Tier 2 CoCos for financial institutions with different characteristics? Have financial institutions only issued CoCos to be in compliance with capital requirements? How will banks respond to the upcoming MREL and TLAC requirement, and will they issue CoCos to comply with these requirements? What is the effect of decreasing the probability of insufficient MDA for AT1 coupon payments on upcoming CoCo issuance? What will happen with the CoCo market if coupon payments are no longer tax deductible?

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Appendix A

Abbreviations

TABLE A.1: List of Abbreviations.

Abbreviation	Full name
ADI	Available Distributable Items
AR	Abnormal Return
ASAR	Average Standardised Abnormal Return
AT1	Additional Tier 1
BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlement
bp	Basis point
BRRD	Bank Recovery and Resolution Directive
C buffer	Countercyclical capital buffer
CAAR	Cumulative Average Abnormal Return
CAR	Cumulative Abnormal Return
CC buffer	Capital Conservation buffer
CDS	Credit Default Swap
CET1	Common Equity Tier 1
CoCo	Contingent Convertible bond
CRD	Capital Requirements Directive
CRR	Capital Requirements Regulation
EBA	European Banking Authority
EP	European Parliament
EU	European Union
FSB	Financial Stability Board
G-SIBs	Global Systemically Important Banks
ISIN	International Security Identification Number
MDA	Maximum Distributable Amount
MREL	Minimum Requirements for own funds and Eligible Liabilities
OLS	Ordinary Least Square
O-SIBs	Other Systemically Important Banks
NPV	Net Present Value
PE	Prediction Error
PONV	Point Of Non-Viability
RoE	Return on Equity
RWA	Risk Weighted Assets
SAR	Standardised Abnormal Return
SRB	Systemic Risk Buffer
SRF	Single Resolution Fund
TLAC	Total Loss Absorbing Capacity

Appendix B

Theoretical CoCo designs

Initial design proposals

Besides Flannery (2005), many other academics contributed to the theoretical design concepts. The broadly similar proposal of Kashyap, Rajan and Stein (2008) uses system wide instead of individual performance to activate the trigger.

McDonald (2010) combines these ideas and designed a dual trigger. This CoCo converts if the firms stock price and the value of a specific financial index simultaneously fall below a trigger value. The combined trigger of French *et al.* (2009) activates CoCo conversion if the regulator declares a systemic crisis and a specific capital ratio of the issuer is below a pre-specified level at the same time. The motivation for both dual trigger proposals is to permit the failure of a poor performing financial institution as long as there is no financial crisis. This implies that CoCos with the suggested dual trigger mechanism only convert during a financial crisis. A comprehensive overview of trigger and conversion mechanisms of initial design proposals can be found in the Appendix of Calomiris and Herring (2013).

Most of the trigger mechanisms of these early proposals are based on the share price of the issuer. The majority of authors recognize that a conversion to equity can potentially lead to dilution, incentives for price manipulation, and death spirals. Initial shareholders are diluted by the conversion of CoCos if the value of shares resulting from the conversion is higher than the face value of the CoCo. The conversion will not lead to dilution if CoCos contain a principal write-down mechanism, or the conversion to equity does not transfer value from share holders to CoCo holders (Chan and Wijnbergen, 2016). In order to minimize concerns about dilution, share price manipulation and death spirals, McDonald (2010) and French *et al.* (2009) use a conversion based on a fixed quantity of shares instead of a fixed value of equity.

Sundaresan and Wang (2010) raise that the pricing of CoCos with a market-value trigger could suffer from a multiple equilibria problem, which makes it impossible to find a unique price for the CoCo. To prevent this, the mandatory conversion based on equity prices needs to ensure that conversion does not transfer value between CoCo holders and shareholders. Otherwise the dilutive CoCo conversion can give rise to death spirals, where expectations that the trigger level is crossed can lead to multiple equilibria. Duffie (2010) describe a mechanism that avoids the multiple equilibria problem while the conversion is triggered by the the share price. If the share price falls below a trigger level, the firm is required to make a rights offering at a price far below the current share price. The risk of this proposal is that the rights offering might fail. According to Chen *et al.* (2013) the multiple equilibria problem is due to a discrete-time model and state that this can be avoided using a continuous-time model.

Advanced theoretical CoCo designs

The introduction of CoCos resulted in an extensive discussion of the optimal design and potential issues that can diminish the effectiveness. The problems recognised in these initial design proposals are addressed by three specific types of CoCos proposed by Calomiris and Herring (2013), Pennacchi, Vermaelen and Wolff (2014), and Bulow and Klemperer (2015). Each take a different design approach and focus on other problems.

- Calomiris and Herring (2013) see the ex-ante risk mismeasurement and mismanagement and, ex post failure to replace equity as two related problems. They claim that these problems are eliminated by a Quasi Market Value of Equity Ratio (QMVER) trigger. This mechanism converts a CoCo into equity based on a 90-day moving average ratio of the equity-market-value to the quasi-market-value of assets. It should provide the management sufficient time to prevent a dilutive trigger event by issuing new shares. Their introduced requirements for CoCos provide incentives for financial institutions to implement strong systems of risk governance to manage and measure risk, and raise additional capital for recapitalization in times of stress.

- Pennacchi, Vermaelen and Wolff (2014) designed a Call Option Enhanced Reverse Convertible (COERC), which is a CoCo including a call option for the initial shareholders that is activated by the trigger event. The conversion mechanism of this instrument initially results in dilution of existing shareholders because the conversion price is set far below the share price at conversion. However, existing shareholders can use the integrated call option to prevent this dilution. This mechanism makes sure that COERC investors get repaid their initial investment and shareholders absorb all the losses that triggered the conversion.

- Bulow and Klemperer (2015) tackle the multiple equilibrium problem by introducing the "Equity Recourse Note" (ERN). ERN investors only receive cash at coupon and maturity dates if the firms stock price exceeds a trigger level. Otherwise payments are made in shares. Unlike other CoCos, the conversion can only take place on specific dates and is not triggered by any other unexpected event.

Unfortunately none of these advanced theoretical designs have currently been implemented in practice. Other advanced design proposals and an extensive review of the literature on these CoCo designs can be found in the paper of Flannery (2014).

Appendix C

CoCos included in the sample

TABLE C.1: List of CoCos included in the sample.

This table reports the available ISIN numbers of the 235 CoCos included in the sample.

CoCos included in the sample (1/2)		
XS1278718686	AU3FN0021952	XS1071551474
XS1135611652	AU0000BENPE4	XS1071551391
NZANBDT013C0	AU0000BENPD6	XS1207306652
US052528AH96	US05565AAN37	NO0010730708
AU3FN0023859	US05565AAQ67	CH0204819301
AU3FN0029575	XS1247508903	XS0732522023
XS1174138708	INE476A09249	XS0848137708
XS1206978543	INE476A09256	XS0954024617
AU0000ANZPF8	INE476A08035	XS0964797194
AU0000ANZPD3	XS0985263150	XS0975320879
AU0000ANZPE1	XS1055321993	CH0229318099
XS0926832907	MYBPN1300614	CY0144180110
XS1033661866	MYBPN1300648	CY0144170111
XS1394911496	XS1219642441	US404280AT69
XS1190663952	US2027A0HR32	US404280AS86
PTBIZQOM0059	AU3FN0025367	XS1111123987
XS0979444402	XS1200840111	US404280AR04
XS1189104356	AU0000CBAPC9	XS1298431104
ES0313860597	AU0000CBAPD7	EK7757934
ES0313860589	AU0000CBAPE5	KR310501G4B3
XS1043535092	US225313AC92	KR310505G596
XS1107291541	US225313AD75	KR310504G599
XS1066553329	XS1055037177	US456837AF06
US061202AA55	US225313AJ46	US456837AE31
XS1122780106	US225313AE58	XS0545782020
XS1326527246	XS1055037920	XS1346815787
XS113867162	US22546DAA46	US46115HAU14
INE084A08037	XS0972523947	BE6248510610
INE084A08045	XS1076957700	BE0002463389
XS0862044798	XS0989394589	KR310210G4C3
XS1248345461	CH0221803791	XS0459086582
XS0810596832	XS0595225318	XS1043552188
US06740L8C27	CH0181115681	XS1043550307
US06739FHK03	XS0810846617	US539439AG42
US06738EAA38	XS1044578273	XS1043552261
XS1068574828	XS1190987427	XS1043545059
US06738EAB11	SG59H0999851	XS0763122909
XS1068561098	SG71A5000002	US55608XAB38

CoCos included in the sample (2/2)		
MYBPN1500155	US780099CJ48	CH0214139930
MYBPN1400216	US780099CK11	CH0271428333
MYBPN1500163	XS0979891925	CH0271428309
JP390290AFF7	RU000A0JVN56	CH0317921697
JP390290AFA8	RU000A0JVN64	CH0271428317
JP390290AF70	RU000A0JVN98	XS1107890847
JP390290AE63	XS1244538523	XS1046224884
JP390290AF62	XS1032750165	XS0527624059
JP390290BF61	US78406JAD63	XS1045409965
JP390290CF60	XS1136391643	SG57A1994579
JP390290BE62	US82460CAJ36	XS1379133058
JP388578AFK9	KR6000011546	SG6QD3000002
US60688UAB26	KR6055551560	SG58I7998534
USJ4599LAH53	US83367TBF57	AU0000WBCPF6
JP388578AE78	USF8586CXG25	AU0000WBCPE9
JP388578BE77	USF43628B413	AU0000WBCPD1
JP388578BF68	XS0867620725	AU0000WBCPC3
AU0000NABPC6	XS0867614595	AU000WBCHBD1
AU0000NABPB08	JP389035AF56	AU0000WBCHB2
AU0000NABPA0	JP389035BF55	AU3FN0030391
XS1136227094	JP389035CF54	XS1200738935
AU3FN0026928	US86562MAA80	XS1273972957
XS1043181269	JP389035AE99	XS1181983443
JP376260ABC4	JP389035BE98	XS1361112052
JP376260BBC2	JP389035AFK9	US98105FAC86
US65557CAM55	JP389035CFK5	US98105FAD69
XS1202090947	JP389035BFK7	US98105HAD26
US65557DAL55	JP389210AFM4	KR6000031569
XS1202091325	JP389210BFM2	XS0747231362
XS1202091671	JP389210AE96	US90261AAB89
XS1227057814	JP389210AF61	XS0703303262
MYBUN1300895	AU0000SUNPE4	CH0272748754
MYBUN1301125	AU0000SUNPC8	AU0000MQGPA7
MYBUN1300960	AU0000SUNPD6	MYBPN1400448
XS1171914515	XS1190655776	DE000DB7XHP3
XS1400626690	CH0286864027	US251525AN16
XS0496281618	CH0236733827	XS1002801758
XS0583302996	CH0244100266	XS1274156097

Appendix D

Composition of market indexes

TABLE D.1: The Market iTraxx Europe Senior Financial index.

This table reports the composition of the iTraxx Europe Senior Financial index. The first column mentions the 30 financial institution included in the index. The other columns show the weight, specific CDS curve and the spread in bp of the corresponding institution.

Financial institution	**Weight**	**5 Year CDS**	**Spread (bp)**
Aegon NV	3,334	CAEGO1E5	98
Allianz SE	3,334	CALZ1E5	38
Assicurazioni Generali SpA	3,334	CASS1E5	135
Aviva PLC	3,334	CAVL1E5	95
AXA SA	3,334	CAXA1E5	65
Banco Bilbao Vizcaya Argentaria SA	3,334	CBBV1E5	134
Banco Santander SA	3,334	CBSH1E5	143
Barclays Bank PLC	3,334	CBAR1E5	113
Bayerische Landesbank	3,334	CBYL1E5	101
BNP Paribas SA	3,334	CBNP1E5	78
Commerzbank AG	3,333	CCMZ1E5	117
Cooperatieve Rabobank UA	3,333	CRAB1E5	69
Credit Agricole SA	3,333	CCAI1E5	77
Credit Suisse Group AG	3,333	CCS1E5	143
Danske Bank A/S	3,333	CDAN1E5	62
Deutsche Bank AG	3,333	CDB1E5	211
Hannover Rueck SE	3,333	CHAN1E5	41
HSBC Bank PLC	3,333	CHSB1E5	79
ING Bank NV	3,333	CING1E5	67
Intesa Sanpaolo SpA	3,333	CBCI1E5	134
Lloyds Bank PLC	3,333	CLOY1E5	93
Mediobanca SpA	3,333	CBCR1E5	188
Muenchener Rueckversicherungs-Gesellschaft AG	3,333	CMURE1E5	37
Societe Generale SA	3,333	CSOC1E5	75
Standard Chartered Bank	3,333	CT695702	148
Swiss Reinsurance Co Ltd	3,333	CRUK1E5	38
Royal Bank of Scotland PLC/The	3,333	CRBS1E5	124
UBS AG	3,333	CUBS1E5	66
UniCredit SpA	3,333	CUNI1E5	184
Zurich Insurance Co Ltd	3,333	CZUR1E5	40

TABLE D.2: The Market iTraxx Asia investment grade index.

This table reports the composition of the iTraxx Asia investment grade index. The first column mentions the 40 financial institution included in the index. The second and third column show the weight and specific CDS curve of the corresponding institution.

Financial institution	Weight	5 Year CDS
Bank of China Ltd	2,5	CBOC1U5
Bank of India	2,5	CT357281
CapitaLand Ltd	2,5	CX425075
China Development Bank Corp	2,5	CSDBC1U5
CNOOC Ltd	2,5	CCNOL1U5
DBS Bank Ltd	2,5	CDBS2U5
GS Caltex Corp	2,5	CLCAL1U5
Hutchison Whampoa Ltd	2,5	CHWAM1U5
Hyundai Motor Co	2,5	CHYN1U5
ICICI Bank Ltd	2,5	CICIC1U5
IDBI Bank Ltd	2,5	CIDB1U5
Industrial Bank of Korea	2,5	CIND1U5
KEB Hana Bank	2,5	CT355768
Kingdom of Thailand	2,5	CTHAI1U5
Kookmin Bank	2,5	CKOOK1U5
Korea Electric Power Corp	2,5	CKELP1U5
KT Corp	2,5	CKTEL1U5
Federation of Malaysia	2,5	CMLAY1U5
Oversea-Chinese Banking Corp Ltd	2,5	COCB2U5
PCCW-HKT Telephone Ltd	2,5	CPCT1U5
People's Republic of China	2,5	CCHIN1U5
Petroliam Nasional Bhd	2,5	CPETR1U5
POSCO	2,5	CPOH1U5
Reliance Industries Ltd	2,5	CRELI1U5
Republic of Indonesia	2,5	CINO1U5
Republic of Korea	2,5	CKREA1U5
Republic of the Philippines	2,5	CPHIL1U5
Samsung Electronics Co Ltd	2,5	CSAMS1U5
Singapore Telecommunications Ltd	2,5	CSTSP1U5
SK Telecom Co Ltd	2,5	CSKM1U5
State Bank of India/London	2,5	CSBII1U5
Sun Hung Kai Properties Ltd	2,5	CT786399
Swire Pacific Ltd	2,5	CSWIR1U5
Telekom Malaysia Bhd	2,5	CTMAL1U5
Export-Import Bank of China/The	2,5	CEMH1U5
Export-Import Bank of Korea	2,5	CEIB1U5
Hongkong Land Co Ltd/The	2,5	CHKLD1U5
Korea Development Bank/The	2,5	CKDB1U5
United Overseas Bank Ltd	2,5	CT355944
Woori Bank	2,5	CHVT1U5

TABLE D.3: The Market iTraxx Australia investment grade index.

This table reports the composition of the iTraxx Australia investment grade index. The first column mentions the 25 financial institution included in the index. The second and third column show the weight and specific CDS curve of the corresponding institution.

Financial institution	**Weight**	**5 Year CDS**
Amcor Ltd/Australia	4	CAMCR1U5
AMP Group Holdings Ltd	4	CAMH1U5
Australia & New Zealand Banking Group Ltd	4	CANZ1U5
BHP Billiton Ltd	4	CBHP1U5
Chorus Ltd	4	CY101176
Commonwealth Bank of Australia	4	CCBA1U5
Crown Resorts Ltd	4	CT786107
CSR Ltd	4	CCSR1U5
GPT RE Ltd	4	CT373028
Jemena Ltd	4	CAGL1U5
Lend Lease Corp Ltd	4	CLLC1U5
Macquarie Bank Ltd	4	CMQB1U5
National Australia Bank Ltd	4	CNAB1U5
Qantas Airways Ltd	4	CQTAS1U5
QBE Insurance Group Ltd	4	CQBE1U5
Rio Tinto Ltd	4	CT410075
Scentre Management Ltd	4	CWEST1U5
SingTel Optus Pty Ltd	4	COPT1U5
Spark New Zealand Ltd	4	CTLNZ1U5
Tabcorp Holdings Ltd	4	CX349405
Telstra Corp Ltd	4	CTELS1U5
Wesfarmers Ltd	4	CWES1U5
Westpac Banking Corp	4	CWBC1U5
Woodside Petroleum Ltd	4	CWOOD1U5
Woolworths Ltd	4	CWOOL1U5

Appendix E

R-squared resulting from risk-adjusted returns model

TABLE E.1: Effect of different CoCo structures on the funding costs of financial institutions.

This table reports the results of the quantitative analysis on the effect of different CoCo structures on the funding costs of financial institutions. N indicates the number of CoCos in the sub-sample. The SAR, Z-value and P-value are reported for the risk-adjusted returns model. In addition, the table reports the average alpha (α), beta (β) and R^2 for each sub-sample. Resulting from the regression as in Equation 3.1: $R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t}$. The *, **, and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively.

			Risk-adjusted returns model					
	Characteristic	**N**	α	β	**SAR**	**Z-value**	**P-value**	R^2
All CoCos		235	-0,001	0,331	-33,14	-2,16	0,031**	0,228
Conversion mechanism	**Equity-conversion**	85	0,000	0,347	-19,46	-2,11	0,035**	0,249
	Fixed price	21	-0,001	0,587	-6,60	-1,44	0,150	0,456
	Floor price	24	0,000	0,445	-4,81	-0,98	0,326	0,330
	Variable number of shares	33	0,000	0,164	-4,60	-0,80	0,423	0,186
	Principal write-down	150	0,000	0,321	-13,68	-1,12	0,264	0,216
	Partial permanent	4	-0,001	0,297	-0,72	-0,36	0,718	0,226
	Temporary	35	-0,001	0,518	-2,09	-0,35	0,724	0,392
	Permanent	78	0,000	0,256	-9,03	-1,02	0,307	0,150
Trigger event	**Mechanical**	146	-0,001	0,401	-16,94	-1,40	0,161	0,293
	$< 5,125\%$	20	-0,001	0,427	3,14	0,70	0,483	0,298
	$5,125\%$	64	-0,001	0,348	-10,93	-1,37	0,172	0,240
	$> 5,125\%$	62	-0,001	0,469	-9,14	-1,16	0,246	0,369
	Discretionary	89	0,000	0,200	-16,20	-1,72	0,086*	0,106
Coupon rate	$< 5\%$	85	0,000	0,193	-10,99	-1,19	0,233	0,308
	$\geq 5\%, < 10\%$	135	0,000	0,436	-22,92	-1,97	0,048**	0,313
	$\geq 10\%$	7	-0,003	0,143	0,65	0,24	0,807	0,134
Tier	**AT1**	137	-0,001	0,371	-22,08	-1,89	0,059*	0,268
	Tier 2	98	0,000	0,274	-11,06	-1,12	0,264	0,173

TABLE E.2: Effect of different issuer characteristics on the funding costs of financial institutions.

This table reports the results of the quantitative analysis on the effect of CoCo issuer characteristics on the funding costs of financial institutions. N indicates the number of CoCos in the sub-sample. The SAR, Z-value and P-value are reported for the risk-adjusted returns model. In addition, the table reports the average alpha (α), beta (β) and R^2 for each sub-sample. Resulting from the regression as in Equation 3.1: $R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t}$. The *, **, and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively.

			Risk-adjusted returns model					
	Characteristic	**N**	α	β	**SAR**	**Z-value**	**P-value**	R^2
	All CoCos	235	-0,001	0,331	-33,14	-2,16	0,031**	0,228
Systemic importance	**G-SIB**	89	-0,001	0,439	-10,83	-1,15	0,251	0,293
	AT1	61	-0,001	0,468	-8,89	-1,14	0,255	0,329
	Tier 2	28	-0,001	0,378	-1,95	-0,37	0,713	0,215
	O-SIB	146	0,000	0,264	-22,31	-1,85	0,065*	0,188
	AT1	76	-0,001	0,294	-13,19	-1,51	0,130	0,218
	Tier 2	70	0,000	0,232	-9,12	-1,09	0,276	0,156
Total assets at issuance	**<Median ($746 bln)**	116	0,000	0,218	-21,70	-2,01	0,044**	0,153
	$\geq$ **Median**	119	-0,001	0,449	-11,44	-1,05	0,294	0,307
	< **$1.500 bln**	171	0,000	0,304	-30,56	-2,34	0,019**	0,217
	$\geq$ **$1.500 bln**	64	-0,001	0,401	-2,58	-0,32	0,747	0,258
Contribution to ratios AT1 & Tier 2	**Tier 1 capital ratio**	**AT1**						
	$< 0,5\%$	88	-0,001	0,438	-8,24	-0,88	0,380	0,308
	$\geq 0,5\%, < 1\%$	33	0,000	0,313	-11,36	-1,98	0,048**	0,313
	$\geq 1\%$	12	-0,001	0,438	-3,25	-0,94	0,348	0,134
	Total Capital ratio	**Tier 2**						
	$< 0,5\%$	64	0,000	0,238	-9,62	-1,20	0,229	0,133
	$\geq 0,5\%, < 1\%$	15	0,000	0,265	-3,77	-0,97	0,330	0, 163
	$\geq 1\%$	7	0,000	0,250	-0,25	-0,10	0,924	0,113
Region	**Asia Pacific**	114	0,000	0,184	-18,89	-1,77	0,077*	0,196
	Europe	121	-0,001	0,475	-14,25	-1,30	0,195	0,357
	Euro area	51	-0,001	0,516	-5,03	-0,70	0,481	0,388
	Non-Euro area	70	-0,001	0,435	-9,22	-1,10	0,271	0,327

Appendix F

Independent sample t-test

TABLE F.1: Independent sample t-test related to the effect of different CoCo structures on the funding costs of financial institutions.

This table reports the results of the independent sample t-test. The independent sample t-test is used to test the significance of the difference between the mean of the standardised abnormal returns of different sub-samples, resulting from cross-sectional comparisons. The *, **, and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively.

Comparison	**Risk-adjusted returns model**	**Market returns model**
Conversion mechanism		
Equity-conversion vs. Principal write-down	0,139	0,0638*
Trigger event		
Mechanical vs. Discretionary	0,475	0,603
Trigger level		
<5,125% vs. 5,125%	0,053*	0,002***
<5,125% vs. $\geq$5,125%	0,031**	0,010**
$5,125\%$ vs. $\geq$5,125%	0,836	0,281
Coupon rate		
<5% vs. $\geq$ 5% and <10%	0,551	0,844
<5% vs. $\geq$ 10%	0,634	0,864
$\geq$ 5% and <10% vs. $\geq$ 10%	0,193	0,660
Regulatory tiering		
AT1 vs. Tier 2	0,433	0,321

TABLE F.2: Independent sample t-test related to the effect of different issuer characteristics on the funding costs of financial institutions.

This table reports the results of the independent sample t-test. The independent sample t-test is used to test the significance of the difference between the mean of the standardised abnormal returns of different sub-samples, resulting from cross-sectional comparisons. The *, **, and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively.

Comparison	**Risk-adjusted returns model**	**Market returns model**
Systemic importance		
G-SIBs vs. O-SIBs	0,737	0,586
G-SIBs AT1 vs. G-SIBs Tier 2	0,608	0,304
O-SIBs AT1 vs. O-SIBs Tier 2	0,784	0,194
Total assets at issuance		
$<$ Median ($746 bln) vs. $\geq$ median	0,289	0,224
$<$ $1.500 bln vs. $\geq$ $1.500 bln	0,168	0,238
Contribution to Tier 1 ratio		
$< 0,5\%$ vs. $\geq 0,5\%$ and < 1	0,038**	0,074*
$< 0,5\%$ vs. ≥ 1	0,395	0,317
$\geq 0,5\%$ and < 1 vs. ≥ 1	0,746	0,934
Region		
Asia Pacific vs. Europe	0,748	0,560
Euro area vs. non-Euro area	0,757	0,213

Appendix G

Sensitivity analysis

TABLE G.1: Sensitivity analysis related to the start of the event-window for the risk-adjusted returns model. Related to the effect of different issuer characteristics on the funding costs of financial institutions.

This table reports the results of the sensitivity analysis related to the start of the event-window. Where the starting date is adjusted to -11, -10, -8 and -7. The SAR and P-value are reported for the risk-adjusted returns model. Where the SAR is reported as the change related to the initial event-window. The focus is on the effect of different CoCo structures on the funding costs of financial institutions. The analysis distinguishes between several CoCo structure characteristics: conversion mechanism, trigger event, coupon rate and regulatory tiering. The *, **, and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively.

		Risk-adjusted returns model									
Event-window		**[-11,2]**		**[-10,2]**		**[-9,2]**		**[-8,2]**		**[-7,2]**	
Characteristic		**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**
All CoCos		20%	0,010**	-3%	0,037**	-33,14	0,031**	-17%	0,073*	-37%	0,176
Conversion mechanism	**Equity-conversion**	-6%	0,047**	-18%	0,085*	-19,46	0,035**	-24%	0,108	-38%	0,188
	Fixed price	-2%	0,160	-29%	0,308	-6,60	0,150	1%	0,147	-7%	0,181
	Floor price	-44%	0,580	-13%	0,394	-4,81	0,326	-43%	0,577	-70%	0,766
	Variable number	16%	0,353	-30%	0,575	-4,60	0,423	-55%	0,717	-91%	0,944
	Principal write-down	56%	0,081*	18%	0,189	-13,68	0,264	-7%	0,300	-37%	0,481
	Partial permanent	12%	0,686	-5%	0,731	-0,72	0,718	-154%	0,847	-195%	0,731
	Temporary	96%	0,489	86%	0,511	-2,09	0,724	-18%	0,773	-110%	0,971
	Permanent	27%	0,196	-5%	0,332	-9,03	0,307	5%	0,285	-9%	0,353
Trigger event	**Mechanical**	8%	0,132	-1%	0,167	-16,94	0,161	-7%	0,191	-37%	0,380
	$< 5,125\%$	16%	0,418	26%	0,377	3,14	0,483	-50%	0,727	-39%	0,666
	$5,125\%$	14%	0,118	12%	0,126	-10,93	0,172	-16%	0,249	-40%	0,414
	$> 5,125\%$	2%	0,236	-8%	0,285	-9,14	0,245	-11%	0,300	-34%	0,440
	Discretionary	33%	0,023**	-6%	0,105	-16,20	0,086*	-28%	0,215	-37%	0,282
Coupon rate	$< 5\%$	61%	0,055**	14%	0,175	-10,99	0,233	-30%	0,405	-27%	0,386
	$\geq 5\%, < 10\%$	-1%	0,051**	-14%	0,088*	-22,92	0,048**	-13%	0,084*	-43%	0,264
	$\geq 10\%$	-128%	0,945	-43%	0,890	0,65	0,807	-51%	0,906	-89%	0,979
Tier	**AT1**	13%	0,032**	-4%	0,070*	-22,08	0,059*	-10%	0,090*	-35%	0,221
	Tier 2	33%	0,138	-2%	0,275	-11,06	0,264	-31%	0,440	-42%	0,516

TABLE G.2: Sensitivity analysis related to the start of the event-window for the risk-adjusted returns model. Related to the effect of different issuer characteristics on the funding costs of financial institutions.

This table reports the results of the sensitivity analysis related to the start of the event-window. Where the starting date is adjusted to -11, -10, -8 and -7. The SAR and P-value are reported for the market returns model. Where the SAR is reported as the change related to the initial event-window. The focus of this table is on the effect of different CoCo structures on the funding costs of financial institutions. The analysis distinguishes between several CoCo structure characteristics: conversion mechanism, trigger event, coupon rate and regulatory tiering. The *, **, and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively.

		Market returns model									
Event-window		**[-11,2]**		**[-10,2]**		**[-9,2]**		**[-8,2]**		**[-7,2]**	
Characteristic		**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**
All CoCos		-2%	0,001***	-18%	0,005***	-52,01	0,001***	-11%	0,003***	-25%	0,011**
Conversion mechanism	**Equity-conversion**	-12%	0,005***	-19%	0,011**	-29,00	0,002***	-15%	0,007***	-28%	0,024**
	Fixed price	-14%	0,147	-31%	0,249	-7,69	0,093*	5%	0,077*	-44%	0,347
	Floor price	-27%	0,189	-5%	0,087*	-8,78	0,073*	-37%	0,256	-45%	0,322
	Variable number	-1%	0,077*	-30%	0,209	-10,27	0,074*	-22%	0,165	-24%	0,174
	Principal write-down	10%	0,039**	-16%	0,115	-23,01	0,060*	-7%	0,082*	-20%	0,132
	Partial permanent	-11%	0,661	-35%	0,751	-0,98	0,624	-62%	0,851	-77%	0,911
	Temporary	9%	0,150	13%	0,135	-7,79	0,188	-2%	0,196	-49%	0,505
	Permanent	6%	0,100	-31%	0,281	-13,70	0,121	-15%	0,185	-10%	0,164
Trigger event	**Mechanical**	-13%	0,011**	-11%	0,010**	-35,21	0,004***	5%	0,002***	-25%	0,030**
	$< 5,125\%$	51%	0,262	48%	0,272	3,32	0,458	-64%	0,791	-35%	0,628
	$5,125\%$	-7%	0,006***	-3%	0,004***	-23,65	0,003***	-3%	0,004***	-14%	0,011**
	$> 5,125\%$	-7%	0,080*	-11%	0,094*	-14,88	0,059*	2%	0,055*	-46%	0,308
	Discretionary	20%	0,032**	-32%	0,223	-16,80	0,075*	-45%	0,326	-23%	0,170
Coupon rate	$< 5\%$	15%	0,016**	-23%	0,105	-19,29	0,036**	-34%	0,170	-11%	0,062*
	$\geq 5\%, < 10\%$	-10%	0,009***	-16%	0,016**	-33,60	0,004***	-1%	0,004***	-37%	0,071*
	$\geq 10\%$	-46%	0,787	-17%	0,680	-1,32	0,618	69%	0,400	116%	0,281
Tier	**AT1**	-4%	0,001***	-13%	0,003***	-40,02	0,001***	-2%	0,001***	-22%	0,007***
	Tier 2	5%	0,205	-33%	0,416	-11,99	0,226	-41%	0,478	-34%	0,427

TABLE G.3: Sensitivity analysis related to the start of the event-window for the risk-adjusted returns model. Related to the effect of CoCo issuer characteristics on the funding costs of financial institutions.

This table reports the results of the sensitivity analysis related to the start of the event-window. Where the starting date is adjusted to -11, -10, -8 and -7. The SAR and P-value are reported for the risk-adjusted returns model. Where the SAR is reported as the change related to the initial event-window. The focus is on the effect of CoCo issuer characteristics on the funding costs of financial institutions. The analysis distinguishes between several CoCo issuer characteristics: systemic importance, total assets at issuance, contribution to capital ratios and region. The *, **, and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively.

		Risk-adjusted returns model									
Event-window		**[-11,2]**		**[-10,2]**		**[-9,2]**		**[-8,2]**		**[-7,2]**	
Characteristic		**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**
All CoCos		20%	0,010**	-3%	0,037**	-33,14	0,031**	-17%	0,073*	-37%	0,176
Systemic importance	**G-SIB**	14%	0,190	-14%	0,326	-10,83	0,251	-9%	0,298	-17%	0,343
	AT1	-9%	0,302	-22%	0,372	-8,89	0,255	-7%	0,292	-29%	0,420
	Tier 2	122%	0,415	18%	0,663	-1,95	0,713	-19%	0,764	36%	0,616
	O-SIB	23%	0,024**	2%	0,060*	-22,31	0,065*	-21%	0,143	-47%	0,328
	AT1	29%	0,051*	8%	0,103	-13,19	0,130	-12%	0,182	-39%	0,357
	Tier 2	14%	0,215	-7%	0,310	-9,12	0,276	-34%	0,469	-59%	0,651
Total assets at issuance	**<Median ($746 bln)**	14%	0,022**	-7%	0,062*	-21,70	0,044**	-17%	0,093*	-32%	0,169
	$\geq$ **Median**	31%	0,168	4%	0,277	-11,44	0,294	-18%	0,389	-48%	0,585
	$<$ **$1.500 bln**	15%	0,007***	0%	0,020**	-30,56	0,019**	-18%	0,055*	-41%	0,166
	$\geq$ **$1.500 bln**	74%	0,575	-39%	0,844	-2,58	0,747	-5%	0,760	3%	0,741
Contribution to ratios AT1 & Tier 2	**Tier 1 capital ratio**	**AT1**									
	$< 0,5\%$	14%	0,318	-2%	0,389	-8,24	0,380	-7%	0,415	-49%	0,652
	$\geq 0,5\%, < 1\%$	2%	0,044**	2%	0,044**	-11,36	0,048**	-12%	0,081*	-31%	0,172
	$\geq 1\%$	21%	0,257	-32%	0,524	-3,25	0,348	-12%	0,407	-13%	0,413
	Total Capital ratio	**Tier 2**									
	$< 0,5\%$	50%	0,071*	9%	0,191	-9,62	0,229	-42%	0,483	-43%	0,494
	$\geq 0,5\%, < 1\%$	-18%	0,427	-27%	0,478	-3,77	0,330	-38%	0,547	-52%	0,643
	$\geq 1\%$	-122%	0,984	27%	0,904	-0,25	0,924	360%	0,662	283%	0,716
Region	**Asia Pacific**	36%	0,016**	2%	0,072*	-18,89	0,077*	-25%	0,182	-41%	0,297
	Europe	-2%	0,204	-10%	0,246	-14,25	0,195	-7%	0,228	-32%	0,382
	Euro area	52%	0,286	46%	0,305	-5,03	0,481	-27%	0,606	-61%	0,782
	Non-Euro area	-31%	0,448	-41%	0,516	-9,22	0,271	4%	0,253	-17%	0,361

TABLE G.4: Sensitivity analysis related to the start of the event-window for the market returns model. Related to the effect of CoCo issuer characteristics on the funding costs of financial institutions.

This table reports the results of the sensitivity analysis related to the start of the event-window. Where the starting date is adjusted to -11, -10, -8 and -7. The SAR and P-value are reported for the market returns model. Where the SAR is reported as the change related to the initial event-window. The focus is on the effect of CoCo issuer characteristics on the funding costs of financial institutions. The analysis distinguishes between several CoCo issuer characteristics: systemic importance, total assets at issuance, contribution to capital ratios and region. The *, **, and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively.

		Market returns model									
Event-window		**[-11,2]**		**[-10,2]**		**[-9,2]**		**[-8,2]**		**[-7,2]**	
Characteristic		**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**
All CoCos		-2%	0,001***	-18%	0,005***	-52,01	0,001***	-11%	0,003***	-25%	0,011**
Systemic importance	**G-SIB**	18%	0,037**	-24%	0,177	-16,67	0,077*	-11%	0,114	-23%	0,171
	AT1	-1%	0,073*	-27%	0,182	-14,20	0,069*	3%	0,062*	-15%	0,124
	Tier 2	129%	0,286	-6%	0,662	-2,47	0,641	-88%	0,956	-64%	0,867
	O-SIB	-12%	0,010**	-15%	0,013**	-35,34	0,003***	-12%	0,010**	-26%	0,030**
	AT1	-6%	0,005***	-6%	0,005***	-25,82	0,003***	-5%	0,005***	-25%	0,027**
	Tier 2	-27%	0,409	-40%	0,493	-9,52	0,255	-29%	0,421	-27%	0,405
Total assets at issuance	**$<$ Median ($746 bln)**	-12%	0,007***	-20%	0,014**	-32,85	0,002***	-13%	0,008***	-14%	0,009***
	$\geq$ Median	14%	0,044**	-14%	0,132	-19,16	0,079*	-9%	0,109	-42%	0,309
	$<$ $1.500 bln	-9%	0,002***	-14%	0,004***	-43,87	0,001***	-10%	0,002***	-29%	0,017**
	$\geq$ $1.500 bln	36%	0,166	-40%	0,541	-8,14	0,309	-21%	0,421	-2%	0,320
Contribution to ratios AT1 & Tier 2	**Tier 1 capital ratio**	**AT1**									
	$< 0,5\%$	-4%	0,025**	-15%	0,046**	-22,03	0,019**	0%	0,018**	-17%	0,052*
	$\geq 0,5\%, < 1\%$	-20%	0,051*	-10%	0,028**	-14,06	0,014**	-5%	0,020**	-31%	0,094*
	$\geq 1\%$	8%	0,118	-20%	0,247	-4,99	0,150	-14%	0,215	-21%	0,257
	Total Capital ratio	**Tier 2**									
	$< 0,5\%$	49%	0,090*	-7%	0,292	-9,10	0,255	-69%	0,724	-51%	0,578
	$\geq 0,5\%, < 1\%$	-30%	0,346	-40%	0,419	-5,21	0,178	-19%	0,274	-27%	0,328
	$\geq 1\%$	41%	0,739	-11%	0,833	0,62	0,814	-96%	0,992	-94%	0,990
Region	**Asia Pacific**	6%	0,002***	-20%	0,019**	-31,42	0,003***	-25%	0,027**	-13%	0,010**
	Europe	-15%	0,112	-14%	0,107	-20,59	0,061*	9%	0,041**	-43%	0,284
	Euro area	20%	0,032**	21%	0,031**	-12,76	0,074*	1%	0,071*	-21%	0,160
	Non-Euro area	-73%	0,797	-70%	0,781	-7,83	0,349	22%	0,253	-78%	0,834

TABLE G.5: Sensitivity analysis related to the end of the event-window for the risk-adjusted returns model. Related to the effect of different issuer characteristics on the funding costs of financial institutions.

This table reports the results of the sensitivity analysis related to the end of the event-window. Where the end date is adjusted to 0, 1, 3 and 4. The SAR and P-value are reported for the risk-adjusted returns model. Where the SAR is reported as the change related to the initial event-window. The focus is on the effect of different CoCo structures on the funding costs of financial institutions. The analysis distinguishes between several CoCo structure characteristics: conversion mechanism, trigger event, coupon rate and regulatory tiering. The *, **, and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively.

		Risk-adjusted returns model									
Event-window		**[-9,0]**		**[-9,1]**		**[-9,2]**		**[-9,3]**		**[-9,4]**	
Characteristic		**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**
All CoCos		-22%	0,091*	-11%	0,056*	-33,14	0,031**	-23%	0,095*	-36%	0,167
Conversion mechanism	**Equity-conversion**	-39%	0,198	-21%	0,094*	-19,46	0,035**	-9%	0,054*	-15%	0,074**
	Fixed price	-80%	0,772	-68%	0,649	-6,60	0,150	0%	0,150	-43%	0,410
	Floor price	13%	0,269	19%	0,241	-4,81	0,326	-54%	0,652	-48%	0,611
	Variable number	-40%	0,628	8%	0,388	-4,60	0,423	21%	0,332	40%	0,264
	Principal write-down	3%	0,251	1%	0,257	-13,68	0,264	-43%	0,523	-66%	0,702
	Partial permanent	-34%	0,812	-3%	0,725	-0,72	0,718	-35%	0,815	-31%	0,803
	Temporary	-50%	0,860	-20%	0,778	-2,09	0,724	-49%	0,856	-149%	0,862
	Permanent	19%	0,226	27%	0,194	-9,03	0,307	-57%	0,660	-62%	0,699
Trigger event	**Mechanical**	-22%	0,277	-17%	0,244	-16,94	0,161	-32%	0,342	-75%	0,725
	$< 5,125\%$	8%	0,447	5%	0,463	3,14	0,483	71%	0,232	100%	0,160
	$5,125\%$	3%	0,158	5%	0,150	-10,93	0,172	-5%	0,195	-25%	0,307
	$> 5,125\%$	-43%	0,507	-36%	0,460	-9,14	0,246	-29%	0,412	-74%	0,764
	Discretionary	-21%	0,175	-6%	0,105	-16,20	0,086*	-13%	0,135	4%	0,073*
Coupon rate	$< 5\%$	-16%	0,318	6%	0,206	-10,99	0,233	-19%	0,335	-5%	0,255
	$\geq 5\%, < 10\%$	-22%	0,124	-20%	0,115	-22,92	0,048**	-23%	0,131	-49%	0,317
	$\geq 10\%$	6%	0,797	7%	0,794	0,65	0,807	4%	0,800	68%	0,682
Tier	**AT1**	-21%	0,138	-21%	0,135	-22,08	0,059*	-15%	0,107	-44%	0,291
	Tier 2	-23%	0,388	7%	0,232	-11,06	0,264	-39%	0,497	-20%	0,373

TABLE G.6: Sensitivity analysis related to the end of the event-window for the risk-adjusted returns model. Related to the effect of different issuer characteristics on the funding costs of financial institutions.

This table reports the results of the sensitivity analysis related to the end of the event-window. Where the end date is adjusted to 0, 1, 3 and 4. The SAR and P-value are reported for the market returns model. Where the SAR is reported as the change related to the initial event-window. The focus of this table is on the effect of different CoCo structures on the funding costs of financial institutions. The analysis distinguishes between several CoCo structure characteristics: conversion mechanism, trigger event, coupon rate and regulatory tiering. The *, **, and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively.

		Market returns model									
Event-window		**[-9,0]**		**[-9,1]**		**[-9,2]**		**[-9,3]**		**[-9,4]**	
Characteristic		**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**
All CoCos		-20%	0,007***	-9%	0,002***	-52,01	0,001***	-13%	0,003***	-21%	0,007***
Conversion mechanism	**Equity-conversion**	-22%	0,014**	-9%	0,004***	-29,00	0,002***	-10%	0,005***	-15%	0,007***
	Fixed price	-55%	0,451	-37%	0,291	-7,69	0,093*	-13%	0,144	-45%	0,355
	Floor price	-15%	0,128	-5%	0,088*	-8,78	0,073*	-49%	0,363	-49%	0,358
	Variable number	-9%	0,106	9%	0,051*	-10,27	0,074*	24%	0,027**	28%	0,022**
	Principal write-down	-18%	0,123	-8%	0,085*	-23,01	0,060*	-17%	0,118	-28%	0,174
	Partial permanent	-139%	0,847	22%	0,549	-0,98	0,624	-59%	0,839	-45%	0,786
	Temporary	-41%	0,439	-21%	0,296	-7,79	0,188	13%	0,137	4%	0,172
	Permanent	0%	0,122	11%	0,085*	-13,70	0,121	-32%	0,290	-42%	0,365
Trigger event	**Mechanical**	-23%	0,025**	-13%	0,011**	-35,21	0,004***	-13%	0,012**	-30%	0,043**
	$< 5,125\%$	16%	0,391	17%	0,385	3,32	0,458	83%	0,174	109%	0,121
	$5,125\%$	-3%	0,004***	0%	0,003***	-23,65	0,003***	0%	0,003***	-12%	0,009***
	$> 5,125\%$	-46%	0,311	-25%	0,159	-14,88	0,001***	-14%	0,103	-29%	0,182
	Discretionary	-14%	0,125	-1%	0,077	-16,80	0,075*	-13%	0,120	0%	0,075*
Coupon rate	$< 5\%$	-4%	0,044**	9%	0,023**	-19,29	0,036**	-8%	0,055*	-1%	0,039**
	$\geq 5\%, < 10\%$	-26%	0,033**	-19%	0,019**	-33,60	0,004***	-15%	0,014**	-32%	0,048**
	$\geq 10\%$	-20%	0,691	-16%	0,675	-1,32	0,618	-10%	0,653	-39%	0,759
Tier	**AT1**	-23%	0,009***	-18%	0,005***	-40,02	0,001***	-4%	0,001***	-19%	0,005***
	Tier 2	-9%	0,271	22%	0,140	-11,99	0,226	-42%	0,485	-27%	0,375

TABLE G.7: Sensitivity analysis related to the end of the event-window for the risk-adjusted returns model. Related to the effect of CoCo issuer characteristics on the funding costs of financial institutions.

This table reports the results of the sensitivity analysis related to the end of the event-window. Where the end date is adjusted to 0, 1, 3 and 4. The SAR and P-value are reported for the risk-adjusted returns model. Where the SAR is reported as the change related to the initial event-window. The focus is on the effect of CoCo issuer characteristics on the funding costs of financial institutions. The analysis distinguishes between several CoCo issuer characteristics: systemic importance, total assets at issuance, contribution to capital ratios and region. The *, **, and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively.

		Risk-adjusted returns model									
Event-window		**[-9,0]**		**[-9,1]**		**[-9,2]**		**[-9,3]**		**[-9,4]**	
Characteristic		**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**
All CoCos		-22%	0,091*	-11%	0,056*	-33,14	0,031**	-23%	0,095*	-36%	0,167
Systemic importance	**G-SIB**	-29%	0,418	-23%	0,377	-10,83	0,251	-57%	0,624	-104%	0,961
	AT1	-44%	0,525	-46%	0,540	-8,89	0,255	-38%	0,484	-96%	0,966
	Tier 2	38%	0,612	82%	0,503	-1,95	0,713	-143%	0,873	-141%	0,881
	O-SIB	-18%	0,130	-6%	0,082*	-22,31	0,065*	-6%	0,083*	-3%	0,073*
	AT1	-6%	0,155	-4%	0,145	-13,19	0,130	2%	0,125	-9%	0,168
	Tier 2	-36%	0,483	-9%	0,322	-9,12	0,276	-17%	0,366	5%	0,251
Total assets at issuance	$<$**Median ($746 bln)**	-26%	0,134	-12%	0,075*	-21,70	0,044**	-2%	0,048**	-3%	0,051*
	$\geq$ **Median**	-15%	0,370	-11%	0,352	-11,44	0,294	-63%	0,696	-98%	0,986
	$<$ **$1.500 bln**	-16%	0,049**	-9%	0,034**	-30,56	0,019**	-14%	0,045**	-15%	0,047**
	$\geq$ **$1.500 bln**	-94%	0,985	-35%	0,835	-2,58	0,747	-125%	0,935	-284%	0,553
Contribution to ratios AT1 & Tier 2	**Tier 1 capital ratio**	**AT1**									
	$< 0,5\%$	-46%	0,636	-36%	0,576	-8,24	0,380	-14%	0,451	-94%	0,955
	$\geq 0,5\%, < 1\%$	-10%	0,074*	-13%	0,087*	-11,36	0,048**	-17%	0,091*	-16%	0,096*
	$\geq 1\%$	-16%	0,432	-1%	0,352	-3,25	0,348	1%	0,341	10%	0,301
	Total Capital ratio	**Tier 2**									
	$< 0,5\%$	-16%	0,313	23%	0,140	-9,62	0,229	-39%	0,463	10%	0,187
	$\geq 0,5\%, < 1\%$	-19%	0,432	-33%	0,512	-3,77	0,330	-11%	0,387	-55%	0,660
	$\geq 1\%$	17%	0,911	52%	0,885	-0,25	0,924	88%	0,858	-142%	0,968
Region	**Asia Pacific**	-12%	0,118	4%	0,066*	-18,89	0,077*	-10%	0,090*	1%	0,075*
	Europe	-35%	0,400	-32%	0,379	-14,25	0,195	-40%	0,438	-85%	0,844
	Euro area	2%	0,473	16%	0,413	-5,03	0,481	-46%	0,704	-89%	0,939
	Non-Euro area	-55%	0,622	-58%	0,646	-9,22	0,271	-37%	0,488	-82%	0,847

TABLE G.8: Sensitivity analysis related to the end of the event-window for the market returns model. Related to the effect of CoCo issuer characteristics on the funding costs of financial institutions.

This table reports the results of the sensitivity analysis related to the end of the event-window. Where the end date is adjusted to 0, 1, 3 and 4. The SAR and P-value are reported for the market returns model. Where the SAR is reported as the change related to the initial event-window. The focus is on the effect of CoCo issuer characteristics on the funding costs of financial institutions. The analysis distinguishes between several CoCo issuer characteristics: systemic importance, total assets at issuance, contribution to capital ratios and region. The *, **, and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively.

		Market returns model									
Event-window		**[-9,0]**		**[-9,1]**		**[-9,2]**		**[-9,3]**		**[-9,4]**	
Characteristic		**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**	**SAR**	**P-value**
All CoCos		-20%	0,007***	-9%	0,002***	-52,01	0,001***	-13%	0,003***	-21%	0,007***
Systemic importance	**G-SIB**	-28%	0,201	-19%	0,152	-16,67	0,077*	-30%	0,218	-60%	0,476
	AT1	-31%	0,211	-36%	0,245	-14,20	0,069*	-18%	0,135	-54%	0,400
	Tier 2	-7%	0,664	80%	0,402	-2,47	0,641	-103%	0,990	-94%	0,978
	O-SIB	-16%	0,015**	-4%	0,005***	-35,34	0,003***	-5%	0,006***	-2%	0,004***
	AT1	-19%	0,016**	-8%	0,006***	-25,82	0,003***	3%	0,002***	0%	0,003***
	Tier 2	-10%	0,304	7%	0,224	-9,52	0,255	-27%	0,404	-9%	0,302
Total assets at issuance	**<Median ($746 bln)**	-23%	0,019**	-11%	0,007***	-32,85	0,002***	6%	0,001***	8%	0,001***
	$\geq$ **Median**	-15%	0,136	-4%	0,093*	-19,16	0,079*	-45%	0,335	-69%	0,587
	$<$ **$1.500 bln**	-18%	0,006***	-11%	0,003***	-43,87	0,001***	-10%	0,002***	-8%	0,002***
	$\geq$ **$1.500 bln**	-31%	0,485	1%	0,304	-8,14	0,309	-33%	0,493	-90%	0,916
Contribution to ratios AT1 & Tier 2	**Tier 1 capital ratio**	**AT1**									
	$< 0,5\%$	-33%	0,118	-26%	0,084*	-22,03	0,019**	3%	0,016**	-26%	0,081*
	$\geq 0,5\%, < 1\%$	-7%	0,023**	-9%	0,026**	-14,06	0,014**	-23%	0,059*	-18%	0,045**
	$\geq 1\%$	-37%	0,366	-3%	0,164	-4,99	0,150	12%	0,106	15%	0,099*
	Total Capital ratio	**Tier 2**									
	$< 0,5\%$	14%	0,194	51%	0,085*	-9,10	0,255	-47%	0,544	2%	0,245
	$\geq 0,5\%, < 1\%$	-46%	0,471	-29%	0,339	-5,21	0,178	-6%	0,205	-37%	0,398
	$\geq 1\%$	-89%	0,979	12%	0,793	0,62	0,814	-133%	0,937	-29%	0,867
Region	**Asia Pacific**	-9%	0,007***	4%	0,002***	-31,42	0,003***	-2%	0,004***	4%	0,002***
	Europe	-37%	0,240	-28%	0,177	-20,59	0,061*	-30%	0,189	-58%	0,435
	Euro area	-27%	0,192	-4%	0,085*	-12,76	0,074*	-8%	0,102	-25%	0,182
	Non-Euro area	-54%	0,665	-67%	0,760	-7,83	0,349	-65%	0,741	-112%	0,910

TABLE G.9: Wilcoxon signed-rank test

This table reports the results of the Wilcoxon signed-rank test. This sensitivity analysis is only performed for significant results of the standardised cross-sectional test. N indicates the number of CoCos in the sub-sample. Proportion negative and P-value are reported for the risk-adjusted and market returns model. The *, **, and *** indicate the statistical significance at the 10%, 5% and 1% levels, respectively.

		Risk-adjusted returns model		Market returns model	
Characteristic	**N**	**Proportion negative**	**P-value**	**Proportion negative**	**P-value**
All CoCos	235	0,66	0,011**	0,72	0,001***
Equity-conversion mechanisms	85	0,69	0,042**	0,74	0,001***
Trigger levels at 5,125% (CET1)	64	0,61	0,063*	0,69	0,013**
Coupon rates between 5% and 10%	135	0,71	0,044**	0,75	0,005***
AT1 CoCos	137	0,70	0,051*	0,89	0,001***
O-SIBs	146	0,68	0,058*	0,78	0,009***
Total assets at issuance below the median	116	0,72	0,019**	0,84	0,001***
Total assets at issuance below $1.500 billion	171	0,81	0,008***	0,85	0,001***
Tier 1 capital contributions ($\geq$ 0,5% and $<$ 1%)	33	0,63	0,082*	0,71	0,039**
Asia Pacific	114	0,68	0,068*	0,77	0,020**
EU Euro area	51	0,54	0,239	0,60	0,052*